Workplan

Integrated Pest Management
Collaborative Research Support Program
2006 – 2007

USAID/EGAT/LRM-funded Project Leader with Associate Cooperative Agreement
EPP-A-00-04-00016-00

Management Entity
Office of International
Research, Education,
& Development (OIRED)

1060 Litton Reaves (0334)
Virginia Tech
Blacksburg, VA 24061
(540) 231-6338
www.oired.vt.edu

USAID
FROM THE AMERICAN PEOPLE

VirginiaTech
Invent the Future

TABLE OF CONTENTS

Ecologically-based Participatory IPM for Southeast Asia

Michael D. Hammig, Applied Economics and Statistics, 220 Barre Hall
Clemson University, Clemson, SC 29634

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

This objective will be achieved by establishing a set of field research and demonstration activities in collaboration with host country and international research institutions in Indonesia and the Philippines. The impact of these activities will be to provide reliable pest management systems that do not rely on synthetic chemical pest control for vegetable farmers in the Southeast Asia region.

Activity 1. IPM for carrots in West Java, Indonesia.

Description. The activity will include a survey of the abundance and identification of nematodes on carrots in field sites in the Puncak area of West Java. The efficacy of broccoli plant residues to control root knot nematode on carrots will be tested in laboratory settings. Field tests of the level of root knot nematode on carrots will be conducted to examine the effect of crop rotations of carrots with a non-host plant crop. A carrot-carrot-carrot rotation will be compared to a carrot-sweet corn-carrot rotation.

Expected outputs. Outputs for the year will include a comprehensive assessment of nematode activity on carrots in a major vegetable growing region of West Java and preliminary evaluations of two IPM strategies to control root knot nematode on carrots in the same region.

Task: Major nematode species attacking carrots identified and symptoms of nematode infestations recorded and included in training materials (Supramana/IPB | 06/07/2006)
Task: Information obtained on the role of plowing in *Brassica* (broccoli) residues on nematode population suppression (Supramana | 06/07/2006)
Task: Data available on how rotation with a non-host crops impacts nematode populations and subsequent carrot yields (Supramana | 07/07/2006)
Task: Information obtained made available to farmers through FFS and carrot yields/quality goes up and pesticide use goes down. (Supramana | 08/07/2006)

Activity 2. IPM for leaf onion in West Java, Indonesia.

Description. Field tests and farmer training for the propagation and use of SeNPV virus to control *Spodoptera exigua* on leaf onion in West Java will be conducted in the Puncak field sites. Laboratory studies on the use of UV-protectants to prolong the effectiveness of SeNPV will be conducted at BAU. A study will be conducted to examine the phenology, population dynamics, and natural enemies of the black aphid, *Neotoxoptera*

formosana on leaf onion. A field study to assess the impact of using detergents to control *Neotoxoptera formosana* on leaf onion will be conducted at Puncak sites. A field study to assess the effectiveness of sticky yellow traps to control leafminer infestations on leaf onion will be conducted at Puncak sites.

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

Task: Farmers learn how to propagate, store and use the insect virus (SeNPV) of the beet armyworm, *Spodoptera exigua* (Yayi Kasumah/IPB | 08/07/2006)
Task: Laboratory results that show which materials can be used to prevent the breakdown of SeNPV by UV light. (Yayi Kasumah | 06/07/2006)
Task: Natural enemies of the black aphid, *Neotoxoptora formosana,* identified and illustrations provided in training materials for farmers. (Yayi Kasumah | 08/07/2006)
Task: Yellow sticky traps tested in the field to assess their efficacy in reducing populations of leaf miners in leaf onions. (Yayi Kasumah | 06/07/2006)
Task: Information from above studies incorporated into training materials for use in farmer field schools. (Yayi Kasumah | 06/07/2006)

Activity 3. IPM for broccoli in West Java, Indonesia.

Description. Use of lime and bokashi to control club root on broccoli will be tested in field site locations. Four treatments: only lime, only bokashi, lime + bokashi, farmer practices.Development of IPM for lepidopteran pests on broccoli using Bt insecticides and hand-picking will be conducted at Puncak field sites. Treatments: Bt + hand-picking vs farmer practices

Expected outputs. These activities will provide useful guidance for development of a treatment program for a key disease problem in broccoli in the region, as well as a demonstration of the impact of an IPM strategy for control of insect pests.

Task: Information obtained on the practical use of lime and bokashi (local plant-derived materials) combinations for control of club-root in broccoli (Widodo/IPB | 08/07/2006)
Task: Spot-spraying with *Bacillus thuringiensis* (Bt) and hand-picking egg masses and larval clusters of lepidopteran pests, such as *Crocidolomia,* assessed in broccoli. (Widodo | 07/07/2006)
Task: Materials from activities above incorporated into farmer field school training materials and used in FFS. (Widodo | 09/07/2006)

Activity 4. IPM for celery in West Java, Indonesia.

Description. A comprehensive study of the phenology, population dynamics, and natural enemies of leafminer on celery will be conducted in field sites in the Puncak area of West Java.

Expected outputs. This research will provide the basis for follow-up studies of IPM strategies for leafminer control.

Task: Information is produced that adds to an understanding of the population dynamics and natural enemies of leaf miners in celery. (Aunu Rauf/IPB | 08/07/2006)
Task: Materials are developed for farmer training that includes information on how to reduce populations of leaf miners in celery without chemical insecticides. (Aunu Rauf | 09/07/2006)

Activity 5. IPM for cucumber in West Java, Indonesia.

Description. Identification of the cause of "menong" – a deformation of Japanese cucumbers that makes them unmarketable and survey of the extent of this damage in the Puncak area of West Java will be conducted.Identification of the cause of wilt disease on Japanese cucumber, and survey of the extent of the damage will be conducted in the Puncak area of West Java.A comprehensive study of the phenology, population dynamics, and natural enemies of leafminer on cucumber will be conducted in field sites in the Puncak area of West Java.

Expected outputs. The above activities will provide the basis for development of IPM strategies for Japanese cucumber in West Java.

Task: "Menong" is a condition in cucumbers that causes the fruit to be deformed. The causal agent for the disease "menong" is identified. (Meity Sinaga/IPB | 08/07/2006)
Task: The cause of "wilt" disease in cucumber is identified and the extent and severity of this disease is determined. (meity Sinaga | 08/07/2006)
Task: Populations dynamics of the leaf miner and identification its natural enemies are determined in cucumber. (Meity Sinaga | 08/07/2006)
Task: Information is incorporated into farmer training materials and farmer training carried out. (Meity Sinaga | 09/07/2006)

Activity 6. IPM for pak choi in West Java, Indonesia.

Description. A comprehensive study of the phenology, population dynamics, and natural enemies of flea beetle on pak choi will be conducted in field sites in the Puncak area of West Java.

Expected outputs. This research will provide the basis for follow-up studies of IPM strategies for flea beetle control.

Task: An understanding of the population dynamics and phenology of flea beetles on pac choi is determined and information incorporated into training materials for farmers. (Idham Harahap/IPB | 08/07/2006)

Activity 7. IPM for chilies in West Java, Indonesia.

Description. Variety testing for resistance to virus diseases in chilies will be conducted at Puncak field sites in West Java.

Expected outputs. Testing will provide for identification of resistant varieties and dissemination of guidance for the use of these varieties to farmers in the region.

Task: Varieties of chilies that have resistance to viruses are identified and this information transferred to farmers via field days and FFS. (Sri Hendrastruti/IPB | 08/07/2006)

Activity 8. Develop system for rearing parasitoid of diamondback moth and field testing microbial agents.

Description.
a. Mass rearing and effect of size of cages on the life cycles of *Diadegma semiclausum*, the major parasitoid on diamondback moth
b. Use of Se-NPV to control *S. exigua* on green onions at Rurukan and Tounsewer (August-Sept 2006
c. 1. Control of *Crocidolomia pavanona* on cabbage using Bt.
2. Use of Commercial *Trichoderma* to control soil-borne diseases on cabbage at Rurukan.

Expected outputs. These activities are designed for the fine tuning of IPM systems for key vegetables in the Lake Tondano watershed area of North Sulawesi.

Task: Optimum cage size for rearing diamondback moth parasitoid is determined. (Dan Sembel/Unsrat | 07/07/2006)
Task: The efficacy of SeNPV against *S. exigua* is determined in field plots. (Dan Sembel/Unsrat | 02/07/2006)
Task: Effective rates of Bt against *Crocidolomia* are identified. (Dan Sembel/Unsrat | 05/07/2006)
Task: The efficacy of *Trichoderma* for soil borne diseases on cabbage is determined. (Dan Sembel/Unsrat | 06/07/2006)

Activity 9. Farmer training for IPM of onions in Modoinding, North Sulawesi.

Description. Conduct FFS training of farmers including demonstration of propagation and use of SeNPV to control the major onion insect pest.

Expected outputs. Completion of training.

Task: Farmers in Modoinding receive training in IPM on onions. (Dan Sembel/Unsrat | 06/07/2006)

Activity 10. PA of pesticide use by cabbage and potato farmers in Modoinding, North Sulawesi, Indonesia.

Description. A survey will be conducted to determine the common use of pesticides by cabbage and potato farmers at Modoinding, North Sulawesi

Expected outputs. Baseline information to provide guidance for IPM training.

Task: Participatory appraisal carried on pesticide use by potato and cabbage farmers in Modoinding. (Dan Sembel/Unsrat | 02/07/2006)

Activity 11. Development of IPM on potato at Modoinding, North Sulawesi.

Description. Demonstration plots comparing IPM to farmer practice on potato in Modoinding will be prepared and farmer training on potato IPM will be conducted in the major potato growing area of North Sulawesi.

Expected outputs. Field comparisons of IPM to farmer practices will be completed, as well as formal farmer training on potato IPM

Task: Completion of demonstration plots for comparing farmer practice with IPM on potato. (Dan Sembel/Unsrat | 04/07/2006)

Activity 12. Use of the parasite *D. semiclausum* to control insect pests of cabbage in Modoinding, North Sulawesi, Indonesia.

Description.
a. Survey the percentage parasitism of *D. semiclausum* on cabbage crops at Modoinding. (Oct 2006 - July 2007)
b. Demonstration of mass rearing techniques for *D. semiclausum* (July - August 2007).

Expected outputs. These activities will provide data on the impact of parasitism by D. *semiclausum* on diamondback moth in cabbage and farmer training to rear and release the parasite in the area.

Task: Completion of surveys to determine parasitism levels on diamondback moth in Modoinding. (Dan Sembel | 07/07/2006)
Task: Training competed on mass rearing of parasitoids of diamondback moth. (Dan Sembel/Unsrat | 08/07/2006)

Activity 13. Vegetable IPM in Lembah Gulen, Karo, North Sumatra, Indonesia.

Description. A set of activities will be conducted in a key vegetable growing region. Baseline data collection will continue from the previous year. Field demonstrations comparing farmer practice to IPM systems will be conducted throughout the year on major vegetables in the area. A Training of Trainers program will be completed, and four farmer-led FFSs will be conducted.

Expected outputs. Baseline data collection will be completed. Farmers in the area will be introduced to IPM practices.

Task: Completion of baseline data collection. (Cahyana/FIELD | 02/07/2006)
Task: Completion of field demonstrations comparing farmer practice to IPM. (Cahyana/FIELD | 06/07/2006)
Task: Training of trainers in IPM completed. (Cahyana/FIELD | 05/07/2006)
Task: Completion of four farmer-lead farmer field schools. (Cahyana/FIELD | 09/07/2006)

Activity 14. IPM for citrus in Karo, North Sumatra, Indonesia.

Description. Surveys will be conducted to identify the major pests of citrus in the Karo district. A control program, requiring area-wide participation, will be proposed and farmer training to describe and demonstrate the efficacy of the program will be completed.

Expected outputs. Expected outputs will include identification of major pest of citrus, selection of an area-wide control strategy, and farmer education on control tactics**.**

Task: Surveys completed that identify major pests of citrus in Karo, N. Sumatra. (Cahyana/FIELD | 04/07/2006)
Task: Development of an area-wide fruit fly control program to be presented to key farmers. (Cahyana/FIELD | 05/07/2006)
Task: The efficacy of the area-wide IPM program on citrus is determined. (Cahyana/FIELD | 09/07/2006)

Activity 15. IPM vegetable crops in West Sumatra, Indonesia.

Description. Test impacts of extracts of seeds from China Berry *Melia azadarach* against insect pest of chilies, cabbage, or Chinese cabbage.Determine the most efficacious strains of the entomopathogenic fungus, *Beauvaria bassiana* against the sweet potato weevil (SPW) by culturing the pest and screening various strains of the fungus against SPW in the laboratory. Set up field tests of promising biocontrol agents on these important vegetable crops in West Sumatra. Field test grafting of EG203 eggplant rootstock to desired varieties of tomato found in West Sumatra.

Expected outputs. Expected outputs will include identification of promising biocontrol agents and field testing of alternative IPM programs for West Sumatra vegetable crops, and incorporation of this information and these biocontrol agents into the offering of existing local "bioagent posts."

Task: Tests completed on the efficacy of seed extracts from *Melia azaderach* against pests of chilies, cabbage and Chinese cabbage. (Zamzami/BPTPH W Sumatra | 08/07/2006)
Task: Selection and of the most effective strain of *Beauveria bassiana* for control of sweetpotato weevil. (Zamzami/BPTPH W. Sumatra | 07/07/2006)
Task: Field testing completed on most promising biological control agents and *Melia* extracts. (Zamzami/BPTPH W. Sumatra | 09/07/2006)
Task: Grafting tomatoes onto resistant eggplant rootstock completed and field tested. (Zamzami/BPTPH W. Sumatra | 05/07/2006)
Task: Production and distribution of new biological control agents by "BioAgent Posts". (Zamzami/BPTPH W. Sumatra | 09/07/2006)

Activity 16. Evaluate current and improved diversification schemes for IPM in legume-rice cropping systems (Mindanao, Philippines, and Lampung, Indonesia)

Description.
a. Evaluation of farmers' current use of varietal and species diversity in socio-economic analyses at target sites (Arakan and Lampung)
b. Evaluation of options for coordinating and designing storage, multiplication, and delivery of improved and landrace seed (Arakan and Lampung)
c. Analysis of functional and genetic diversity of traditional and improved rice germplasm (Arakan and Lampung)
d. Evaluation of temporal and spatial deployment methods for rice and legume under rubber plantation for improved IPM in participatory research programs with farmers (Arakan and Lampung)

Expected outputs. In the first year for Lampung, we will develop preliminary evaluations of current deployment of crop diversity and of options for seed delivery. We will also initiate participatory research programs to evaluate current and proposed new varietal deployment for IPM. This is the second year of the project in Arakan, and we will continue the activities initiated in Year 1.

Task: Surveys completed on varieties used by farmers in the Arakan Valley of Mindinao (Philippines) and in Lampung (southern Sumatra, Indonesia). (N. Vera Cruz/IRRI | 02/07/2006)
Task: Socio-economic analysis completed in Arakan Valley and Lampung. (N. VeraCruz/IRRI | 03/07/2006)
Task: Options determined for designing, multiplying and delivering of improved varieties. (N. VeraCruz/IRRI | 06/07/2006)

Task: Germplasm analysis completed for traditional and improved rice varieties. (N. VeraCruz/IRRI | 08/07/2006)
Task: Methods developed for rice and legume production in rubber plantations. (N. VeraCruz/IRRI | 09/07/2006)

Activity 17. Develop an understanding of the pest complex in La Trinidad strawberry fields with an emphasis on spider mites.

Description. Intensive sampling of strawberry and associated plants will be conducted in representative fields of the "swamp ecosystem" and the "upland ecosystem" Population data will be analyzed in relation to the climate, farmers' pest control practices, nutrient management and crop establishment system. A reference collection of predatory and phytophagous mites found on strawberry and associated plants in La Trinidad municipality will be made. Phenology of the pests, beneficials and strawberry production will be developed as a guide for pest management. Feasibility of developing a strawberry IPM calendar for farmers will be investigated.

Expected outputs. A slide collection of representative mites associated with strawberry will be created for reference. An key to predatory mites of La Trinidad will be developed with drawings and a lucid key will be developed if economically feasible. Information on the population dynamics of the major pests and their natural enemies will be generated.

Task: Sampling completed in "swamp" and upland strawberry ecosystems. (B. Gerdeman/WSU | 06/07/2006)
Task: Completion of reference slide collection of mites. (B. Gerdeman/WSU | 07/07/2006)
Task: Completion of a key to the predatory mites. (B. Gerdeman/WSU | 06/07/2006)
Task: Information generated on population dynamics of major pests and their natural enemies. (B. Gerdeman/WSU | 09/07/2006)

Activity 18. Mass rearing *Neoseiulus longispinosus*, a native predatory mite.

Description. A mass-rearing facility will be designed and constructed in La Trinidad. Techniques for mass production will be evaluated. Varietal testing of poinsettias will determine best candidates for banker plants, e.g., those plants that attract and hold large numbers of predators. Selected varieties of poinsettia will be mass propagated by the municipality.

Expected outputs. The fungal pathogen suppressing the spider mite colonies will be identified. Strategies for utilizing fungal pathogens for spider mite control will be investigated. Mass production of predatory mites will occur on a smooth and timely manner. Most promising local varieties of Poinsettias will be available for use as banker plants dependent upon "year-long" results.

Task: Techniques for mass rearing predatory mites developed. (B. Gerdeman/WSU | 05/07/2006)

Task: Field tested completed on the use of poinsettias as "banker" plants. (B. Gerdeman | 06/07/2006)
Task: Techniques for mass propagation of banker plants developed. (B. Gerdeman/WSU | 05/07/2006)

Activity 19. Demonstrate IPM techniques to strawberry growers.

Description. Three farmer participatory research plots testing the efficacy of *N. longispinosus* will be expanded to $50m^2$. Fertilization regimes and soil amendments will be evaluated to determine effects of soil fertility on spider mites and cyclamen mites. Field experiments will test the efficacy of banker plants in strawberry for the control of spider mites and cyclamen mites. Fungicide compatibility with *N. longispinosus* will be tested.

Expected outputs. Evaluation of the farmer participatory research programs will determine proper timing, release rates and methodology for *N. longispinosus*. Locally available fungicides compatible with *N. longispinosus* will be identified. Efficacy of Bt against *N. longispinosus* will be determined.

Task: Efficacy of predatory mites determined in farmer participatory plots. (B. Gerdeman/WSU | 06/07/2006)
Task: Effect of soil amendments on spider mites and cyclamen mite is determined. (B. Gerdeman/WSU | 07/07/2006)
Task: Efficacy of "banker" plants for control of spider mites and cyclamen mites determined. (B. Gerdeman/WSU | 05/07/2006)

Activity 20. Farmers' handling and release of predatory mites.

Description. Depending upon mass rearing production, farmers will be trained in the proper procedure for handling prior to release, release methods and methods to maintain and encourage dispersal of predatory mites in the fields. Farmers will receive training in release procedures utilizing predatory mites on banker plants dependent upon "year-long" results of banker plant survey.

Expected outputs. Farmers will be able to perform releases of mass produced predatory mites. Farmers will plant and manage poinsettia for use as banker plants in their fields or as border plantings.

Task: Farmers trained on proper procedures for handling and releasing predatory mites. (B. Gerdeman | 08/07/2006)

Activity 21. IPM for eggplant and tomato in Batangas, Philippines.

Description. Conduct field tests of IPM (grafting of EG203 eggplant rootstock to tomatoes and local varieties of eggplants) to demonstrate the benefit of the disease resistance provided by EG203 in Tanauan village, Batangas. Incorporate weed

management options into the pest management program. Investigate options for IPM in other vegetables in the area, including Pechay. Conduct season-long farmer training on the use of grafted plants and grafting techniques. In cooperation with the local government, encourage farmers to engage in grafting as a cottage industry.

Expected outputs. Results of field trials for tomatoes and eggplant to show yield impacts of grafted vs non-grafted crops, and alternative weed management options. Completed farmer training for these techniques. Initiation of a local grafting industry. An end of year field day for farmers from the area.

Task: Testing completed on resistant eggplant rootstock (EG 203) grafted onto tomato and eggplant. (C. Adalla/UPLB | 07/07/2006)
Task: Weed management options incorporated into pest management programs. (A. Baltazar/UPLB | 08/07/2006)
Task: Farmer training completed on the use of grafting tomato and eggplant onto resistant eggplant rootstock. (C. Adalla/UPLB | 07/07/2006)
Task: Evaluation completed on the possible use of grafting as a cottage industry. (C. Adalla | 09/07/2006)

Activity 22. On-station research activities for Luzon, Philippines

Description. Using 2 varieties of eggplant and tomato (farmers' variety and promising hybrid/variety) test:
Weed Management - small plot trial on selective herbicide for tomato and eggplant
Disease Management – start with *Trichoderma* Root Dip, grafting to resistant stocks

Expected Outputs. Research results for incorporation into IPM systems for field testing.

Task: Evaluation completed on selected herbicides on tomato and eggplant (C. Adalla/UPLB | 09/07/2006)
Task: Tests completed using *Trichoderma* and grafting for disease management. (C. Adalla | 09/07/2006)

Activity 23. Insect pest management for vegetables in Luzon, Philippines.

Description. Evaluation of Insect Pest Management approaches:
- 21 DAT application of systemic granulars if leafhopper population exceeds 20 nymphs per leaf.
- 30 DAT release of *Trichogramma* eggmasses against fruit and shoot borers; application of NPV in case of heavy *Spodoptera* infestation.

Expected outputs. Research data to evaluate these pest management approaches.

Task: Field tests completed on leafhopper control using granular. (C. Adalla/UPLB | 08/07/2006)

Task: Evaluation completed on the use of *Trichogramma* against the fruit and shoot borer. (C. Adalla/UPLB | 08/07/2006)
Task: Feld tests completed on the use of NPV against *Spodoptera* spp. (C. Adalla/UPLB | 08/07/2006)

Activity 24. Technology transfer and promotion of pest management technologies in rice- vegetable cropping system

Description. The technology promotion activity will be done in a participatory manner for greater impact. Information materials to be produced, delivery method to be used and technologies to be promoted will be determined in a participatory manner. The impact of the technology will be measured by increased production, decreased inputs and increased net income.
Farmers and extension personnel trainings on vegetable IPM will be continuously conducted to scale up well-informed and well-equipped farmers and technicians on vegetable IPM.

Expected outputs. IPM CRSP technologies promoted, disseminated and adopted by cooperators and other farmers in the site.
Information and courseware and campaign materials, trainings, demonstration.
Media publicity
Simplified decision rules for the technologies
Stakeholders' workshops

Expected impact. Increased productivity and profitability without harming the environment

Task: IPM training for farmers and extension workers (TOT (HR Rapusas/PhilRice | 08/07/2006)
Task: Modified Farmers Field School and PTD (HR Rapusas/PhilRice | 05/07/2006)
Task: Farmers' interview (HR Rapusas/PhilRice | 09/07/2006)
Task: Development of simplified rules of the technologies (HR Rapusas/PhilRice | 09/09/2006)
Task: Preparation of coursewares (HR Rapusas | 09/09/2006)
Task: Media releases (HR Rapusas/PhilRice | 09/09/2006)
Task: Impact evaluation (HR Rapusas/PhilRice | 09/09/2006)

Activity 25. Feasibility study of the commercial production of biological control croducts for rice vegetable cropping system

Description. The market, technical, organization and management, financial, social and environmental, and economic feasibility of commercially producing vesicular arbuscular mycorrhiza (VAM) for biological control of vegetable diseases will be evaluated.

Expected outputs. Feasibility study of commercial production of VAM for bio-control of vegetable diseases.

Expected impact - Knowledge of the potential for commercial production, and strategies and frameworks for promotion and commercialization of VAM will help sustain adoption and create impact.

Task: Market study (Casiwan/PhilRice | 09/07/2006)
Task: Technical study (HR Rapusas/PhilRice | 09/07/2006)
Task: Organization and management (Casiwan/PhilRice | 09/07/2006)
Task: Social and environmental study (Casiwan | 09/07/2006)
Task: Financial and economic study (Casiwan/PhilRice | 09/07/2006)

Activity 26. Effect of no tillage and rice straw mulch on the incidence of insect pests and its natural enemies in onion

Description. Insect pests are important factors that limit profitable onion production in the Philippines. Most of the time, farmers' pesticide application is prophylactic resulting to high cost of production and destruction of natural enemies. Most of the onion farmers in Aritao, Nueva Ecija plant onion immediately after rice claiming that they reduce production cost especially on herbicides and insecticides with no tillage and application of rice straw mulch before transplanting of onion.

Six farmers' fields will be used in the study. Three of the fields will be no tillage and with rice straw mulch. The remaining fields will be thoroughly prepared and without rice straw mulch. Key insect pests of onion, damage to the crop and its natural enemies will be monitored weekly.

Hypothesis: No tillage and rice straw mulch will increase populations of beneficial organisms in the field thereby reducing population of insect pests and its damage to the crop.

Expected outputs. Effect of no tillage and rice straw mulch on insect pest density, its damage and beneficial arthropods in onion determined.

Task: Monitoring of insect pests and damage (GS Arida/PhilRice | 09/07/2006)
Task: Monitoring of natural enemies of pests (GS Arida/PhilRice | 09/07/2006)

Activity 27. Survey of larval parasitoids of leafminers (LM) in vegetables and weeds in the Philippines

Description. Leafminers are important insect pests of vegetables and ornamental plants in the Philippines. It is believed that most of the species attacking vegetables and ornamental plants are accidentally introduced in the country. Management of leaf miners with pesticides is expensive, temporary and therefore not sustainable. Several species of parasitoids was reported to attack larvae of leaf miner.

Different kinds of vegetables and associated weeds will be sampled from October 2006-September 2007 in different areas in Luzon Island, Philippines. Leaves bearing larvae of LM will be collected in the field and brought in the laboratory for rearing until adults of LM or parasitoids emerged. Percentage of larval parasitism will be computed for every sampling occasion. Parasitoids will be identified.

Hypothesis: In the absence of natural enemy killing pesticides, larval parasitoids could significantly reduce LM populations below level that cause significant yield loss.

Expected outputs. Incidence (percentage parasitism and identification of parasitoids) of LM larval parasitism in vegetables and associated weeds collected from several provinces determined.

Task: Collection of LM damaged leaves of various vegetables and weeds (GS Arida | 09/07/2006)
Task: Rearing of collected damaged leaves in the laboratory (GS Arida/PhilRice | 09/07/2006)
Task: Identification of parasitoids and determine percentage of mortality (GS Arida/PhilRice | 09/07/2006)

Activity 28. Management of tomato fruitworm, *Helicoverpa armigera*: Monitoring adult populations with sex pheromone baited traps

Description. Fruit worm, *H. armigera* is an important insect pest of corn, cotton, tomato, soybean, pepper and other vegetables. Farmers normally spray their crop when damage was observed in the field. However, when the larvae are inside the fruits like in tomato, insecticide spray is almost wasted. Since young larvae bore immediately upon hatching, timing of application of intervention is critical for successful management strategy against this pest.

One-month tomato seedlings will be transplanted in 2000 m^2 field inside the PhilRice Central Experiment Station. Three sex pheromone-baited traps of *H. armigera* will be installed immediately after transplanting. The field will be divided into 3 main plots each representing a replication. Each plot will be further subdivided into 12 subplots, each measuring 20 m^2. Eggs of *H. armigera* will be monitored weekly from 3 subplots by cutting off shoots and flowers from 5 randomly selected plants for counting in the laboratory. Damage fruits and number of live larvae will be recorded. Trap catches will be monitored 3 times a week and pheromone dispenser will be changed every month.

Hypothesis: Sex pheromone traps can predict the arrival of *H. armigera* in tomato and trap catches is highly correlated with eggs and could be used as monitoring tool for effective timing of interventions.

Expected outputs. Relationship between sex pheromone trap catches and population of fruit worm eggs, larvae and its damage in tomato determined.

Activity 29. Management strategies of whiteflies in rice-based cropping system
Description. IPM approaches such as cultural, mechanical, biological and use of biorationals will be evaluated to test their effectiveness in managing whiteflies population. Evaluation of cultural practices such as trap cropping, cropping sequence, intercropping and herbal plants as companion crop will be evaluated. Experiments on the use of yellow sticky traps, removal of plant parts with eggs as mechanical approach and evaluation of identified natural enemies will also be done.

Expected outputs. Identified and developed management strategies for the control of whiteflies in rice-based cropping system.

Activity 30. Farm women's roles in IPM: The case of the Philippines

Description. Farm women are involve in several pest management activities and, on several countries on the average, devote more time to pest management than do men. Given the gender division of labor and differences in access to agricultural technologies, information, and productive resources, the technological needs of women farmers are in many ways distinct from those of men. Farm women need low external input, gender friendly, and time-saving technologies adapted to small areas. The basic principles of IPM are therefore well-suited to such needs. However, few mechanisms, both in the national and international levels, exist to incorporate gender issues into the research and

development of IPM technologies. Better data on farm women and incorporation of gender issues into IPM research agendas are therefore needed.

Primary data will be collected from farm women using a semi-structured interview schedule. The questionnaire will focus on farm women's roles. Situation, and constraints with regards to IPM. The review of literature, focus group discussions and interview with key informants last season guided the development of the questionnaire. Frequency distribution, means, correlation analyses and multivariate analyses will be used for data analyses. Socioeconomic, household, and farm characteristics will be used to predict women's involvement in pest management. An analysis of how IPM technologies reach farm women will also be made.

Expected outputs. A report discussing the roles of farmwomen roles, situation and constraints with regards to IPM.

Expected impact: This research seeks will show that gender is an issue which has important implications for the generation and implementation of IPM in the Philippines. Results of the project will be considered and incorporated in all IPM CRSP technologies, trainings, and information disseminating strategies. This will assure that technologies and trainings had incorporated the gender variable and are gender-friendly.

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

This objective will be achieved by developing mechanisms for regular communication among collaborating institutions involved with CRSP activities, holding workshops for researchers and trainers, and the production of training curricula and materials aimed at the farmer level.
The impact of these activities will be to improve the capacity of collaborating institutions in the region to conduct IPM research and convey research results to appropriate target audiences.

Activity 1. Conduct regional workshops to establish communication systems among SE Asia IPM CRSP collaborators

Description. A workshop will be held to communicate IPM programs in the various locations and to establish a communications network – in collaboration with the IT Global Theme project – such that IPM scientists, students, and trainers throughout the region can learn from each other and reinforce activities region-wide.

Expected outputs. A workshop to share experiences, report on activities and plan future activities.

Activity 2. Organize and monitor farmer-participatory field studies as demonstrations for farmer field schools in North Sumatra

Description. The USAID-funded ESP program in North Sumatra will support 4 farmer-led FFSs during the year. This activity will provide synergy for the USAID/Jakarta program by establishing a technical support capacity at the local level.

Expected Outputs. Demonstrations of IPM principles in farmer fields in one of the major vegetable growing regions of Indonesia, with farmer involvement in the design and implementation of the activity.

Activity 3. Socio-demographic profile of strawberry farming households in La Trinidad

Description. Farmers will be interviewed using a semi - structured survey instrument, which will cover socioeconomic characteristic of farmers, their knowledge/perception of pests and diseases, pest control practices, gender roles in a household, labor arrangement, land tenancy, and marketing and credit systems. A minimum of 10% of the population for each of the strawberry agro-ecosystem would be taken as a sample. These data will be validated using secondary data from concerned agencies, if available and informal discussion with key informants.

Expected outputs. Database for project monitoring and evaluation.

Activity 4. Investigations into improved marketing, techniques and value added products.

Description. Expansion of current market areas for fresh fruit sales will be investigated. Improvement of shipping methods will be investigated. Improvement of current "value added" products (i.e. strawberry wine, jam/preserves) to increase farmer income and investigations into additional products including "fruit-leather" and dehydrated strawberries.

Expected outputs. Farmers will benefit from improving production techniques of current "value added products" and a wider choice as a result of new products. Additional incomes for strawberry farmers will act to spread risk and allow increased/improved production.

Activity 5. Partial udgeting for strawberry producers in La Trinidad

Description. Partial budgeting is a tool used to estimate the financial impact of a particular change in an agribusiness practice. By estimating revenue and expenses affected by proposed a specific change, in this case the introduction of *N. longispinosus* as an alternative treatment that replaces or reduces chemical treatments while reducing the damage by spider mites, the researcher and the farmer may determine the likely impact of the treatment. During this year the *N. longispinosus* is expected to be harvested from poinsettias but may also be available through mass rearing. Data will be collected on both demonstration plots and in farmer managed areas adjacent to the plots. Partial

budgets will be constructed for both alternatives as they evolve. The partial budget(s) will describe the immediate impact of the two alternative treatment regimes proposed.

Expected outputs. It is anticipated that the field staff and farmers will collect data on costs and revenues. These will include, but will not be limited to (under each regime): quantities of fruit harvested, quality of fruit harvested, price for different grades of strawberries in the local market, pesticide usage, herbicide usage, cultural practices that may differ across the demonstration and farmer managed plots, imputed cost of mass rearing *N. longispinosus* and labor required to collect *N. longispinosus* from the banker plants and/or rearing facilities.

Objective 3. Enhance the capacity of SE Asian institutions to support research and extension of IPM systems.

A. This objective will be achieved by involving graduate students and field technicians in the implementation of IPM research. Training at all levels will be a primary emphasis of the project.

B. The impact of these activities will be to significantly strengthen the ability of host country institutions to maintain ongoing programs of IPM research and training.

Activity 1. Conduct a regional workshop to establish communication systems among SE Asia IPM CRSP collaborators.

Description. Scientists and field technicians to be selected prior to the workshop. Participating institutions include some or all of the following: Clemson University, North Carolina State University (IT Global Theme), Bogor Agricultural University, Sam Ratulangi University, PhilRice, University of the Philippines, Los Baños, FIELD/Indonesia, Ministries of Agriculture – Philippines, Indonesia, IRRI, AVRDC, CIP, and FAO.

Expected outputs. A workshop to bring expertise from the region, placing special focus on vegetable IPM: the potential and the problems and identifying a mechanism for information sharing.

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

A. This objective will be achieved by providing farmer training for the production of high quality products in the key areas of the region where trade (regional and international) historically is important.

B. The impact of these activities will be to enhance farmer incomes and expand the abilities of universities and other institutions to gain a comprehensive appreciation for the importance of IPM as an alternative to synthetic chemical pest control.

Activity 1. Coordinate activities among collaborating institutions in the region with a focus on improving production systems and marketing channels for IPM products.

Description. All participating institutions in the project will be involved in this area with Clemson University having primary responsibility. Other collaborators are Bogor Agricultural University, Sam Ratulangi University, PhilRice, University of the Philippines, Los Baños, FIELD/Indonesia, Ministries of Agriculture – Philippines, Indonesia, IRRI, AVRDC, CIP, and FAO.

Expected outputs. This objective is an overriding theme of the project. Production of high quality products is one step in the process. Targeting markets that will provide premium returns for quality are equally important.

Activity 2. Technology transfer through end-of-season field days and season-long training of farmer cooperators

Description. The farmer-cooperators in the on-farm studies will be trained on the management strategies being evaluated through on-hands participation in the season-long studies. At the end of the cropping season, a field day will be conducted in each location to showcase the technologies, accompanied with discussions and open forum.

Expected outputs
1. Reduced crop protection input cost
2. Higher crop yields

Regional Integrated Pest Management Research and Education for South Asia

Edwin G. Rajotte, Department of Entomology, Pennsylvania State University,
501 Ag. Sci. & Ind. Bldg., University Park, PA 16802

Objective 1. Regional network establishment

Expected impact. Understanding of the scope of the vegetable pest problems within the region and the subsequent development of research and technology transfer proposals to develop economically and environmentally acceptable pest management strategies that are common to all sites and draw upon synergies of each country and the global theme projectsDevelopment of an IPM Center of Excellence in Bangladesh that delivers IPM programming information to the region.

Expected outputs. The regional meeting and on-site discussions will provide guidance for the research and technology transfer activities to be conducted on a regional basis starting in Year 3 of the project.

Description. Expansion of the successful IPM CRSP collaborative model in South Asia by continuing the collaboration with Bangladesh, and expanding the relationship with Nepalese and Indian institutions, including scientists from IARCs, NARS and NGOs. Particular attention will be devoted to vegetable and fruit systems, identified from the stakeholders meetings, subject to confirmation during participatory appraisals, baseline surveys, and crop-pest monitoring as described below. The program will advance IPM science; develop IPM technologies, information and systems; and will work to develop and integrate sustainable, resource-based local enterprises into domestic and international markets. Attention will be devoted to reforming and strengthening policies and local/national institutions that influence pest management.

To facilitate development of IPM systems, communication, education, and technology transfer within and across countries we will establish a regional network of IPM expertise. This will provide a resource for all countries and USAID missions in the region to address IPM needs and promote IPM principles and methods throughout the region and beyond. We will initiate this model in Bangladesh by establishing our BARI collaborators as a de facto IPM Center of Excellence; a national resource for deliverers of IPM programming. In addition to scientists in the principal geographic sites in Bangladesh, India and Nepal, the network will include expertise from National and International Agricultural Research Centers and universities (IRRI, ICRISAT, AVRDC, TNAU), NGO IPM programs (Winrock, FAO, MCC, CARE), and U.S. universities, among others. The network will facilitate development of IPM systems, communication, education, and technology transfer within and across countries.

Activity 1. Regional meeting

Description. Due to lack of funds a full regional meeting could not be held. We are substituting site visits.

Expected outputs. In Yr 1, we plan to conduct a regional meeting of key PIs from each country site and key host country collaborators to identify participants for the projects and develop research and technology transfer proposals for studies to be conducted in Yrs 3-5.

Task: Visit collaborators in lieu of regional meeting. (| 12/01/2006)

Activity 2. Establish a regional network of IPM expertise

Description. Regional expertise networking will result from electronic communications among sites as well as participation in a separately funded insect transmitted plant virus workshop. Due to budget reductions, face to face networking is not possible.

Expected outputs. Networking**.**

Task: Arrange for participation in insect transmitted plant virus workshop (Rajotte, Rayapati, Mohankumar | 10/18/2007)

Activity 3. Seek USAID Mission support

Description. Indian USAID mission visited in Summer 2006. Will be visited again in 2007. Bangladesh mission will be visited in November 2006. Nepal mission will be visited in October 2006.

Expected outputs. Develop a Leader with Associates funding scheme to enhance IPMCRSP workplan.

Objective 2. Promote Regional and International Communication

Description. A web site initially maintained at Penn State University, and linked to the Virginia Tech IPM CRSP Web site, will provide an information center for regional IPM activities, Components of this web site will include results of participatory appraisals, trip reports, research reports, reproductions of technology transfer literature (fact sheets, manuals, radio drama mp3s, etc.), an 'ask the expert' section, a listing of IPM experts in each country, among other features.

We will construct a web-based survey questionnaire where potential IPM network members can describe their jobs, education, contact information, areas of expertise, willingness to consult, etc. This information will be compiled into a database that can be searched by keywords.

Expected impact. Promotion of communication regionally among country sites and internationally among IPMCRSP Regional Centers and Global Themes thus promotion of solving of pest problems on a global basis.

Expected outputs for the year. Initial establishment of the website, email listserver and expertise directory.

Activity 1. Establish an E-mail listserver

Description. An e-mail listserver will be established as a 'push technology' communications device. The listserver will act to notify IPM network members about future events, new IPM discoveries and successes, etc

Activity 2. Website development

Description. A web site initially maintained at Penn State University, and linked to the Virginia Tech IPM CRSP Web site, will provide an information center for regional IPM activities, Components of this web site will include results of participatory appraisals, trip reports, research reports, reproductions of technology transfer literature (fact sheets, manuals, radio drama mp3s, etc.), an 'ask the expert' section, a listing of IPM experts in each country, among other features.

Task: Expand web site to include all partners (Rajotte, Heinrichs | 10/18/2007)

Activity 3. Establish an expertise directory

Description. We will construct a web-based survey questionnaire where potential IPM network members can describe their jobs, education, contact information, areas of expertise, willingness to consult, etc. This information will be compiled into a database that can be searched by keywords. Expected impact directory of expertise survey will be sent.

Expected outputs. Promotion of communication regionally among country sites and internationally among IPMCRSP Regional Centers and Global Themes thus promotion of solving of pest problems on a global basis. Expected outputs for the year Initial establishment of the website, email listserver and expertise directory

Task: Send expertise survey (Rajotte, Heinrichs | 10/18/2007)

Objective 3. Collaborate with global theme projects and regional centers

Description. The overall goal of this objective is to develop, for synergistic purposes, collaboration with Global Themes including;
(1) impact assessment,
(2) insect transmitted viruses,
(3) regional diagnostic laboratories and
(4) information technology and databases.

Expected impact. Projects that meet proposed needs.

Expected outputs for the year. Establish linkages resulting in jointly conducted activities.

Activity 1. Meet with the lead PI of the tospovirus global theme

Description. Meet with the lead PI of the tospovirus global theme in India to develop plans for collaboration in research and technology with emphasis on pest diagnosis and field studies on insect transmitted viruses of tomato

Expected outputs. Collaboration between South Asia regional site and tospovirus global theme. A separately funded virus workshop will be held in India in 2007.

Task: Arrange for IPMCRSP partners to attend virus workshop in 2007 (Rajotte, Rayapati, Mohankumar, Hienrichs, Luther | 10/18/2007)

Objective 4. Develop baseline information

Description. The participatory approach will be evident in all phases of the proposed project from establishing the priority of local pest problems through forming research and technology transfer teams with scientists, educators and NGO personnel to conducting on-farm research, to soliciting feedback from farmers and others about technology transfer methods.

The first step for research and technology transfer teams is to build a 'rich picture' of the pest management problem. Building a rich picture requires exploring the elements of a particular pest management problem and then exploring the connections of that problem with the surrounding community. We have already begun this process in the proposal planning exercise in Bangladesh but a (1) mini- participatory appraisal, (2) benchmark survey and (3) a pest and beneficials survey need to be conducted in Nepal and India. A substantial portion of the proposed project will invest in expanding this picture to try to define not only the characteristics of the crop/pest situation, but also the context within which any IPM program would operate.

One of the first activities in the IPM CRSP methodology is to do a two-year pest and beneficial field survey (crop-pest monitoring). While the participatory appraisal reveals perceived pest problems, a biological survey can confirm and sometimes refute these perceptions. This is especially true of pest organisms that are difficult to see, such as nematodes.

The impact of IPM on biodiversity is intuitively positive because diversity-reducing factors such as pesticides are reduced or eliminated. However, changes in biodiversity are very difficult to measure and even more difficult to attribute to a single set of IPM practices. We will begin to address biodiversity issues by first assessing the status of threatened species in each country and which threatened species can be affected by pest management practices. This will allow us to factor these threats into our research prioritization process. A second aspect of our approach will be to assess changes in biodiversity as a result of IPM implementation.

Expected impact. Selection of research topics that will be targeted at the most important pests and development of technology that will conserve biodiversity.

Expected outputs for the year. Completion of the mini-participatory appraisal and benchmark survey. Initial establishment of the pest and beneficials survey and biodiversity study which be continued in Yrs 2-4.

Activity 1. Mini-participatory appraisal

Description. Mini participatory appraisal will be carried over from the first year. Both India and Nepal will be completed by the end of 2006.

Task: A participatory appraisal will be done in India and Nepal (Heinrichs, Rajotte | 10/18/2007)

Activity 2. Benchmark survey

Description. Benchmark surveys will be done in Nepal and India. The subject of the surveys will be farmers who grow vegetable crops selected during the participatory appraisal.

Task: Benchmark surveys initiated in India and Nepal (Heinrichs, Rajotte | 10/18/2007)

Activity 3. Identify biodiversity indicators

Description. For the purposes of this project, biodiversity assessment will be based on the presence and abundance of beneficial organisms.

Expected outputs. Baseline assessment of beneficial organisms as an indicator of biodiversity**.**

Task: Include beneficial organism assessments in pest and beneficial surveys. (Heinrichs, Rajotte | 10/01/2007)

Activity 4. Pest and beneficials survey

Description. In crops selected as priority crops during the participatory appraisal, pest and beneficial surveys will be performed in selected fields of collaborating farmers.

Expected output. Presence and distribution of pests and beneficial organisms**.**

Objective 5. IPM Technology development

Description. Research activities will, by nature, be ecologically-based, realizing that a crop contains several interacting physical and biological elements. As research progresses from a component orientation through the development of IPM packages, ecological

interactions and biodiversity impacts will be considered. All tactics from the simplest hand removal of insects through biotechnological applications will be considered for their economic, environmental and social value. We will coordinate with the IPM CRSP no cost extension project in developing fruit and shoot borer resistant eggplant by (1) transferring the codon –optimized gene, (2) testing for stability of transference, (3) conducting laboratory insect feeding trials and (4) field evaluation to determine the level of resistance. This project will play a major role in field evaluations. We will also seek partners for the commercialization process through collaboration with TNAU, AVRDC, and other potential collaborators (e.g. UAS, RASI Seed Co. Mahyco and IIHR)

Expected impact. Development of technology that effectively manages vegetable pests and diseases and preserves natural enemy populations and conserves biodiversity

Participating scientists: US PIs and host country collaborators.
Evaluation of tomatoes with TNAU and lead PI, tospovirus global theme, and possibly RASI Seed Co. and Mahyco in India. Field evaluation of eggplants with TNAU. Host country national programs and NGOs in Nepal and Bangladesh.

Activity 1. Field evaluation of transgenic eggplants for FSB control

Description. Eggplant is a staple vegetable throughout South Asia. It is attacked by a number of pests resulting in extremely heavy pesticide usage (>50 sprays per season) and an increased probability of pesticide residues on harvested fruit. In South Asia, the eggplant fruit and shoot borer (*Leucinodes orbonalis*; EFSB) is a very serious pest of eggplant. The EFSB is a lepidopteran insect that bores into the shoots and fruits of the eggplant, making insecticidal control extremely difficult and expensive. Reports of economic losses due to EFSB range from 40% (Allam et al. 1982) to around 54% (Lall and Ahmed 1965; Gowda et al. 1971; Atwal and Verma 1972). Scientists in India have transferred a synthetic cry1Ab gene coding for an insecticidal crystal protein of *Bacillus thuringiensis* (var. *kurstaki*) into eggplant by transgenic means (Kumar et al. 1998). But the expression is not up to the satisfactory control of EFSB. Now the work with cry2Aa gene (from local Bt isolate) is in progress at TNAU under IPM-CRSP project. The Cry2Aa protein gave more than 80 percent mortality to neonates of EFSB. The transformation of this new gene is in progress. Hence, in this project, this lepidopteran-resistant eggplant will be tested in the greenhouse. This technology has the potential to greatly reduce the number of insecticidal sprays on eggplant in South Asia. In Okra, yellow vein mosaic virus is considered to be a major biotic constraint limiting the yield. The root –knot nematodes (*Meloidogyne* spp.) are commonly associated with both eggplant and okra and cause yield loss up to 30 percent. Hence, the budget supports the activities including baseline surveys, crop pest and disease monitoring in eggplant and okra (priority crops), laboratory, greenhouse, and on-farm field experiments on pest management components and testing of IPM packages.
Task: 1. Evaluation of transgenic eggplant with cry2Aa gene at green house for gene expression and efficacy against *Leucinodes orbonalis* (heinrichs, Rajotte, Mohankumar | 10/01/2008)

Task: Conducting field trials to study integrated management of ESFB in egg plant and yellow vein mosaic virus in okra with cultural methods, botanicals and biopesticides (Heinrichs, Rajotte, Mohankumar | 10/01/2008)
Task: 3. Documentation of insecticide resistance and characterization of *Leucinodes orbonalis* and *Bemisia tabaci* populations using molecular tools (Heinrichs, Rajotte, Mohankumar | 10/01/2008)

Activity 2. Test soil amendments for control of soil borne diseases and nematodes

Task: Initiate soil amendment experiments in Nepal and continue experiments in Bangladesh. (Rajotte, Miller | 10/01/2007)

Activity 3. Fruit fly management using pheromones
Task: Initiate fruit fly management experiments in Nepal and continue experiments in Bangladesh. (Rajotte | 10/01/2007)

Activity 4. Weed management for control of alternate hosts of insect transmitted viruses
Task: Study of weeds as alternate hosts of insect pests, disease pathogens and natural enemies in vegetable eco-system (landscape ecology (Rahman, BARI | 10/01/2007)

Activity 5. Develop IPM components

Task: Survey for assessing the pest status of different mite species and develop IPM package for their management (Alam, Rajotte- BARI | 10/01/2007)

Activity 6. Weed management for control of alternate hosts of insect transmitted viruses

Task: Survey and identification of major weed species in rice-based vegetable crops (Rahman, BARI | 10/01/2007)

Activity 7. Develop IPM components

Task: Evaluation of eggplant and tomato germplasm for resistance to fruit and shoot borer (FSB), jassids, bacterial wilt (BW), virus disease, and root-knot nematode (RKN (S. Ahamd-BARI | 10/01/2007)
Task: Development of pumpkin variety resistant to PRSV and WMV2 (Rashid-BARI | 10/01/2007)
Task: Development of virus resistant variety of cucumber (*Cucumis sativus*): (Rashid-BARI | 10/01/2007)
Task: Evaluation of okra germplasm for developing varieties resistant to yellow vein mosaic virus (YVMV): (Rashid-BARI | 10/01/2007)
Task: Grafting of watermelon with cucurbit root (Rashid-BARI | 10/01/2007)
Task: Development of IPM packages for insect pests of country bean, cabbage and tomato (Alam-Bari | 10/01/2007)

Task: Development of a management package of (Nassirudin-Bari | 10/01/2007)
Task: Development of an effective and economic weed management practice for onion production (A. Rahman-Bari | 10/01/2007)
Task: Study of nematode trophic groups in IPM and non- IPM system (M.A. Rahman-BARI | 10/01/2007)
Task: Identification of diseases of summer tomato grown under polythene tunnels- A new cultivation system (M.A. Rahman-BARI | 10/01/2007)
Task: Mass rearing of green lacewing and evaluation of efficacy as biocontrols (Alam-Bari | 10/01/2007)
Task: Commercial preparation of *Trichoderma* spp. in the laboratory for its use in seedbed nurseries to control various soil-borne pathogens (M.A. Rahman-BARI | 10/01/2007)

Activity 8. Assessment of socioeconomic constraints to the adoption of IPM

Task: Dissemination and impact assessment of IPM technologies (Hossain, Norton | 10/01/2007)

Objective 6. Training, education, and institutional capacity building

Description. We will address institution building on several fronts. The first will be to assess the IPM research and technology transfer abilities present in a given country during our participatory appraisals. When shortcomings are found, we will plan to strengthen that area through short-term training, enhancement of local graduate education, online distance education courses targeted toward specific needs, graduate training in the United States, or a sandwich program that involves a combination of local and U.S. or regional training. We will also assess physical assets available for IPM research and budget for their improvement (as much as the budget allows).

We are budgeting training expenses at several institutions to encourage cross training among IPM institutions in the region. We had great success with this model over the last several years when, due to a USAID initiative, we needed to improve the ability to work with transgenic vegetables in Bangladesh and Philippines. We will continue this cross training effort with TNAU and expand training institutions to include ICRISAT, IRRI and additional training at AVRDC.

Expected impact. Development of institutional capacity to develop vegetable IPM technology after the present project terminates

Participating scientists: US PIs and host country collaborators

Expected outputs for the year
1. Identification of the training needs (institutions, numbers and IPM disciplines) for degree and non-degree training
2. Determination of the physical needs for vegetable IPM research

Activity 1. Train graduate students from participating countries at U.S. universities

Task: Continue graduate program for student at Penn State University (Rajotte | 10/18/2008)
Task: Continue graduate education for plant pathology graduate student at Ohio State University (Miller | 10/18/2008)
Task: Continue graduate education for agricultural economics graduate student at Virginia Tech (Norton | 10/18/2008)

Objective 7. Technology transfer

Description. We will include technology transfer in several ways. The first is using government-based technology transfer pathways including extension. Since our research plots are primarily in farmers' fields, the IPM researchers do some technology transfer in the communities where the research takes place. A second way is interacting with various non-governmental organizations that, in many cases, have substantial technology transfer efforts already in place. By their own admission, while they have hundreds of staff to train farmers, there is a paucity of subject matter, especially newer IPM techniques.

Our technology transfer plan will be take advantage of technology transfer mechanisms already in place and take into consideration of a diverse array of approaches in order apply those most effective and efficient. In our proposed sites, we have commitments from major organizations that reach tens of thousands of farmers with well-funded technology transfer efforts (FAO, CARE, MCC, Winrock, public extension systems). These organizations use diverse methods from simple messages to intensive farmer field schools. Specific IPM tactics can be matched to different types of methods. One of our collaborators (Heong) was awarded the World Bank's Development Marketplace Award for innovative radio dramas to promote IPM (IRRI Bulletin, 3 June. No. 2005.22). In Bangladesh we will work with CARE International and the Mennonite Central Committee. Between these two NGOs, literally tens of thousands of farmers are reached through training programs. Our objective will be to train the trainers using research outputs from IPMCRSP.

Winrock International has ongoing programs in Bangladesh and Nepal. We will collaborate with Winrock to merge the processes and techniques of IPM CRSP with their projects. This will give IPM CRSP entry into Nepal and connection to their IPM training network there.

One important success of the Winrock program has been the improvement of the value chain for IPM tools. In the past we have been frustrated by the difficulty of farmers obtaining IPM inputs. These inputs include pheromones, disease test kits, entomopathogenic organisms, traps, etc. For the purpose of our experiments these inputs were purchased in the United States and brought into the country by U.S. scientists. However, when it came time for technology transfer, we were frustrated by the lack of local availability of these inputs, either due to regulatory barriers or the unwillingness of local companies to import them.
Winrock International has concentrated on developing the value chain for these products so that they were generally available in Nepal. Winrock has used innovative methods to

stimulate small business development around these products. Not only does this provide incentives to procure these tools, but also is a sustainable approach that provides these inputs far into the future. Investigating the value chains for IPM products will be incorporated in both Bangladesh and Nepal.

In India we will network with NGOs such as the Association for the Promotion of Organic Farming, AVRDC, National Center for IPM, state departments of agriculture and universities to transfer technology to farmers. Each technology transfer method will be evaluated based on educational effectiveness, economic efficiency and the potential for behavioral change.

Expected impact. Development of farmer acceptable technology that effectively manages vegetable pests and maintains natural enemy populations and conserves biodiversity.

Participating scientists. US PIs and host country collaborators

Expected outputs for the year. Completion of the mini-participatory appraisal and benchmark survey and initial establishment of the pest and beneficials survey and biodiversity study to be continued in Yr 2.

Activity 1. Establishment of technology transfer network

Activity 2. Identification of relevant technology already available in India and other S and SE Asian countries and testing of selected technologies in farmer's fields in India, Bangladesh and Nepal.

Objective 8. Monitoring and evaluation

Description. The South Asia regional site will hold annual review and planning meetings in the region during which progress from the previous year will be reviewed and planning for the coming year completed. During the review, each scientist and NGO representative will report on progress/results and the rest of the group, local and international, will comment and make suggestions. An annual report prepared for the region will be an accounting of progress toward several key indicators. Those indicators will relate to the goals of the IPM CRSP. The key targets and indicators of impact that the regional program will are listed below.

Key indicators of impact: (a) Wide-spread adoption of IPM technologies, (b) Reduced pest-induced losses, (c) Reduced pesticide use, (d) Changes in farmers' perceptions of pests and natural enemies, (e) Increased farm income and economic growth, (f) Increased exports of products produced with IPM with minimal pesticide residues, (g) IPM programs institutionalized, (h) Scientists and graduate students trained in the HCs and the U.S., (i) Regional collaborative network formed among U.S. and HC universities, IARCs, and other public and private institutions, (j) IPM training programs or events completed for trainers from CARE, MCC, departments of agricultural extension, and others who will be extending IPM results from the previous phase of the IPM CRSP, (k) Increases in

exports from host countries of products produced with IPM, (l) Spread of the IPM CRSP program beyond the initial sites, (h) IPM in schools programs developed in the region.

Target 1. IPM science advanced, with ecologically-based IPM technologies, in the region.

Indicators of impact. (a) ProfitableIPM technologies, information, and systems developed, recommended, and released, (b) IPM scientific discoveries described and published in international, regional, and national journals, (c) IPM solutions developed in one country is adapted and adopted in other countries

Target 2. Improved IPM communication.

Indicators of impact: (a) increased IPM capacity of host-country scientific and outreach institutions, (b) enhanced ability of practitioners to manage IPM knowledge, and (c) widespread adoption of ecologically-based IPM technologies, practices, and systems, with measurable impacts.

Target 3. Information provided and capacity built that reformed and strengthened policies and local/national institutions that influence pest management.

Indicators of impact: (a) Greater understanding of social, gender, and institutional factors influencing IPM, (b) Policy recommendations adopted that encourage adoption of IPM, (c) Capacity for IPM policy analysis has been increased

Target 4. Sustainable, resource-based local enterprises developed and integrated into regional, national, and international markets

Indicators of impact. (a) Resource-based, local private enterprises are formed that supply inputs to farmers such as biocontrol products, grafted seedlings, pheromones, and technical IPM advice, (b) Marketing cooperatives or firms for horticultural products are formed and strengthened that are linked to regional, national, and international markets, with pre-clearance procedures established to enable them to succeed in these markets.

Expected impact. Promotion of the IPM CRSP S Asia Regional Center within host countries and internationally

Participating scientists. US PIs and host country collaborators

Expected outputs for the year. Annual review and planning meeting conducted, annual report produced, and preparation of plans for impact assessment study.

Activity 1. Annual report submission

Activity 2. Annual regional review and planning meeting

Description. Due to budget shortfalls, regional planning will be done during site visits.

Expected outputs. Annual adjustments in research and technology transfer plans

Activity 3. Meet with the Impact Assessment Global Theme Lead PI to develop a plan to obtain baseline information in Yr 2 and for the impact assessment study to be conducted in Yr 5.

Task: Initiate baseline survey in Nepal in concert with Evaluation Global Theme (Rajotte, Norton |)

Ecologically-Based Participatory and Collaborative Research in the Central Asia Region

Karim Maredia, Institute of International Agriculture, Michigan State University, 416 Plant and Soil Science Building, East Lansing, MI 48824

Objective 1. Conduct research on landscape ecology to enhance biodiversity and biological pest management.

Increasing crop monocultures and decreasing landscape diversity are frequently accompanied by a reliance on agricultural pesticides to help suppress crop pests. The specific objectives of this research project are to adapt existing principles and practices of landscape management to enhance IPM for use in Central Asian agricultural landscapes, to research the use of native plants for conserving natural enemy communities and enhance biological control of field crop pests in Central Asia and to investigate and implement the most promising landscape management techniques in partnership with governmental agencies, universities, NGOs and farmers in the region.

Activity 1. Initiate collaborative research on landscape ecology in Central Asian agro-ecosystems

1. Increased understanding and management of agroecosystems for enhancing biological control of pests and biodiversity.
2. Native species that can thrive in open agriculture landscape are know/ identified.
3. Scientists are informed of existing natives species that can enhance habitat diversity.
4. Develop a brochure aimed at explaining the importance of habitat diversity.

Task: Conduct monitoring and discuss result of demonstration plot with nectar plants. (Dr. Douglas Landis, Michigan State University, Dr. Mustapha El-Bouhssini, ICARDA ,Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan | 10/01/2006)
Task: Workshop on IPM for Government, Donors, Researchers, Universities, Local and International NGO and Farm Association. (N. Saidov | 12/01/2006)
Task: Establish research plots and start collecting insects data collection (N. Saidov | 09/01/2007)
Task: Design and publication of leaflet on nectar plant diversity and insect natural enemies (N. Saidov, D. Landis and M. El-Bouhssini | 09/01/2007)

Objective 2. Enhance efficiency, products line, and crop usage of Central Asian biolaboratories

The overall goal of this component is to work with Central Asian researchers, educators and farmers to identify, produce and introduce into vegetable production systems candidate entomophages for management of spider mites and insect pests which are not currently targets of those produced by Biolaboratories.

Activity 1. Improving efficiency and expanded product lines of biolaboratories in the central Asia region.

1. Identification of potential species for considerations for adding to the product lines of biolaboratories.
2. Development of partnership with private or public institutes or biolaboratories for evaluating potentials predator mite candidates for mass rearing in the region.
3. Local methods for mass rearing of new potential species will be developed.
4. Local methods for maintaining predator mite stock cultures during the winter will be developed.
5. Determine potential sources and methods for importation and release of cereal leaf beetle parasitoids.

Task: Study and evaluate conditions for maintaining and rearing candidate predator mites and their prey in culture and during the winter. (B. Tashpulatova and F. Zalom | 12/01/2006)
Task: Conduct a survey and develop a draft paper on history, initiation, development and current status of biolaboratories in Central Asia (B. Tashpulatova and F. Zalom | 03/01/2007)
Task: Determine potential sources and methods for importation and release of cereal leaf beetle parasitoids (Tentative) (B. Tashpulatova and F. Zalom | 05/01/2007)

Objective 3. Develop and implement IPM extension/outreach and university education programs

Integrated pest management (IPM) is a comprehensive approach that utilizes all available tools and methods for the management of pests (insects, disease and weeds). IPM is a knowledge and information intensive. The goal of the IPM extension/outreach and educational programs will be to:
1. To further develop the capacity of ATC of RAS, Kyrgyzstan and Winrock International in the region to become regional centers for training of trainers in Central Asia.
2. Develop a pool of trainers that can support Farmer Field Schools (FFS) and other outreach activities.
3. Using the Training of Trainers (ToT) approach, integrate new information, teaching tools and methodologies into existing IPM curriculum.

Activity 1. Initiate development of IPM training modules/materials that can be integrated into crop management training programs offered by the NGOs and government institutions.
1. Distribution of electronic database of printed materials on IPM to scientific organizations
2. IPM materials are available and accessible to many farmers in local languages.
3. Training of Trainers and FFS will include module on IPM techniques to control pests.
4.IPM training modules on major crops are available.

Task: Develop and make available electronic databases of printed materials on IPM of consulting services and the research organizations of Tajikistan. (M. Aitmatov, G. Bird and W. Pett | 07/01/2007)

Task: Establish collaboration with Universities for developing IPM brochures and translate in local languages. (M. Aitmatov, G. Bird and W. Pett | 09/01/2007)
Task: Develop modules on major crop IPM techniques for training selected trainers-facilitators, and training of trainers and FFS to increase the use of IPM in pest management. (M. Aitmatov, G. Bird and W. Pett | 09/01/2007)

Activity 2. Develop an inventory of IPM educational resources and a directory of IPM specialists in the region

1. Inventory of IPM training course in the region
2. Directory of IPM specialists in the region

Task: Identification of trainers (M. Aitmatov, G. Bird and W. Pett | 05/01/2007)
Task: Identification of IPM training courses in various universities in the region (M. Aitmatov, G. Bird and W. Pett | 09/01/2007)

Objective 4. Develop and implement regionalization and globalization strategy

We recognize the importance of networking and linkages among various stakeholders and institutions working on IPM within the region and globally to help facilitate the transfer of technology, information and knowledge. We will make all possible efforts and avenues to share the research results and IPM information to IPM stakeholders in the region beyond these two countries. Our two partners - ICARDA and Winrock International have well-established regional networks in central Asia, and they will serve as excellent vehicles for regionalization and globalization. We will use the following strategy to foster interactions, cooperation and linkages among various stakeholders.

Activity 1. Membership in the International Association of Plant Protection Sciences (IAPPS)

1. IPM Specialists from the regions are connected to the outside world.
2. Increase networking and access to information on current issues related to plant protection and IPM.
3. Increased access to information and exchange .

Task: Provide membership in IAPPS (K. Maredia | 05/01/2007)

Activity 2. Facilitate participation in regional IPM meetings and forums organized by ICARDA, Winrock International and other NGOs.

1. Participation of 3 research fellows in regional IPM meetings and workshops.
2. Increased networking with regional IPM specialists

Task: Facilitate participation of research fellows in regional meetings/workshop (K. Maredia | 09/01/2007)

Activity 3. Facilitate participation of IPM specialists from the region in the MSU's International Agroecology, IPM and sustainable agriculture short course.

1. One to two IPM specialists from the Central Asia region are trained.
2. Increased linkages and collaboration between Central Asia and US IPM specialists

Task: Recruit IPM specialists from the region to participate in the MSU's international Agroecology, IPM and sustainable agriculture short course (K. Maredia | 05/01/2007)

Objective 5. Conduct impact assessment of the regional IPM program

Our regional IPM program will assess economic, environmental (including biodiversity), institutional and gender impacts. The project has identified two socio-economists in the region—Dr. Shuhrat Sattarov (Samarkand Agricultural Institute) and Ms. Nodira Khusanova (Human Resource Development Center, Tashkent, Uzbekistan) who will help to implement the impact assessment activities. They will work closely with the socio-economics team leaders based at MSU and Virginia Tech (Prof. George Norton, leader of the global theme on the IPM CRSP impact assessment). We will seek input from Dr. Richard Bernsten and other specialists at MSU in assessing the socio-economic and gender impacts of this project.

Activity 1. Initiate baseline survey of pest management practices in Kyrgyzstan and Uzbekistan or Tajikistan
Baseline survey of pest management practices

Task: Conduct baseline surveys (K. Maredia | 09/01/2007)

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

Mark Erbaugh, International Programs in Agriculture, Ohio State University
113 Agricultural Administration Bldg., 2120 Fyffe Road, Columbus, OH 43210-1009

Objective 1. Development of a regional model of collaborative IPM research, training, and knowledge dissemination.

Description: The Coordination Unit (CU) at Makerere University and the Regional Technical Committee (RTC) consisting of one representative from each country will be continued and will coordinate IPM research, training, extension, and capacity-building activities in the region.

Expected Impacts:

- A regional model of collaborative IPM research, training and knowledge dissemination continued;
- A participatory approach to IPM research and technology transfer implemented;
- Regional IPM research needs for priority horticultural crops identified;
- Effective IPM strategies identified and shared throughout the region;
- An effective technology transfer and dissemination plan for reaching regional producers including women developed;
- Enhanced human resource capacity that will increase IPM research and training capabilities of the region;
- Increased networking and enhanced institutionalization of IPM in the region.

Activity 1. Implement Year II Regional IPM program Work Plan activities.

Description:
(i) Implement and complete Year II work plan activities in cooperation with RTC and Disease Diagnostics Global Theme and determine reporting schedule.

Task: Enhance RP/EA website portal.
Task: Host second meeting of RTC to assess progress and formally complete work plan and annual timetable.
(ii) Specify and implement additional socioeconomic baseline activities:

Task: Complete write-up of Year I socioeconomic baseline studies;
Task: Coordinate training plan design for additional socioeconomic baseline studies.
Task: Implement additional socioeconomic baseline surveys

(iii) Implement Year II biological monitoring programs.

Task: Assess progress of Year I biological monitoring activities and determine need for improvements and/or additional biological monitoring activities.
Task: Implement additional biological monitoring activities.

(iv) Develop training program

Task: Complete and initiate training program for regional graduate students, graduate student and research associates coming to USA
Task: Complete Development of Regional Modular IPM program

Expected outputs for the year:
1) RTC contributions to annual report completed; 2) Second RTC meeting held; 3) Web-portal for RP/EA enhanced; 4) socioeconomic baseline reports completed; 5) Biological Monitoring programs continued; 5) Pest Management priorities list developed from socioeconomic and biological monitoring activities; 6) Training Programs completed and initiated; 7) Pesticide training manual completed.

Objective 2. Developing IPM research programs for higher value marketed horticultural crops.

Description. To continue implementing a specialized, ecologically-based IPM research program focused on priority pest constraints of higher value marketed horticultural crops.

Impacts:

- reduce high-value horticultural crop losses due to pests;
- reduce the use of pesticides to minimize adverse environmental impacts including reductions in bio-diversity;
- lower cost-of-production;
- improve food safety and quality;
- increase crop marketability and value.

Activity 1. **Vegetables**: To develop IPM package for focal vegetable crops that reduces crop losses due to pests and reduces the use of pesticides.

Sub-Activity: Tomato

Description:
(i) **Uganda:** Field trials using IPM package for tomato were continued with 3 farmer groups and 40 farmers were exposed to grafting techniques. A trial that investigates different forms of staking will also be introduced (ii) **Kenya**: A socioeconomic baseline study of tomato growers in Mweya has been completed and biological monitoring begun and the write-up of these two studies will be completed. Based on the results, an on-farm research program will be designed and implemented in Year II. (iii) **Tanzania:** A socioeconomic baseline study of tomato growers in Morogoro Region has been completed and on-station integrated trials initiated. The write-up of the socioeconomic

baseline study of tomato growers will be completed and on-farm trials designed and implemented. (iv) **AVRDC**: At the AVRDC Regional Center for Africa and in farmers' fields in the Arusha area, tomato varieties will be screened for resistance to: a. Tomato yellow leaf curl virus; b. Early blight; c. Spider mites. An RCBD will be used with at least 3 replications.

Expected Outputs for the year. (i) Uganda, to complete tomato activities as outlined in No-cost Extension Work Plan, test alternative interventions as mentioned above, and promote grafting including grafting manual for farmers; and end year with clarified package; (ii) Kenya, on the basis of socioeconomic baseline and biological monitoring to begin implementation of limited field trials of improved IPM practices. (iii) Tanzania**,** on the basis of socioeconomic baseline and biological monitoring to begin implementation of limited field trials of improved IPM practices. (iv) AVRDC: Results from screening trials of tomato varieties showing resistance to the above pests will be analyzed and shared with regional collaborators.

Sub-Activity: Hot Pepper

Description. This is a continuing activity. It will focus on developing IPM technologies for key pests and diseases of scotch bonnet hot pepper. On going studies have indicated that the most common pests of pepper are aphids, whiteflies and fruit flies. The key diseases are bacterial leaf spot, *Cercospora* leaf spot and viral diseases. The viral diseases were the most serious this year in Uganda affecting over 50 percent of the crop. The planned work is to determine losses caused by the above pests and characterize viral diseases. The disease diagnostics will be done in collaboration with AVRDC and the global theme on insect transmitted viruses. Additionally, farm production survey indicated that most farmers were using home-saved seed which have been used for 5+ years. Therefore new germplasm will be introduced and tested. **Objectives:** (1) Viral disease characterization; (2) On-farm trials to reduce incidence of major pests and diseases will be designed and implemented; (2) A study on the affect of seed quality on disease incidence will be initiated; (3) AVRDC: At the AVRDC-RCA and in farmers' fields in the Arusha area, hot pepper varieties will be screened for resistance to: Spider mites; *Phytophthora*; *Verticillium* wilt and Thrips. Germplasm of varieties which have shown some resistance/tolerance to these four pests/diseases are being sent to RCA from AVRDC Headquarters in Taiwan. Trials will use an RCBD with at least 3 replications.

Trap cropping trials will also be conducted at the AVRDC-RCA and in nearby farmers' fields. Marigolds and sunhemp (*Crotalaria juncea*) will be tested as trap crops to attract thrips away from hot peppers. The trials will have 3 replications of the two treatments and control (RCBD). All plots will be bordered on all four sides by maize, which will function as a barrier between plots.

i. Treatment 1: Chili pepper with marigold trap crop
ii. Treatment 2: Chili pepper with sunhemp trap crop
iii. Control: Chili pepper monoculture

(4) Cost of production information will be collected and analyzed.

Expected outputs for the year. (i). Viral diseases characterized; (ii) On-farm trial components assessed; (iii) seed-borne diseases analyzed; (iv) Screening trials of new varieties implemented and analyzed for resistance to major pests and diseases; (v) Effectiveness of trap crops to reduce thrips tested.

Sub-Activity. Task Integrated Vegetable systems

Description. Tanzania, to continue implementation of long-term, on-station trials for integrated vegetable systems.

Expected outputs for the year. Second year of data from long-term, on-station trials; initiation of on-farm trials; and integration of Tanzanian Graduate Student at OSU into research process in Tanzania and his work on seed-born diseases of tomato.

Sub-Activity. Biologically based interventions for managing *Helicoverpa armigera*.

Description. Sampling was initiated in Year 1 and will continue in Year 2 at research locations in four Ugandan Districts (Wakiso, Masaka, Kayonga and Mbale). Ten tomato farms will be sampled per District. Location and elevation will be obtained from the GPS unit. Each farm will be sampled twice during the season, i.e. during flowering and fruiting. *H. armigera* will be sampled on all alternate host plants within a 100m radius of our focal tomato field. In addition, other tomato fields within a 100m radius of the focal tomato field will be sampled. Parasitoids will be sampled by collecting bollworm larvae of various instars and rearing them out. Common predatory species will be sampled. Information will be obtained from the farmer about all pesticide use for the season up to that point. All other plant species (that are at a significant density) within a 100m radius of the focal tomato field will be recorded. This includes intercrops and other vegetation within the focal tomato field. Tomato variety and planting date will also be noted. Soil type, land use, precipitation and other data may be obtained from other sources, depending on budget limitations.

GIS data layers are being assembled with assistance from GIS contacts in Africa and the U. S. ArcView 3.2 software is being reinstalled on computers at Makerere and ArcGIS 9.1 software will be purchased for subsequent work. Sample locations collected with GPS receivers will be loaded into the preliminary GIS in Uganda and also transferred to Virginia Tech for processing. All GIS data, both collected as part of the bollworm project and GIS baselayers, will be integrated into the first version of the bollworm GIS in Uganda.

Objective 3.

(1) To develop an IPM package which emphasizes biologically based interventions to manage *Helicoverpa armigera* on tomatoes. (2) To reduce the use of pesticides on tomatoes by developing alternative interventions for controlling *H. armigera*. (3) To establish a GIS database to map pest density and related geographic factors and to search for ecological factors which may be manipulated to reduce bollworm infestations on tomatoes and other crops. (4) To develop farmer field school protocol for participatory

implementation and evaluation of tomato trials. (5) To assist project economists in developing cost of production factors for further assessing effectiveness of the IPM package.

Expected outputs for the year. (1) Research program continued. (2) GIS research results of spatial and temporal characteristics of *H. armigera*, its natural enemies, host plants and non-host plants in Ugandan tomato agroecosystems.

Activity 1. Passion Fruit. Developing an integrated disease management strategy for passion fruit in the region.

Description. (i) Detailed integrated work plan for passion fruit remains to be developed at the technical committee meeting in September. To date, a protocol to identify passion fruit viruses has been developed and virus identification implemented. (ii) Kenyan Ph.D student at OSU, Robert Geisimba, on HEPAD Project has completed his course work and will be returning to Egerton University to initiate research work on screening Passiflora species for resistance, rooting and suitability as rootstocks. Resistant rootstocks and purple passion fruit will then be propagated using tissue culture and transformed to contain the resistant genes for the woodiness virus; (iii) Growers and research locations for conducting biological baseline and monitoring and conduct a survey of passion fruit varieties and viruses still to be implemented; (iv) A Ugandan research assistant will visit Biosciences East and Central Africa (BECA) to develop diagnostic protocol for molecular characterization of virus population and screening varieties for resistance.

Progress to date. A *Potyvirus* species has been isolated in Uganda and is undergoing characterization; however, preliminary results indicate the possible occurrence of strains. A collection of germplasm with promising quality and disease tolerance attributes has been made in Uganda and phenotypic characterization is in progress.

Expected outputs for the year. Survey of passion fruit varieties and viruses in Kenya completed; the diagnostic protocols for molecular characterization of the virus population for Kenya developed; and screening of varieties for resistance initiated.

Activity 2. **Banana. To develop Biotechnology tools for studying *Xanthomonas campestris* pv. *musacearum* (bacterial wilt) and evaluating banana cultivars for resistance to the disease.**

Description. A comprehensive collection of strains of the pathogen of banana xanthomonas wilt, *Xanthomonas campestris* pv. *musacearum,* is being assembled from countries in the region, where the disease is found. Isolates will be characterized in the Miller lab (OSU) by Dr. Geoffrey Tusiime (Makerere University) or his designate, and PCR primers and a traditional PCR assay will be developed. The initial target region for primer development will be the internal transcribed spacer region in rDNA of the pathogen genome. Collaboration with IITA scientists in developing a serological assay to detect this pathogen has begun. This project will be done in cooperation and cost-

shared with the IPM CRSP Global Theme on Regional Diagnostic Laboratories Project. The global theme will support the collection of strains of the pathogen from Rwanda.

Progress to date. The IPM CRSP East Africa Regional Program and the IPM CRSP Regional Plant Disease Diagnostic Laboratories project, have initiated molecular characterization of *Xanthomonas campestris* pv. *musacearum*. The OSU plant pathology laboratory (Miller) has secured and distributed APHIS permits, and cultures of the *X. campestris* pv. *musaceraum* have been received from IITA (Mwangi) from Congo, Tanzania and Rwanda with Ugandan and Ethiopian cultures to arrive shortly. Molecular fingerprinting will be done to determine the amount of variation among strains from different geographic regions and hosts (banana and ensete). A concept note to develop a highly specific monoclonal antibody diagnostic tool for BXW was developed and sent to USAID/REDSO seeking additional funding.

Expected outputs for the year. 1) Comprehensive collection of strains of *X. campestris* pv. *musacearum*; 2) PCR assay for *X. campestris* pv. *musacearum*.

- Comprehensive collection of strains of *X. campestris* pv. *musacearum*
- PCR assay for *X. campestris* pv. *musacearum*.
- A selective media for the pathogen
- Pathogen population structure and distribution.
- Molecular diagnostic tools
- A germplasm collection for use in of resistance levels of different banana cultivars.

Start/end date. 10/1/06-9/30/07

Activity 3. **Coffee**. Developing an IPM research program on major insect pests and diseases of coffee in the region.

Description. (i) To develop linkages with regional coffee networks and coffee research institutes and define IPM research priorities on Arabica coffee; (ii) To complete and implement an IPM research work plan for Arabica coffee; (iii) To assemble and develop a coffee wilt technology transfer program for Uganda and the Bukoba region of Tanzania.

Collaborative linkages will be established between the major coffee stakeholders in East Africa including regional coffee networks and coffee research institutes. Through these linkages, IPM research priorities on Arabica coffee will be defined and an IPM research work plan for Arabica coffee defined. It is envisaged that the research will include exploring potential of biological control agents, cultural practices and economic thresholds in the management of Antestia bug *(Antestiopsis sp,)* coffee stem borer (*Bixadus seirricola), a*nd coffee berry disease.

From the on-going work on coffee wilt in Uganda, IPM technologies will be developed and disseminated within the region. Among the technologies under development is biological control using Fluorescent pseudomonas. There is, however, a need to explore other biological control agents, such as *Trichoderma* spp in the management of coffee

wilt. Therefore *Trichoderma* strains from different parts of the region will be evaluated for efficacy. The use of grafting robust on resistant Arabic root stocks has great potential for managing the disease. Therefore different root stocks will be tested.

Progress to date. Contacts were established with coffee research institutes and IPM research priorities on Arabica coffee are being refined through grower surveys and biological monitoring. Planning workshops were held with extension agents and scientists in Uganda and Tanzania to develop protocols and tools for socioeconomic surveys and biological monitoring. A socioeconomic survey was pre-tested, refined, and administered to 130 coffee growers in Mbale, Sironko, and Manafa districts in the Mt. Elgon area of Uganda and biological monitoring initiated in three sub-counties in these same districts with the APEP project. Early contacts made with regional coffee networks need to be pursued.

Inoculation methods for *Fusarium xylarioides* have been developed and are being used to screen for resistance. The host range of *Fusarium xylarioides* has been studied and established there are no alternative hosts for the pathogen. The mode of transmission has been established as being through various infected plant parts. It has been established that the pathogen has no survival propagules in soil suggesting it is a weak pathogen surviving for less than one year in the soil. Disease spread is erratic without a defined trend. Using biotechnological tools, the pathogen has been characterized and the presence of a biocontrol *Pseudomonas* spp. in Ugandan soils has been established. Laboratory studies have indicated that the biocontrol agent limits growth of the pathogen *in vitro*. There is need for testing this potential under field conditions. Furthermore exploring the potential of other biological control agents would strengthen the chances for this approach in the disease management.

Expected Outputs for the year. Following discussions with regional coffee networks, organizations and institutes to complete an IPM work plan for arabica coffee.

- Socioeconomic survey data analyzed for Uganda and Tanzania;
- Biological monitoring activities continued in Uganda and initiated in Tanzania;
- Research work plans completed;
- Characterization of coffee berry disease initiated;
- Coffee wilt technology transfer program for the Bukoba region of Tanzania completed.

West Africa IPM Center of Excellence

Donald Mullins, Department of Entomology, 319B Price Hall, Virginia Tech, Blacksburg, VA 24061

Objective 1. Development of an online whitefly monitoring system

Activity 1. Implementation of the first full season of the whitefly monitoring system and analysis of data accrued to date
The information obtained from the first full season of the whitefly studies will be integrated and reported in the West Africa website that will be available to researchers and farmer advisors in the region.

Task: Provide a functional web site for W. Africa whitefly information (Brewster/VA Tech | 06/30/2007)
Task: Acquisition of satellite imagery on the cropping system and deployment of the Whitefly Pest Management System (Brewster/VA Tech | 03/30/2007)
Task: Begin integration of GIS on whitefly and deployment on Whitefly Management System (Brewster/VA Tech | 09/30/2007)

Objective 2. Develop and implement IPM strategies for viral diseases of tomatoes

Activity 1. Understand socioeconomic and agroeconomic aspects of tomato production
Information on the socioeconomic and agroeconomic assement of the impacts of the tomato virus will be used in directing IPM technology developed to control this pest.

Task: Carry out a tomato virus impact survey in Senegal (Mullins VA Tech | 09/30/2007)

Activity 2. Finalize and implement a plan for collaboration with the Global Themes projects on diagnosis of insect transmitted viruses in tomatoes and other vegetable crops
Coordination of data development and reporting on the West Africa Website will make the information widely accessible.

Task: Begin developing the linkages and reporting results on insect transmitted viruses on the West Africa website (Mullins VA Tech | 09/30/2007)

Objective 3. Influence of agroecosystem biodiversity on virus levels.

Activity 1. Continue to build database and compile geographic and temporal data on weeds in the region and their propensity to host whiteflies and viruses
New information on the relationships between weeds as virus hosts and whiteflies as

virus vectors will be integrated into the data base

Task: Identify weed species in and around vegetable crops (Westwood | 09/30/2007)
Task: Collect whitefly and weed samples for testing (Westwood/Gilbertson/Brewster | 09/30/2007)

Activity 2. Coordinate data tabulation of information from the Diagnostics Lab and the Insect-Transmitted Viruses Global Themes to the West Africa Regional IPM Website

Task: Data from Activity 3.1 will be collated with information generated by the Diagnostics Lab and the Insect-Transmitted Viruses Global Themes (Westwood VA Tech | 09/30/2007)

Objective 4. Prioritize regional needs through a participatory planning process

Activity 1. Conduct a series of surveys on cropping systems in Guinea
Gathering more information on small holder farming crops in Guinea will assist in developing IPM strategies for vegetable and tree crops.

Task: Conduct an in-depth socioeconomic survey of horticultural activities in the four PA villages around Kankan (Diarra INSAH | 06/30/2007)
Task: Conduct an agronomic study of cabbage (including quantifying and characterizing pesticide use). (Diarra INSAH | 06/30/2007
Task: Establish a survey network for cashew trunk borers in ten villages (| 06/30/2007)

Objective 5. Investigate pests of potato in storage and propagation

Activity 1. Conduct surveys to determine the incidence and abundance of potato tuber moths
Information on the potato tuber moth will be used to determine its importance as a pest in the West Africa region.

Task: Develop a map of the WA region where potatoes are grown, integrated with the seasons they are grown, and correlated with the abundance of the potato tuber moth. (MBata/Fort Valley State | 08/30/2007)
Task: Conduct an assessment of other crops that might serve as refugia for the potato tuber moth (MBata/Fort Valley State | 08/30/2007)

Activity 2. Biology and food preference of the potato tuber moth
Understanding the basic biology of the potato tuberworm will enhance development of pest management strategies for its control.

Task: Conduct small plot experiments to determine preferences and alternate host of the potato tuber moth. (MBata/Fort Valley State | 08/30/2007

Task: Evaluate the time of and magnitude of potato tuberworm infestation during production and storage (MBata/Fort Valley State | 08/07/2006)

Objective 6. Develop, coordinate, and expand quality assurance and pesticide safety education

Activity 1. Conduct a regional workshop on pesticide safety training in conjunction with a workshop on pesticide residue analysis
Upon completion of this activity, the pesticide training materials will be revised and made available to the pesticide safety trainers in the West Africa region.

Task: Advertise workshop and invite participants (Hipkins VA Tech | 01/07/2007)
Task: Develop, produce and deliver program (Hipkins VA Tech | 01/01/2007)
Task: Evaluate program, revise curriculum and assess impacts (Hipkins VA Tech | 06/30/2007)
Task: Plan and carry out a pesticide impact survey in Senegal (Mullins VA Tech | 08/30/2007)

Objective 7. Quality Assurance: Pesticide Residue Training

Activity 1: Intra- and inter-laboratory pesticide residue methods validation
Coordination of the selection and validation of pesticide residue methods will be an important capacity building step towards ISO 17025-accredidation.

Task: Determine methods which will be validated common to participating laboratories (Cobb VA Tech | 01/30/2007)

Activity 2. Regional laboratory mentorship
Task: Lead laboratories will initiate mentoring relationships with counterpart laboratories in the WA region (Cobb VA Tech | 09/30/2007)

Activity 3. Conduct a regional workshop on residue analysis in conjunction with a workshop on pesticide safety training

Task: Advertise workshop and invite participants (Cobb | 01/01/2007)
Task: Develop, produce and deliver program (Cobb VA Tech | 02/02/2007)

Integrated Pest Management of Specialty Crops in Eastern Europe

Douglas Pfeiffer, Professor of Entomology, Virginia Tech, 205C Price Hall, Blacksburg, VA 24061

Objective 1. Identify and describe the technical, social, economic, political and institutional factors affecting pest management

Description. In the first year of the study, a Participatory Appraisal (PA) was held in Ukraine and Moldova (a PA for the expansion of the IPM CRSP in Albania was held in August 2004). This objective is important in developing an IPM system that works under local conditions. American scientists representing several disciplines (entomology, plant pathology, weed science and horticulture met with Host Country scientists to review PA approaches. Following the PA, a baseline survey will be completed, adding a more quantitative base for our understanding of technical factors affecting pest management. The survey portion of the Baseline Survey will be completed in summer-fall 2006. In 2006-2007, analysis and report generation will take place. Objective 2 in the original proposal (Identify and describe the social, economic, political and institutional factors affecting pest management) has been subsumed into the current objective.

Expected impact. This Objective will create the data base necessary to plan detailed IPM research appropriate to Eastern Europe, and to support later discussions on IPM-related policy.

Activity 1. Participatory Appraisal in Tomatoes and Cucumbers

Description. Farm visits were made to vegetable operations in Ukraine and Moldova. The vegetable PA was held in L'viv, Dnipropetrovsk and Odessa oblasts in Ukraine, and in Moldova. An orientation session was held at the outset, presenting PA techniques, followed by farm visits with interviews with farmers that produce these crops.

Expected outputs. After the farm visits, specific IPM problems were identified and constraint to their solution discussed. Detailed research plans were initiated for tomato and cucumbers.

Task: Write report on the appraisal that took place in May 2006.

Activity 2. Baseline Survey in Tomatoes and Cucumbers

Description. The survey of farmers and farm families will take place in summer -fall 2006. Analysis and report preparation will take place in Year 2 (2006-2007).

Expected outputs. A quantitative description of the state of IPM in high-value horticultural crops will be available.

Task: Complete farm interviews that were started in September 2006
Task: Summarize data from farm interviews
Task: Write report of Baseline Survey

Objective 2. Work with participating groups to design, test, and evaluate appropriate participatory IPM strategies

Description. Following the PA, a series of IPM studies were developed to address the issues raised during the PA. Several avenues of research are likely. The research plan developed in Objective 1 will be implemented. Application of newer pest management tactics will be included. Biological control avenues will be explored, especially with rearing facilities for entomophagous species currently available (though in need of capital). Simple information transfer will make significant inroads because of the poor state of biological knowledge is some areas.

A three-fold research approach will be followed: 1) Improvements in chemical control tools, 2) Study and implementation of biological methods, and 3) Study of the biology of pests, including lab and field research.

The role of specific chemical control tools, including organically acceptable products will be explored. The degree of efficacy provided will be determined, as well as the effect on beneficial organisms, and cost efficiency. Biological methods to be explored will include naturally occurring predators and parasites, artificial augmentation of natural enemies, especially in greenhouse settings. Basic phenological studies of the main pests will be made in these areas; such studies will serve as a basis for temperature-based prediction models.

Expected impact. This objective will produce IPM methods that can be used by farmers in Albania, Moldova and Ukraine to produce high quality horticultural crops with a minimum use of pesticides, allowing more effective competition in the European market.

Activity 1. Pest biology in tomatoes and cucumbers

Description. Arthropod composition phenology will be studied in vegetable fields in the three countries. Races of pathogens will be determined.

Expected outputs. A better understanding of species and races present in the areas will be developed. Accurate phenological data will enable development of cultural control tactics for target pests.

Task: Survey pest populations in greenhouse vegetable situations (Albania) and field situations (Moldova and Ukraine).

Task: Nematode monitoring (Durres, Lushnje, Tirane, Fier, Berat).
density per 100 ml soil and galling index (GI) 0-5.
Task: Determine presence and species composition of beneficial species

Activity 2. Arthropod management in tomatoes and cucumbers

Description. Collaboration will be established across national borders to produce natural enemies for augmentation trials in vegetable greenhouse settings. Target insects will include whiteflies and spider mites.

Expected outputs. Biological control agents and information on their proper use will be more widely available to producers in the three countries.

Tasks:
Arthropod management:

1. Evaluate cultural methods and novel pesticide chemistry for Colorado potato beetle in field-grown tomatoes.
2. The use of cultural methods as an alternative on IPM strategy in tomato and cucumber
3. Evaluation of botanical pesticides for greenhouse whitefly, *Trialeurodes vaporariorum*, and spider mite, *Tetranychus urticae*, control.
4. The use of *Encarsia formosa, Phytoseiulus persimilis* and other biological control agents for whiteflies, mites and other pests
5. The evaluation of insecticides and acaricides on whiteflies and mites control (tomato, cucumber)

Nematode management:
Cultural methods

To use IPM strategie as a mean to reduce the environmental impacts.

1. Destruction of tomato and cucumber roots after harvest, reduce population densities.
2. Nematode populatins on greenhouse tomato and cucumber are controled by a well selected crop rotation.
3. Use grafted plant method
4. Resistant cultivars
5. Chemical control – determine interactions between solarization and nematicides in protected settings (glasshouses and plastic tunnels)

Activity 3. Disease management in tomatoes and cucumbers

Description. Efficacy and appropriate timing of chemical control agents will be evaluated. Races of pathogens will be studied. Biological control agents will be produced and evaluated in field and greenhouse settings.

Expected outputs. Knowledge of pathogen races will enable more effective resistance management. Development of biological approaches will reduce selection pressure for pesticide resistance. Growers will have a better knowledge base of chemical control alternatives.

Task: Determine the dependence of widespread, injurious and symptoms of Late Blight from the meteorological conditions and variety of tomato.
Task: Investigate into the biological and ecological features of the causal organism of tomato Late Blight (*Phytophthora infestans* (Mont.) de Bary) in the different agro-climatic regions of Ukraine (Dnipropetrovs'k – central region, Lviv – west region, Odessa – south region)
Task: Investigate the efficiency of application of fungicide for the protection of tomato from Late Blight in the Dnipropetrovs'k condition.
Task: Evaluation of cultural methods as an alternative mean to reduce the downy mildews and botrytis grey mould on tomato and cucumber.
Task: Combination of biological and synthetic IPM fungicides to control botrytis grey mould on tomato and cucumber.

Activity 4. Weed management in tomatoes and cucumbers

Description. Efficacy and timing of selected chemical control agents will be evaluated in field settings. Cultural control methods will be evaluated as appropriate.

Expected outputs. Weed control will be enhanced, and applied in a more environmentally sensitive manner.

Task: Evaluate efficacy of modern chemical tools and compare with cultural methods of weed control

Objective 3. Work with participating groups to promote training and information exchange on participatory IPM

Description. This is a critical area for project implementation. Training and information exchange will be addressed at several levels:

- Training of specialists in IPM methods as well as statistical/GIS systems.
- Training of growers and farm managers and industry reps through information transfer sessions.
- Training of HC students in a US land grant university for a doctoral degree. This will be provided if supplemental funding can be obtained.
- Will collaborate with CNFA NGO for grower training through their established network.

Statistics and GIS
Short-term training was provided for scientists in Albania in the first phase of the Eastern European CRSP project, and this will continue. Several statistics workshops were held in the Albanian site. These workshops were highly successful and allowed host country scientists to analyze data on-site. This will be repeated for the new country teams. Basic sessions will be held for new members of the Eastern European team, and higher level sessions for previous team members.

A segment on Geographical Information Systems will be added to the workshops, to allow host country scientists to be better able to predict pest populations and pest risk. There is some activity in this area already with a program tracking temperature-driven development of some insect pests across Moldova. This may be expanded to aid in predictive models for control decisions (prediction of critical degree-day attainment in various sections), as well as estimation of pest risk.

Information transfer
Information sessions will be held for growers (Extension) in several locations in the region. These sessions can begin immediately with certain basic material. For example, there is a critical need for information on pesticide safety and the proper role of pesticides within IPM. Later, as the project generates original results, these results can be transmitted in a timely manner. When possible, these sessions will be held in conjunction with other sessions held by NGOs, etc., in order to make the most effective use of our resources.

Additional funds will be sought to initiate involvement of American and Host Country extension agents in reciprocal visits to the countries of each.

Partnering with NGO. Contacts will be made with NGOs to foster collaboration with these groups.

Expected impact. This objective will expand the capacity of host country scientist to cooperate in IPM research, evaluate and report on results and share data and reports across the language barrier in this region. Information will be disseminated to growers across borders, taking advantage of the cross-country collaboration.

Activity 1. Statistical/GIS Training

Description. This work will be carried out in year 2 as well as subsequent years.

Expected outputs. The eventual outcome will be enhanced ability among the HC scientists to design experiments, analyze data, and report results in an appropriate fashion for publication in scientific journals.

Task: Hold statistical training workshop

Activity 2. Language translation technology

Description. Translation software under development will be adapted to our IPM research/technology transfer programs. One manual is almost complete that will serve as a trial of this technology; a second manual is in early stages of production. The goal is to make versions of these manual available in the language of the project countries.

Expected outputs. Manuals to enable safer and more effective fruit pest management available to growers and extension specialists in the participating countries.

Task: Complete two manuals and translate into Ukrainian, Russian and English versions

Activity 3. Technology transfer for IPM in high value horticulture crops

Description. Meetings will be organized and held, and the number of attendees noted. Two fruit publications are in development and will be subjected to translation according to Activity 2.1. These publications will be available at least in electronic format.

Expected outputs. Two manuals will be available that will allow fruit producers in Ukraine to make more effective and safer pest management decisions.

Task: Prepare a pest management guide for one of the high-value horticultural crops in Albania.
Task: Disseminate the two guides from Activity 2.1 in Ukraine and Moldova.
Task: Hold grower educational meetings for high-value horticultural crops.

Objective 4. Work with participating groups to foster policy and institutional changes

Description. We have already initiated dialogue with governmental representatives in Albania, Ukraine and Moldova. For example, in June 2005, we met with the Chief of Plant Protection in the Ministry of Agriculture in Chisinau, Moldova, and the Chiefs of Plant Protection in L'viv and Odessa Oblasts, Ukraine. These discussions will be critical for the ultimate adoption of our results on a large scale. Our successful results in Albania on attract-and-kill techniques for olive fruit fly allowed the Ministry of Agriculture and Food to purchase thousands of traps for a wide-scale implementation project.
Cooperation with appropriate governmental agencies will facilitate dissemination of results to agricultural district offices in the host countries (e.g., nationwide in Ukraine there are 26 regional plant protection stations, staffed by 68 agricultural specialists). Maintenance of political contacts and effective communication with the various agencies is critical to the success of this program and will be a high priority.

Expected impact. It is expected that discussions based on our baseline survey and original research will help pave the way for policy discussions for the purpose of reducing impediments to IPM adoption.

Activity 1. Development of IPM policy-related issues

Expected outputs. Improvements are expected in policies involving information transfer, and other public policy such as taxation etc., that will serve to remove barriers to IPM adoption.

Task: Meet with governmental, university and plant protection service officials to determine obstacles to IPM development and implementation, and possible solutions.

IPM in Latin America and the Caribbean: Crops for Broad-based Growth and Perennial Production for Fragile Ecosystems

Jeffrey Alwang, Agricultural and Applied Economics, Virginia Tech, 215 Hutcheson Hall, Blacksburg, VA 24061

Objective 1. To develop effective farmer-friendly technologies for IPM in vegetables and perennials and advance IPM science in the LAC region

Activity 1. Identify and further refine *Fusarium* control techniques in naranjilla-growing areas of Ecuador

Although rootstocks resistance to *Fusarium oxysporum* and rational strategies to control late blight are available; these strategies require a technology transfer process and increment production costs. Plant resistance on the other hand is a cheap and practical strategy. Resistance for both pathogens exists in naranjilla relatives in the section *Lasicarpa.* Crosses between *S. quitoense* with *S. hyporhodium*, *S. vestissimum* and *S. felinum* were made by Dr. Charles Heiser from Indiana State University. F2 Segregants of these crosses are being evaluated for both, *F. oxysporum* and *P. infestans* pathogens. F3 plants resistance to these pathogens will be agronomically evaluated. The resistance material will be planted in the field and traits as yield, fruit size and fruit quality among others will be evaluated.
Task: Plant resistant material in experimental fields and evaluate traits as yield, fruit size and fruit quality, among others (Ochoa (INIAP) | 09/01/2007)

Activity 2. Develop early test to evaluate cocoa resistance to frosty pod and witches´ broom

Expected outputs for the year Detailed information on resistance to witches' broom and frosty pod from cultivars of known reaction against the diseases. Establishment of rooted cutting nursery system for clonal reproduction of superior lines of National cacao. Refinement of techniques that will allow evaluation of selections of 'National' cacao for resistance to witches' broom, frosty pod, and black pod.

Description. Although some resistant cultivars for the two diseases under consideration exist, they do not have other desirable economic traits and therefore more genes are required and large populations of hybrids have to be tested for resistance. An early evaluation method, especially against frosty pod rot (FPR) is highly desirable for plant breeders and farmers. The other handicap faced on this task is the slow process of multiplication of material with promising genes. Based on the available knowledge of cocoa physiology and the pathogens biology, several bioassays will be carried out to establish plant reactions able to discriminate resistant and susceptible material.

Task: Carry out several bioassays out to establish plant reactions able to discriminate resistant and susceptible material (Suarez (INIAP) | 09/01/2007)

Activity 3. Assessment of pathogens in cocoa/plantain-producing areas

Expected outputs for the year: Survey results of local area for severity of cacao diseases at various altitudes. Survey of lowland and foothill production sites for relationship of air drainage, slope, planting density, etc. for relationship to severity of key cacao diseases. First years data on severity of cacao diseases and plantain diseases intercropped in research plots planted in different spatial arrangements and planting densities.

Description. This activity will contain two components. One will be an experimental plot to compare type and amount of disease affecting the cocoa/plantain system under three spatial arrangements + monocrops. Epidemiological parameters such as phenology of the crops, rain, relative humidity, temperature and pathogen production and dispersal will be measure as a mean to take decisions about disease control. The second component will involve identifying and quantifying main pests & diseases on the system and factors that influence them using participatory methods on three or four farms within the study area. A survey partially accomplished in year 1, will better determine the relationships of altitude, planting density, and land slope on disease severities in cacao and plantain. Based on this survey, future research will be developed that will better define low and high risk planting areas.

Task: Set up an experimental plot to compare type and amount of disease affecting the cocoa/plantain system under three spatial arrangements + monocrops (Suarez (INIAP) | 09/01/2007)
Task: Identify and quantify main pests & diseases on the system and factors that influence them using participatory methods on three or four farms within the study area (Suarez (INIAP) | 09/01/2007)

Activity 4. Assess potential for field sanitation methods for control of diseases in naranjilla-producing areas of Ecuador

Expected outputs for the year. An assessment of the field sanitation and its potential contribution to reduced transmission of naranjilla-related diseases. Based on this assessment, further research will be proposed and designed for subsequent years of the project.

Description. Visit to field with a team of experts, comprised of plant pathologists, entomologists, weed scientists and specialist in horticultural production.
Task: Visit to field with a team of experts, comprised of plant pathologists, entomologists, weed scientists and specialist in horticultural production (Ochoa (INIAP) | 09/01/2007)

Activity 5. Epidemiological information on late blight epidemic build up in naranjilla.
Rainfall, temperature and relative humidity will be monitored during naranjilla late blight epidemic. Threshold parameters for infection and pathogen sporulation will be calculated which will be used for designing better control strategies of late blight in naranjilla.

Task: Establish experiments described above (Ochoa (INIAP) | 09/01/2007)
Task: Monitor, collect and analyze experimental data. (Ochoa (INIAP) | 09/01/2007)

Activity 6. Refine IPM package for mixed cultivation in plantain, Ecuador

Expected outputs for the year. Information on control met pest severities, and present control practices were gathered in year one, and will continue. Verify the present practice of cutting-up the stumps of weevil infested plantains to reduce local severities. Better determine if there is a relationship between calcium nutrition in plantain, and sigatoka severity. Better determine relationship of planting density and rotation to disease issues in plantain and cacao. Outcomes on these issues should allow eventual development of integrated management systems for intercropped cacao and plantain. Ph.D. student starting part-time on inducing disease resistance in cacao.

Description. Several IPM challenges for plantain persist in Ecuador. These include: limited knowledge of the pest complex (and appropriate IPM strategies) in mixed cacao-coffee-plantain systems, technology transfer in areas where publicly supported technology transfer is extremely limited, and regional dissemination of IPM knowledge in plantain is rarely accomplished. Begin development of biocontrols for cacao diseases utilizing Ecudorian isolates of *Bacillus* spp., and evaluate organic strategies to disease control. . The work under this activity will begin the expansion of IPM research in these areas.

Task: Begin development of biocontrols for cacao diseases utilizing Ecudorian isolates of Bacillus spp., and evaluate organic strategies to disease control (Suarez (INIAP) | 09/01/2007)
Task: Establish experiments to examine effectiveness (Suarez (INIAP) | 09/01/2007)

Activity 7. Evaluate biological fungicides to control late blight in naranjilla
Most farmers complain about difficulties in controlling late blight. Biological fungicides applied based on epidemiological parameters will be useful in controlling late blight and in this way develop organic production alternatives for naranjilla. The most promising biological compounds available will be tested. Chemical controls will be also included in this study. Recommendations for late blight control will be made.

Task: Establish each of the experiments described above (Ochoa (INIAP) | 09/01/2007)
Task: Monitor, collect and analyze experimental data. (Ochoa (INIAP) | 09/01/2008)

Activity 8. Technology transfer of the use of soil solarization techniques for management of soil borne pests in vegetable crops

Expected outputs for the year. Transfer of an environmentally friendly and effective, low technology alternative to the use of hard, Restricted Use chemical pesticides for seedbed and nursery substrate disinfestations to vegetable growers in the Comayagua Valley and Highland area of Honduras.

The publication and dissemination of a grower-friendly, illustrated publication and companion PowerPoint on solarization of soil and substrates used for crop production.

Task: Continue experiments on demonstration plots (with no-treatment controls) of the use of soil solarization for seedbed and substrate treatment in onions that are still produced in open-field seedbeds (Rivera (FHIA) | 09/01/2007)
Task: Conduct a thorough revision of the literature available on solarization (Rivera (FHIA) | 09/01/2007)
Task: Produce a grower-friendly illustrated publication, accompanied with a PowerPoint presentation (Rivera (FHIA) | 09/01/2007)

Activity 9. Technology transfer of the use of transplants produced in anti-insect screen houses as an IPM tool in production of crops of the Solanaceae, Cucurbitaceae and Brassicaceae

Expected outputs for the year. Transfer to growers in the Comayagua Valley and Highland regions of Honduras of a low-level, clean-transplant production technology enabling them to establish their field planting with material free of insects, nematodes and fungal or viral diseases.
The publication and dissemination of a grower-friendly, illustrated publication and companion PowerPoint, on the use of low-level screen-house technology to produce clean transplanting material.

Task: Use model screen houses for technology transfer demonstrations throughout the production year to growers of these regions (Rivera (FHIA) | 09/01/2007)
Task: Conduct demonstrations of scouting and monitoring techniques with concurrent plant protection measures (Rivera (FHIA) | 09/01/2007)

Activity 10. Determination of the sexual status of the Late Blight pathogen of potatoes (*Phytophthora infestans*) in Honduras and its relation with resistance to mefenoxam-based fungicides

Expected outputs for the year. Determination of the sexual status of *Phytophthora infestans* in Honduras.

Determination of the level of sensitivity (resistance) of *Phytophthora infestans* to mefenoxam-based fungicides in the Honduras potato production region.

Development of an IPM program outline for potato production to be validated and implemented in the successive years of the IPM-CRSP.

Task: Collect isolates of the pathogen from representative areas of the potato-cropping region and subject them to a standardized protocol to determine the sexual status of the pathogen (Rivera (FHIA) | 09/01/2008)
Task: Begin experiment to determine the pathogen's sensitivity to the several fungicides presently being used for its control (Rivera (FHIA) | 09/01/2007)

Activity 11. Evaluation of cowpea, *Vigna unguiculata*, as a rotation crop for the management of purple nutsedge, *Cyperus rotundus*, and as a host for beneficial insects

Expected outputs for the year. Validation and quantification of the use of Cowpea green manure rotation for the reduction of yellow nutsedge.

Transfer to vegetable growers of the Comayagua Valley and the Highlands of Honduras of the multi-impact use of Cowpea green manure in controlling yellow nut sedge, providing nitrogen and organic matter to the soil, and maintaining populations of 'beneficial' insects and of biodiversity.

An inventory of the most predominant families of insects, with emphasis on 'beneficials', fostered by the use of Cowpea as a green manure, and a statement as to the importance of this practice to maintaining biodiversity.

Task: Continue experiment to quantitatively determine if the establishment of a green cover crop of Cowpea crop reduces the population of nutsedge during the following cropping cycle (Diaz (FHIA) | 09/01/2007)
Task: Produce an inventory of the predominant families of insects developing in the canopy of Cowpea, with emphasis on those that are classified as 'beneficials'. (Diaz (FHIA) | 09/01/2007)

Activity 12. Evaluation of predatory mites as part of management programs for tarsonemid mites that affect eggplant and strawberry production in Honduras

Expected outputs for the year. Preliminary validation of the parameters under which the use of *N. californicus* as a biological control agent against phytophagous mites can be effective in two climatological situations and two crops in Honduras.

Transfer to Honduran growers of the principles of the technology of using predator mites as biological control agents against phytophagous mites in the production of oriental eggplant and strawberry in Honduras.

A manual for the correct application of predator mites to a crop and the monitoring systems to use to determine efficacy of control of the target mite.

Task: continue validation trials in Comayagua for eggplant and in the Highland area of Honduras for *P. pallidus* in strawberries (Espinoza (FHIA) | 09/01/2007)

Activity 13. Evaluation of entomopathogenic nematodes and cultural practices to manage the white grub larva of *Phyllophaga obsoleta* in vegetables and strawberries in the Honduran Highlands

Expected outputs for the year. Preliminary information on the efficacy of stinernematid nematodes used as a biological control agent to control the larva of *P. obsolete* in the soil and climate conditions of highland Honduras. Preliminary information on the use of leguminous green manures to control *P. obsoleta* larvae.

Task: Conduct field and pot trials to evaluate the efficacy of steinernematid nematodes in the control of white grub in lettuce (Espinoza (FHIA) | 09/01/2007)
Task: Establish additional trials to evaluate impact in strawberries (Espinoza (FHIA) | 09/01/2007)
Task: Continue trial comparing the effect of crop management practices on grub population and crop damage (Espinoza (FHIA) | 09/01/2007)

Activity 14. Development of an IPM-based strategy for management of the *Thrips tabaci-Alternaria porri* complex in onions in Honduras

Expected outputs for the year. Preliminary recommendations to growers, through field days and bulletins, of improved management practices for the production of fresh onions. Assessment of the efficacy of utilizing omnivorous predators as a released biological control agent reinforced by habitat enhancement through planting of refuge crops between rows.

Task: Establish trial (Espinoza (FHIA) | 09/01/2007)

Activity 15. Evaluation of the effect of mycorrhizal fungi on growth, yield and disease occurrence on tomato, bell pepper and cucumber

Expected outputs for the year. Sound data for dissemination to growers on whether commercial mychorrizae applications should be used in improving the health and performance of annual vegetable crops, or whether it is just an unnecessary production cost based on anecdotal information and not on sound, scientific data.

Preliminary data and recommendations for the use of mychorrizae applications to transplant plugs to assist the plant to take up phosphorous in minimally fertilized or compost-fertilized low-grade soils of hillside growers in Honduras.

Task: Establish trials (Melgar (FHIA) | 09/01/2007)

Objective 2. To become a global center of recognized excellence by building human capacity, generating IPM knowledge, and promoting adoption of IPM for vegetable and perennial crops pests.

Activity 1. Complete socioeconomic study and investigation of information-diffusion methods in naranjilla-growing areas of Ecuador

Expected outputs for the year. M.S. Thesis terminated, publication on naranjilla production and marketing.

Task: Complete publication (Barrera (INIAP) | 09/01/2007)

Activity 2. Transfer of plantain and vegetable IPM programs from Ecuador and Central America to other areas of the Caribbean (South-south transfer)

Network established.

Task: Identify best venue (virtual or real) to begin process of information sharing (| 09/01/2007)

Objective 3. Analyze and disseminate IPM info for enhanced profitability of products through planning, pre-planting, pest management and value enhancement during production, processing and marketing.

Activity 1. Study of cocoa marketing system in cocoa-growing areas of Ecuador

MS thesis completed.

Task: Data analysis (Alwang, Mainville, Jano |)
Task: Write-up (Alwang, Mainville, Jano |)

Activity 2. Monitoring and impact study of alternative IPM programs in Honduras

Expected outputs for the year.
Monitoring systems established

Objective 4. To understand and strengthen linkages between pest management, profitability, and environmental and social systems and enhance prospects for sustainable economic development

Activity 1. Monitoring and impact study of alternative IPM programs in Honduras

Expected outputs for the year. Monitoring systems established; basic information for impact assessment collected

Task: identify best means of monitoring (Weller (Purdue) | 09/01/2007)

Management of the Weed Parthenium (*Parthenium hysterophorus* L.) in Eastern and Southern Africa Using Integrated Cultural and Biological Measures

Wondi Mersie, Agricultural Research, Virginia State University, P.O. Box 9061 Petersburg, VA 23806

Objective 1. To conduct a meeting of all partners in Ethiopia to report on objective implementation, challenges, review of procedures, train staff and make changes in experimental protocols if necessary.

A second meeting of all project participants will be held in Bahir Dar, Ethiopia in October 2006.

Activity 1. Organize a meeting of project participants in Bahir Dar, Ethiopia in October 2006.

Task: Contact all participants, plan meeting, prepare program, make presentations and compile the proceeding (VSU, Virginia Tech, EIAR, ARARI | 10/31/2006)

Objective 2. Collect accurate information on the distribution and spread of parthenium in eastern and southern Africa and asses its socio-economic impact in Ethiopia.

Surveys of parthenium will be conducted in Ethiopia, Uganda, Swaziland, and South Africa annually at least for two consecutive years. In same cases a third year of survey may be necessary depending on the progress made in the first two years. The socio-economic impact of parthenium in Ethiopia will be determined using a structured questionnaire.

Activity 1. Survey the distribution of parthenium in participating countries.

Task: Acquire necessary materials for survey, train support staff on survey techniques, prepare forms, and start survey (AU, ARARI, Mekelle University, PPRI-South Africa, Makerere Unv-Uganda | 11/30/2007)

Activity 2. Conduct a survey on the socio-economic impact of parthenium in Ethiopia

Task: Conduct the survey (EIAR, ARARI, Mekelle University | 10/30/2007)

Objective 3. Determine the effect of parthenium on plant diversity.

Under this objective the impact of parthenium on the composition and diversity of herbaceous vegetation and soil seed bank will be determined in Ethiopia.

Activity 1. Conduct surveys on the effect of parthenium on the diversity of plants

Task: Collect data on the impact of parthenium on biodiversity (EIAR, AU | 11/30/2007)

Objective 4. Evaluate and release insect agents for the control of parthenium.

This objective will be implemented in South Africa and Ethiopia, and the results obtained from these studies will be passed to other partnering countries. Studies will be conducted under quarantine condition to determine the impact of bicontrol agents, the stem-boring weevil *Listronotus setosipennis*, the leaf-feeding beetle *Zygogramma bicolorata*, the stem-galling moth *Epiblema strenuana* and others on major crops of the region, as well as on selected indigenous plants and ornamentals. Insect agents, pending proof of host-specificity and approval for release from relevant government authorities, will be mass-reared and released against parthenium at trial sites in South Africa and Ethiopia during the project period.

Activity 1. In Ethiopia modify/improve quarantine facilities and then secure permit to import biocontrol agents from South Africa

Task: Continue to improve the quarantine facility at Ambo (EIAR | 09/30/2007)

Activity 2. Determine the safety of biocontrol agents to major crops and selected native plants.

Task: Continue to evaluate the safety of parthenium control agents to major crops in South Africa. Begin similar evaluation in Ethiopia (PPRI- South Africa, EIAR-Ethiopia | 12/31/2007)

Objective 5. To evaluate and demonstrate pasture management methods for the control of parthenium.

Beneficial forage plants proved to replace parthenium elsewhere and native forage species will be inter sown on fenced pasture heavily infested with parthenium weed.

Activity: Repeat field trials to determine effective pasture management systems against parthenium.

Task: Conduct the field trials in Jijiga, Ethiopia (AU | 12/31/2007)

International Plant Diagnostic Network

Sally Miller, Department of Plant Pathology, Ohio State University, 1680 Madison Avenue, Wooster, OH 44691-4096

Objective 1. Create regional systems

Create regional systems with the technical capacity to diagnose plant diseases in three participating regions, beginning with “hub” laboratories in one country per region, progressing to “spoke” laboratories in nearby countries within the region.

Description. A unified network of plant diagnostic laboratories [International Plant Diagnostic Network (IPDN)] will be established to identify pathogens of phytosanitary importance and detect outbreaks of plant disease epidemics as early as possible in order to avoid high crop losses, and to recommend up to date IPM practices. The network will be modeled after the U.S. National Plant Diagnostic Network (NPDN). The core of this system will consist of three regional plant diagnostic laboratories (“hubs”) in Benin, Tanzania and Guatemala that will develop a communication and data network with other laboratories (“spokes’) in their own regions (West Africa, East Africa and Central America, respectively). Regional laboratories will be responsible for deploying standardized diagnostic approaches for identification of domestic and exotic pathogens that are high risk for that region. Each regional laboratory will communicate and cooperate with the IPM CRSP regional project in its region on specific projects identified below and/or developed during Year 1.

Expected impact. The increased capacity of regional diagnostic laboratories will facilitate plant disease diagnosis and increase sample throughput in these countries. These laboratories will be linked with a strong communications system that will form the core of an expanded plant disease diagnostic system in these regions.

Activity 1. Identify regional needs for plant disease diagnostics and opportunities for cooperation

Expected outputs for the year.
• The stakeholder meeting will be completed in East Africa.
• An East African regional spoke laboratory will be selected.
• A baseline survey of regional plant disease diagnostic capability will be completed for East Africa.

Task: Conduct a stakeholder meeting and diagnostics training session for the East Africa regional site. (Dr. Drissa Silue, AVRDC Arusha Tanzania | 01/30/2007)

Activity 2. Establish IPDN Regional Diagnostic Laboratories

Expected outputs for the year
• The three hub labs will be upgraded an diagnostic output increased.
• Spoke labs will have modest upgrades and improved diagnostic services.

Task: Operate hub diagnostic lab in West Africa (Fen Beed, IITA | 09/30/2009)
Task: Operate hub diagnostic labs in East Africa (Drissa Silue, AVRDC | 09/30/2006)
Task: Operate hub diagnostic labs in Central America (Marco Arevalo, Agroexpertos | 09/30/2006)
Task: Develop regional diagnostic projects for West Africa site (Fen Beed, IITA | 09/30/2007)
Task: Develop regional diagnostic project for East Africa site (Drissa Silue | 09/30/2007)
Task: Develop regional diagnostic projects for Central America site (Marco Arevalo, Agroexpertos | 09/30/2007)
Task: Coordinate quarterly Operations Committee Meetings (Sally Miller, Ohio State University | 09/30/2009)
Task: Explore additional sources of funding (Sally Miller, Ohio State University | 09/30/2008)

Objective 2. Develop a communication and data networking system

Develop a communication and data networking system that details pathogen distribution, diagnosis and IPM options and links target countries to each other and to experts in the U.S. and elsewhere.

Description. A comprehensive communication infrastructure, with real time data, voice, still image and video capabilities, essential for effective and efficient operations of the early detection and distributed diagnostics efforts, will be established. An economical and modern communication network will be implemented to manage day-to-day operations of the IPDN. This network will serve the needs of diagnosticians, Operation Committee, other personnel of the IPDN, and volunteer subject matter experts. An IPDN L-serve and website will also be developed.

Expected impact. Capacity for real-time communications will be increased significantly; diagnosticians from three IPM CRSP target regions ("hub" labs) will be able to interact with one another and with U.S. cooperators on a regular basis and as specific issues arise. This will increase the capacity for these labs to carry out plant disease diagnostic activities.

Activity 1. Establish and operate IPDN subject matter committees
• Up to five subject matter sub-committee topics will be identified and tasks determined.
• The participants in the subject matter sub-committees will be identified.
• Working groups within each region will be formed to cover the activities of the subject matter sub-committees.

Activity 2. Set up IPDN website

Expected outputs for the year. The IPDN website will be up and populated with information useful to IPDN members and stakeholders.

Activity 3. Develop and Test the Distance Diagnostic and Identification System/Clinic Information Management System (DDIS/CIMS) for IPDN

• Data network standards for a Clinical Information Management System (CIMS) will be established.
• DDIS/CIMS will be developed for all IPDN sites by the University of Florida.
• DDIS/CIMS testing will be initiated in each site and training programs for direct users will be completed.
• Disease management recommendations for at least 10 major diseases per region will be developed or accessed from the literature and added to the database.

Activity 4. Establish the IPDN communications network

Expected outputs for the year. A fully tested and functioning communications system allowing timely interactions between U.S. collaborators and IITA (Benin), AVRDC (Tanzania) and Agroexpertos (Guatemala) will be tested, with list-serve and Polycom communication tools.

Objective 3. Develop and carry out comprehensive training programs

Develop and carry out comprehensive training programs to increase diagnostic capacity within host country institutions for phytosanitary and IPM applications.

Description. Human capacity building is a critical component of sustainable plant disease diagnostic programs. Such training must be at both the professional plant pathologist level and at the level of the various stakeholders in the program. Training during Year 1 will focus broadly on general diagnosis based on symptoms of diseases important in each region, as well as sample processing, shipping and storage. Training during Year 2 will be highly focused on laboratory diagnostics utilizing classical and modern techniques. Years 3 and 4 training will be directed toward increasing plant disease diagnostic capacity in spoke laboratories.

Expected impact.

•Stakeholders will become more aware of plant disease problems and will be trained in diagnosis of critical problems in their regions. They will learn how to interact with the IPDN labs to solve plant disease problems, beginning with accurate diagnoses.
•Diagnosticians in participating countries will update and improve their skills in plant disease diagnostics, resulting in increased capacity and sustainability.
•The long-term impact is improved management of plant diseases, reduced economic impact of disease, reduced use of pesticides and improved household income.

Activity 1. Conduct regional plant disease diagnostics training workshops

Year 3+4

Activity 2. Conduct diagnosticians' short course.

• Up to nine diagnosticians will be trained in advanced plant disease diagnostic techniques and the Distance Diagnostic and Identification System/Clinic Information Management System (DDIS/CIMS).

Activity 3. Develop and carry out stakeholder training programs in three regions
Expected outputs for the year
• Completed stakeholder training in plant disease diagnosis, sample processing and storage in East Africa.

Activity 4. Conduct regional plant disease diagnostics training workshops
Year three and four

Objective 4. Develop/adapt biotechnology-based diagnostic tests

Develop/adapt biotechnology-based diagnostic tests and protocols to meet the needs of regional IPM CRSP programs, USAID Missions and/or other donors.

Description. Diagnostic assays and/or protocols that specifically meet critical needs identified by IPM CRSP Regional Programs or other entities will be developed. These projects will be undertaken on a cost-sharing basis with IPM CRSP Regional Programs or with other Global Theme programs, or by request from other entities such as USAID Missions. Due to funding constraints, cost-sharing by this project will be very limited, and each project will be negotiated prior to commencement of activities. Four critical issues have been identified: banana xanthomonas wilt (BXW) in East Africa; insect-transmitted viruses; Asian soybean rust; and disease diagnosis for African indigenous crops.

Expected impact. The availability of rapid, biotechnology-based assays for critically important diseases will vastly improve diagnostic capacity in each region and will contribute substantially to development and implementation of programs to manage these diseases. +

Activity 1. Develop diagnostic methods for diseases of African indigenous crops
Expected outputs for the year
• Development of methods/protocols for diagnosis of diseases of African indigenous crops will be started.

Activity 2. Develop, test and deploy assays for detection of whitefly- and aphid-transmitted viruses

Expected outputs for the year
• Assays for whitefly-transmitted and aphid-transmitted virus deployed in hub and spoke labs in each region.

Activity 3. Develop PCR-based diagnostic assay for banana xanthomonas wilt (BXW)
Expected outputs for the year. A widely tested PCR assay ready for implementation in laboratories in East Africa.

Activity 4. Deploy assays for Asian soybean rust

Expected outputs for the year. Initial tests completed for assays for Asian soybean rust tested in hub labs in appropriate regions.

Integrated Management of Thrips-borne Tospoviruses in Vegetable Cropping Systems

Naidu Rayapati, Department of Plant Pathology, Irrigated and Agriculture Research & Extension Center, Washington State University, 24106 N. Bunn Road, Prosser, WA 99350

Objective 1. Establish a network of institutions in South & Southeast Asia countries to address activities of common interest between Global and Regional IPM projects

Description. International agricultural research involves collaborative, multi-disciplinary team approach because it is the contribution of the team that usually leads to the many complex problems being resolved. A longer term strategy is vital for science-based knowledge and technologies and institutional capacity building to bear on the research for development continuum. Due to lack of adequate financial resources for each of the IPM CRSP project in the region, it is necessary to develop partnerships for maximum developmental impact with less overlap and redundancy, and make collective efforts in attracting additional funding support from agencies seeking international public goods. Thus, the principal aim of this objective is to (i) establish longer term strategic partnerships to address specific constraints in developing countries of South & Southeast Asia and (ii) promote participatory model of agricultural research for developing "solutions that cross state borders." This "global alliances for regional solutions" paradigm involves research institutes with specialized talents in the USA, international institutions supporting agricultural research, international and national research organizations, universities and private sectors seeking solutions to national/regional problems, and NGOs and extension agencies working directly with farmers and other target groups.

Expected impact. Expected impacts include: (i) an enabling environment for South-South cooperation and South-North exchanges of knowledge and practical skills in developing regional solutions to shared problems, (ii) public-private partnership and multi-stakeholder participation to extend the application of new science and technologies to reduce the impact of virus diseases in small holder agriculture, (iii) improved production efficiency through environmentally benign IPM strategies adapted to local environments, (iv) reliable family income for small holder farmers, thus contributing to farmers' livelihoods towards poverty reduction and improved nutritional status of poor people including women and children.

Activity1. Develop formal linkages with other Global and Regional IPM-CRSP projects to initiate project activities in South & Southeast Asia

Description. A coordinated approach between Global and Regional projects is vital for solving complex problems in developing countries in South & Southeast Asia and for the success of IPM CRSP in promoting Global IPM. Due to limited financial resources

available for each project, partnerships and networking between IPM CRSP projects and their host country institutions in South & Southeast Asia region will promote cost-effectiveness through sharing of resources and logistic support for greater synergies. This will enable to overcome geographical barriers and open new window of opportunities to increase the speed, quality, and relevance of research leading to a “snowball effect”.

Expected outputs for the year. Expertise on virus disease problems provided to regional IPM projects in South & Southeast Asia. Funding opportunities explored to strengthen IPM CRSP activities on insect-transmitted virus diseases in the region

Task: Strengthening collaborations with Global and Regional IPM CRSP projects to develop partnerships in research & development (Rayapati, N (WSU) | 09/30/2007)

Objective 2. Conduct strategic research on tospoviruses and vector thrips species in South & Southeast Asia region

Description. Thrips-borne tospoviruses are emerging as a significant limiting factor in the sustainable production of vegetables and other economically important crops in South and Southeast Asia (S & SEA) region. Of the fifteen tospoviruses characterized globally so far, at least seven occur primarily in different crops in the region. In recent years, several of these tospoviruses and vector thrips have assumed greater economic significance due to various factors including pesticide misuse. As a result, the production of quality vegetables by subsistence farmers has been increasingly affected by diseases caused by tospoviruses. Many of these tospoviruses have a broad host range and can perpetuate through out the year on a variety of crops and non-crop plants. They exhibit a wide range of differences in symptom expression in different host plants and in different cultivars of a host plant, and under contrasting environmental conditions. The extreme symptom differences among different isolates of a tospovirus, similarities between some tospovirus symptoms and those associated with fungal, bacterial, or other viral pathogens are confounding diagnosis of diseases caused by tospoviruses based on visual symptoms. Consequently, the economic significance of tospoviruses in vegetables has been underestimated and disease control measures recommended have become ineffective. Misdiagnosis of tospovirus disease problems is resulting in unnecessary application of fungicides and pesticides with harmful effects on human health and the environment. In addition, virus diseases, if left unchecked, will spread throughout any suitable ecosystem available to them, regardless of national boundaries, and cause crop losses with social and economic impact. The crop failure due to virus diseases has a ripple effect; not only will subsistence farmers move into abject poverty, but those groups who depend on producers, including agricultural laborers, traders, transporters and processors, will also suffer. Although long-term disease management will come through deployment of cultivars resistant to tospoviruses and/or their vectors, in the short-term, a detailed understanding of the nature and diversity of tospoviruses and enhanced diagnostic capabilities will help to minimize virus spread and reduce the economic impact of diseases caused by tospoviruses in vegetables.

Many different species of thrips (Thysanoptera) have been documented in the region. Although the vectoring capacity of these thrips is not known, at least six of them are known vectors of tospoviruses in different parts of the world. The minute size of thrips and their cryptic behavior make them difficult to detect either in the field or in fresh vegetables, fruits and ornamental flowers transported through trade and commerce. It is also documented that a single species of vector thrips can transmit more than one tospovirus and different species of thrips can vector a tospovirus. Since tospoviruses replicate in vector thrips, the insects not only spread the virus throughout their life but also serve as a virus host. Because registered insecticides give poor control of thrips and the virus can be transmitted within a few minutes of feeding, efforts to control thrips vectors with insecticides have been mostly unsuccessful. As a result, many species of thrips and tospoviruses have now spread from their original natural habitats and hosts to favorable new environments of valuable crops. Consequently, tospoviruses are seemingly among the most aggressive emerging plant viruses causing widespread losses to several agricultural and horticultural crops worldwide. It has been estimated that tospoviruses cause yield losses up to $1 billion in a wide range of crops worldwide.
Therefore, a complete understanding of tospovirus pathosystem in a given agro-ecosystem will facilitate the deployment of ecologically-based participatory IPM strategies to reduce losses caused by tospoviruses for stable production of quality vegetables and improving the nutritional value of vegetables consumed, and the overall economic well-being of small holder farmers, many of whom are women, in S & SEA region.

Expected impact. The expected outputs and impacts include (i) improved knowledge and awareness of the distribution and economic significance of tospoviruses in vegetables in South and Southeast Asia through research publications, extension and information bulletins, field days, annual reports, and presentations in in-country and international scientific meetings, (ii) availability of high throughput methods for the diagnosis of tospoviruses, and (iii) strengthened institutional capacity for accurate identification of tospoviruses and thrips and in conducting problem-oriented research on vector-borne virus diseases.

Activity 1. Identification of principal vector thrips species in vegetables and study their vectoring capacity

Description. Thrips continue to increase as major pests of agricultural and greenhouse crops. Although thrips are damaging on their own right, their potential for harm is far greater because they serve as vectors of tospoviruses. Of the many thrips species described in S & SEA region, only a few are capable of transmitting tospoviruses. One of the basic issues is the heterogeneity of vector thrips species with respect to host-plant preference and their capacity to be vectors for a given tospovirus. This is further complicated by misdiagnosis of vector thrips species since the external characteristics of a species can be variable within the species or can overlap with those of other species. Given the ecological and host plant diversity in which different tospoviruses have been encountered in the region, it is vital to accurately identify different species of thrips in vegetable crops and have an understanding of the seasonal dynamics of various

thrips species in vegetables. This would help to understand the role of different thrips species in the epidemiology of tospoviruses and develop targeted strategies for sustainable disease management tactics.

Expected outputs for the year. Collection and preservation of thrips from major vegetables crops for further identification. Initial indication of thrips species capable of vectoring tospoviruses.

Activity 2. Identification of thrips species infesting vegetables
Collection and preservation of thrips from major vegetables crops for further identification. Key for morphological identification of at least one thrips species developed.

Task: Collection and preservation of thrips from selected vegetables crops in India and develop key for identification of one thrips species (Riley, D (UGA), Anitha, C (UGA), Ravi, K (Mahyco), Rao, V (Agric. Coll., Bapatla) | 09/30/2007)

Activity 3. Vectoring capacity of thrips species infesting tomato
Optimization of protocols for detection of PBNV in thrips
Task: Begin developing protocols for thrips rearing and virus detection in thrips (Ravi, K (Mahyco), Riley, D (UGA), Rayapati, N (WSU) | 09/30/2007)

Activity 4. Characterization and diversity of economically important tospoviruses in vegetables

Description. At least four distinct tospoviruses from India and three from Thailand have so far been documented in different crops. Interestingly, tospoviruses in India are phylogenetically more diverse than those present in Thailand. They also show geographic structuring in that tospoviruses present in India have so far not been found in Thailand and vice versa. However, recent reports suggest that tospoviruses are expanding their geographic boundaries due to globalization of agriculture and liberalized trade policies, thus transforming S & SEA into a biological 'Cuisinart' with many unintended negative consequences. It is therefore imperative that the impact of tospovirus diseases to the sustainable vegetable production in small holder agriculture is well understood. Additionally, very little information is available on the occurrence and distribution of tospoviruses in vegetables in other countries of S & SEA. It is also not known if there are 'new' tospoviruses infecting vegetables that have been misdiagnosed as 'other' disease problems. Thus, a detailed analysis of the geographic distribution and diversity of the field strains of different viruses is essential for accurate diagnosis, estimating their economic significance, understanding their epidemiology and interrelationships, and developing IPM strategies to minimize losses due to thrips-borne tospoviruses in vegetables.

Activity 5. Reconnaissance studies for the occurrence of tospoviruses in vegetables.
Information on the distribution of tospoviruses in vegetables grown in different geographic regions of India available

Task: Documentation of tospoviruses in vegetable crops grown in different regions of India (Ravi, K (Mahyco), Rayapati, N (WSU) | 09/30/2007)

Activity 6. Molecular analysis of Watermelon bud necrosis virus (WBNV) genome
Purified preparations of WBNV and its nucleocapsids avaiulable for cloning of viral genomic segments

Task: Purification of WBNV and nucleocapsid preparations for viral extractions (Ravi (Mahyco), Rayapati, N (WSU) | 09/30/2007)

Activity 7. Develop membrane-based diagnostic methods for the detection of tospoviruses in plants and thrips

Expected outputs for the year. A panel of antibodies assembled for the detection of tospoviruses infecting vegetables.

Activity 8. Develop membrane-based diagnostic methods for the detection of tospoviruses in plants and thrips
Membrane-based diagnostic assay optimized for the detection of PBNV in tomato

Task: Optimize protocols for tissue blot immunoassay for the detection of PBNV (Ravi, K.(Mahyco), Rayapati, N. (WSU), Adkins, S (USDA ARS USHRL) | 09/30/2007)

Objective 3. Develop strategies for strengthening institutional capacities within host countries to conduct problem-oriented research on virus diseases

Description. Training and learning, both in research organizations and individually, are the foundation of long term institution building in developing countries. “Sandwich” graduate training programs is an excellent opportunity for students from host country institutions to receive training in a wide variety of state-of-the-art technical approaches in dealing with viruses and vectors, acquire necessary knowledge to understand the dynamics of a virus disease and develop practical skills in tackling ‘real world’ problems. The purpose of this training is to prepare future agricultural scientists to be active participants in the new frontiers of virus research by equipping them with the necessary technical capabilities and by educating them in interdisciplinary and integrative approaches to deal with the vagaries of virus disease problems in tropical environments.

Expected impact. Linking students trained in the U.S. with their home country institutions will facilitate North-South exchanges of knowledge and practical skills for enhanced crop production in developing countries.

Activity 1. Facilitate international exchanges of knowledge through long-term and short-term training programs

Expected outputs for the year. Two Indian students (at least one female) take course work in U.S. institutions as part of their graduate training

Activity 2. Facilitate international exchanges of knowledge through long-term and short-term training programs
Institutional capacity in India strengthened for the management of insect-transmitted viruses in vegetables

Task: Provide graduate training leading to Ph D for students from India (Rayapati, N (WSU), Riley, D (UGA), Adkins, S (USDA ARS USHRL), Ravi, K (Mahyco), | 09/30/2007)
Task: Provide training in virology for a faculty member from TNAU at WSU (Rayapati (WSU) | 09/30/2007)

Activity 3. Conduct technology dissemination to various stakeholders on tospovirus diseases in vegetables
Knowledge on tospovirus diseases in vegetables promoted for basic science and agricultural impact by publishing leaflets and journal articles

Task: Develop leaflets describing symptoms of PBNV in tomato, WBNV in watermelon and IYSV in onion (Ravi, K (Mahyco), Rayapati, N (WSU) | 09/30/2007)
Task: Submit research articles for publication in scientific journals (Rayapati, N (WSU) | 09/30/2007)

Collaborative Assessment and Management of Insect-transmitted Viruses

Sue Tolin, Department of Plant Pathology, Physiology, & Weed Science, Virginia Tech, 4345 Old Glade Road, Room 102, Blacksburg, VA 24061

Objective 1. Develop a crop-based database documenting the identity, distribution and diversity of plant viruses in vegetable crops in the collaborating countries.

Information on viruses in particular crops and collaborating host country locations will be complied, initially from various sources. Participating scientists will coordinate their activities and develop a standardized set of data entry fields to facilitate comparisons and identify data gaps. Source data are from published reports, as well as non-published but validated reports, particularly for previously non-reported virus-vector complexes. This objective will establish linkages with the Information Systems Global Theme.

Expected impact. A crop-based database on viral diseases and specific viruses and vectors will accelerate rapid identification of disease outbreaks and provide information to in-country and regional pathologists to be used in developing management strategies. As new information is gathered during the project, additional data will be added to the database.

Activity 1. Compile an inventory of insect-transmitted and other viruses of vegetable crops in Central America and the Caribbean

Population of the commodity virus inventory database with information from existing databases. Collection of available information in at least two Honduras and Jamaica, and assemble into crop-specific databases accessible to IPM CRSP partners. A working document describing the incidence and distribution of recorded viral disease and phytosanitary problems, and their insect vectors.

Task: Complete inventory of viruses specific to each vegetable crop in the project and compare across regions. (Tolin, VT | 08/01/2007)

Activity 2. Compile an inventory of whitefly-transmitted and other vector-transmitted viruses in the vegetable-sweet potato-cassava cropping systems in sub-Saharan Africa host countries.

Initiation of the virus inventory reflecting available information about the identity and distribution of plant virus-insect vector complexes from host country and IITA records. Information availability on whitefly-transmitted viruses in vegetable (tomato, pepper, cucurbits, okra), Cassava, and sweet potato.

Task: Complete inventory of viruses found in sub-Saharan African cropping systems (Brown, U of A | 08/30/2007)

Objective 2. Develop, optimize and employ advanced diagnostic resources for diagnosis of viral diseases of vegetable crops.

Molecular diagnostics are increasingly recognized as vital tools for identifying whitefly genotypes/biotypes, which is a vital first step in developing an understanding of their ecological interactions and in developing IPM strategies to control them. Improvements in laboratory capability will be necessary in order to reach this objective, including access to specialized laboratory equipment for serological and molecular diagnosis (-80^{o}C freezer, in-house source of MilliQ water, molecular primers for PCR, etc.) and personnel training. Comprehensive surveys will be carried out during the project aimed at increasing the proportion of samples with virus disease symptoms to which a causal virus is identified. It has been the experience of FHIA, that when the basic commercially available virus diagnostic kits are used, up to 30% of plants with virus-like symptoms are negative for all tested viruses.

Expected impact. Improved diagnostic capacities in collaborating host countries. Knowledge of virus identity that can be shared regionally and globally. Established linkage with the Global Theme on Diagnostics, and participation in the IPDN.

Activity 1. Develop, optimize, and implement improved diagnostics of viruses in African vegetable systems

Initiation of optimizing PCR, dot-blot hybridization for various virus/species groups, with emphasis on detecting begomoviruses, and/or protein-based methodologies for detection of other viruses in the vegetable (tomato, pepper, cucurbits, okra)-cassava-sweet potato cropping systems. Collection of local virus-vector complexes for development and optimization of methods, and of positive and negative controls from expert laboratories. Increased laboratory capabilities and trained personnel. Established linkages with the Diagnostics Global Theme project and their hubs in East and West Africa, and with the East and West Africa regional IPM centers.
Task: Begin optimizing in-country, begomovirus/vector identification in Africa (Brown, U of A; Legg, IITA | 04/30/2007)

Task: Establish linkages with the Diagnostics Global Theme project and their hubs in East and West Africa, and with the East and West Africa regional IPM centers. (Gilbertson, UC-D; Tolin, VT | 08/30/2007)

Activity 2. Assess and improve diagnostic capabilities in Central America and the Caribbean

Identification of a cadre of scientists who, if trained in diagnostic methodologies for viruses and have access to data on expected viruses, can design and utilize more targeted assay methodologies. Assessment of current capabilities and relative costs for in-country diagnosis., collaborative with Global Theme on Diagnostics.

Task: Optimize and implement PCR-based methods for detection and identification of Begomoviruses and whitefly biotypes (Brown, U of A; McLaughlin, UWI; Palmieri, UdV | 08/31/2007)

Task: Initiate tests for unidentified viruses not yet found in vegetables in Honduras, (Rivera, FHIA; Roca, Zamorano; Brown, U of A; Tolin, VT | 05/30/2007)
Task: Establish a functional virus diagnostic laboratory in Dominican Republic (Martinez, IDIAF; Deom, UGa | 03/01/2007)

Activity 3. Distribution and genetic characterization of aphid-transmitted viruses infecting peppers and cucurbits.
Data to indicate genetic diversity of TEV infecting peppers in Jamaica and comparisons with other known TEV. Preliminary data on presence and diversity of CMV and TEV in Dominican Republic, and CMV in Jamaica. Assessment of cucumovirus and potyvirus frequency in Honduras.

Task: Assess diversity of TEV and other potyviruses in Jamaica (McLaughlin, UWI; Tolin, VT | 01/31/2007)
Task: Examine TEV in the Dominican Republic, and train in diagnosis and diversity (Martinez, IDIAF; Tolin, VT; McLaughlin, UWI | 06/01/2007)
Task: Begin examination of incidence and diversity of CMV in cucurbits and peppers (Tolin, VT | 09/30/2007)

Objective 3. Ecosystem analysis: Diagnosis of virus and vector problems, prediction of potential management practices, and introduction of ecologically based management practices

From previous research we are in a position to develop ecologically based IPM strategies for management of insect-transmitted virus diseases in different agroecosystems of Central America. Host country collaborators will identify major virus problems in different agrosystems. Once the precise study area or field site has been identified, including confirmation of the identity of the virus(es) involved, monitoring the sites and implementing IPM strategies will begin. We will evaluate and develop IPM packages and identify farmers willing to implement these packages and begin to assess impact. Strategies for management of aphid-transmitted viruses can be fine-tumed as a risk-indices based management practice. Similar field studies will be conducted in tomato for whitefly-transmitted viruses to define strategies, including practices such as use of planting dates, natural repellents, barrier crops, weed management, general field sanitation, and straw and plastic mulches. We will begin to assess and identify predominant viral diseases and associated vector problems in cropping systems involving vegetables, cassava and sweetpotato in the African site countries of Burkina Faso, Cameroon, and Tanzania. Whiteflies, begomoviruses and ipomoviruses are known to be problematic in all locations, but this project will produce the first set of representative and systematic virus collections and their identification. It will also document the distribution of biotypes of the whitefly, *Bemisia tabaci*, in collaboration with the West Africa Regional IPM CRSP project.

Expected impact. Development of IPM strategies for management of virus diseases designed for particular ecosystems. A model system useful to any researchers needing to design a virus and vector management program.

Activity 1. Implement an IPM strategy for viruses in the Salama Valley of Guatemala
Review of capabilities for geminivirus diagnosis, and ability to confirm identity of all viruses in the Salama Valley. An optimized method for detecting begomoviruses in whitefly vectors, and for using it to establish temporal epidemiology. Training information for growers to distribute at workshops.

Task: Apply diagnostic methods to confirm identity of viruses in the valley and educate growers (Gilbertson, UC-D; Palmieri, UdV | 12/31/2006)
Task: Develop tests to detect begomoviruses in whiteflies for temporal epidemiology (Gilbertson, UC-D | 12/31/2006)
Task: Begin implementation of an IPM plan, with periodic monitoring (Gilbertson, UC-D; Palmiery, UdV | 11/01/2006)

Activity 2. Initiate an IPM strategy for the Ocoa Valley in Dominican Republic
Formation of a working team in the host country, and development of a plan for future work. An assessment of the impact of current practices on management of the geminivirus complex on tomato, and technology transfer and education of farmers.
Task: Establish a local working team and assess capabilities and needs (Martinez, IDIAF | 11/01/2006)

Task: Conduct meeting with growers and agricultural personnel and plan for IPM systems development and implementation (Gilbertson, UC-D; Deom, UGa; Tolin, VT; Martinez, IDIAF | 05/01/2006)

Activity 3. Ecology and management of insect transmitted viruses in tomato and pepper in the Caribbean
Strategies for management of aphid-transmitted viruses in pepper fine-tuned as risk-indices, based management practices. Similar field studies in tomato for whitefly-transmitted viruses to define strategies, including practices such as use of planting dates, natural repellents, barrier crops, weed management, general field sanitation, and straw and plastic mulches. Data on spatial and temporal dynamics of field spread of TYLCV in tomato. Management of aphid-transmitted virus in hot pepper based on IPM packages.

Task: Monitor for TYLCV in tomatoes in two areas of Jamaica (McDonald, MINAG; McLaughlin, UWI | 03/01/2007)
Task: Evaluate and transfer IPM packages for aphid-transmitted viruses in pepper in Jamaica (McDonald, Myers, MINAG | 08/31/2007)
Task: Initiate assessment of CMV and TEV ecology in pepper in Dominican Republic (Martinez, IDIAF | 10/31/2006)

Activity 4. Design and validation of ecologically based virus management practices in diverse cropping systems
A start at evaluating IPM packages for viral disease management in specific crops and geographic areas to include: 1) vegetables in the Comayagua Valley of Honduras; 2) organic vegetable production in southwestern Honduras.
Task: Completion of evaluation of practices in two locations in Honduras, the Comayagua Valley and in Southwestern Honduras under an organic agriculture scenario (Rivera, FHIA; Roca, Zamorano | 05/31/2007)

Activity 5. Appraisal of predominant, problematic viral diseases and vectors in African cropping systems
Early in the project, we will begin to identify predominant virus-vector complexes in samples collected by each of the teams. A system will be developed whereby co-PIs in each country will direct all collecting activities, sample organization, record keeping, acquisition of laboratory supplies, reagents, diagnostics kits, PCR primers, DNA probes, etc. and will initiate laboratory analysis of virus-vector complexes. DNA sequence will be obtained for any begomoviruses identified, as well as serological identification of RNA viruses present. Knowledge of specific biotypes/haplotypes of *B. tabaci* and identification to species of other homopteran insect vectors of importance in the cropping system. Planning and identifying funds to train a student who will combine survey work with a Ph.D. program, preferably at the University of Witwatersrand, South Africa.

Task: Initiate appraisal in Burkino Faso (Koutou, INERA; Legg, IITA | 01/31/2007)
Task: Initiate appraisal in Cameroon (Leke, IRAD; Legg, IITA | 07/01/2007)
Task: Initiate appraisal in Tanzania (Legg, IITA | 08/31/2007)

Objective 4. Identification and deployment of varieties having disease resistance to economically important insect-transmitted viruses.

Description. One of the most ecologically friendly, inexpensive, and effective means of virus disease management is through deployment of plants with resistance or tolerance to viruses. In this Objective, we focus on approaches building capacity in country to assemble and screen germplasm for different regions, and to develop varieties for the grower. Once data are collected in above objectives, an assessment should then be made of the needs and priorities of host countries for viruses they need resistance to in what crops, and the desired characteristic of the germplasm.

Expected impact. Reduced impact of viral diseases in vegetable crop production, with no pesticide input. In country capacity for crop variety evaluation and selection.

Activity 1. Identify and deploy vegetable varieties with resistance to prevalent viruses
A plan for prioritizing the needs of host countries for germplasm. An inventory of sources of potential germplasm for testing will be developed. A system for distribution of germplasm to collaborators. Initial information on performance of selected germplasm for resistance to one or more viruses, through standardized screening tests. One season's

information on performance of selected germplasm for begomovirus and other virus resistance. Distribution of germplasm to host country collaborators for release and screening for virus resistance/tolerance at specific test sites.

Task: Prioritize needs of host countries for virus resistant germplasm, and assess impact of the availability and use of such germplasm, with the Global Theme on Impact Assessment (Deom, UGa | 06/28/2007)
Task: Obtain accessions from public and private sources, increase, distribute, and begin screen for resistance (Deomm UGa; Green, AVRDC | 09/01/2006)
Task: Continue evaluation of germplasm in Burkino Faso and Mali (Green, AVRDC; Gilbertaon, UC-D; Legg, IITA | 06/01/2006)
Task: Compile data on tomato germplasm previously screened for TYLCV resistance in Jamaica and other countries (McDonald, MINAG; Brown, U of A | 08/31/2007)

Activity 2. Explore the use of transgenic resistance to viruses
We will attempt to identify specific funds with which to continue the transgenic tomato project, toward identifying, validating, and prioritizing for field-testing the most resistant lines in the U-Arizona and U-Georgia labs. Subsequent work will require introgression of transgenes to locally useful tomato cultivars, with the help of seed companies and tomato breeders. We also expect to make progress toward understanding and making possible implementation of the national guidelines toward testing selected transgenic tomato lines in field trials in Honduras and Jamaica.

Task: Complete review of policies in place in specific sites for deploying transgenic, virus-resistant crops (Tolin, VT | 12/15/2006)
Task: Link with US-AID biotechnology projects in other countries, addressing this issue (Gilbertson, UC-D | 12/31/2006)
Task: Develop a strategy to advance transgenic resistance in tomato to several viruses (Brown, U of A; Deom, UGa | 12/31/2006)

Activity 3. Assess the use of induced resistance for virus disease management
Data to indicate whether biorationals can be used in management of pepper viruses in Honduras.

Task: Initiate tests of selected compounds known to induce systemic acquired resistance to viruses (Rivera, FHIA; Brown, U of A | 02/28/2007)

Objective 5. Socioeconomic Analysis of Virus Management Practices, and Impact

Description. During decade from about 1985 to 1995, there were several regional, Central American, initiatives in IPM, all of which had components designed to measure and record the socio-economical impact of the promotion and use of IPM programs in agricultural production at the different levels of sophistication from campesino growers to large-area agro-industrialists. The main institutions managing these regional programs

were: CATIE, ROCAP-USAID, and EAP-Zamorano. There were also efforts in Nicaragua through the European donor agencies in collaboration with CATIE and IICA. IPM initiatives have also been emphasized in the CARICOM nations, led by CARDI. Socio-economic studies were also done in the Caribbean, mainly Trinidad&Tobago, Barbados, and Jamaica, through the previous IPM-CRSP. Virus management in tomato through imposition of crop-free periods has been implemented in the Dominican Republic for five or more years, and at a much smaller scale in Guatemala, but no sociological studies have been done. Thus we will examine prior studies and compare these results with current surveys and analyses directed specifically toward virus disease management.

Expected impact. Knowledge of the understanding by farmers, including women farmers, of viruses and management approaches will ultimately lead to greater adoption of IPM for virus disease management.

Activity 1. Development and Implementation of a Survey of Farmers' Current Practices and Perceptions of Potential Problems and Solutions
A summary of reports from the region. A survey document and system for conducting interviews relative to virus disease management will be developed and tested, and sites for future work will be prioritized.

Task: Prepare and review a survey of farmers, assuring attention to gender-related issues (Sell, U of A | 11/30/2006)
Task: Collaborate with LAC Regional Site on prior sociological work in Guatemala and on-going data collection in Honduras (Sell, U of A | 01/30/2007)

Applications of Information Technology and Databases in IPM in Developing Countries and Development of a Global IPM Technology Database

Yulu Xia, Assistant Director, NSF Center for Integrated Pest Management,
North Carolina State University, 1730 Varsity Dr. Suite 110, Raleigh, NC 27606

Objective 1. To develop Decision Support Tools (to organize, analyze, communicate and store IPM information)

Description. On the base built in the first year, we will continue to develop and link the decision support tools such as database and expert systems. We now expand our work to include three major tasks: The Global IPM Technology Database, the West African IPM Network, and the Southeast Asia IPM Network.
Expected impact: Please refer to the corresponding part in our first year workplan.

Expected impact. The databases/information systems and other decision support tools developed from or provided by this project will enhance capacity in research, training, education, extension, and IPM practice, help communication of pest information among the regions and HCs, expand reach of IPM data and information. It also improves the quality of policy making by providing sound information and efficient communication channels.

Activity 1. Databases and information systems development

Expected outputs for the year
1. Program additional services.
2. Conduct more training/workshops
3. Provide technical services to the collaborators in terms of uploading information to the systems and using the systems.

Task: Technical Services (Yulu Xia, NC State | 09/30/2007)
Task: Major Programming (Yulu Xia, NC State | 09/30/2007)
Task: Add additional links (Yulu Xia, NC State | 09/30/2007)
Task: Workshop/meeting (Yulu Xia, NC State | 09/30/2007)

Activity 2. West Africa IPM Network (Whitefly information system)
1. The submission and update function completed
2. The search function partially completed
3. Information about whitefly, crop distribution, and other pests are partially completed

Task: Major programming (Yulu Xia, NC State | 09/30/2007)
Task: Content upload and upgrade (Don Mullins, VT | 09/30/2007)
Task: Workshop/training (Yulu Xia, NC State | 09/30/2007)
Task: Major programming (Yulu Xia, NC State | 09/30/2007)

Task: Content upload and upgrade (Don Mullins, VT | 09/30/2007)
Task: Workshop/training (Yulu Xia, NC State | 09/30/2007)

Activity 3. Southeast Asia IPM Network
1) Complete the submission and information uploading services.
2) Work with collaborators in the US and host country on collection of the research results from previous IPM programs in the region.
3) Work with collaborators in the US and host country on data and information of crop quality assurance and pesticide use information.

Task: Workshop (Yulu Xia, NC State | 09/01/2007)
Task: Major programming (Yulu Xia, NC State | 09/30/2007)
Task: Technical Service (Yulu Xia, NC State | 09/30/2007)
Task: Workshop (Yulu Xia, NC State | 09/01/2007)
Task: Major programming (Yulu Xia, NC State | 09/30/2007)
Task: Technical Service (Yulu Xia, NC State | 09/30/2007)

Objective 2. Analyze data, model interactions, and provide visualization and communication of results

Description. GIS, databases, and Web application projects for visualization and improved understanding and communication of biotic and economic interactions will be developed through collaboration with RPs, GT, and HC institutions.

Expected impact. Result from this activity will help communication among scientists, IPM practitioners, growers, and policy makers in regarding pest population dynamics, interactions biological and non-biological factors in regarding agricultural pests and their natural enemies. It will help understanding the factors that impact pest population and control outcome.

Activity 1. Web, database, and GIS/ interactive cartography integration and applications

Expected outputs for the year 1. Coordination meeting among those involved with software development for invasive species and those involved with interactive cartography of endemic fruit flies.2. System design meeting. Travel by Penn State software designers from the Center for Environmental Informatics (http://www.cei.psu.edu/) to RADA Jamaica. Determine hardware and software system criteria that will be used host whatever software is developed, and thus facilitate technology transfer of the software. Draft software design elements for both interactive cartography and web pages within which that will be housed. System prototype development. Interactive cartography development by Penn State, and webpage development about fruit flies by RADA Jamaica. 4. Technology transfer. Transfer of operational interactive cartography software to servers within RADA Jamaica. Embedding of the MacroMedia Application, and data capture software (ASP application), within the RADA-developed webpage.

Task: Technology Transfer (Shelby Fleischer, Penn State | 09/30/2007)
Task: Coordinate Regional Meeting (Shelby Fleischer, Penn State | 11/01/2006)
Task: System Design (Shelby Fleischer, Penn State | 09/01/2007)
Task: System prototype development (Shelby Fleischer, Penn State | 09/30/2007)
Task: Technology Transfer (Shelby Fleischer, Penn State | 09/30/2007)
Task: Coordinate Regional Meeting (Shelby Fleischer, Penn State | 11/01/2006)
Task: System Design (Shelby Fleischer, Penn State | 09/01/2007)
Task: System prototype development (Shelby Fleischer, Penn State | 09/30/2007)
Task: Technology Transfer (Shelby Fleischer, Penn State | 09/30/2007)
Task: Coordinate Regional Meeting (Shelby Fleischer, Penn State | 11/01/2006)
Task: System Design (Shelby Fleischer, Penn State | 09/01/2007)
Task: System prototype development (Shelby Fleischer, Penn State | 09/30/2007)

Objective 3. A human and information technology infrastructure will be established for agricultural pest information storage and pest monitoring

Description. HC, RP and GT programs need to build necessary information capacity for pest information storing and sharing so that by the end of this funding period the HC and the regions can have their own IPM information infrastructure in place and have the necessary skills and expertise for continuing operation and development. This program will help to build necessary infrastructure and human training.

Expected impact. By completion, this activity will improve the capacity and ability of the HC and region in pest monitor, regional pest information sharing, and coordination of region wide IPM effort.

Activity 1. Development or improvement of information systems/database will be developed/enhanced in host countries for pest monitoring, and GIS capacity building

Expected outputs for the year

1. Target pests and areas are identified and preliminary field and programming works are conducted.
2. Web interfaces and database designed and partially functioned.
3. Preliminary data and links are reported. Databases are partially populated.
4. Training/workshops conducted.

Task: Southeast Asia (Yulu Xia, NC State | 09/30/2007)
Task: West Africa (Yulu Xia, NC State | 09/30/2007)

Objective 4. IT support and capacity building

Description. Almost all IPM CRSP active programs involve IT and database applications. This GT will provide necessary support and consultation in these programs. At the meantime, this program will conduct some basic programming works for capacity building.

Expected impact. This work will impact all IPM CRSP programs and pest management practice in the HCs and regions in near and long run. Specifically, by expanding IT into research and extension programs, this work can improve the efficiency of research and education in the HC and the regions. Secondly, this program will help to bring RP together so that information can be readily shared and any technology developed from a IPM CRSP program can be easily transferred other regions. Lastly, this program helps RP and HC layout information infrastructure for future work.

Activity 1. Hardware and software readiness, Database design and metadata definitions, web browsing, and dynamic web programming

Expected outputs for the year

1. The workshop will help to build interoperable invasive species information nodes that use common standards and form a network to support the work of the invasive species community in Asia, including the four USAID countries, e.g. Indonesia, Philiphines, India, and Bangladesh. Within each country, the network focal point would be requested to inventory information and develop an Internet-accessible node using I3N Cataloguer. Each focal point would systematically document, and provide electronic access to sources of information on the taxonomy, distribution, ecology, impacts, control, and management of alien invasive species. They would also inventory and document the information available in the country on invasive species lists, projects, experts, and biological datasets. When the system is fully implemented, users will have single-entry-point access to metadata on data holdings of the 10 countries and of any other countries in the Asia-Pacific that choose to develop I3N nodes.
2. Added more hardware (computer) and software.
   Continue providing support for all region

Task: IT support, training, and workshop (Yulu Xia, NC State | 09/30/2007)

Objective 5: Link to USDA Regional IPM Centers' information and IPM CRSP reporting system

Description. A number of national and international IPM information systems such as USDA Regional IPM Centers' information system are available. IPM CRSP is expanding its reporting system. This GT will provide links and programming so these key information sites can communicate and link with each other

Expected impact. The linked system will provide users such as IPM CRSP researchers and HC scientists with a single access site for searching relevant IPM information. It will enhance efficiency of IPM research and extension.

Activity 1. Global IPM Technology Database will use Web Services to seamlessly integrate search functions with both USDA Regional IPM Centers' databases and the IPM CRSP Reporting System

Expected outputs for the year

1. Add major links for the region
2. Integrate major IPM information.

.

Task: Links and Programming (Yulu Xia, NC State | 09/30/2007)

Objective 6. Impact assessment of this global theme on host countries

Description. This is to assess the impacts of this GT on HC (e.g. the significance on HC's economy, society, environment)

Expected Impact. After completion of the assessment, we will have a better idea on how this GT can help HC in terms of information sharing, communications, and infrastructure building. These results will provide us with the knowledge on how we can improve our research and service activities in the future.

Activity 1: Development of the technique and plan for impact assessment

Expected outputs for the year. Consult with Impact Assessment GT to develop IT components to survey instruments for regional programs for which the IT global theme collaborates.

Task: Development of Assessment Technique (Yulu Xia, NC State | 09/30/2007)

IPM Impact Assessment

George Norton, Department of Agricultural & Applied Economics, Virginia Tech, 205B Hutcheson Hall,Blacksburg, VA 24061

Objective 1. Develop a common set of methods

A common set of methods will be organized around a matrix that establishes the linkages among, data, methods, and impacts at various geographic scales and on different types of outcomes. Field data will be combined with other information (e.g., adoption rates, prices) and with models for producing indicators of impacts on income, poverty reduction, nutritional improvement, or health/environmental improvement.

Activity 1. Identify minimum data needs, models, and impact indicators at each level.
Refinements to methods developed and distributed for use in each site will continue this year. Discussions will continue with someone in each site about the data needed and how to use the methods.

Task: Working with a graduate student at Virginia Tech, we will refine methods for gender analysis (George Norton | 09/01/2007)
Task: Working with a graduate student at Virginia Tech, we will refine methods for evaluating the environmental impacts of IPM (George Norton | 09/01/2007)

Objective 2. Collaborate with scientists in each IPM CRSP regional and global theme site to apply assessment methods to evaluate impacts of specific IPM CRSP activities.

Collaborating with scientists (including social scientists) in the regional programs, the common components of the methodology to be applied in each region as noted above are: a) baseline surveys (where funds permit in the regional programs); b) collection and budgeting of experimental and price data in standardized formats; c) assessment of farmer adoption of IPM technologies; d) GIS and economic surplus analysis of market-level impacts of IPM; e) calculation of poverty impacts; and f) data collected on changes in pesticide use for farmers who adopt IPM technologies, estimation of changes in environmental and human health risks and their perceived value. Other indicators and benchmarks for human capacity building and contributions to IPM-related science will be calculated as well.

Activity 1. Carry out baseline surveys
Working with project leaders, baseline surveys will be completed in regional sites and the data summarized and analyzed. Surveys that have been initiated in Latin America, West Africa, East Africa, and South Asia will be completed and the data summarized. Surveys in Central Asia, South East Asia, Eastern Europe and the Caribbean will be initiated. Collection of cost and yield information in each regional site will begin.

Task: Work with individuals from the following sites: Latin America/Caribbean, West Africa, East Africa, and South Asia, to summarize the data from the baseline surveys underway. (George Norton | 09/01/2007)
Task: Work with individuals in Central Asia, Southeast Asia, Eastern Europe to help them initiate their baseline surveys. (George Norton | 09/01/2007)

Activity 2. Work with project leaders in each site on collection of budget data from experiments and on collection of survey data

Task: Review initial data collected and suggest means to improve collection methods and data summaries (George Norton | 09/01/2007)

Objective 3. Development of consistent and integrated, spatially-referenced and tabular datasets

Development of a consistent, integrated, spatially-referenced and tabular datasets for IPM impact assessments for 15-20 commodities locally, nationally, regionally, and globally will continue, led by Minnesota and IFPRI (and also using funds from other sources) in order to address a larger set of commodities than would be possible with IPM CRSP resources alone. This activity will support IPM impact assessments at multiple scales and facilitate the projection of which IPM interventions are likely to have the greatest impacts locally, nationally, regionally, and globally

Activity 1. Collect production, consumption, price, and crop performance data to simulate pest control benefits

Data on production, price, and consumption, crop performance will continue to be collected. Data collection on losses by pests by crop and by region within countries will begin

Task: Literature review of published data on the incidence of and losses to key pests for the major crops in the world at the country level and disaggregated by agro-ecological zones within countries. (Phil Pardey (Minnesota), Stan Wood (IFPRI), George Norton (Virginia Tech) | 09/01/2007)
Task: Include in a GIS the global biophysical landscape of insects, diseases, and weeds by country and disaggregated by agro-ecological zone to the extent possible. (Stan Wood (IFPRI) | 09/01/2007)

Objective 4. Coordinate with other IPM programs at IARCs and with other USAID-supported agriculture and natural resource management programs on developing and applying assessment methods

Coordination will occur with both social and biological scientists at the IARCs working on IPM and impact assessment.

Activity 1. Establish collaborative relationships

Meetings with IARC economists and others at IFPRI, IRRI, IITA, AVRDC, CIP, and others to coordinate methods used for impact assessment.

Task: Interact with IARC economists at CIP, IITA, ICARDA, AVRDC, IFPRI, and IRRI through email, joint work on impact studies, and visits when in the countries where they are located. (George Norton, Phil Pardey, Stan Wood | 09/01/2008)

Objective 5. Enhance the building of institutional capacity of regional and national partners to undertake impact assessment

Host country specialists will be trained in IPM impact assessment in each region. In some cases, this training will involve obtaining a graduate degree working under the direction of the co-PIs on this impact assessment project. In other cases, this training will involve short-term training with Co-PIs or at selected IARCs. The co-PIs will also present at least one seminar in each regional IPM site.

Activity 1. Train graduate students and other scientists

One student continues graduate program and one receives short term training at Virginia Tech.

Task: Graduate training for a student from the Philippines and one from India in collaboration with the South Asia site at Virginia Tech. (George Norton | 09/01/2008)
Task: Training of one U.S. graduate student at Minnesota. (Phil Pardey (Minnesota) | 09/01/2008)

Objective 6. Facilitate access to the methods, tools, applications and analyses

Extension and Dissemination of information on IPM impact assessment methods beyond the IPM CRSP will occur through publication of articles, an impact progress report series, a book, and through the Worldwide Web, (both through the IPM CRSP website and through the IFPRI website). The methods will be spread though presentations at professional meetings both within the disciplines and at meetings such as the National IPM Symposia. Presentations will be made at workshops affiliated with USAID, USDA regional IPM Centers, and with the IARCs when impact assessment methods are discussed. We will organize a workshop at IFPRI during the last year of the project with both internal (to the project) and external participants.

Activity 1. Bring methods and analyses to a broad audience.

One article published and several presentations at both professional and non-technical meetings.

Task: One article published and presentations at both professional and non-technical meetings. (George Norton | 09/01/2007)