Integrated Pest Management Collaborative Research Support Program (IPM CRSP):
A New Paradigm for Implementing Ecologically-Based Participatory IPM in a Global Context

Technical Workplan

(1 October 2008– 30 September 2009)

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Management Entity:
The Office of International Research, Education, and Development (OIRED)
International Affairs Offices
526 Prices Fork Road
Virginia Tech
Blacksburg, VA 24061-0334 USA

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Management Entity

S.K. De Datta, Administrative Principal Investigator
OIRED Director and Associate Vice President for International Affairs
R. Muniappan, Program Director
Larry Vaughan, Associate Program Director
Maria Elisa Christie, Program Director, Women in International Development
Miriam Rich, Editor and Communications Coordinator
Debbie Francis, Program Coordination Assistant
Annie Steed, Research Associate

USAID

Robert Hedlund, CTO, IPM CRSP

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

Jeff Alwang, Department of Agricultural and Applied Economics, Virginia Tech.

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

Activity 1.1: Evaluation of control alternatives for botrytis in black berry and anthracnose in tree tomato in the valley of Chillanes.

Expected Outputs
Rational management of diseases in these fruits is a key factor for the economical and ecological improvement of valleys agro-ecosystems. Black berry botrytis *(Botrytis cinerea)* and tree tomato anthracnose (*Colletotrichum gloeosporioides*) are the main constrains of these fruits in Chillanes valley. In previous studies, the fungicides commercially available to control *C. gloeosporioides* were evaluated and the most efficient one was identified. Efficient fungicides strategically applied with sanitation measures appear the most appropriate alternatives to reduce fungicide applications and increase the control of three tomato anthracnose. Similarly, identification of the most effective fungicides to control *B. cinerea*, and then their use with appropriate cultural practices will improve botrytis control. Developing management strategies to control these diseases will improve three tomato and black berry productivity and improve ago-ecosystems health.

Activity 1.2: Assessment of IPM packages for vascular wilt, late blight, root knot nematode and fruit borer control of common naranjilla in Ecuador

Expected Outputs
Assessment of the individual and combined contributions of vascular wilt, late blight, root knot nematode and fruit borer control will provide valuable epidemiological information on these diseases. This study will also provide arguments for technology transfer specialist on the importance of integrating IPM packages to succeed in the rational and economical management of the crop.

Sanitation is another strategy that has also been evaluated in previous studies. Seed disinfection with fungicides has been proven to be effective to control of seed transmission of *F. oxysporum* and therefore can be implemented in fields that have never had naranjilla cultivation. These studies will be conducted in collaboration with NGO`s and other organizations interested in sustainable management of rain forest and with active programs in farmer development. The study will also help to institutionalize the IPM technologies that have been developed for improving naranjilla cultivation. Best practices for IPM will be delivered in a dedicated web page for this project. Preliminary results will be published

Task: Validation and Outreach (Ochoa (INIAP), Gallegos(INIAP | 09/01/2009)

Activity 1.3: Develop early test to evaluate cocoa resistance to frosty pod and witches´ broom

Expected Outputs
Techniques developed will allow evaluation of elite selections of 'National' cacao for resistance to witches' broom & frosty pod rot pathogens. By the end of year three we expect to develop a validated early test for WB with a preliminary set of cocoa clones. Also, we would expect to develop preliminary information for FPR resistance-testing protocols.

1. Task: We have designed a test in consultation with USDA/ARS/SPCL and INIAP who have been conducting frosty pod tests for two years in Costa Rica. This trial will be deployed in two locations in Ecuador (Pichilingue and Victoria) and results will be related to the cocoa clone, and to biocontrol bacillus screened earlier for Witches' broom control We will also enter a third year of evaluation of clones and biocontrol agents for witches' broom suppression (Backman (PSU))
2. Task: Complete and refine bioassays out to establish seedling and pod reactions able to discriminate resistant and susceptible material. Define at least one alternative method for early screening of frosty pod rot (Suarez (INIAP) | (06/01/2009)

Activity 1.4: Assessment of pathogens in cocoa/plantain-producing areas

Expected Outputs
Survey results from various areas for severity of cocoa/plantain diseases at various altitudes. Survey of lowland and foothill production sites in Bolivar, Los Rios and Guayas areas for relationships of air drainage, slope, planting density, intercropping, etc, and for relationships to disease severity including black pod rot, WB, FPR and Ceratocystis. From this information develop a prototype management plan for evaluation of the factors that favor or inhibit spread of targeted diseases. This study will provide the basis for a better definition of low and high risk areas and will give information on the use of crop diversity as a means for a more efficient IPM strategy for these pathosystems. We plan to develop by the end of the year, a data base with the physical attributes of the land, but also crop(s), diseases and pests found, level of damage or severity of the attack. The interrelationship of these factors should allow determination of attributes fostering diseases, and those attributes that suppress disease.

1. Task: Further elaboration of a core collection of identified causal agents of pests and diseases affecting mixed cropping systems.
2. Task: Monitoring and managing two established experimental plots with cocoa/plantain intercropping under three spatial arrangements as well as monocrops; to better define factors that influence their incidence and severity using participatory methods four farms within the study area. (Suarez, Solis, Vera (INIAP) | (09/15/2009))

Activity 1.5: Identify and further refine Fusarium control techniques in naranjilla-growing areas of Ecuador

Expected Outputs
Resistance studies: Selection of resistant material in which traits such as yield, fruit size and fruit quality, among others will also be evaluated. **Chemical control**, experimental set up established, fungicide treatments applied, disease and yield evaluated and data analyzed.

Task: Validation and outreach (Ochoa (INIAP) | 09/01/2009)

Activity 1.6: Refine IPM package for mixed cultivation in plantain, Ecuador

Expected Outputs
Information on control methods: Information on pest severity and control practices begun in phase one and year one of this phase will continue. Areas where some IPM practices are more or less established will serve to verify its impact as control measures of main pest and diseases in plantain (Banana stem borer, Black Sigatoka). Information on the effectiveness of the present practice of cutting up stumps of harvested stems on levels of weevil damage; determine if there is a relationship between calcium and/or potassium nutrition in plantain and Black Sigatoka disease. Verify laboratory results that show bacterial and fungal endophytes of cacao can suppress diseases in Ecuador. Best practices for IPM will be delivered in a dedicated web page for this project. Preliminary results will be published.

1. Task: Purify and multiply isolates of Bacillus spp.; establish experiments; examine effectiveness against pathogens, evaluate other biocontrol agents and organic strategies for disease control. (Melnick-Vera-Solis (INIAP) | 09/01/2009) (|)
2. Task: Assess impact of cultivation systems and densities on insect populations (Flowers (FAM) | 09/01/2009)

Activity 1.7: Technology transfer of the use of soil solarization techniques for management of soil borne pests in vegetable crops

Expected Outputs
Transfer of an environmentally friendly and effective, low technology alternative to the use of hard, Restricted Use chemical pesticides for disinfestations of seedbeds, nursery substrate and the soil of plants beds in smallholdings of 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.

1. Task: Finalize experiments on demonstration/validation plots (with no-treatment controls) of the use of soil solarization for seedbeds, seedlings substrate and the soil of field plants beds in vegetable crops (Rivera (FHIA) | 09/01/2009).
2. Task: Initiate demonstration/dissemination of solarization for disinfestations of cottage media used in local nurseries for production of fruit plants in different environments (Rivera (FHIA) | 09/01/2009).
3. Task: To finalize production a grower-friendly illustrated publication, accompanied with a PowerPoint presentation, describing its benefits and the procedures for its implementation in field, seedbed and greenhouse/nursery environments (Rivera (FHIA) | 09/01/2009).

Activity 1.8: 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
- 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.

1. Task: To continue field trials to quantitatively determine if the establishment of cover crops reduces the population of purple nutsedge and root-knot nematodes during the following cropping cycle (A. Rueda (Zamorano) | 09/01/2009)
2. Task: To validate the effect of cover crops on soil conditions (A. Rueda (Zamorano) | 09/01/2009)
3. Task: To produce an inventory of the predominant families of insects developing in the canopy of covercrops, with emphasis on those that are classified as 'beneficial' (A. Rueda (Zamorano) | 09/01/2009)

Activity 1.9: Evaluation of predatory mites as part of management programs for tarsonemid mites that affect eggplant and strawberry production in Honduras

Expected Outputs

- Conclusive 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.

1. Task: To conduct trial to determine effect of hot water treatment of strawberry planting material on plant survival (Rivera (FHIA) | 09/01/2009)
2. Task: To conduct trial to determine efficacy of miticides with ovicidal effect as pre-plant treatment for disinfestation of mites in strawberry planting material (Rivera (FHIA) | 09/01/2009)
3. Task: Publication of a leaflet with the recommendations for Strawberry Mite management based on the results of the above mentioned trials (Rivera (FHIA) | 09/01/2009)
4. Task: Conduct demonstration plots of Strawberry Mite management with growers (Rivera (FHIA) | 09/01/2009)

Activity 1.10: Development of an IPM-based strategy for management of the *Thrips tabaci-Alternaria porri* complex in onions in Honduras

Expected Outputs

- Preliminary recommendations to growers, through field days and bulletins, of improved management practices for the production of fresh onions and other crops.

1. Task: To establish field test to monitor onion thrips in three onion fields to study the correlation between sticky trap catches and direct counts on plants (Rivera (FHIA) | 09/01/2009)
2. Task: Conducting a field trial testing modified spray lances and rigs together with variations in foliar spray volume for improved thrips control (Rivera (FHIA) | 09/01/2009)
3. Task: Establish a field trial of Chinese eggplant interplanted with sunflower and monitor in it the populations of beneficial reduviid and anthocorid bugs (Rivera (FHIA) | 09/01/2009)

Activity 1.11: Evaluation of the legumes as rotation crops for the management of soil-borne pests in tomatoes, sweet potatoes and other important horticultural crops

Description

Component 1. Management of the root-knot nematode (*Meloidogyne* spp)
Component 2. As a host for beneficial insects and as a cover crop for the improvement of soil conditions

Expected Outputs

- Continue validation and quantification of the use of Cowpea green manure rotation for the reduction of root-knot nematode populations in the soils.
- Economic evaluation of the effect of the rotation with Cowpea on the follow-up commercial crop (several candidate crops, including tomatoes and sweet potatoes).
- Transfer to vegetable growers of Honduras (particularly at the Comayagua valley) of the multi-impact use of green manures in controlling the root-knot nematode, 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 legumes as a green manure, and a statement as to the importance of this practice to maintaining biodiversity.

1. Task: To continue experiments to quantitatively determine the effect on the root-knot nematode populations in the soil, and on the economics of the follow-up commercial crops (candidate crops sweet potatoes and tomatoes), of the establishment of a green cover crop of Cowpea and/or other legume crops (Diaz (FHIA) | 09/01/2009)
2. Task: Validate the effect that the use of green cover has on the soil conditions (Diaz (FHIA) | 09/01/2009)
3. Task: Continue producing 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) | 09/01/2009)

Activity 1.12: Mechanical control of papaya fruit fly *Toxotrypana curvicauda*

Description
Currently, papaya growers depend on chemical products to control papaya fruit fly *Toxotrypana curvicauda*. Zamorano evaluated physical control using thermal mesh bags and compared to a chemical control for papaya fruit fly. Results showed that damage caused by *T. curvicauda* in the physical control was significantly lower than plants treated with chemical control, attributable to the interference of the mesh in the oviposition. In the fourth year, Zamorano will continue to evaluate different methods of mechanical control of papaya fruit fly using different shapes of thermal mesh bags.

Expected Outputs:
- Validation of alternative mechanical methods to control papaya fruit fly.

Task: continue validation trials in Zamorano (A. Rueda (Zamorano) | 09/01/2009)

Activity 1.13: Production of biological control agents to control the main horticultural pest of Honduras

Description
Currently, growers depend on chemical insecticides for the management and control of horticultural pests. Biological control agents can be an attractive and environmentally safe alternative to reduce the use of chemical insecticides. We will explore production protocols for the natural enemies in our laboratory in Honduras.

Table 1: List of natural enemies to control and hosts for mass production

Predator	Pest to Control	Predator Host for Mass Production
Heterorhabditis bacteriophora Enthomophatogenic nematode	White grubs *Phyllophaga* spp., melonworm *Diaphania hyalinata*, banana weevil *Cosmopolites sordidus* and fall army worm *Spodoptera frugiperda*	*Galleria mellonella*
Orius insidiosus Generalist predator	*Thrips tabaci*	*Sitotroga cerealella*
Phytoseiulus persimilis Predatory mite	*Tetranychus urticae*	*Tetranychus urticae*
Eretmoserus eremicus	Whiteflies *Bemisia tabac*i and *Trialeurodes vaporiorum*	*Bemisia tabaci*
Neoseiulus californicus	*Tetranycus urticae*	*Tetranychus urticae*

Expected Outputs
- Production protocols for *Heterorhabditis bacteriophora*, *Orius insidiosus*, *Phytoseiulus persimilis*, *Eretmocerus eremicus* and *Neoseiulus californicus*.
- A manual for the correct application of predators to a crop and the monitoring systems used to determine efficacy of control.

Task: Production of predators. (A. Rueda, R. Trabanino, A. Joya, (EAP-Zamorano) R. Foster (Purdue University) Luis Cañas (Ohio University)| 09/01/2009). (Rueda (Zamorano) | 09/01/2009)

Activity 1.14: Detection of main diseases affecting papaya plantations in Honduras

Description
Diseases are the most common limiting factor affecting papaya plantations worldwide. During this study, we will continue to identify and systematize the symptomatology of the main diseases affecting papaya plantations in Zamorano.

Expected Outputs
- Main fungal, bacterial and viral diseases identified.
- A guide describing the main diseases affecting papaya and their symptoms.

1. Task: Collection of vegetative material of papaya plantations at Zamorano (Rueda (Zamorano) | 09/01/2009)
2. Task: analysis and identification of main diseases (Rueda (Zamorano) | 09/01/2009)

Activity 1.15: Management of the eggplant fruit borer *Neoleucinodes elegantalis* (Lepidoptera: Pyralidae).

Description
During 2006, several shipments of eggplant from Honduras were detained upon entrance to the United States because of presence of *N. elegantalis* larvae. The larva is an internal feeder that leaves no scar or trace of its presence, which makes it difficult to detect damaged fruit. Surveys at packing plants revealed that infestation levels were less than 1%, which may be an indication of low population levels. A pheromone that attracts *N. elegantalis* males has been developed elsewhere, which will be used to monitor populations in six locations of the Comayagua Valley.

Expected Outputs
- Learn about the population trend of *N. elegantalis* through the year and use that information to design management schemes.
- Produce a publication with the findings and interpretation of the study aimed to manage the pest.

1. Task: Deployment of traps with pheromone and weekly servicing in six locations of the Comayagua Valley. (Espinoza (FHIA), Weller and Foster (Purdue) | 09/01/2009)
2. Task: Publication of a leaflet with the information gathered. (Espinosa (FHIA), Weller and Foster (Purdue) | 09/01/2009)

Activity 1.16: Manual for prevention of *Phytopthora* spp. Root and crown rot of avocado in nurseries and young field plantings

Description
Cropping of the "Hass" cultivar of avocado is strongly being promoted locally by different parties, including FHIA and FINTRAC through the Millennium Challenge Account initiative. The crop is an

important source of cash and it also substitutes for imports currently being brought from México and Guatemala. The most important problem found for successfully establishing the groves is the occurrence of plants death caused by species of the soil borne pathogen *Phytophthora*, which rots the roots and crown of the plants. In most cases the problem is carried from the nursery where the plants are produced. There is an obvious need to know what the proven measures are to prevent plant losses due to the disease caused by *Phytophthora* in avocadoes.

Expected Outputs
- Collection of a body of bibliographical information on the cultural practices which, together with effective and safe chemical plant disease control, are conducive to successful commercial production of avocadoes.
- Publication of a practical guide for prevention of losses of avocado plants due to *Phytophthora* and other soil borne problems.

1. Task: To finalize a literature search and review on cultural and chemical practices conducive to an integrated and more efficacious control of the disease (Rivera (FHIA) | 09/01/2009)
2. Task: Publication of a practical guide for prevention of losses of avocado plants due to Phytophthora and other soil borne problems (Rivera (FHIA) | 09/01/2009)

Objective 2: 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 1.1: Transfer of plantain and vegetable IPM programs from Ecuador and Central America to other areas of the Caribbean (South-south transfer)

Expected Outputs
Network established

1. Task: Participation in regional IPM meetings.
2. Task: Celebration of the XI International IPM Congress of the Mesoamerican region (A. Rueda (Zamorano) | 10/01/2009).

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.

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

Activity 1.1: Monitoring and impact study of alternative IPM programs in Honduras

Expected Outputs
Socioeconomic baseline analyzed; impact study conducted

Activity 1.2: Socioeconomics of IPM in vegetables in Honduras and cacao and other crops in Ecuador

Expected Outputs
Honduras: working paper based on household survey data from La Paz and Comayagua; qualitative data collection on market outlets, access, and incomes for small-scale horticultural producers with and without IPM technology transfer.

Ecuador: working paper on household survey data from Chillanes/Guaranda to analyze determinants of IPM adoption, crop choice and participation in higher valued markets.

1. Task: Impact assessment for Naranjilla IPM (Alwang (VT) | 09/01/2009).
2. Task: Evaluation of IPM package for Andean Fruits in Chillanes, Ecuador (Alwang (VT) | 09/01/2009).

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

Mark Erbaugh, International Programs in Agriculture, Ohio State University.

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 representatives from each country 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;
- Effective technology transfer and dissemination plan for reaching regional producers including women completed;
- 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 1.1: Implement Year IV Regional IPM program Work Plan activities

Regional Technical Committee: Site Chair, Dr. J.M. Erbaugh, The Ohio State University; Regional Coordinator, Dr. S. Kyamanywa, Makerere University; Dr. Monica Waiganjo, KARI, and Drs. A. P. Maerere & K. P. Sibuga, SUA.

Uganda:
- Makerere University: R. Namirembe-Ssonko, F. Birungi Kyazze, S. Kyamanywa, M. Mugonola, S.B. Mukasa, J. Karungi, M. Ochwo-Ssemakula, G. Tusiime, J. Bonabana, S. Adikini;
- National Agricultural Crop Resources Research Institute (NACCRI): P Seruwagi, M. Otim, P. Kucel, and P. Kahangire
- Ministry of Agriculture Animal Industry and Fisheries (MAAIF): Z. Muwanga

Tanzania:
- Sokoine University of Agriculture: A.P. Maerere, K.P. Sibuga, H. Mtui, M.W. Mwatawala;
- Tanzania Coffee Research Institute (TaCRI): J.M Teri, G. Maro, F. Magina

Kenya:
- Kenya Agricultural Research Institute (KARI): M. Waiganjo, R. Amata, M.Otipa, B.M. Ngari, S. Kuria, J. N. Kahinga, and J. Mbaka; Egerton University, R. Gesimba.

USA:
- Ohio State University: M. Erbaugh, S. Miller, G. Kovach, M. Ivy, and M.D. Kleinhenz;
- Virginia Tech. University: D. Taylor and R. Roberts

AVRDC:
- G. Luther and Drissa Silue

Description

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

1. Task: Enhance RP/EA website portal.
2. Task: Host 5th meeting of RTC to assess progress.

(ii) Specify and implement additional socioeconomic baseline activities

1. Task: Complete impact assessment studies;
2. Task: Implement additional impact assessment activities.

(iii) Complete biological monitoring programs.

1. Task: Complete biological monitoring activities.
2. Task: Implement additional biological monitoring activities.

(iv) Complete on-farm/station trials of IPM technologies.

1. Task: On-farm/station trials conducted in Uganda, Kenya and Tanzania.
2. Task: Data collected and written up.

(v) Complete training program

1. Task: Complete training programs for regional graduate students.
2. Task: Implement IPM curricular revisions at SUA.

(vi). Technology transfer program

1. Task: Implement Pesticide Safety and Usage Program hot-pepper and coffee in Uganda and Tanzania; and tomato in Kenya and Tanzania.

Expected Outputs

- Completion of Year 4 work plan activities;
- Fifth RTC meeting held;
- Web portal for RP/EA enhanced;
- Impact Assessments completed;
- Lists of key pests and disease and their seasonal distribution documented from the Biological Monitoring programs;
- IPM packages for various crops identified and validated.
- Training Programs completed;
- Technology transfer activities completed.

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

Description

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

Expected 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 2.1: Tomato

Uganda

1. Task: To disseminate tomato IPM package among farmers by using trained farmers as trainers;
2. Task: Confirm effect of grafting;
3. Task: Develop training manuals for the various tomato IPM practices (including: Grafting and cultural practices-Resistant tomato variety, Mulching, Staking and reduced pesticide use).
4. Task: Assess impact of tomato IPM packages on tomato production.

Tanzania

1. Task: Disseminate recommended IPM practices
2. Task: Prepare extension materials on recommended IPM practices
3. Task: Complete on station trials to assess yield loss due to weeds in tomato and some selected vegetables
4. Task: Implement training on safe use of pesticides and IPM technologies for extension agents, farmers and traders
5. Task: Assess impact of tomato IPM package on tomato production in Tanzania

Kenya

1. Task: Evaluation of introduced lines for tolerance/resistance to begomoviruses
2. Task: Complete evaluation of locally developed and introduced tomato lines against wilt tolerance;
3. Task: Complete Biological Monitoring and identification of tomato production constraints in the farmers' fields in Mwea Division
4. Task: Evaluate screen house beds for whitefly control in tomato on-station and on-farm
5. Task: Training of trainers
6. Task: Conduct modified farmer field schools

AVRDC

1. Task**:** Complete screening tomato lines against Red Spider Mites (RSM) and Leaf Miner Fly (LMF).
2. Task: Complete evaluation trials of *Cleome gynandra* "spiderplant" as repellent crop and *Crotalaria ochroleuca* "sunhemp" as trap crop for thrips in Tomato

3. Task: Complete trials on biocontrol of soilborne diseases using Brassica and African Indigenous crops.

Expected Outputs

Uganda: a) 200 farmers exposed tomato IPM packages; b) Number of trainers of tomato IPM packages increased from 20 to 40; c) Increased income levels for farmers using the tomato IPM technological package; d) 6 simple training manuals on tomato IPM technologies and other production techniques developed for farmer and extension use; e) 3 journal papers submitted (grafting, cultural practices, adoption of tomato IPM package). II)

Tanzania: a) One demonstration plot established; b) Brochure/fact sheets produced on general tomato pests and IPM practices; c) On station yield loss weed trial on tomato and selected vegetables completed; d) At least 50 farmers exposed to IPM technologies in tomato production; e) At least 30 farmers, 10 extension agents and 10 traders trained on safe use of pesticides; f) At least one field day on tomato IPM technologies conducted; g) Final project report (including impact assessment) and at least two journal publications produced. III)

Keny:, a) Varieties with tolerance to Begomovirus documented; b) Three publications in refereed journal; c) At least two lines tolerant to *Ralstonia* sp. documented; d) Tomato production constraints at Mwea confirmed and documented; d) One presentation in a Conference; e) Whitefly transmitted virus diseases minimized and tomato yields increased by 10%; f) Economic benefits of whitefly control documented; g) At least 15 extension officers trained on pesticide use and safety; h) A modified training module developed; i) Manuals on pesticide use and safety developed; j) Farmers knowledge enhanced by 30%; k) At least two farmer field schools conducted in Mwea Division, Kirinyaga. IV)

AVRDC: (a) Tomato varieties which are resistant /tolerant to the key pests identified. (b) Effectiveness of spiderplant to reduce thrips numbers on intercropped tomato plants documented. (c) Effectiveness of *Crotalaria juncea* as a trap, to reduce thrips numbers on tomato plants documented. (d) Complete evaluation of biocontrol of soilborne diseases using Brassica and African Indigenous crops.

Activity 2.2: Hot pepper

Uganda

1. Task: Ascertain the virus strains that are occurring in Uganda at the molecular level
2. Task: Complete evaluation (in screen house and field) of role of seed in transmission of viral diseases
3. Task: Disseminate developed IPM options.

AVRDC

1. Task: Screening hot pepper varieties for resistance to Spider mites, *Phytophthora*; *Verticillium* wilt and Thrips completed.
2. Task: Trap cropping trials completed.
3. Task: Marigolds and sunhemp (*Crotalaria juncea*) used as trap crops to attract thrips away from hot peppers will be completed.
4. Task: Biocontrol of soil-borne diseases using Brassica crops completed.

Expected Outputs

a) Virus strains on hot pepper in Uganda verified; b) Economic losses of viral diseases to hot pepper production in Uganda quantified; c) Confirmation of phenotypic selection of virus disease-free seeds as a management strategy; d) 60 farmers trained in pepper pest identification and management; and e) Publications (2 scientific papers submitted, and brochures).

Activity 2.3: Integrated Vegetable Systems

Tanzania: Activity and output descriptions for this activity can be found under Activity 2.1: Tomato

Expected Outputs
Data collected and written up from third season, year 3 and trials continued.

Activity 2.4: Biologically-based interventions for managing *Helicoverpa armigera*

1. Task: To establish a fully functional GIS database for mapping *H. armigera* density and related geographic factors
2. Task: To complete studies investigating ecological factors that may be manipulated to reduce *H. armigera* infestation and damage on tomatoes
3. Task: To complete studies on effect of intercropping tomato with maize, sorghum and beans on the population dynamics of *H. armigera* and its natural enemies
4. Task: To assess the efficacy of reduced spray regimes for control of *H. armigera* in tomato fields.

Expected Outputs
a) GIS database established; b) The role of intercrops on the population dynamics of *H. armigera* and its natural enemies determined; c) Reduced spray schedule for *H. armigera* developed; d) Documentation of ecological factors influencing *H. armigera* population dynamics; and e) Publications (2 journal papers).

Activity 2.5: Passion fruit

Uganda

1. Task: Validate developed primers using a collection of isolates from major passion fruit growing areas of Uganda
2. Task: Evaluate germplasm for tolerance to passion fruit viruses.

Tanzania

1. Task: Complete survey on pest problems, germplasm diversity and cultural systems; and
2. Task: Effect technology transfer, to Tanzania, of disease identification and management protocols developed in Kenya and Uganda.

Kenya

1. Task: Resistance trials using at least 7 lines from Thika, Embu and Egerton tested in the screen house for tolerance to viral and fungal pathogens of passion fruit
2. Task: Morphological, Molecular and Serological characterization of passion fruit viruses and fungi
3. Task: Complete evaluation of bio-control agents against passion fruit fungal diseases.

Expected Outputs
Uganda: a) Survey information on major pests of yellow passion fruit in Tanzania reported; b) Technology transfer and plant material exchange within the region for passion fruit initiated with Tanzania; and c) Survey report and at least one publication produced.

Tanzania: a) Diagnostic tools validated; and b) Passion fruit germplasm screened using diagnostic tools

Kenya: a) At least two fungal and two viral resistant lines identified; b) At least three publications developed; c) GIS distribution maps of fungal and viral diseases developed; d) A list of viral/fungal pathogens associated with passion fruits in Kenya confirmed and documented; e) Two bio-control agents evaluated and disseminated to growers.

Activity 2.6: Banana

Uganda

1. Task: Complete studies on transmission of *Xanthomonas campestris* pv. *musacearum* (Xcm) by suckers using Xcm diagnostic specific primers
2. Task: Prepare a guide on the use of PCR in detection of *Xcm*
3. Task: Conduct dissemination workshop for researchers and farmers on management of *Xcm.*

Kenya

Tasks: Disseminating banana *Xanthomonas* information.

Expected Outputs
Uganda: a) Recommendations for selecting clean planting material developed; b) A guide on the detection of Xcm in banana plants produced; c) Extension agents and farmers trained; and d) Publications (1 journal paper submitted). II)

Kenya: a) At least one Seminar presented; and b) One farmer awareness training conducted.

Activity 2.7: Coffee

Uganda

1. Task: Complete work on developing IPM packages for key insect pests:- stem borers (*Bixadus seirricola)* and root mealybugs (*Planococcus ireneus*), Antestia bugs *(Antestiopsis sp,)* and coffee berry borer (*Hypothenemus hampei*)
2. Task: Study the effect of cultural practices on coffee berry disease (*Colletotricum kahawae*) and coffee leaf rust *Hemileia vastatrix*
3. Task: Conduct coffee field days.

Tanzania

1. Task: Complete on station trials for IPM in coffee (resistant varieties, grafting, botanicals)
2. Task: Complete on station experiment on the effect of shade under coffee/banana intercropping systems on coffee pest infestation
3. Task: Implement training on safe use of pesticides and IPM technologies for extension agents and farmers
4. Task: Disseminate Arabica coffee IPM technologies to TaCRI farmer groups.

Expected Outputs
Uganda: a) IPM technologies for key insect pest of coffee developed; b) Effect of cultural practices on disease severity developed; and c) Farmers trained in IPM of coffee.

Tanzania: a) Development of IPM packages for the key pests of Arabic coffee completed; b) At least 100 farmers apply IPM technologies; c) Extension materials on Arabica coffee IPM practices produced; d) At least 50 farmers and 10 extension agents trained on safe use of pesticides; e) Final project report and at least two publications produced.

Objective 3: Collaborations with Global Themes

Activity 3.1: Integrated Management of Thrips-Borne Tospoviruses in Vegetable Cropping Systems

Uganda

1. Task: Complete collection and identification of thrips on tomato and scotch bonnet in Uganda
2. Task: Baseline survey for tospovirus disease problems in vegetables (tomato, peppers).

Expected Outputs
Uganda: a) List of species of thrips on tomato and hot-pepper; b) special project research report.

Activity 3.2: Collaboration with International Plant Disease Diagnostic Global Theme: Management of Geminiviruses in Tomato

Kenya

1. Task: Assess the effect of using screen-houses to protect tomato seedbeds from whiteflies and thus geminivirus infection
2. Task: Assess geminivirus-resistant varieties;

Regional

Task: To develop standard operational procedures for different diseases and insect pests.

Expected Outputs
Kenya: a) Evaluate the effect of screening seedbeds for exclusion of whiteflies on subsequent disease incidence, yield and quality of tomatoes; b) Determine which geminiviiruses are common in East African tomato fields; c) Effectiveness of geminivirus-resistant varieties will be determined; d) SOPs established.

Activity 3.3: Establish an Interaction with the Insect Transmitted Virus Global Theme

Uganda

1. Task: Provide training to Dr. James Mukasa of Makerere University on protocols for viral disease identification of aphid- an seed transmitted viruses
2. Task: Conduct viral disease survey assessment of scotch bonnet in Uganda
3. Task: Evaluate farmer saved seed for seed-transmitted viruses
4. Task: Collaborate with passion fruit team to identify and characterize important viral diseases and vectors, and develop a membrane-based immunoassay for detection of specific viruses such as passion fruit woodiness virus.

Expected Outputs
(a) Initiate collaboration in East Africa; (b) exchange preliminary protocols and information for development of future research work plan.

Objective 4: Performance Indicators for Monitoring and Evaluation

Milestone Tasks

ID	Description	Completion Date	Responsible Individual
Activity 1	Implement Year IV workplan activities	9/30/09	Kyamanywa, Erbaugh
Task	Enhance RP/EA website portal	9/30/09	Kyamanywa, Taylor
Task	Host Fifth RTC meeting	4/30/09	Kyamanywa
Task	Complete Annual Report	10/30/08	Kyamanywa, Erbaugh
Task	Determine and complete any additional impact assessments/follow-up surveys	9/30/09	Taylor, Erbaugh, Bonabana
Task	Complete biological monitoring activities	9/30/09	Kyamanywa
Task	Implement IPM curricular revisions at SUA	9/30/09	Maerere
Task	Complete Training programs of regional graduate students	9/30/09	Kyamanywa, Erbaugh
Task	Complete on-farm trials in Tz, Ug & Ky. & data written-up	9/30/09	
Activity 2.1	Complete Tomato IPM program	9/30/09	Kyamanywa
Tasks	Uganda: Dissemination of IPM package using training-of-trainers, confirm effect of grafting, assess impact of tomato package.	9/30/09	Kyamanywa, Karungi, Ssonko, Bonabana,Mugonola
Tasks	Kenya: Complete resistance evaluations of tomato lines for wilt & begomoviruses, complete biological monitoring, complete evaluation of screen houses, and conduct modified farmer field schools.	9/30/09	Waiganjo
Tasks	Tanzania: Disseminate recommended IPM practices; prepare extension materials on recommended IPM practices; Complete on station trials to assess yield loss due to weeds in tomato and some selected vegetables; training on safe use of pesticides and IPM technologies for extension agents, farmers and traders; and assess impact of tomato IPM package on tomato production in Tanzania	9/30/09	Maerere, Sibuga, Mtui
Tasks	AVRDC: Complete screening	9/30/09	Luther, Silue

ID	Description	Completion Date	Responsible Individual
	tomato lines against Red Spider Mites (RSM) and Leaf Miner Fly (LMF). Complete evaluation trials of *Cleome gynandra* "spiderplant" as repellent crop and *Crotalaria ochroleuca* "sunhemp" as trap crop for thrips in Tomato; Complete trials on biocontrol of soilborne diseases using Brassica and African Indigenous crops		
Activity 2.2	Complete: Hot Pepper	9/30/09	Kyamanywa, Karungi, Silue
Tasks	Uganda: Characterize at the molecular level virus strains in Uganda; Complete evaluation (in screen house and field) of role of seed in transmission of viral diseases; Disseminate developed IPM options.	9/30/09	Kyamanywa and Karungi
Tasks	AVRDC: Screening hot pepper varieties for resistance to Spider mites, *Phytophthora*; *Verticillium* wilt and Thrips completed. Trap cropping trials completed. Marigolds and sunhemp (*Crotalaria juncea*) used as trap crops to attract thrips away from hot peppers completed. Biocontrol of soilborne diseases using Brassica crops completed.	9/30/09	Luther, Silue
Activity 2.3	Integrated Vegetable Systems	9/30/09	Maerere, Sibuga, Mtui
Task	Tan: On-station trials completed as in tomato	9/30/09	Maerere
Activity 2.4	*H. armigera* Mgt.	9/30/09	Luther, Roberts, Kyamanywa, Otim
Tasks	i) Establish a fully functional GIS database for mapping *H. armigera* density and related geographic factors; ii) Complete studies investigating ecological factors that may be manipulated to reduce *H. armigera* infestation and damage on tomatoes; iii) Complete studies on effect of intercropping tomato with maize, sorghum and beans on the population dynamics of *H. armigera* and its natural enemies;	9/30/09	Luther, Roberts, Kyamanywa, Otim

ID	Description	Completion Date	Responsible Individual
	and iv) Complete efficacy assessment of reduced spray regimes for control of *H. armigera* in tomato fields.		
Activity 2.5	Passion Fruit Disease Mgt.	9/30/09	Kyamanywa, Ochwoh, Amata, Otipa& Gisemba
Tasks	Uganda:Validate developed primers using a isolate collection; and Evaluate germplasm for tolerance to passion fruit viruses	9/30/09	Ochwoh
Tasks	Kenya: Resistance trials using lines from Thika, Embu and Egerton tested in the screen house for tolerance to viral and fungal pathogens of passion fruit; Morphological, Molecular and Serological characterization of passion fruit viruses and fungi; and iii) Complete evaluation of bio-control agents against passion fruit fungal diseases.	9/30/09	Amata, Otipa, Gesimba
Tasks	Tanzania: i) Complete survey on pest problems, germplasm diversity and cultural systems; and ii) Effect technology transfer to Tanzania of disease identification and management protocols developed in Kenya and Uganda.	9/30/09	Maerere, Sibuga
Activity 2.6	Banana wilt mgt.	9/30/09	Miller, Tusiime,
Tasks	Uganda**:** i) Complete studies on transmission of *Xanthomonas campestris* pv. *musacearum* (Xcm) by suckers using Xcm diagnostic specific primers; ii) Prepare a guide on the use of PCR in detection of *Xcm;* and iii) Conduct dissemination workshop for researchers and farmers on management of *Xcm.*	9/30/09	Miller, Tusiime,
Task	Kenya: Disseminating banana *Xanthomonas* information.	9/30/09	KARI - Waiganjo
Activity 2.7	Coffee program	9/30/09	Kyamanywa, Erbaugh, Maerere, Magina

ID	Description	Completion Date	Responsible Individual
Tasks	Uganda: i) Complete work on developing IPM packages for key insect pests:- stem borers, root mealybugs, Antestia bugs and coffee berry borer; ii) Study the effect of cultural practices on coffee berry disease and coffee leaf rust; and iii) Conduct coffee field days.	9/30/09	Kyamanywa, Magina
Tasks	Tanzania: i) Complete on station trials for IPM (resistant varieties, grafting, botanicals); ii) Complete on station experiment on the effect of shade under coffee/banana intercropping systems on pest infestation; iii) Implement training on safe use of pesticides and IPM technologies for extension agents and farmers; and iv) Disseminate Arabica coffee IPM technologies to TaCRI farmer groups.	9/30/09	Maerere, Magina
Activity 3.1	Integrated Mgt. of Tospoviruses	9/30/09	Naidu, Kyamanywa, Ochwoh
Tasks	Uganda: Complete collection and identification of thrips on tomato and scotch bonnet in Uganda; and baseline survey of tospovirus disease problems in vegetables (tomato, peppers).	9/30/09	Naidu, Kyamanywa, Ochwoh
Activity 3.2	IPDN: Geminiviruses in Tomato	9/30/09	Ochwoh, Miller, Maxwell, Waiganjo
Tasks	Kenya: Assess the effect of using screen-houses to protect tomato seedbeds from whiteflies and thus geminivirus infection, and ii) Assess geminivirus-resistant varieties;		Ochwoh, Miller, Maxwell, Waiganjo

West Africa IPM Center of Excellence

Donald Mullins, Department of Entomology, Virginia Tech.

Objective 1: Development of an online whitefly monitoring system

Description
Whitefly-transmitted geminiviruses (WTG) are important constraints in the production of crops such as tomato and green bean in the West Africa Region. Like other vector-borne diseases, efficient management of WTG requires a reduction of the basic reproductive rate of the parasite below unity. For WTG, this reduction can be achieved in several ways: by reducing whitefly population density, reducing whitefly life expectancy, decreasing contact between the whitefly and its host plants, or by reducing the rate of infection of the virus in host plants. Recently, the use of virus-resistant germplasm and small-scale implementation of host-free periods has been attempted in Mali for the management of WTG. Some success has been achieved with these approaches. The use of a host-free period, for example, was found to be most appropriate only within localized areas where traditionally there was a lapse in crop production during parts of the year (e.g., in Baguineda, Mali). Two virus resistance tomato varieties have been identified and allow for increased tomato production in Baguineda. The continued importance and prevalence of whiteflies in the West Africa region and the constraints of localized management strategies require that we rethink our approach to the whitefly problem to consider area-wide studies that would allow us to identify, through quantitative analyses, areas that are prone to and circumstances that encourage infestations within the region.

Activity 1.1: Implementation of the third full season of whitefly monitoring and analysis of data accrued to date

Expected Outputs
The information on whitefly populations obtained to date from spatial monitoring will be combined with species identification data and land cover characteristics into a GIS that will be reported on the West Africa website. The whitefly project will continue to be the major research focus for a doctoral student.

1. Task: Use exploratory data analysis (EDA) to understand and compare the patterns inherent in the spatial data on whitefly populations collected during two full seasons of monitoring in Senegal and Mali (Brewster/VA Tech | 10/31/2008).
2. Task: Collect whitefly specimens at sampling locations in each of the study areas in Senegal and Mali for species identification using molecular techniques (Brewster/VA Tech | 01/31/2009).
3. Task: Combine the whitefly population and species data, and land cover information obtained from satellite imagery of each of the study areas in Senegal and Mali in a Geographic Information System (GIS) (Brewster/VA Tech | 04/30/2009).
4. Task: Integrate the GIS developed for the whitefly into the Whitefly Information System on the WA web site (Brewster/VA Tech | 05/31/2009).
5. Task: Continue with the Ph.D. graduate student training under the whitefly project (Brewster/VA Tech, DPV, 11/01/2008).

Objective 2: Develop and implement IPM strategies for viral diseases and other pests of tomatoes

Description
The overall goal of this objective is to develop an understanding of major viral disease problems of vegetable crops in West Africa and to develop and implement IPM strategies for their management. Initially, the focus of this objective will be on tomato, because of the importance of tomato as a cash crop for small farmers, the significant economic impact that whitefly transmitted viruses are having on tomato production in West Africa and the progress made to date in Mali on the whitefly-transmitted viruses of tomato.

Activity 2.1: Understand socioeconomic and agroeconomic aspects of tomato production

Expected Outputs
Information on the socioeconomic and agroeconomic assessment of the impacts of the tomato virus will be used in directing IPM technology developed to control this pest.

Task: Ex ante impact analysis on tomato virus management developed by the IPM CRSP in Baguineda, Mali with extension of the analysis to other parts of Mali and other countries in the regional program where suitable data exists (Mullins/VA Tech | 01/08/2000).

Activity 2.2: Continue to implement a plan for collaboration with the Global Themes projects on diagnosis of insect transmitted viruses in tomatoes and other vegetable crops

Expected Outputs
Coordination of data development and reporting on the West Africa Website will make the information widely accessible.

Task: Continue to develop the linkages and reporting results on insect transmitted viruses on the West Africa website (Insect Transmitted Virus Global Theme and The Regional Diagnostic Laboratories Global Themes (Mullins/VA Tech | 08/15/2009).

Activity 2.3: Develop an IPM package for bacterial wilt on tomato

Description
Tomato is the main vegetable grown and consumed in Mali. It is both cultivated during the dry season fresh and in rainy season. However, despite its importance as a domestic staple crop, tomatoes production has many constraints, such as viral infection of the tomato TYLCV transmitted by whiteflies and bacteria wilt. Identification of solenaceous plants for resistance to bacterial wilt or virus is important in development of strategies for improving tomato production in Mali.

Expected Outputs
An effective rootstock will be chosen, and tomato grafting will be promoted as a management technique against bacterial wilt.

1. Task: Screen wild solenaceous plants for resistance to bacterial wilt or virus (Mullins/VA Tech and Gamby, Théra & Traoré/IER | 09/30/09).
2. Task: Test the preferred geminivirus-tolerant tomato varieties grafted on the most promising virus or wilt-resistant solanaceous rootstock (Mullins/VA Tech and Gamby, Théra & Traoré/IER IER & Vaughan/VA Tech) | 09/30/09).
3. Task: Screen tomato varieties for resistance to bacterial wilt or virus (Mulling/VA Tech & Gamby, Théra, Traoré & Nantoumé/IER | 09/30/09).

Activity 2.4: Develop an IPM package for managing *Helicoverpa armigera* on tomato

Description
Helicoverpa armigera is the main tomato fruit pest in Mali. The yield loss is between 40 to 60%. Farmers typically spray carbofuran or cotton pesticides to control *H. armigera*. This activity will evaluate alternate methods for *H. armigera* control with biorational pesticides.

Expected Outputs
Less harmful and less environmentally damaging alternative pesticides recommended controlling *H. armigera* on tomato.

Task: Conduct a pesticide trial comparing biorational pesticides (e.g. spinosad,) and biopesticides (e.g. *Bacillus thuringiensis*, neem) against commonly used pesticides that have undesirable drawbacks (e.g. carbofuran). (Mullins/VA Tech & Gamby, Traoré, & Nantoume/IER | 09/30/09)

Activity 2.5: Expand the testing of host-free periods into new locations in Mali

Description
Several horticultural crops are the plants host of the whitefly, *Bermisia tabacci*. The host free period activity eliminates population growth on *B. tabacci* host plants. During this period pepper, tomato and African eggplant don't grow during June, July and sometimes August. After obtaining excellent results with this practice, this year we plan to extend the practice through the main growing area of tomato. The transfer technology is making by the extension service and NGO's.

Expected Outputs
The host free period delays the onset of viral infection of tomatoes. It reduces the whitefly infestation and reduces the tomato yield loss to 40 to 50%.

1. Task: Assess interest among OHVN, NGO, Policies, IICEM project/USAID and Peace Corps in transferring host-free period information to the main tomato growing area (Mullins/VA Tech, Gamby, Noussourou, & Traoré/IER; Sidibé/OHVN; Peace Corps & Care/Mali | 09/30/09)
2. Task: Create a monitoring protocol so that performance of the host-free periods can be documented (Mullins/VA Tech & Gamby/IER | 09/30/09)

Objective 3: Influence of agroecosystem biodiversity on virus levels.

The role of weeds as reservoirs for insects and viruses will be examined. Weed scientists in Mali, Burkina Faso, and Senegal will work with Global Theme collaborators (Insect Transmitted Viruses and Regional Diagnostic Laboratories) on whiteflies and geminiviruses to inventory weeds common to fields where these pests are a problem. The result will be an inventory of weeds associated with crops that harbor whiteflies and/or the geminiviruses. This activity will be coordinated by the Regional Coordinator, Amadou Diarra, to ensure that the surveys are conducted at regular intervals and that information is shared with project personnel. It is especially important to link this information with the IT personnel so that weeds can be incorporated into spatial representations of crop, insect, and disease populations. Weeds that are identified as harboring whiteflies will be evaluated to determine whether they can also host the Gemini virus.

Activity 3.1: Build a database and compile geographic and temporal data on weeds in the region and their propensity to host whiteflies and viruses

Expected Outputs
New information on the relationships between weeds as virus hosts and whiteflies as virus vectors will be integrated into the data base.

1. Task: Identify weed species in and around vegetable crops: Expand activity from Mali to Senegal (Westwood/VA Tech & Dembele & Noussourou/IER | 09/30/09)
2. Task: Collect whitefly and weed samples for testing (Westwood/VA Tech, Gilbertson/UC Davis & Brewster/VA Tech | 09/30/09)
3. Task: Compile weed images into an online resource for project and public use. (Westwood/VA Tech & Diarra/INSAH & various cooperators | 09/30/09).

Activity 3.2: Coordinate data tabulation of information from the Diagnostics Lab and the Insect-Transmitted Viruses Global Themes to the West Africa Regional IPM Website

Expected Outputs
Expanded database linking weed, virus, and whitefly incidence levels across West Africa.

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, Diarra/ INSAH, Kollo/AVRDC, Tolin/VA Tech, Miller/OSU | 09/30/2009).

Activity: 3.3 Training of a student in IPM with research focusing on assessing weed ability to host Gemini viruses.

Expected Outputs
Increased capacity for IPM research within Senegal and collaboratively with partners throughout West Africa.

1. Task: Train Djibril Badiane (Ph.D. student at the University of Dakar, Thies, Senegal) in methods of weed identification, whitefly biology and virus detection. Provide this student with intensive training in English. (Westwood/VA Tech. Mullins/VA Tech, Carlyle/VA Tech & Diarra/INSAH. | 09/30/2009).
2. Task: Continue to develop project to empirically test weed ability to host and transmit viruses by whitefly (Westwood/VA Tech, Gilbertson/UC Davis, Brewster/VA Tech, Diarra, INSAH.| 09/30/2009).

Objective 4: Prioritize regional needs through a participatory planning process

We will continue to support our original regional Participatory Planning Process (PPP) to supplement information designed to determine and prioritize regional needs (key pests, crops, and sites) and begin studies designed to implement IPM practices on selected crops.

Activity 4.1: Continue to conduct in depth studies on cropping systems fruits and vegetables in Guinea

Expected Outputs
The information gathered during the two cropping seasons will be used to develop IPM strategies for vegetable and tree crops. Socio-economic data will be available for developing IPM strategies. Vegetables crops will be (environmental friendly) protected against major pests and house income for women will be improved Cashew trunk borers will be controlled.

1. Task: Finalize the socioeconomic survey of horticultural activities in the four PA villages around Kankan (Diarra INSAH; IRAG | 06/30/2009).
2. Task: Conduct IPM trials to improve vegetable production (including cabbage) by women (Diarra INSAH, Sangare IRAG | 06/30/2009).
3. Task: Apply IPM strategies and continue the establishment of a network for cashew trunk borers in ten villages (Diarra INSAH, Sangare IRAG | 06/30/2009).

Objective 5: Investigate pests of potato in storage and propagation

In Mali, potatoes are considered to be one of the most economically important vegetable crops and are becoming more important because they are considered to be a crop with high nutritional value, a high value cash crop, and a potential export crop for Malian farmers. Bacterial wilt disease caused by *Ralstonia solanacearum* has become a serious problem limiting potato production while growing potatoes has become more popular in Mali. The disease has caused farmers to stop growing potatoes in many fields in the main potato growing area near Sikasso and Kati and potato production has dramatically decreased. Attempts to control the disease have been ineffective because of the large diversity of the pathogen and its host plants in Mali (tomato, pepper and eggplant). This activity consists to develop and implement IPM strategies for bacterial wilt disease of potatoes, to identify the best sites for disease free seed potatoes production and intensify potato growing in Mali. The potato tuber moth is also a very important pest of potato in Senegal and Guinea. Experiments will be carried out in Senegal to determine measures that can reduce infestation of potato by this moth. Other crops (or plants) that serve as refugia for the moth have to be identified, and incidence of the moth on them assessed. This activity will be carried out in Senegal. Information on the potato tuber moth will be used to determine its importance as a pest in the West Africa region.

Activity 5.1: Conduct surveys to determine the incidence and abundance of potato diseases and pests

Expected Outputs
Information on the potato tuber moth will be used to determine its importance as a pest in the West Africa region.

1. Task: Analyze soil and water of different localities to detect the presence of bacterial wilt; and continue with surveys to determine incidence and abundance of the potato tuber moth. This information will be used to develop a map for potato producing areas indicating the season potato is grown and correlated with the disease free seed potato production and abundance of the potato tuber moth (Mbata/FVSU & Thera/IER OHVN | 09/30/2009).
2. Task: Conduct an assessment of other crops that might serve as refugia for the potato tuber moth (Mbata/FVSU & Mbaye/ISRA OHVN | 09/30/2009).
3. Task: Conduct studies on the race, the biovar and the disease epidemiology (Mbata/FVSU & Thera & Traoré /IER OHVN | 09/30/2009).
4. Task: Conduct plot experiments to compare different strategies of control (sanitary measures and adapted agricultural techniques) and varieties that are resistant to the disease (Mbata/FVSU & Thera & Traoré /IER & OHVN | 09/30/2009).
5. Task: Conduct plot experiments to screen for varieties that have longer storage times under local conditions for use as seed potatoes. Conduct plot experiments to produce minitubers for seeds (Mbata/FVSU & Thera & Traoré /IER & Adama//IPR/ISFRA OHVN | 09/30/2009)

6. Task: Conduct plot experiments to produce potato crops twice a year with rainy season planting (Mbata/FVSU & Thera, Gamby & Traoré/IER & Adama//IPR/ISFRA OHVN | 09/30/2009).

Activity 5.2: Biology and food preference of the potato tuber moth

Description
A Senegalese team observed that apart from potato, tomato and egg plants are infested by PTM. Small plot experiments are to be carried out to compare the food preferences of PTM on potato and alternate hosts. If the alternate hosts are wild and non economic crops could they serve as trap plants for PTM. This can be the case if the alternate hosts are preferred. However, if the alternate host is a crop, losses arising from mixed cultivation or crop rotation with potato will be assessed. Other experiments will involve investigating the details of the life history of the moth and how they affect different phenological stages of the potato plant. We have to determine the stage of the plant the moth commences infestation of the crop, and the stage of development at which moth tubers are attacked. The Senegalese team is carrying out further experimentation to understand the biology of the PTM and the food preferences of moth. We will also investigating if early harvest will mitigate losses. A protocol has been developed with the Senegalese team that can be used in other countries for the study of the potato tuber moth. Understanding the basic biology of the potato tuberworm will enhance development of pest management strategies for its control.

Expected Outputs
Understanding the basic biology of the potato tuberworm will enhance development of pest management strategies for its control.

1. Task: Conduct small plot experiments to determine preferences and alternate host of the potato tuber moth. (Mbata/FVSU & Mbaye/ISRA OHVN | 09/30/2009).
2. Task: Evaluate the time of and magnitude of potato tuberworm infestation during production and storage (Mbata/FVSU & Mbaye/ISRA OHVN | 09/30/2009).

Activity 5.3: Compare traditional potato storage structures in Mali (Sikasso) and Burkina Faso with improved ventilated structures provided by the USAID in Sikasso or Bamako

Determining the storage structures that will enhance the shelf-life of harvested potatoes will encourage more farmers to cultivate potatoes. High temperatures result in about 50% of harvested potatoes to rot in storage.

Expected Outputs
Determining the storage structures that will enhance the shelf-life of harvested potatoes will encourage more farmers to cultivate potatoes. High temperatures result in about 50% of harvested potatoes to rot in storage.

1. Task: Conduct experiments to compare the shelf-life of harvested in traditional mud structures in use in Mali, Traditional irrigated underground hermetic storage in use in Burkina Faso and improved USAID ventilated structures currently in use in Mali (Mbata/FVSU & Thera & Sanogo/IER OHVN | 09/30/2009).
2. Task: Compare the 18 varieties in 5 different conditions of storage as follows: local refrigerant technique, evaporative cooling system, local adapted, storage, refrigerator, cooling system at 5^{o}C (Mbata/FVSU & Thera & Sanogo/IER OHVN | 09/30/2009).

Activity 5.4: Compare the yield, tolerance to pests and resistance to diseases of 4 improved potato seed varieties with an indigenous variety

Expected Outputs
Potato varieties tolerant to insect infestation and diseases will be determined.

Task: Previous year's study showed that microtubers of imported potato varieties produced potato seeds that were highly tolerant to diseases and sustained low insect infestation. The potato seeds from these microtubers will be distributed to farmers in the Fouta Djalon who will plant them in their farms. The performance of these varieties will be compared for pest tolerance and disease resistance (Mbata/ FVSU & Kamano/IRAG OHVN | 09/30/2009)

Activity 5.5: Compare yield, rot of whole imported potato seeds with those cut into pieces

Expected Outputs
Whole potato seeds rot in the ground because of their large sizes. Cutting the potato seeds into small pieces will reduce underground rotting

Task: Imported potato seeds cut into pieces and whole potato seeds will be planted in the same plots but in different rows. Sprouting and yield will be compared for the different treatments (Mbata/FVSU & Thiera/IER OHVN | 09/30/2009).

Objective 6: Quality Assurance: Pesticide Safety Education

Activity 6.1: Develop additional pesticide safety education program support materials adapted for use in West Africa, based on needs identified at the regional workshop (May-June 2007) and cooperator input.

Expected Outputs
Upon completion of this activity, additional pesticide training materials will be produced and made available to pesticide safety trainers in West Africa.

1. Task: Produce at least one additional lesson plan (English/French) w/ demonstrations and activities on the subject of protection of the environment (ex. protecting water quality, pesticide container cleaning and disposal). (Hipkins/VA Tech with Sidibé/OHVN; Gamby, Traoré, & Camara/IER; and possibly other West African pesticide safety educators | 09/30/09)
2. Task: If funds and time permit, develop draft text and illustrations for one or two new booklets (for farmers in Bamanan) and poster books with corresponding content (for trainers, in French and Bamanan): 1). The Pesticide Label (hazard color-codes, meanings of pictograms; also, a list of the information provided on a typical label); and 2) Backpack and Hand Sprayer Calibration. (Hipkins/VA Tech with Sidibé/OHVN; Gamby, Traoré & Keïta/IER; and possibly other West African pesticide safety educators | 09/30/09)
3. Task: Include pesticide safety lessons and information in a mango IPM book. (Hipkins/VA Tech & Gamby & Traoré/IER; Sidibé/OHVN | 09/30/09)
4. Task: If funds and time permit, translate posters acquired in Senegal (produced by PAN and FAO/ANCAR-FLEX-PPEA) into Bamanan; print and distribute copies. (Hipkins/VA Tech & Gamby & Traoré/IER; Sidibé/OHVN | 09/30/09)

Activity 6.2: Continue and expand pesticide safety education programs in Mali.

Expected Outputs

Upon completion of this activity, the network of Malian-based pesticide safety educators will be strengthened and expanded, and more Malian farmers will receive pesticide safety training.

1. Task: Hold comprehensive "train the trainer" sessions for new IER and OHVN employees. Invite Malian trainers working outside the horticultural production zone near Bamako, Mali. Use lesson plans 1-13 and the booklets/poster books developed and printed to date: basic safety, IPM tactics, using the pesticide label. (Hipkins/VA Tech & Gamby/IER, Sidibé/OHVN & others | 09/30/09).
2. Task: Hold "train the trainer" sessions to demonstrate new materials (developed in 2007-08) for experienced/practicing IER and OHVN technicians and scientists. (Hipkins/VA Tech & Gamby/IER, Sidibé/OHVN & others | 09/30/09).
3. Task: Conduct additional continuing education programs (Lessons 9-13: first aid and emergency response, proper selection and use of application equipment, calibration, using the pesticide product label, pesticide storage, pre-application preparations) for farmers who have already received basic pesticide safety training. (Hipkins/ VA Tech & Gamby, Traoré, & Keïta/IER; Sidibé/OHVN; & others | 09/30/09).
4. Task: Conduct pesticide safety training sessions, using all materials developed to date, in additional sites in Mali, such as: 1) 10 villages of OPIB (L'Office du Périmètre Irrigué de Baguineda), and 2) farmers in the regions of Sikasso, Segou, and Mopti, in collaboration with IER/CRU (Regional Committee of Users). Offer training for additional villages/sites within and outside of the OHVN zone. Collaborate with PCDA (Programme de Compétivité et Development Agricole) on pesticide safety training in the main area of mangoes production. (Hipkins/ VA Tech & Gamby, Traoré, & Keïta/IER; Sidibé/OHVN; & others | 09/30/09).

Activity 6.3: Provide technical assistance to pesticide safety educators in West Africa

Expected Outputs

Upon completion of this activity, additional West African pesticide safety educators will have materials and technical information for their use (along with training re: effective program delivery methods), and pesticide safety educators working in West Africa will communicate and "network". As a result, more West African farmers will receive pesticide safety training.

1. Task: Respond to questions from pesticide safety educators in West Africa. (Hipkins/VA Tech, in cooperation with Gamby & Traoré/IER & Sidibé/OHVN | 09/30/09).
2. Task: Post lesson additional lesson plans and poster books on project website. (Hipkins/VA Tech, in cooperation with project webmasters | 09/30/09).
3. Task: Via e-mail, continue to contact the participants of the 2007 workshop and other cooperators/interested parties, informing them of the availability of new materials and other news. Encourage communication between interested parties. (Hipkins/VA Tech, in cooperation with Gamby/IER, Sidibé/OHVN, and other pesticide safety educators in West Africa | 09/30/09).
4. Task: West African pesticide safety educators from Sénégal (DPV, ISRA, ANCAR) and (if possible) Guinea visit Mali to observe both IER and OHVN "train-the-trainer" sessions and farmer training programs, using materials (lessons, poster books, booklets, etc.) developed by the Mali-VT team. (Hipkins/Virginia Tech, in cooperation with Gamby, Traoré, and Keïta/IER, Sidibé/OHVN, and other pesticide safety educators in West Africa| 09/30/09).
5. Task: Train Peace Corp volunteers and staff members and other NGOs. (Hipkins/Va Tech & Traoré & Keïta/IER | 09/30/09).

Objective 7: Quality Assurance: Pesticide Residue Training

Activity 7.1: Conduct a method validation using the Quechers method for pesticide residue analysis of fruits and vegetables with laboratories preparing for accreditation to ISO 17025

Expected Outputs
Method validation of the Quechers method, following hands-on training at the 2007 Quechers workshop in Bamako, and at the 2008 Quechers work session in Dakar, will allow laboratories to fully implement Quechers for routine testing of specific commodity/pesticide groups.

1. Task: Develop protocol for study (Cobb VA Tech | 12/1/2008).
2. Task: Coordinate meeting of chemists to review and amend protocol (Cobb/VA Tech | 2/01/2009).
3. Task: Distribute protocol and timeline for conduct of study (Cobb/VA Tech | 02/27/2009).
4. Task: Interpret data from participating laboratories (Cobb/VA Tech | 07/01/2009).
5. Task: Prepare report (Cobb/VA Tech | 08/01/2009).

Activity 7.2: Enhance West Africa Pesticide Programs web site as a networking tool for pesticide chemists and safety educators (http://wapp.biochem.vt.edu)

Expected Outputs
The web site provides a central location to for chemists to access information and continues to showcase the activities of pesticide residue chemists to various stakeholders.

1. Task: Improve functionality of web site (Cobb/VA Tech | 12/30/2008).
2. Task: Expand web site to include additional content of interest to chemists and educators in West Africa (Cobb/VA Tech | 12/30/2008).

Regional IPM Research and Education for South Asia

Ed Rajotte, Department of Entomology, Penn State University, and
George Norton, Department of Agricultural and Applied Economics, Virginia Tech.

Objective 1: Establish a regional network

Description
Expansion of the successful IPM CRSP collaborative model in South Asia by continuing the collaboration with Bangladesh, Nepalese and Indian institutions, including scientists from IARCs, NARS and NGOs. Particular attention will be devoted to vegetable and fruit systems. 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. The network will facilitate development of IPM systems, communication, education, and technology transfer within and across countries.

Expected Impacts
(1) 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 projects, (2) Development of an IPM Center of Excellence in Bangladesh that delivers IPM programming information to the region. Expected outputs for the year, (3) Regional meeting and on-site discussions will provide guidance for the research and technology transfer activities to be conducted on a regional basis in Year 4 of the project.

Activity 1.1: Regional meeting
In Yr 4, we plan to conduct a regional meeting of key PIs from each country site and key host country collaborators to share research results and technology transfer ideas.

Activity 1.2: Maintain regional network of IPM expertise
Networking.

Activity 1.3: Seek USAID Mission support
Be responsive to needs of USDAID missions where possible in seeking support to enhance the project.

Objective 2: Promote Regional and International Communication

Description
A web site 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.

Expected Impact
Promotion of communication regionally among country sites and internationally among IPM CRSP Regional Centers and Global Themes, thus promoting the solving of pest problems on a global basis.

Activity 2.1: Promotion of communication regionally

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

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 Outputs

Maintain linkages resulting in jointly conducted activities.

Activity 3.1: Collaborate with the lead PI of the Tospovirus global theme

Collaboration between South Asia regional site and Tospovirus global theme.

Task: TNAU will record tospovirus spread in vegetables through insect vectors (| 09/30/2009)

Objective 4: Develop baseline information

Description

The participatory approach is evident in all phases of the 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 began this process in the planning exercises in Bangladesh, India, and Nepal. Mini-participatory appraisals, a baseline survey, and a pest and beneficial insect survey were conducted. 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 addressed 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 allowed 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.

Activity 4.1: Pest and beneficial insect survey

- Surveys for assessing pest status of mite spp. and develop IPM package for their control
- Survey and identification of major weed species in summer tomato crop in different agro-ecological zones

1. Task: Surveys for assessing pest status of mite spp. in Bangladesh (S.N. Alam, BARI | 09/30/2009)
2. Task: Survey & identification of major weed species in summer tomato crop in different agro-ecological zones in Bangladesh (M. Azizur Rahman | 09/30/2009)

Objective 5: IPM Technology development

Expected Impact
Development of technologies that effectively manage vegetable pests and diseases, preserve natural enemy populations, and conserve biodiversity.

Activity 5.1: Test soil amendments for control of soil borne diseases and nematodes
- Farmers' field trial of *Trichoderma harzianum*
- Study of nematode trophic groups in IPM & non-IPM systems

1. Task: Farmers' field trial of *Trichoderma harzianum* (M. A. Rahman | 09/30/2009)
2. Task: Study of nematode trophic groups in IPM & non-IPM systems (M. A. Rahman | 09/30/2009)

Activity 5.2: Weed management for control of alternate hosts of insect transmitted viruses and other pests
Continuing activity--Study of weeds as alternate hosts of insect pests, diseases and natural enemies in vegetable eco-system (Landscape Ecology)

Task: Study of weeds as alternate hosts of insect pests, diseases and natural enemies in vegetable eco-system (Landscape Ecology) in Bangladesh (M. Azizur Rahman | 09/30/2009)

Activity 5.3: Develop mass rearing techniques for predators and parasitoids
Bangladesh-Ongoing

Task: Development of mass-rearing techniques for predators & parasitoids, and their efficacy evaluation in greenhouse & field (S.N. Alam, BARI | 09/30/2009)

Activity 5.4: Disease management in cucumber using biocontrol

Task: Test biocontrol agents and plant extracts on cucumber to control disease (M. A. Rahman, BARI | 09/30/2009)

Activity 5.5: New cultivation system for summer tomatoes

Task: Integrated management of diseases in summer tomato grown under poly tunnel (M. A. Rahman, BARI | 09/30/2009)

Activity 5.6: IPM packages development for vegetable pests
- Development of IPM package for controlling insect pests of country bean, cabbage & tomato
- Development of IPM package for fruit fly and borer pest complex of cucurbit crops

1. Task: Development of IPM package for controlling insect pests of country bean, cabbage & tomato (S.N. Alam, BARI | 09/30/2009)
2. Task: Development of IPM package for fruit fly and borer pest complex of cucurbit crops (S.N. Alam, BARI | 09/30/2009)

Activity 5.7: IPM package development after mite survey
- IPM package for mites

Task: Develop IPM package for mite control (S.N. Alam, BARI | 09/30/2009)

Activity 5.8: Develop insect and disease resistant vegetable varieties

- Evaluation of eggplant and tomato germplasm for resistance to FSB, Jassid, BW, virus disease and RKN
- Evaluation of cucumber germplasm for Fusarium wilt resistance (at seedling stage in sick-beds): Development of pumpkin variety resistant to PRSV &WMV2 virus diseases
- Development of virus-resistant cucumber varieties
- Evaluation of okra germplasm to develop variety resistant to yellow vein mosaic virus (YVMV)
- Development of country bean (*Dolicos lablab*) varieties resistant to bean pod borer & virus diseases

1. Task: Evaluation of eggplant & tomato germplasm for resistance to FSB, Jassid, BW, virus disease and RKN (Dr. Shahabuddin Ahmad | 09/30/2009)
2. Task: Evaluation of cucumber germplasm for Fusarium wilt resistance (at seedling stage in sick-beds (Dr. Shahabuddin Ahmad | 09/30/2009)
3. Task: Development of pumpkin variety resistant to PRSV &WMV2 virus diseases (M. A. Rashid | 09/30/2009)
4. Task: Development of virus-resistant cucumber varieties (M. A. Rashid | 09/30/2009)
5. Task: Evaluation of okra germplasm to develop variety resistant to yellow vein mosaic virus (YVMV (M. A. Rashid | 09/30/2009)
6. Task: Development of country bean (*Dolicos lablab*) varieties resistant to bean pod borer & virus diseases (M. A. Rashid | 09/30/2009)

Activity 5.9: Nepal IPM components

- Grafting. Conduct adaptive research building on the IPM CRSP Bangladesh work in grafting. The research will focus on identification of suitable root stocks and suitable varieties and include quantification of yield and returns and set the stage for field level promotion of the technology
- Pheromone and bio pesticide assessment. Conduct adaptive research for efficacy of pheromones and bio pesticides to develop packages of practices around their use for specific vegetable crops.
- Coffee Stem Borer. Conduct adaptive research on control of stem borer. Develop materials/approaches to introducing best practices to control stem borer. Healthy seedlings, adequate shade, and improved fertility.
- Tea. Work to develop and synthesize tea pest/disease control packages to help enable organic production in tea. (there are major market opportunities for organic tea)
- IPM strategies. Work to integrate strategies to promote IPM including the integration of supply chain strategies that make available IPM products with training programs such as farmer field schools.
- Coordination. Work to coordinate efforts to promote IPM, including efforts to take advantage of realistic market opportunities in country.

1. Task: Conduct adaptive research building on the IPM CRSP Bangladesh work in grafting. The research will focus on identification of suitable root stocks and suitable varieties and include quantification of yield and returns and set the stage for field level promotion of the technology (B.K. Gewali | 09/30/2009)
2. Task: Conduct adaptive research for efficacy of pheromones and bio pesticides to develop packages of practices around their use for specific vegetable crops. (B.K. Gewali | 09/30/2009)
3. Task: Develop materials/approaches to introducing best practices to control stem borer in coffee. Healthy seedlings, adequate shade, and improved fertility. (B.K. Gewali, Winrock | 09/30/2009)
4. Task: Work to develop and synthesize tea pest/disease control packages to help enable organic production in tea (B.K. Gewali, Winrock | 09/30/2009)
5. Task: Work to integrate strategies to promote IPM including the integration of supply chain strategies that make available IPM products with training programs such as farmer field schools (B.K. Gewali, Winrock | 09/30/2009)

Objective 6: Training, education, and institutional capacity building

Description
Short term scientist training and graduate training (at Virginia Tech, Ohio State, and Bangladesh institutions)

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

Participating Scientists and Institutions
US PIs and host country collaborators

Expected Outputs
One MS student completed at Virginia Tech. Several scientists receive short term training in each of the three S.A. countries

Activity 6.1: Train graduate students from participating countries at U.S. and Indian universities

Thesis research for PhD student from Bangladesh completed in India at TNAU

Task: Ph.D. research training of Bangladesh student at TNAU in India (09/30/2009)

Activity 6.2: Short term training

1. Task: Short term training for four host country participants at International IPM symposium in Portland (04/01/2009)
2. Task: Short term training of Bangladesh scientists in Nepal and India (09/30/2009)
3. Task: Short term training of one Bangladesh scientist in U.S. (09/30/2009)

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 in each country and take into consideration the 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, Practical Action, Winrock, public extension systems, TERI). These organizations use diverse methods from simple messages to intensive farmer field schools. Specific IPM tactics can be matched to different types of methods.

In Bangladesh we will work with CARE International, Practical Action, and the Mennonite Central Committee. These NGOs reach tens of thousands of farmers with training programs. Our objective is to train the trainers using research outputs from IPM CRSP. Winrock International has ongoing programs in Bangladesh and Nepal. We collaborate with Winrock to merge the processes and techniques of IPM CRSP with their projects. This gives IPM CRSP entry into Nepal and connection to their IPM training network there. Winrock International has concentrated on developing the value chain for IPM 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. In India we will continue to network with TERI, AVRDC, and TNAU 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 Impacts
Development of farmer acceptable technology that effectively manages vegetable pests and maintains natural enemy populations and conserves biodiversity.

Expected Outputs
In Bangaldesh: Thousands of farmers will be reached through IPM training by NGOs mentioned above. In India: Organize farmers meeting on tomato in UP and other crops in the Southern India. Organize field day during second season demo of okra, brinjal, and tomato. Training of farmers on IPM in general. Validation of IPM packages on okra, brinjal and tomato in UP, AP, and Karnataka Demonstration of IPM packages on Cucurbits in UP

Activity 7.1: Identification of relevant technology available in India, Bangladesh, Nepal, and elsewhere and transferring them to farmers through NGOs, government extension agencies and private sector

In India working through our partner TERI, IPM packages for vegetables like okra, Tomato, Eggplant and Cucurbits that were demonstrated last year will be validated and extended in three regions. Knowledge will be provided about Bt, NPV, Beauveria, Trichogramma cards and natural enemies of arthropods in group meetings and field days for showing differences between IPM and current practices. In Bangladesh BARI supplies the technologies and training to local NGOs who do the extending with their own budgets. The technologies are also extended to the private sector which extends the technologies as a business. Finally, the Department of Extension uses Government resources to extend the IPM practices. In Nepal, Winrock, the Government extension service, and private groups are extending the IPM practices.

Expected Output
Thousands of farmers trained

1. Task: In India working through our partner TERI, IPM packages for vegetables like okra, Tomato, Eggplant and Cucurbits that were demonstrated last year will be validated and extended in three villages (N. Kaushik | 09/30/2009).
2. Task: In Bangladesh BARI supplies the technologies and training to local NGOs such as CARE, Practical Action, and the Mennonite Central Committee who do the extending with their own budgets. The technologies were also extended to the private sector and then extend the technologies as a business. Finally, the Department of Extension uses Government resources to extend the IPM practices. (R. Karim | 09/30/2009).
3. Task: In Nepal, Winrock, the Government extension service, and private groups are extending the IPM practices (B. Gyawali | 09/30/2009).
4. Task: In India, working through TNAU, farmer meetings and demonstrations will be conducted for eggplant and okra IPM practices on cultural methods, botanicals and biopesticides (N. Kaushik | 09/30/2009).

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, information, and systems developed for managing key pests on target crops in the region. Indicators of impact: (a) Profitable IPM 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 Impacts
(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 Impacts
Promotion of the IPM CRSP S Asia Regional Center within host countries and internationally D. Participating scientists: US PIs and host country collaborators E. Expected outputs for the year Annual review and planning meeting conducted, annual report produced, and preparation of plans for impact assessment study.

Activity 8.1: Annual regional review and planning meeting
Annual adjustments in research and technology transfer plans

> Task: Hold annual planning and review meetings in each country site (E.G. Rajotte, Penn State | 06/01/2009)

Activity 8.2: Annual report submission

Task: Prepare and submit annual report (E.G. Rajotte, Penn State | 10/15/2009)

Activity 8.3: Impact assessment in South Asia
Summary report of key impacts of IPM CRSP in South Asia

Task: Impact assessment of IPM-CRSP technologies in Bangladesh (A. Hossain | 09/30/2009)

Ecologically-Based Participatory IPM for Southeast Asia

Michael Hammig, Clemson University

1) West Java, Indonesia

(Led by Bogor Agricultural University, Bogor)

Objective 1: West Java: Farmer Level Production of Biotic Agents

Description

Two "Pos Pelayanan Agens Hayati (Posyanti)" / Biotic Agents Service Post have been established in 2008. We will improve the capability of the posts in mass-production of bokashi, SeNPV, *Trichoderma harzianum*, *Bacillus subtilis*, *Pseudomonas flourescence*, and *Beauveria bassiana.* In addition, at least three new Posyantis will be established.

Expected Outputs

Bokashi, SeNPV, *Trichoderma harzianum*, *Bacillus subtilis*, *Pseudomonas flourescence*, *Beauveria bassiana* will be available for IPM field trials.

1. Task: Maintain pure culture of biotic agents for distributing to farmer collaborators. (Meity Sinaga, Asih Nawangsih, Ruly Anwar, Yayi Kusuma).
2. Task: Provide new Posyantis with facilities and equipments for propagating biotic agents. (Aunu Rauf).
3. Task: Train farmer collaborators in mass-propagation of various biocontrol agents. (Meity Sinaga, Asih Nawangsih, Ruly Anwar).

Objective 2: West Java: IPM for broccoli in West Java, Indonesia

Description

Trichoderma mixed with bokashi and dipping of seedling in *Bacillus subtilis* and *Pseudomonas fluorescence* will be tested against club root on broccoli, while hand-picking and botanical insecticide will be used to control lepidopteran pests.

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.

1. Task: Information obtained on the practical use of bokashi and various biocontrol agents for management of club-root in broccoli. (Meity Sinaga, Asih Nawangsih).
2. Task: Spot-spraying with botanical pesticide and hand-picking egg masses and larval clusters of lepidopteran pests, such as *Crocidolomia*, assessed in broccoli. (Pudjianto).
3. Task: Materials from activities above incorporated into farmer field school training materials and used in FFS. (Idham S. Harahap).

Objective 3: West Java: IPM for green onion in West Java, Indonesia

Description

Field trials on green onion will test an IPM package consisting of: (1) use of SeNPV virus to control *Spodoptera exigua*, (2) application of botanical insecticide to control black aphid *Neotoxoptera*

formosana, (3) use of sticky yellow traps to control leafminer infestations, and (4) use of bokashi, *Trichoderma*, *Bacillus subtilis*, and *Pseudomonas flourescens* to induce plant resistance to diseases.

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

1. Task: Information obtained on the practical use of bokashi and various biocontrol agents for management diseases in green onion. (Meity Sinaga, Asih Nawangsih)
2. Task: Spot-spraying with botanical pesticide againsts *Neotoxoptera formosana* assessed in green onion. (Wayan Winasa)
3. Task: Yellow sticky traps tested in the field to assess their efficacy in reducing populations of leaf miners in leaf onions. (Aunu Rauf)
4. Task: Information from above studies incorporated into training materials for use in farmer field schools. (Idham Harahap)

Objective 4: West Java: IPM for hot chili pepper in West Java, Indonesia

Description
Field trials on hot chili pepper will test the use of bokashi, *Trichoderma*, *Bacillus subtilis*, and *Pseudomonas flourescens* to induce plant resistance to diseases, especially to geminivirus. Several lines from AVRDC will also be tested.

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

1. Task: Information obtained on the practical use of bokashi and various biocontrol agents for management diseases in hot chili pepper. (Meity Sinaga, Asih Nawangsih).
2. Task: Evaluation of resistance of AVRDC lines to major diseases. (Supramana).
3. Task: Materials from activities above incorporated into farmer field school training materials and used in FFS. (Idham Harahap).

Objective 5: West Java: IPM for yard-long bean and cucumber in West Java, Indonesia

Description
A Participatory Appraisal (PA) will be held in Kecamatan Leuwisadeng, Bogor. Following the PA, a baseline survey will be completed, adding a more quantitative base for our understanding of technical factors affecting pest management in yard-long bean and cucumber..

Expected Outputs
Specific IPM problems will be identified and constraint to their solution discussed. Detailed IPM research plans will be initiated for yard-long bean and cucumber.

Task: Conduct participatory appraisal and baseline survey for yard-long bean and cucumber farmers. (Wayan Winasa).

Objective 6: West Java: IPM for banana in West Java, Indonesia

Description
Among major constraints of banana production in Cugenang-Cianjur are banana wilt and banana weevil. Several biocontrol agents (*Trichoderma harzianum*, *Bacillus subtilis*, *Pseudomonas flourescens*, and mycorhiza) will be tested against the banana wilt. Population of banana weevil (*Cosmopolites sordidus*) will be monitored using pheromone. *Beauveria bassiana* will be used to control the banana weevil.

Expected Outputs
The studies will provide the basis for a comprehensive IPM program for the control of insect pests and diseases on banana in the key banana growing area of Cianjur.

1. Task. Evaluation on the effectiveness of *Trichoderma harzianum* and mycorhyza to control banana wilt. (Meity Sinaga)
2. Task. Evaluation on the effectiveness of *Bacillus subtilis* and *Pseudomonas flourescens* to control banana wilt. (Asih Nawangsih)
3. Task. Use of pheromone to monitor population of banana weevil. (Idham Harahap)
4. Task. Evaluation of *Beauveria bassiana* to control banana weevil. (Ruly Anwar)

Objective 7: West Java: Study on A newly introduced pest (papaya mealybug)

Description
Papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) is native to Mexico. It was first reported as a pest of papaya in St. Martin Island in the Caribbean in1995 and by 2000 it has spread to 13 countries in the Caribbean, Florida in the U.S. and three countries each in Central and South America. In early 2002, it was observed in the island of Guam in the Pacific and subsequently in Palau in 2003 and in Hawaii in 2005. IPM CRSP team consisting of Robert Hedlund, R. Muniappan, Mike Hammig, Merle Shepard, Gerry Carner and Aunu Rauf who visited Bogor Botanical Gardens on May 29, 2008 found mealybug infesting a papaya tree. This is the first report of occurrence of papaya mealybug in Indonesia and in Southeast Asia. Since it is a newly introduced pest, no study has been conducted in Indonesia.

Expected Outputs
Information on spread, host plants, natural enemies, and economic impact of papaya mealybug in Indonesia.

1. Task. Gathering information on the spread of papaya mealybug in Indonesia via communication with Pest Observers. (Aunu Rauf)
2. Task. Field surveys to collect data on plants infested by papaya mealybug. (Aunu Rauf)
3. Task. Collection and identification of natural enemies associated with papaya mealybug. (Aunu Rauf, Ruly Anwar)
4. Task. Preliminary study on the economic impact of papaya mealybug. (Ali Nurmansyah)

Objective 8: West Java: Survey of pests and their natural enemies and plant diseases in selected fruit crops

Description
Insect pests, plant diseases, and insect natural enemies will be surveyed regularly in banana, mangosten, papaya, and guava. Samples of plant diseases will be brought to the laboratory for isolation and identification. Insect pests and predators will be observed directly in the field. Parasitism rates will be determined by collection of eggs, larvae and pupae and reared in the laboratory.

Expected Outputs
Inventory of pests and diseases affecting banana, mangosten, papaya, and guava. Improve understanding of the role of natural enemies in pest management.

1. Task: Collection and identification of plant diseases affecting banana, mangosten, papaya, and guava. (Meity Sinaga, Asih Nawangsih)
2. Task: Collection and identification of plant insect pests associated with banana, mangosten, papaya, and guava. (Aunu Rauf, Idham Harahap, Dewi Sartiami)
3. Task: Collection and identification of insect natural enemies present banana, mangosten, papaya, and guava ecosystems. (Pudjianto, Nina Maryana)

2) North Sulawesi

(Led by Sam Ratulangi University, Manado)

Objective 1: North Sulawesi: Training and Field School for Farmers and Extension officers (PPL) in Langowan, District of Minahasa.

Description
Training and Field School for farmers and Extension officers (PPL) in Langowan, District of Minahasa. The training will include mass rearing of local strain Trichoderma and local strain of Metarhizium for the development of Organic Crops. It is based on request by local authorities and farmers from Langowan (4 sub-districts)

Objective 2: North Sulawesi: Survey on "The Role of Minahasan Women in Agriculture Development Technology".

Description
Minahasan women are known to be more energetic and open. Often there are clear distinctions on the responsibilities of women and men in the field.

Objective 3: North Sulawesi: State of Predation of Mirid, *Nisiodiocoris tenuis* on vegetable crops (continuation).

Description
Research to investigate the state of predation of mirid on vegetable crops will be continued. Most farmers still consider this mired bug as pest of vegetable crops. Some literatures indicated that there are predators and not pests.

Objective 4: North Sulawesi: Implementation of local strain Metarhizium to control lepidopteran pest on vegetable crops.

Description
A local strain of Metarhizium has been tested in the field and proved to be an effective fungus to control *Crocidolomia binotalis* and *Plutella xylostella* on cabbage. This strain will be used in the field as biological agent to control lepidopteron pests on vegetable crops.

Objective 5: North Sulawesi: Isolation, identification and the role of local strain pathogenic microorganisms from infected insect pests (continuation).

Description
Survey in 2007/2008 indicated that there are a lot of insect pests infected by pathogenic microorganisms (fungi, bacteria and virus). It is important to study the role of these natural enemies in acting as natural control of insect pests on crops.

Objective 6: North Sulawesi: Pathogenicity tests of selected microorganisms isolated from infected insect pests (continuation).

Objective 7: North Sulawesi: Demonstration plot for the use of local strain of Trichoderma and Metarhizium

3) North and West Sumatra, Indonesia
(Led by FIELD, Indonesia)

North Sumatra

Description
North Sumatra has been implemented in integrated manner with the USAID/Jakarta Mission's Environmental Services Program (ESP) in the province, especially in Lau Biang sub-watershed and Lembah Sibayak area of Lau Petani sub-watershed of Karo district. Through Farmer Field School on Sustainable Livelihoods Analysis ESP has facilitated local community in learning, planning and organizing actions for environmental conservation and livelihoods development, while the IPM CRSP provides technical basis on ecological agriculture management for them through FFS on Vegetable in Lembah Sibayak and Farmer Study on Citrus in Lau Biang.
Up to this year, ESP has facilitated the community groups in the area to establish farmer networks for organizing wider actions. 2 Farmer networks have been established: "Ersinalsal Lembah Sibayak" in Lembah Sibayak, covering 2 villages: Doulu and Semangat Gunung, and "Arih Ersada" in Lau Biang, covering 6 villages: Serdang, Penampen, Sari Manis, Tanjung Barus, Tangkidik, and Siberteng-Kabung. Both communities/farmer networks determine Ecological Agriculture development as one of their main programs.

For supporting the movement of those farmer networks, IPM CRSP program in the year 2008-2009 will continue to focus on Farmer to Farmer Field Schools/Field Studies and related activities which will be organized by Ersinalsal Lembah Sibayak and Arih Ersada. For preparing farmer trainers in both sites, a TOT (Training of Trainer) has been conducted together by ESP and FIELD on 21-27 April 2008 in Lembah Sibayak. The TOT was joined by 26 farmers (FFS alumni) from Lau Biang and Lembah Sibayak, facilitated by senior facilitator from FIELD (Mr. Simon HT) and ESP Team (Cahyana, Syafrizaldi, Melani Miranda, Jon Betrit and Fajar Suryono).

Since other FFS on Cacao has been running in 7 villages in other sub-watershed (Lau Petani) in Sibolangit area of Deli Serdang District, and new community network is on its way to establish, a small support for this area is also included into the plan.

The planned programs for year 2008-2009 are:

Objective 1: North Sumatra: Farmer to Farmer FFS / Field Study on Vegetable in Lembah Sibayak

Description
1 Unit of FFS / Field Study on Vegetable will be conducted in Doulu village of Lembah Sibayak. This will be facilitated by Farmer Trainer of Ersinalsal Lembah Sibayak. The activity will combine small field studies on tomato (related to management of nutrition, pest and disease issues) with regular meeting of FFS. This will be joined by some previous FFS alumni and new farmers in the village.

Objective 2: North Sumatra: Farmer to Farmer FFS / Field Study on Citrus in Lau Biang

Description
The FFS will be conducted in 3-4 villages in Lau Biang, facilitated by Farmer Trainer of Arih Ersada, to be joined by new farmers in those villages. Topics to learn will be related to management of plantation health (soil and nutrition, branch and leaves density, pest – diseases and natural enemies, sanitation etc) related to falling fruit reduction. Learning process will be conducted through comparison of treated and untreated plants that will be observed and analyzed in the regular meeting. In the same meeting each farmer group will also learn special topics that relevant with current situation.

Objective 3: North Sumatra: Farmer Trainer Workshop

Description
For evaluating the FFS / Field Study progress while also building capacity of farmer trainers, series of workshop for farmer trainers will be conducted during the FFS season. This workshop will be conducted for Citrus Farmer Trainer in Lau Biang and Vegetable Farmer Trainers in Lembah Sibayak.

Objective 4: North Sumatra: Farmer Communication Media development

Description
Since networking needs a good communication, a farmer communication media is needed to support Arih Ersada and Ersinalsal to build communication with other community members in Lau Biang and Lembah Sibayak. For this purpose, a small support will be provided by this program for them to initiate development of farmer media. The support will be consisted of training and small fund for starting action. The form of the media will be determined by farmer networks after the training.

Objective 5: North Sumatra: Farmer Study on Cacao in Lau Petani

Description
A small support will be provided for cacao farmer groups for conducting simple field studies as follow up activities of their Cacao agroforestry FFS, in collaboration with ESP Field Staff.
Note: Team of FIELD-ESP will explore possibilities to implement some technical inputs including protein baits, biodegradable plastic, and fruit piercing moth observation, etc. in FFS/Farmer studies.

West Sumatra

Objective 1: West Sumatra: To test impacts of China Berry seed extracts against insect pests, and to determine the most efficacious strains of the entomopathogenic fungus *Beauvaria bassiana* against sweet potato weevil.

Description
In the previous period, Plant Protection Center of Agriculture Service of West Sumatra province in collaboration with Field-ESP conducted laboratory studies as follows:

- 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.

Results

- China Berry can control thrips and *Empoasca* in chili, and it can control *Plutella xylostella* and *Crocidolomia binotalis* in cabbage with low dosage (100 ml/10 liter water).
- *Beauvaria bassiana* can control *Cylas formicarius.*

Objective 2: West Sumatra: For fiscal year 2008-2009, both studies will be tested at field level in collaboration with farmer groups and additional plans possibly prepared after conducting field visit to West Sumatra.

Description
Technical Support by FIELD team
For supporting the activities, regular field visits by FIELD team in collaboration with ESP staff will be conducted during the FFS / Field studies, Farmer Trainer Workshop and other training (such as media training).

4) Laguna, Philippines

(Led by University of the Philippines, Los Baños)

General Objectives: Develop, validate and disseminate component technologies that will reduce pests and pest infestations (insects, diseases, weeds) in eggplant and tomato.

Description

- Evaluate the effectiveness of grafting, host plant resistance, and soil additives (VAM) in reducing bacterial wilt infection and other soil-borne pathogens infesting tomato and eggplant
- Evaluate efficacy of preplant control methods (stale-seedbed technique) and post-emergence control methods (heribicides) for weed control in tomato and eggplant and determine weed population dynamics in a vegetable-vegetable cropping system.
- Evaluate the efficacy of cultural methods biological control agents (earwig, *Trichoderma*, *Trichogramma*, NPV against insect pests infesting tomato and Eggplant.
- Disseminate promising technologies identified from research results to vegetable farmers in Laguna and Batangas areas.

Objective 1: UPLB: Evaluation of ecologically-based alternative IPM technologies in eggplant and tomato in on-farm trials in Calauan, Laguna, Philippines

Activity Category:
Research and Technology Transfer

Participating Scientists and Institutions:
Candida B. Adalla, UP Los Banos (IPM)
Aurora M. Baltazar, UP Los Banos (Weed Science)
Nenita L. Opina, UP Los Banos (Varietal Development)
Jhoana L., Opena, UP Los Banos (Weed Science, IPM)
Gerry Carner, Michael Hammig, Merle Shepard, Clemson University

Description
Prior to the field tests, a pest assessment survey will be conducted in several farms in Calauan, Laguna to determine the major insects, diseases and weeds infesting vegetable farms in these areas. Crops will focus on eggplant and tomato. On-farm study will include evaluation of grafted and ungrafted seedlings to demonstrate the benefit of disease resistance provided by grafting and use of soil additives such as VAM (vesicular arbuscular mycorhizza). Alternative weed management practices (stale seedbed technique, selective postemergence application of herbicides with a shielded nozzle) will be included in the pest management program. Biological control agents such as earwig, *Trichogramma* will be evaluated for efficacy against insect pests.

Expected Outputs
Results from the field study to show yield advantages of IPM technologies over existing farmers' practices (ie grafted v/s ungrafted seedlings, stale-seedbed technique v/s weekly hand weeding, biological control agents v/s weekly spraying of insecticides). These practices aim to reduce costs of inputs without reducing control efficacy while maintaining or increasing crop yields thus increasing farmer profits.

Start/End Date
Start: November/December 2008; End: March 2009

Objective 2: UPLB: On-station research activities to develop and fine-tune IPM technologies against pests in eggplant, and tomato

Activity Category
Research

Participating Scientists and Institution
Candida B. Adalla, UP Los Banos (IPM)
Aurora M. Baltazar, UP Los Banos (Weed Science)
Nenita L. Opina, UP Los Banos (Varietal Development)
Joana L. Opena, UP Los Banos (Weed science, IPM)

Description
These studies will be conducted in small-plot trials at UPLB Central Experiment Station (Agripark) to screen promising technologies and/or evaluate specific problems in the field that may require understanding of control mechanisms which are essential to the development of improved control methods. Examples are understanding population dynamics of weeds under various management strategies (herbicides, stale seedbed technique), studies to validate sources of eggplant, tomato and pechay resistance to insect pests and diseases and to integrate resistance to other components of integrated pests management. Greenhouse or controlled environment studies will also be conducted to on some component studies needing controlled environment conditions.

Expected Outputs
Data to be obtained from these studies will allow a better understanding of the factors and mechanisms involved in pest-crop relationships and will facilitate technology transfer and utilization. Up scaled trial will also allow evaluation of the technology for better efficacy and cost effectiveness.

Start/End Date
Start: May 2009; End: September 2009

Objective 3: UPLB: Technology transfer through workshop-seminars and end-of the season field days and farmer demo plots

Activity Category
Technology Transfer

Participating Scientists and Institutions
Candida B. Adalla, UP Los Banos (IPM)
Aurora M. Baltazar, UP Los Banos (Weed Science)
Nenita L. Opina, UP Los Banos (Varietal Development)
Joana L. Opena, UP Los Banos (IPM, Weed Science)

Description
One-day training lectures and seminars will be coordinated with the Calauan, Laguna Department of Agriculture extension workers and will be attended by both the Department of Agriculture staff and farmers in the area. Farmers will have an opportunity to learn how to identify the pests infesting their vegetable crops and the control methods against these pests through lecture- demonstrations. End-of the season field days will also be held. Interested farmer participants will be provided with IPM technology materials (ie grafted seedlings) which they will grow in their farms with assistance from IPM CRSP staff on how to use these technologies.

Expected Outputs
- Reduced crop protection inputs and higher crop yields and net profits for farmer
- Increased awareness of pests infesting vegetable crops and ecological approaches to their control

5) Nueva Ecija and Nueva Vicaya, Philippines
(Led by PhilRice, Muñoz)

General Objectives
1. To enhance the capacities of extension workers and farmers that would result in the adoption of the recommended technologies, thus, increasing their productivity and profitability.
2. To search and identify effective predators of leafminers attacking vegetables and other crops.
3. To evaluate sex pheromone baited traps as a tool for effective timing of interventions against *H. armigera* in tomato.
4. To determine if light trap could be a substitute for sex pheromone traps in pest surveillance and monitoring of key lepidopteron pests of vegetables.
5. To identify and evaluate mix cropping practices on tomato as management option in controlling whiteflies infestation.
6. To determine the loss in yield of tomato due to whitefly infestation
7. Establish the relevance of gender to IPM.

Objective 1: PhilRice: Technology Transfer and Promotion of Pest Management Technologies in Rice- Vegetable Cropping System

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
H. R. Rapusas, G. Y. Ilar, R. G. Zagado (PhilRice), M. Hammig, B. M. Shepard (Clemson University), et al.

Description
The technology promotion will be done through training and extension. To continuously enhance the capacities of the LGUs extension workers on the latest vegetable IPM technologies, training of trainers will be conducted. These extension workers will then implement a FFS in their areas of coverage in tandem with expert of PhilRice. To enhance their learning, participatory technology demonstrations will be established. These will served as their learning field and as showcase of the latest technologies on vegetable IPM to neighboring communities. Technical briefings will also be conducted to inform farmers on these technologies. Interested farmers will then be trained on specialized training on vegetable IPM.
In support to the trainings which will be conducted, extension materials will be developed like Flip charts, posters, field guides, training manual, etc. Information campaigns will also be developed.

Expected Outputs
- Extension workers trained – 60
- Farmers trained (FFS) – 100
- Farmers and other stakeholders briefed – 500
- Farmers trained in specialized courses – 250
- Vegetable IPM technologies promoted – 5
- Extension materials developed – 5

Expected Impacts
Capacities of extension workers and farmers enhanced resulting in adoption of the technologies, thus, increasing their productivity and profitability.

Start/End Date
October 1. 2008 – September 30, 2009

Performance Indicators for Monitoring and Evaluation

Progress to Date
- IPM training for farmers and extension workers and other stakeholders done. Training on the use and mass production of VAM and *Trichoderma* sp. were also conducted.
- FFS and PTDs conducted.
- Training modules prepared

Milestone Tasks

ID	Description	Completion Date	Responsible Individual
Activity 1			
Task 1	TOTs	2009	HRRapusas, GYIlar
Task 2	Technical briefings	2009	HRRapusas, GYIlar
Task 3	Farmers training	2009	HRRapusas, GYIlar
Task 4	Update training manual	2009	HRRapusas, GYIlar RGSagado
Task 5	Preparations of extension materials	2009	HRRapusas, RGSagado, GYIlar
Task 6	Farmers' interview and impact evaluation	2009	HRRapusas, IPM CRSP staff
Task 7	Report writing	2009	HRRapusas, RGSagado, GYIlar

List of Co-PIs and Partner Institutions

Co-PI	Institution	E-mail Address
Herminia R. Rapusas	PhilRice	hrapusas@philrice,gov.ph
Glen Y. Olar	PhilRice	gyilar@philrice.gov.ph
Ronan G. Zagado	PhilRice	rgzagado@philrice.gov.ph

Objective 2: PhilRice: Management of leafminer in vegetables grown after rice with naturally occurring natural enemies.

Activity Category
Research

Participating Scientists and Institutions
GS Arida, BS Punzal (PhilRice) and BM Shepard, Clemson University

C. Description of the Study: Natural enemies of leafminers are considered key factor in its management. Results of studies indicated that insecticide application resulted to ever more problems due to destruction of naturally occurring natural enemies. Development of management strategies against leafminer should focused on the use on of naturally occurring biological control agents. Results of our survey on larval parasitism show high incidence in some locations sampled and in some vegetable crops in spite of the fact that most of the field sampled were sprayed with insecticides. Studies conducted in Thailand indicated that predatory flies had a big impact in reducing population of leaf miner adults. Several species of *Coenosia* flies were collected and identified. It is therefore important to search for alternative management strategies to effectively manage leaf miner in vegetables and other crops. The study has the following objectives:

- To search and identify effective predators of leafminers attacking vegetables and other crops.
- To develop simple rearing method (breeding chambers) of the predator for farmers.
- To develop and promote the use of non-chemical technologies for leafminers attacking vegetables and other crops.

Predatory flies will be collected from different vegetable growing areas in Central Luzon. Collected predators will be initially tested in the laboratory to confirm its predatory habit. Once predation is recorded, the specimens will be identified either through local taxonomists or authorities from aboard. The biology of the predator will also be studied in the laboratory.

A breading chamber will be developed. Studies will be conducted on its prey composition, consumption, preference etc. The population density and abundance will be studied in the field.

For the parasitoids of leaf miner, conservation by need-based and selected use of insecticide spray and the use of yellow sticky board traps for trapping of adult LM will be evaluated in several vegetable fields. The activity is planned for 2 years.

Expected Output
Key predators of LM identified, evaluated in the greenhouse and augmentation techniques developed. Non-chemical management strategies against LM in vegetables develop and evaluated.

Start/End Date
October 1, 2008-September 30, 2009

Performance Indicators for Monitoring and Evaluation

Progress to Date
Initial collection of larval samples from string beans, tomato and onion were made from different sides. A total of 496 w*ere reared in the laboratory to evaluate degree of parasitism. Larval parasitism ranged from* 18-26%. *Neochrysochalis formosa* (Westwood) and *N. okasaki* Kamijo were the most abundant species of parasitoids that emerged from the field-collected

Milestone Task

ID	Description	Completion date	Responsible individual
Activity 2			
Task 1	Survey and collection of predators	09/2009	GS Arida/BS Punzal
Task 2	Laboratory and greenhouse studies to confirm predation	09/2009	GS Arida/BS Punzal
Task 3	Development of breeding chamber for predators for in the field	09/2009	GS Arida/BS Punzal
Task 4	Study on population density and abundance in the field	09/2010	GS Arida/BS Punzal
Task 5	Evaluate yellow sticky board trap on string beans and other vegetables	09/2010	GS Arida/BS Punzal

List of Co-PIs and Partner Institutions

Co-PI	**Institution**	**E-mail address**
GS Arida	Philippine Rice Research Institute (PhilRice)	gsarida@philrice.gov.ph
BS Punzal	PhilRice	bs_punzal@yahoo.com
BM Shepard	Clemson University	mshprd@clemson.edu

Objective 3: PhilRice: Evaluation of Sex pheromone baited-traps as a tool for effective timing of interventions against *H. armigera* in tomato.

Activity Category
Research

Participating Scientists and Institutions
GS Arida, BS Punzal (PhilRice) and BM Shepard Clemson University

Description
Tomato 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.
The study aims to evaluate sex pheromone baited traps as a tool for effective timing of interventions against *H. armigera* in tomato.
Sex pheromone traps will be installed immediately after transplanting. Trap catches will be monitored every 3 days and application of interventions will be done at different days after reaching a peak in sex pheromone trap catches.

Treatments are as follows: 1) Weekly spray of insecticide, 2) Spray insecticide 3 days after peak in trap catches, 3) Spray insecticide 5 days after peak in trap catches, 4) Spray insecticide 7 days after peak in trap catches and 5) Untreated control. The number and weight of healthy and damaged fruits will be recorded every harvesting. Total yield will also be recorded for each treatment.
Hypothesis: Sex pheromone traps can predict the arrival of *H. armigera* adults in the field and could be used a monitoring tool for effective timing of interventions.

Expected Output
Effective timing of intervention against *Helicoverpa armigera* in tomato evaluated and determined.

Start/End Date
October 1, 2008-September 30, 2009

Performance Indicators for Monitoring and Evaluation

Progress to Date:
Catches of male *H. ar*migera moths in the sex pheromone traps showed a single peak during the crop period. Initial analysis of the data showed high population of eggs recorded before, during and after the peak of trap catches indicating the possibility that trap catches could be used as a monitoring and surveillance tool for timing of interventions against *H. armigera*. The relationship between sex pheromone trap catches and damaged fruits and number of larvae is still being analyzed.

Milestone Tasks

ID	Description	Completion date	Responsible individual
Activity 1A			
Task 1	Preparation of field supplies (seeds, fert, traps, seed box, etc	09/2009	GS Arida/B. Punzal
Task 2	Seeding in greenhouse, seedlings in plastic box, land preparation	09/2009	GS Arida/B. Punzal
Task 3	Transplanting, installation of traps, field and trap maintenance, sampling and data collection	09/2009	GS Arida/B. Punzal
Task 4	Data analysis and writing of reports	09/2009	GS Arida/B. Punzal

List of Co-PIs and Partner Institutions

Co-PI	Institution	E-mail address
GS Arida	Philippine Rice Research Institute	gsarida@philrice.gov.ph
BS Punzal	Philippine Rice Research Institute	B s_punzal@yahoo.com
BM Shepard	Clemson University	

Objective 4: PhilRice. Comparison of Sex Pheromone Trap and Light Trap Catches

Activity Category
Research

Participating Scientists and Institutions
G.S. Arida, B.S. Punzal (PhilRice) and B.M. Shepard (Clemson University)

Description
Surveillance and monitoring tools are important component for an effective IPM program. Sex pheromone trap had been shown as an effective monitoring tool for timing of interventions against lepidopteran pests of vegetables. However, due to lack of interests by industries to market sex pheromones in the Philippines, there is a need to find a substitute that farmers could rely on as basis for application of interventions. The study aims to determine if light trap could be a substitute for sex pheromone traps in pest surveillance and monitoring of key lepidopteran pests of vegetables. Sex pheromone traps of *S. litura*, *S. exigua* and *H. armigera* will be installed in the field. In addition a kerosene light trap will also be installed nearby and trap catches will be recorded every 3 days. This will be conducted for 2 seasons. Catches from all the traps will be compared and analyzed statistically.

Expected Outputs
Catches of moths of *S. itura*, S. *exigua* and *H. armigera* in sex pheromone and catches in light traps compared and analyzed statistically.

Start/End Date
October 1, 2008 – September 30, 2009

Performance Indicators for Monitoring and Evaluation

Progress to Date
Sex pheromone traps had been found as an effective monitoring tool for timing of interventions against lepidopteran pests of vegetables. However, due to its unavailability in the market in the Philippines, there is needed to find a substitute that farmers could rely on as basis for interventions.

Milestone Tasks

ID	Description	Completion Date	Responsible Individual
Activity 1B			
Task 1	Site selection and preparation of field	09/2009	GS Arida/BS Punzal
Task 2	Fabrication and installation of traps	09/2009	GS Arida/BS Punzal
Task 3	Data collection on trap catches and trap maintenance	09/2009	GS Arida/BS Punzal
Task 4	Data analysis and writing of report	09/2009	GS Arida/BS Punzal

Lists of Co-PIs and Partner Institutions

Co-PIs		**E-mail address**
GS Arida	Philippine Rice Research Institute	gsarida@philrice.gov.ph
BS Punzal	Philippine Rice Research Institute	bs-punzal@yahoo.com
BM Shepard	Clemson University	

Objective 5: PhilRice: Mix Cropping as Management Strategy for Shoot and Fruit Borer of Eggplant and Whitefly on Tomato

Activity Category
Research and Technology Transfer

Participating Scientists and Institutions
Aurea c. Roxas, Marilyn G. Patricio - Central Luzon State University, Herminia R. Rapusas - PhilRice

Description
Integrated management approaches such as cultural will be evaluated to test its effectiveness in managing whiteflies population. Evaluation of mix cropping of both herbal and other vegetables crops as one component of pest management will be tested.

Expected Output
Identified crops (herbal or vegetables) as companion crops of tomato effective to manage the population of whiteflies.

Start and End Date
October 1, 2008 – September 30, 2009

Performance Indicators

Progress to Date
Result of the experiment on melon and tomato showed that when they were planted with other plants surrounding them, population of whiteflies decreased.

Milestone Task

Activities	Description	Completion	Responsible Individual
Task 1	Integrated management approach such as mix cropping will be evaluated to test its effectiveness in managing whiteflies population. Evaluation of mix cropping of both herbal and other vegetables crops as one component of pest management will be tested.	October 2009	Aurea C. Roxas Marilyn G. Patricio

List of Co-PIs and Partner Institutions

Co-PI	Institution	e-mail address
Aurea C. Roxas	Central Luzon State University	au_roxas24@yahoo.com
Marilyn G. Patricio	Central Luzon State University	Mgpatricio_clsu@yahoo.com
Herminia R. Rapusas	PhilRice	hrrapusas@philrice.gov.ph

Objective 6: PhilRice: Yield Loss Assessment on Tomato Due to Whiteflies

Activity Category
Research

Participating Scientists and Institutions
Aurea C. Roxas, Marilyn G. Patricio and Ms. Herminia Rapusas, Central Luzon State University (CLSU) and PhilRice.

Description
Whiteflies will be introduced into the tomato plants and the yield loss due to the effect of the pest will be assessed and determined.

Expected Output
Determined and assessed the yield loss on tomato due to whiteflies.

Expected Impact
Preventive measure on the occurrence of whiteflies to increase yield

Start/End Date
October 1, 2008 – September 30, 2009

Performance Indicators for Monitoring and Evaluation

Progress to Date
Whiteflies population reduced with the application of *G. sipium.* Tomato is the most preferred host of whiteflies

Milestone Task

ID	Description	Completion date (mm/yy)	Responsible individual
Activity Task 1	Whiteflies will be introduced into the tomato plants and the yield loss due to the effect of the pest will be determined.	October 2009	Aurea C. Roxas Marilyn G. Patricio

List of Co-PIs and Partner institution

Co-PI	Institution	Email address
Aurea C. Roxas	CLSU	au_roxas24@yahoo.com or au_roxas24@live.com
Marilyn G. Patricio	CLSU	mgpatricio_clsu@yahoo.com
Herminia Rapusas	PhilRice	hermierapusas@yahoo.com

Objective 7: PhilRice: Mulching and Use of Biological Control Agents for Managing Whitefly (*Bemisia sp.*) on Melon

Activity Category
Research

Participating Scientists and Institutions
Aurea C. Roxas Ph.D. -Central Luzon State University (CLSU)
Marilyn G. Patricio Ph.D. - Central Luzon State University (CLSU)
Ms. Herminia Rapusas - Philippine Rice Research Institute (PhilRice)

Description
The experiment was laid out following the split plot design with three replications. Main plot will be type of mulch and the sub-plot, the release of earwig. The variety commonly grown by farmers will be used in this study. Seedlings were raised in seedling trays and transplanted into the field two weeks after at planting distance of 1.0 x 0.5 m. All cultural practices in the production of melon such as fertilizer application, irrigation and weeding will be employed. The following are the treatments;

Main Plot (Mulch type)
- M_1 – Silver mulch
- M_2 – Yellow mulch
- M_3 – Rice straw mulch
- M_4 – Without mulch (control)

Sub-plot (Number of Earwigs)
- S_1 – 2 per meter^2 or 20,000 per ha
- S_2 – 3 per meter^2 or 30,000 per ha

The effects of treatments will be assessed in terms of population build-up of the target insect pests, other pests, damage/disease intensities, weed densities as well as fruit yield
- All the data gathered will be analyzed following the split plot design using IRRISTAT (Version 3.1). Treatment means will be compared using DMRT at 5% level of significance.

Data to be gathered
1. Population of insects per plant – to be counted by carefully examining the whole plant and counting the number of insects in each plant.
2. Insect pest damage (%) – to be determined by counting the number of damage and undamaged tissue/ plant.
3. Disease intensity (% incidence and severity).
4. Population of natural enemies/ parasitoids
5. Weed density
6. Fruit yield

Expected Outputs

- Right combination of mulching material and level of biocontrol agent (earwig) to prevent population and damage of whiteflies on melon were identified/established.
- Expected impact: Reduction in pesticide used which resulted in the production of safe products and increased in insect diversity within the area.

Start /End Date
October 1, 2008 – September 30, 2009

Performance Indicators

Progress to Date
White fly populations were decreased by about 70% using yellow mulch on melon, based on the control (no mulch), and about 36.65% with rice straw.

Milestone Task

ID	Description	Completion Date (mm/yy)	Responsible Individual
Activities 3			
Task 1	Selection of site and procurement /securing of materials needed.	July-August 2008	Marilyn G. Patricio and Aurea C. Roxas
Task 2	Conduct of the experiment	August- October 2008	Marilyn G. Patricio and Aurea C. Roxas
Task 3	Data gathering/collection	Sept-October, 2008	Marilyn G. Patricio and Aurea C. Roxas
Task 4	Data analysis	November, 2008	Marilyn G. Patricio and Aurea C. Roxas
Task 5	2nd trial of the experiment	December- 2008 March 2009	Marilyn G. Patricio and Aurea C. Roxas
Task 6	Data consolidation/analysis and report writing	May – June 2009	Marilyn G. Patricio and Aurea C. Roxas

List of Co-PIs and Partner Institutions

Co-PI	Institution	E-mail address
Aurea C. Roxas Marilyn G. Patricio Herminia R. Rapusas	Central Luzon State University, PhilRice	au_roxas24@yahoo.com mgpatrico_clsu@yahoo.com hrapusas@philrice.bov.ph

Objective 8: PhilRice: Farm Women's Roles in IPM: The Case of the Philippines

Activity Category
Research

Participating Scientists and Institutions
Philippine Rice Research Institute
Irene R. Tanzo, Ronell Malasa

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.

Expected Outputs
- Identified roles of farmwomen in IPM
- Identified constraints/needs faced by farmwomen on IPM
- Identified factors affecting farmwomen's participation in IPM
- Identified contributions of farmwomen in IPM

- Identified process on how women are reached by IPM
- Policy implication

Expected Impact
This research seeks to 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.

Start/End Date
October 2008 - September 2009.

Performance Indicators for Monitoring and Evaluation

Progress to Date
Survey data from three provinces had been processed already. Output tables on the socio-demographic characteristics, pest management roles of women, in rice and vegetables, technological needs of farmwomen, and pesticide safety practices are already available. Regression analysis is currently being done to determine what socio-demo and farm factors affect women's involvement in pest management. The Gender impacts of IPM are also being determined.

Paper presentation on the safety practices of farmwomen had been presented at the 39th PMCP conference held at Puerto Princesa City, Palawan.

Milestone Tasks for the year

ID	Description	Completion Date (mm/yy)	Responsible Individual
Activity 1	Survey		
Task 1	Data processing from 3 sites	Jan-Mar 2008	I.Tanzo
Task 2	Production of output tables	Mar-May 2008	I.Tanzo
Task 3	Data analysis	April-July, 2008	I.Tanzo
Task 4	Write-up	June-Sept 2008	I.Tanzo
Task 5	Presentation and submission of report	May 2008, Oct.-Dec. 2008	I.Tanzo

List of Co-PIs and Partner Institutions

Co-PI	**Institution**	**E-mail Address**
Irene R. Tanzo	PhilRice	itanzo@philrice.gov.ph
Ronell Malasa	PhilRice	rmalasa@philrice.gov.ph

6) Benguet, Philippines

(Led by Washington State University, Municipality of La Trinidad)

Rearing, Evaluation and Release of Native Predatory Mites in Benguet, Province, Philippines

Objective 1: WSU: Develop an understanding of the pest complex in La Trinidad strawberry fields with an emphasis on spider mites.

Description

Intensive sampling of mites from all strawberry producing barangays in La Trinidad Municipality occurred during 2007 and 2008. Based on this survey, phenology of pests and predatory mites will serve as a guide for spider mite management. Analyses will be based on weather data, farmer's pest controls, nutrient management and cultural practices.

Expected Outputs

A comprehensive slide collection of mites associated with strawberry in Luzon will be developed as a reference for students, professionals and growers. A taxonomic key to identify predatory mites found on strawberry will be developed. Ongoing development of a phenological calendar of spider mites and predator mites as a predictive model and distribution maps for species.

1. Task: Completion of slide voucher identifications.
2. Task: Completion of taxonomic keys to predatory and phytophagous mites of strawberry in La Trinidad.
3. Task: Population dynamic studies of spider mites and predatory mites of strawberry will be completed.

Objective 2: WSU: Development of a sustainable Municipal model for mass production of *Neoseiuluslongispinosus*, a native predatory mite, for the control of spider mites on strawberry through technology transfer.

Description

Production of spider mites as food for predatory mites is the key bottleneck for mass production. In tropical high elevations, such as La Trinidad, Luzon, low temperatures and high humidity are additional challenges to overcome. This project will serve as a model for development of regionally specific production systems in other tropical high elevation locations. BarangayAlno is the lowest elevation in La Trinidad Municipality exhibiting the highest temperatures, thus has been identified as the most suitable site for spider mite production in the province. La Trinidad Municipality is building a mass-rearing facility in Alno, as a result of this project and should be completed by 2009. This facility will be responsible for rearing spider mites to feed predatory mites at a different location in barangay Puguis, to minimize contamination issues. An interagency task force consisting of the Bureau of Plant Industry, Benguet State University, Office of the Municipal Agriculturist, Office of the Provincial Agriculturist, Fertilizer and Pesticide Authority and this USAID IPM CRSP project will divide efforts to develop a strawberry demonstration plot, utilizing good agricultural practices including the use of *N. longispinosus*. The different agencies have accepted different tasks for success of the demonstration plot including pre-planting soil amendments, cultivar selection, disease-free planting stock, monitoring for pests, residue analysis to maintain strict guidelines agreed upon by the farmer cooperators, yield data and other aspects of economic interest.

Expected Outputs
Continued technology transfer and capacity building through training of university, municipal, provincial and national government personnel in mass production techniques of prey and predatory mites. Developing interagency coordination to mass produce predatory mites to promote sustainability through sharing ownership of the process, while diminishing risks of failure and encouraging long-term sustainability of the project. Development of a large demonstration plot that emphasizes good agricultural practices in strawberry production using IPM.

1. Task: Coordination of the numerous agencies to develop timely production schedules and baseline needs for large-scale release of predatory mites.
2. Task: Technology transfer of strawberry IPM practices to strawberry farmers. Developing interaction between farmers and local expertise.
3. Task: Identify the most suitable techniques for large-scale production of spider mites in tropical high elevations and implementing an interagency wide effort to mass-produce predatory mites.
4. Task: Issues such as cool temperatures and low light levels will be studied to determine ways of averting partial diapause to promote robust numbers of both spider mites and predatory mites.
5. Task: Focus on large-scale predatory mite production for the interagency strawberry demonstration plot as a guide for their future projected needs.

Objective 3: WSU: Investigations into the use of the guava guild of predatory mites for the control of cyclamen mites infesting strawberry.

Description
Leaves from the guava tree are placed in the cyclamen infested strawberry. The predatory mites feed on the cyclamen mites and eliminate the pests. Normal leaves are observed within two weeks following treatment.

Expected Outputs
Determining the efficacy of the guava mite guild for control of cyclamen mites on strawberry.

1. Task: Analyses of life table data for each of the predatory mites found on guava to determine their potential in controlling cyclamen mites.
2. Task: Continued research into the guava guild of predatory mites for control of cyclamen mites infesting strawberry through laboratory and field experiments.
3. Task: Determine the distribution of the guava mite guild through surveys of guava within the municipality, to evaluate its potential for widespread use in controlling cyclamen mites on strawberry.
4. Task: Continued testing of guava leaves as a prophylactic treatment for nursery stock prior to distribution to the farmers.

Objective 4: WSU: Introduction of small fruits such as commercial varieties of blueberries and cranberries into the mountainous communities of Luzon as possible high cash value alternative crops and subsequent development of small fruit IPM for the Cordilleras.

Description
Development of diversified commercial small fruits in Benguet province. Native blueberries grow in high elevation areas of Benguet such at Atok. Their presence suggests commercial varieties might be suitable and accepted as alternative crops particularly in the rainfed communities of the Benguet highlands where vegetable production is difficult. Likewise hardy commercial varieties of caneberries may be well adapted and offer a lucrative option to growers. Simple inexpensive fog catching systems to obtain water for irrigation will be tested at several on-farm sites where irrigation water is impossible to obtain due to remoteness of the location or economic reasons. Drip irrigation systems will be investigated.

Expected Outputs
Continued strawberry varietal importation and testing. Determine suitable commercial varieties of blueberry and caneberry for Benguet. Feasibility of fog catching as a reliable source for supplemental irrigation and drip irrigation systems will be evaluated.

1. Task: Varietal evaluations for commercial small fruits.
2. Task: Fog catching will be evaluated.
3. Task: Testing of different drip irrigation systems.

7) COTABATO, PHILIPPINES

(Led by Kansas State University, IRRI, University of Southern Mindanao)

Objective 1: KSU: Evaluate current and improved diversification schemes for IPM in vegetable-rice cropping systems (Mindanao, Philippines, and Lampung, Indonesia)

Activity Category
Research, Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Karen A. Garrett, Kansas State University
Dr. Christopher C. Mundt, Oregon State University
Dr. Casiana Vera Cruz, International Rice Research Institute
Dr. Edwin Hondrade, University of Southern Mindanao
Dr. Rosa Fe Hondrade, University of Southern Mindanao

Description
- Evaluation of farmers' current use of varietal and species diversity in socio-economic analyses at target sites
- Evaluation of options for coordinating and designing storage, multiplication, and delivery of improved and landrace seed
- Analysis of functional and genetic diversity of traditional and improved germplasm
- Evaluation of temporal and spatial deployment methods for vegetable-rice intercropping in rubber agroforestry for improved IPM in participatory research programs with farmers
- Evaluation and implementation of plans to scale-up successful strategies
- Evaluation of the low disease and insect pest load in the area, identifying potential reasons for this success and how strategies might be implemented in other areas

Expected Outputs
- We will submit a technical report or journal article describing current use of varietal and species diversity.
- We will submit a technical report describing methodologies for seed chain methodologies and provide further training in their use.
- We will submit a journal article describing the functional and genetic diversity of germplasm in the study region.
- We will submit a journal article describing the rubber agroforestry analysis.
- We will submit a technical report about options for scaling up successful strategies discovered in our experiments and implement plans for training with farmer groups.
- We will develop and implement a survey of IPM needs in the area, current strategies, and success stories for publication in technical and popular publications and distribution through farmer groups.

Start/End Date
The activities will begin November 2008 and continue through September 2009.

8) Regional Activities
(Led by Clemson University)

Objective 1: Clemson: Conduct a regional workshop for monitoring of progress and program planning.

Activity Category
Research, Capacity Building, Technology Transfer, and others.

Participating Scientists and Institutions
Gerry Carner, Clemson University
Michael Hammig, Clemson University
Merle Shepard, Clemson University
Representatives of each of the SE Asia program sites.

Description
A workshop will be held in a field location in Indonesia or the Philippines to bring together participants in the regional program to review individual progress and to plan activities for the future. Scientists from Clemson University and regional experts from AVRDC will provide input into field activities and make recommendations for planning of future activities.

Expected Outputs
The output of the workshop will be information sharing among the regional sites, updates of accomplishments and lessons learned from activities conducted during the year, and a plan for future program development.

Start/End Date
The workshop will be held sometime during June or July, 2009.

Ecologically-Based Participatory and Collaborative Research and Capacity Building in IPM in Central Asia

Karim Maredia, Institute of International Agriculture, Michigan State University

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

Description
Increasing crop monocultures and decreasing landscape diversity are frequently accompanied by a reliance on agricultural pesticides to help suppress crop pests. Ecologically based IPM seeks to maximize the suppression of insect, weed and disease pests by enhancing the effectiveness of their natural enemies, and prior research has shown that many natural enemies are enhanced by landscape diversity. The specific objectives of this research project are to adapt existing principles and practices of landscape management to enhance IPM 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.

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

Activity 1.1: Introduction of successful local nectar plant into existing vegetables farming systems in collaboration with local farmers and NGOs.

Ten to twelve species of nectar plants will be introduced into existing vegetable farming systems in various agro ecological zones of Tajikistan and Kyrgyzstan in collaboration with farmers and NGOs.

Activity Categories
Research, Capacity Building, and Technology Transfer

Participating Scientists and Institutions
Dr. Douglas Landis, Michigan State University
Dr. Mustapha El-Bouhssini, ICARDA
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan
Institute of Zoology and Parasitology, Tajikistan
Department of Plant Protection, Institute of Plant Production, Tajikistan
Botanical Institute, Kyrgyzstan
Bio-soil Institute, Kyrgyzstan
Farmers' Association
Oxfam GB in Livelihood program in Kulyab region of Tajikistan

Description
Initial research has been focused on screening native plant materials for enhancing IPM use in Central Asia. During three years (2006-2008) of research activities 24 species nectar plants were tested for their attractiveness to natural enemies of pests. Based results of this study, 10-12 most attractive plants species will be introduced into existing vegetables farming systems in various agro ecological zones of Tajikistan and Kyrgyzstan in 2009. These plants include species that will thrive in open agricultural landscapes, have a diversity of bloom periods encompassing the growing season, provide easily accessible pollen and nectar for natural enemies, require low inputs of water and be compatible with other land uses (e.g., grazing). The project will assess the impact of these plants on beneficial insects and their effects on vegetables pest population.

Expected Outputs
Successful local Nectar plants candidates will be introduced for broad planting into existing vegetables farming systems in Central Asia region and help reduce the impact of pests on crops.

Start/End Date
November 1, 2008 – September 30, 2009

Activity 1.2: Design and publish a brochure/booklet on landscape ecology and habitat management

Design and publish a brochure/booklet on Landscape Ecology and Habitat Management (in Russian language)

Activity Categories
Research, Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Douglas Landis, Michigan State University
Dr. Mustapha El-Bouhssini, ICARDA
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Murat Aitmatov, Education Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Anvar Jalilov, Department of Plant Protection, Institute of Plant Production, Tajikistan

Description
The Landscape Ecology and Habitat Management play key role in enhancing biological control of pests. However, this concept is currently new in Central Asia. To increase awareness and knowledge about the landscape ecology, we are planning to publish a brochure explaining in greater details the importance of these concepts.

Expected Outputs
Brochure/booklet explaining the importance of landscape will be published.

Start/End Date
January 1, 2009 – June 30, 2009

Objective 2: Enhance efficiency and increase product lines of Central Asian biolaboratories

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

Study the effect of *Amblyseius mckenziei* on spider mite control in cotton field

Spider mites, especially the two-spotted spider mite (*Tetranychus urticae*) are serious pests for many crops grown in Central Asia including cotton, strawberries, tomatoes, beans, cucurbits, tree fruit and flowers. Spider mites damage crops by feeding on foliage, reducing photosynthesis, transpiration, leaf chlorophyll content and leaf nitrogen. Mite feeding can also reduce bud formation and fruit size, as well as cause poor fruit finish and color development. Spider mites are typically controlled by synthetic acaricides which offer effective short-term control when they are applied correctly. However, there is considerable interest in reducing or eliminating the use of synthetic pesticides to reduce the risk of residues on fresh market products or to enable organic certification. The objective of this research is to study the effect of *A. mckenzie* on spider mite control in cotton. We will conduct field evaluation of different ratio of predator:prey of *A. mckenziei* for spider mite control in cotton fields in the Andijan region (Uzbekistan) and Osh region (Kyrgyzstan). The predators will be supplied by scientists at the Kyrgyzstan Biological Center and from a colony established on *Acarus farris* at a biolaboratory in Tashkent. The fields will be monitored weekly by collecting leaves and counting the number of spider mites per leaf.

Expected Impact

The optimal predator-prey ratio of predator mite application at different pest densities will be established.

Activity 2.1: Estimate the best methodology of application of predatory mite on cotton against spider mites.

Activity Categories

Research and Capacity Building

Participating Scientists and Institutions

Dr. Frank Zalom, UC Davis
Dr. Barno Tashpulatova, Research Fellow, ICARDA-PFU, Tashkent
Institute for Plant Protection Uzbekistan UzNIIZR-140
Kyrgyzstan Center of Biological Facilities Production for Plant Protection, Chui region, Sokuluk district.

Description

This study will focus on estimating the best methodology of colonization of predator mites, conditions for rearing candidate predator mites and their prey. This activity will focus on finding best combination of predator: prey ratio for field release.

Expected Outputs

- The protocol for predator mites release in the field will be developed
- The optimal way for spider mites control in cotton will be established

Start/End Date

October 1, 2008 – September 30, 2009

Activity 2.2: Colonization of spider mites in laboratory conditions: Study the effect of predatory mite *Amblyseius cucumeris* on development of spider mites *Tetranychus urticae*.

Activity Categories

Research and Capacity Building

Participating Scientists and Institutions
Dr. Frank Zalom, UC Davis
Dr. Barno Tashpulatova, Research Fellow, ICARDA-PFU, Tashkent
Institute for Plant Protection Uzbekistan UzNIIZR-140
Kyrgyzstan Center of Biological Facilities Production for Plant Protection, Chui region, Sokuluk district.

Description
Spider mite is the most serious pest on cotton and vegetable crops in Central Asia. It is necessary to study the conditions of predation of *Amblyseius cucumeris* on spider mite. This study will focus on the conditions for rearing candidate predatory mites on spider mites *T. urticae* and *A. farris*. This laboratory study will focus on the effect of predatory mites on spider mites and estimate the predation ratio - optimal predator-prey ratio.

Expected Outputs
- The effect of predatory mite *A. cucumeris* on the development of spider mite will be determined
- The predation ratio - optimal predator-prey ratio will be determined

Start/End Date
November 1, 2008 - December 31, 2008

Activity 2.3 Study the survivability of predatory mite *A. cucumeris* during the winter time

Activity Categories
Research and Capacity Building

Participating Scientists and Institutions
Dr. Frank Zalom, UC Davis
Dr. Barno Tashpulatova, Research Fellow, ICARDA-PFU, Tashkent
Institute for Plant Protection Uzbekistan UzNIIZR-140
Kyrgyzstan Center of Biological Facilities Production for Plant Protection, Chui region, Sokuluk district.

Description
Study surviving conditions of predatory mites in winter time in Uzbekistan and Kyrgyzstan to determine conditions of *Amblyseius* sp. reproduction. Last winter we studied the effect of plant pollens on survivability of *A. cucumeris*. Results showed that pollens positively affect the development, survival and reproduction of *A. cucumeris* during the winter time. It is necessary to obtain more details on the effect of pollens of wild plants and orchard plants on the development of predator mites at different temperatures.

Expected Outputs
- Growth and development stages of predator mites fed with pollens will be determined;
- Survival of *Amblyseius* mites will be determined.
- Reproduction (eggs produced and hatched) of *Ambliseius cucumeris* (adult females) fed with pollens will be determined.

Start/End Date
December 1, 2008 – February 28, 2009

Activity 2.4: Review literature and Study the effect *A. cucumeris* on whitefly and aphids development in greenhouses in vegetable crops

Activity Categories
Research and Capacity Building

Participating Scientists and Institutions
Dr. Frank Zalom, UC Davis
Dr. Barno Tashpulatova, Research Fellow, ICARDA-PFU, Tashkent
Institute for Plant Protection Uzbekistan UzNIIZR-140
Kyrgyzstan Center of Biological Facilities Production for Plant Protection, Chui region, Sokuluk district.

Description
In spring time whitefly and aphids are the most spread pests in greenhouses crops (tomatoes, cucumbers, sweet peppers etc). We will start with a review of literature on any study conducted on the effect of *A. cucumeris* on whitefly and aphids. We will conduct a study to determine the role of predatory mite *A. cucumeris* on whitefly and other pests in greenhouse.

Expected Outputs
Based on literature review, the study of Ambyseius sp will be designed and regularly reviewed.
Predation of vegetable pests will be known.
Predator's number of eggs per female, egg hatch and length of time on spider mites and grain mites will be determined. Development of *Amblyseius* sp. to adult stage at some constant will be studied

Start/End Date
February 1, 2009 - May 31, 2009

Activity 2.5: Laboratory experiments on vegetable plots in Uzbekistan and Kyrgyzstan regions

Activity Categories
Research and Capacity building

Participating Scientists and Institutions
Dr. Frank Zalom, UC Davis
Dr. Barno Tashpulatova, Research Fellow, ICARDA-PFU, Tashkent
Institute for Plant Protection Uzbekistan UzNIIZR-140
Kyrgyzstan Center of Biological Facilities Production for Plant Protection, Chui region, Sokuluk district.

Description
The objective of this study is to estimate *Amblyseius* sp predation level on spider mite (*T. urticae*) and grain mite (*A.farris*). For a second year, we will establish laboratory trials on the effect of *A. cucumeris* against spider mites on bean plants to determine the level of predation. This study will carried out at the Institute of Plant Protection in Uzbekistan. In addition, trials on the effect of predator mites on onion thrips will be carried out and test of *A. cucumeris* effect on *Aculops lycopersici* (tomato russet mite).

Expected Outputs
- Increase use of biological control agents for pest control
- Optimal predator:prey ratio at different pest density will be established.
- *Amblyseius* sp. effect on vegetable crop pests in Central Asia will be known.
- Methods for predatory mites application/rearing on plants against spider mites are determined.

Start/End Date
June 1, 2009 – September 30, 2009

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

Description
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 is to:

- Integrate IPM information into existing curriculum using new teaching tools and methodologies in various universities (Kyrgyz Agrarian University) and into existing agricultural development programs run by NGOs.
- Using the Training of Trainers (ToT) approach to train a pool of trainers that can support Farmer Field Schools (FFS) and other outreach activities.

Expected Impact
- Increase IPM knowledge by university teachers, students and development agents.
- Increase in development and publication of IPM training material for universities and NGO.
- Increase adoption of IPM technology by farmers.
- Improved teaching curriculum by inclusion of IPM.

Activity 3.1: Implement IPM Training Programs for Faculty and Advisory Group at Kyrgyz Agrarian University

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. George Bird, MSU
Dr. M. El Bouhssini, ICARDA
Dr. Murat Aitmatov Research Fellow, ICARDA-Tashkent
Dr. Kubat Junusuv, chair of Plant and Pest Management from Kyrgyz Agrarian University
Dr. Bekmat Juldashev, chair of Plant and Pest Management from Kyrgyz Agrarian University
Dr. Kamil Satarov, chair of Woods and nut from Kyrgyz Agrarian University (KAU)
Dr. Ismailov, from Department of Agriculture Kyrgyzstan
Bio-soil Institute of Academy of Sciences of Kyrgyz Republic
Kyrgyz Agrobiocentre Department of Agriculture Kyrgyzstan

Description
Based on assessment of teaching curriculum in universities and agricultural programs of various NGOs, IPM Training programs for university lecturers and NGO personnel will be developed. These training programs will target first the Kyrgyz Agrarian University. Similarly, an IPM training program for Student Field Schools (SFS) will be developed. Among the first steps is the training of trainers (university faculty) who will help with the Student Field School.

Expected Outputs
- Increase number of trained lecturers and development agents who are going to implement IPM in their teaching curriculum and agricultural package.
- Improved teaching curriculum that include IPM information.
- Increase IPM knowledge by student through Students field school (SFS) and by farmers through Farmers Field School.

Start/End Date
October 1, 2008 – August 30, 2009

Activity 3.2: Transfer knowledge and disseminate information to clients

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. George Bird, Michigan State University
Dr. Murat Aitmatov, Research Fellow, ICARDA-Tashkent
Kyrgyz Agrarian University and new NGO
Bio-soil Institute of Academy of Sciences of Kyrgyz Republic

Description
There is a need to document and publish IPM practices in the region. There is a need to enhance the capacity of Agricultural Research Institutions in Kyrgyzstan and Tajikistan through the development and dissemination of IPM information. Data collected through survey and interviews with farmers will be published for wider distribution and use. This information will help ToT to better understand the needs of farmers in IPM. Based on this information, posters, booklet on IPM for students will be developed.

Expected Outputs
- Increase understanding of farmers knowledge and needs of farmers in IPM
- Development of publications to better serve farmers' needs in IPM

Start/End Date
October 1, 2008 – March 30, 2009

Activity 3.3: Design and publish brochures and leaflets on various IPM issues

Activity Categories
Capacity Building and Technology transfer

Participating Scientists and Institutions
Dr. George Bird, MSU
Dr. Walter Pett, MSU
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Barno Tashpulatova, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Murat Aitmatov Research Fellow, ICARDA-Tashkent
Dr. Allovidin Hamraev, Institut Zologii, Uzbekistan
Dr. Kubat Junusuv, chair of Plant and Pest Management from Kyrgyz Agrarian University
Dr. Bekmat Juldashev, chair of Plant and Pest Management from Kyrgyz Agrarian University
Dr. Kamil Satarov, chair of Woods and nut from Kyrgyz Agrarian University (KAU)
Dr. Ismailov, from Department of Agriculture Kyrgyzstan
Bio-soil Institute of Academy of Sciences of Kyrgyz Republic
Kyrgyz Agrobiocentre Department of Agriculture Kyrgyzstan

Description
Various materials will be developed to assist farmers in understanding pests and control methods in field and vegetable crops. To help farmers and students identify pests, a dictionary of vegetable pests will be published in Russian, Kyrgyz and Latin. In parallel, a book describing pests of vegetable crops in Kyrgyzstan will be developed for teachers. The emphasis on these documents will be placed on biological control methods. In addition, various crop calendars will of vegetable crops will be developed.

Expected Outputs
- Publish brochures, extension bulletins, crop calendars and leaflets
- Publish dictionary of terminological on pest, diseases and weed

Start/End Date
October 1, 2008 – July 31, 2009

Objective 4: Evaluate wheat nursery for resistance to cereal leaf beetle (CLB).

Description
In the last decade, Cereal leaf beetle (*Oulema melanopus L.)* has become an important pest of wheat and barley in Central Asia region. The goal of this study is to conduct research on screening 60 wheat lines for resistance to cereal leaf beetle (CLB) and survey of Cereal leaf beetle parasitoids in Central Asia region.

Expected Impact
Impact of CLB on wheat is reduced through use of resistant varieties.

Activity 4.1: Screening of wheat varieties for resistance to Cereal leaf beetle (CLB)

Activity Categories
Research, Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Douglas Landis, Michigan State University
Dr. Mustapha El-Bouhssini, ICARDA
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan
Institute of Zoology and Parasitology of the Academy of Sciences of Tajikistan
Department of Plant Protection, Institute of Plant Production, Tajikistan
Bio-soil Institute of Academy of Sciences of Kyrgyz Republic

Description
In the last decade, cereal leaf beetle (*Lema melanopus L.)* became one of the most dangerous pest in wheat crop fields in Central Asia. Through breeding programs, researchers at ICARDA have developed different wheat lines that may be resistant against the pest. Therefore the objectives of this study will be to 1) identify sources of resistance to Cereal leaf beetle, which will be used in breeding programs to develop resistant cultivars to this pest; 2) Determine the role of egg and larval parasitoids in regulating the Cereal leaf beetle populations.

Expected Outputs
- Resistant/tolerant wheat lines to cereal leaf beetle will be known.
- Parasitoids of Cereal leaf beetle will be identified in Central Asia.

Start/End Date
November 1, 2008 - July 31, 2009

Objective 5: Develop and implement regionalization and globalization strategy

Description
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. Our partners ICARDA and other international NGO's have well-established regional networks in central Asia, and will serve as excellent vehicles for regionalization and globalization.

Expected Impact
Enhanced regional cooperation and new linkages with the regional and global IPM community.

Activity 5.1: Membership in the International Association of Plant Protection Sciences (IAPPS)

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Karim Maredia, Michigan State University
Dr. Dieudonné Baributsa, Michigan State University
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Murat Aitmatov, Outreach Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Barno Tashpulatova,Research Fellow, ICARDA-Tashkent, Uzbekistan

Description
More than 13 scientists, including the three research/outreach fellows, from the region have received their membership in the IAPPS.

Expected Outputs
- IPM Specialists from the regions are connected to the outside world
- Increase access to information on current issues related to plant protection and IPM

Start/End Date
October 1, 2008 – September 30, 2009

Activity 5.2: Facilitate participation in regional IPM meetings and forums organized by National, International NGOs and other IPM CRSP Regional Programs and Global Themes.

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Karim Maredia, MSU
Dr. Dieudonne Baributsa, MSU
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent
Dr. Barno Tashpulatova, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Murat Aitmatov, Outreach Fellow, ICARDA-Tashkent, Uzbekistan
Advisory Training Center, Kyrgyzstan

Description
In order to enhance cooperation and linkages with other regional IPM programs, the project will facilitate participation of key personnel from Central Asian collaborating institutions in various IPM meetings and workshops in the region and in South Asia. Discussions are underway with the IPM CRSP Management Office to facilitate linkages with existing IPM programs in India and Bangladesh. Linkages will be established with Global Themes programs.

Expected Outputs
- Participation of key personnel of collaborative institutions in regional workshops
- Participation of 3 research/outreach fellows in regional IPM meetings and workshops
- Increased networking with regional and international IPM specialists

Start/End Date
October 1, 2008 – September 30, 2009

Activity 5.3: Organize the Second Regional IPM Forum in Central Asia, spring 2009 in Bishkek, Kyrgyzstan.

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Karim Maredia, MSU
Dr. Dieudonne Baributsa, MSU
Dr. Nurali Saidov, Research Fellow, ICARDA-Tashkent
Dr. Barno Tashpulatova, Research Fellow, ICARDA-Tashkent, Uzbekistan
Dr. Murat Aitmatov, Outreach Fellow, ICARDA-Tashkent, Uzbekistan

Description
The IPM CRSP Program in Central Asia has generated a lot of information for the past 2 years. The program has attracted a lot of interest from various stakeholders including NGOs, Government agencies and ministries, International organizations and farmers. In order to share the information and experiences of the Central Asia regional IPM program, a Forum will be organized in spring 2009 in Bishkek, Kyrgyzstan. This Forum will serve as a platform for Global Themes such as the Regional Diagnostic Labs (Dr. Sally Miller) and Viruses (Dr. Naidu Rayapati) to share their experience and knowledge with researchers in the region through a training workshop.

Expected Outputs
- Increased information sharing on IPM CRSP project with the Central Asian IPM stakeholders
- Increase knowledge in other pest diagnostic and other relevant issues in Central Asia

Start/End Date
March 1, 2009 – May 31, 2009

Activity 5.4: Facilitate participation of IPM specialists from the Central Asia region in the MSU's International Agroecology, IPM and Sustainable Agriculture short course.

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions
Dr. Karim Maredia, MSU
Dr. Dieudonne Baributsa
National Agricultural Research Programs
International Agricultural Research Centers
Non-governmental Organizations

Description
MSU will facilitate participation of 2 IPM specialists in the international IPM short course in June 2009. This will help in linking IPM specialists from Central Asia to the IPM specialists from U.S. and other countries.

Expected Outputs
- 2 IPM specialists from the Central Asia region are trained
- Increased linkages and collaboration between Central Asia and US IPM specialists

Start/End Date
October 1, 2008 – September 30, 2009

Objective 6: Conduct baseline survey of the regional IPM programs

Description
Our regional IPM program is conducting a baseline survey of the regional IPM CRSP Programs in Central Asia. Socio-economists at MSU in collaboration with the three IPM CRSP research/outreach fellows are implementing the impact assessment activities.

Expected Impact
- Enhanced accountability of public investments in this project.

Activity 6.1: Continue baseline survey of pest management practices in Kyrgyzstan, Uzbekistan and Tajikistan

Activity Categories
Research and Capacity Building

Participating Scientists and Institutions
Dr. Richard Bernsten, Michigan State University
Dr. Mywish Maredia, Michigan State University
Dr. George Norton, Virginia Tech
Dr. Karim Maredia, MSU Dr. George Norton, Virginia Tech
Dr. Dieudonne Baributsa, Michigan State University

Description
In order to assess farm-level impacts of the IPM tactics and packages, it is important that some credible information is available to assess the "without" project counterfactual scenario. The baseline surveys will continue to be conducted to gather farm-level information that will help build the "before project" scenario for impact assessment. Though, this will not be the same as the "without" project counterfactual, it will provide a base to make such estimates necessary to assess ex post impacts of any research project.

Expected Outputs
- Increase knowledge and understanding of IPM practices in the region

Start/End Date
October 1, 2008 – September 30, 2009

List of Co-PIs and Partner Institutions

Co-PI	Institution	E-mail Address
Christopher Martius	ICARDA	c.martius@cgiar.org
Frank Zalom	UC-Davis	fgzalom@ucdavis.edu
Douglas Landis	MSU	landisd@msu.edu
George Bird	MSU	birdg@msu.edu
Walt Pett	MSU	pett@msu.edu
Mustapha El-Bouhssini	ICARDA	m.bohssini@cgiar.org
Dieudonne Baributsa	MSU	baributs@msu.edu

List of Global themes and Regional Programs cooperating
The Central Asia Regional IPM Program will collaborate with the global themes of the IPM CRSP project:

- Impact Assessment Global Theme– Dr. George Norton, Virginia Tech
- Regional Diagnostic Labs Global Theme- Dr. Sally Miller, The Ohio State University
- Thrips-Borne Tospoviruses – Dr. Naidu Rayapati, Washington State University
- Application of IT and Databases in IPM – Dr. Yulu Xia and Dr. Ron Stinner, North Carolina State University.

Integrated Pest Management of Specialty Crops in Eastern Europe

Doug Pfeiffer, Department of Entomology, Virginia Tech

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 was completed in summer-fall 2006. In 2008-2009, analysis and report generation will be completed. 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 1.1: 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.

Tasks for 08-09:
Completed. Publish report.

Activity 1.2: Baseline Survey in Tomatoes and Cucumbers

Description
The survey of farmers and farm families took place in summer -fall 2006. Analysis and report preparation is in progress.

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

Tasks for 08-09:
Completed. Publish report.

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 undertaken. 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 2.1: 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.

Tasks for 08-09:
1. Survey pest populations in greenhouse vegetable crops (Albania) in field situations as well as greenhouses (Moldova and Ukraine)
2. Nematode monitoring (Durres, Lushnje, Tirane, Fier, Berat) density per 100 ml soil and galling index (GI) 0-5.
3. Determine presence and species composition of beneficial species in Moldova.

Activity 2.2: 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. Insectaries within countries will be explored as well. Target insects will include whiteflies and spider mites. Beneficial rearing facilities within countries will be explored.

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

Tasks for 08-09
Arthropod Management

1. Evaluate cultural methods and novel pesticide chemistry for Colorado potato beetle in field-grown tomatoes in Moldova and Ukraine.
2. The use of cultural methods as an alternative on IPM strategy in tomato and cucumber in Ukraine.
3. Evaluation of botanical pesticides for greenhouse whitefly, *Trialeurodes vaporariorum*, and spider mite, *Tetranychus urticae*, control in Moldova.
4. The use of *Encarsia formosa, Phytoseiulus persimilis* and other biological control agents for whiteflies, mites and other pests in Ukraine.
5. The evaluation of insecticides and acaricides on whiteflies and mites control (tomato, cucumber) in Albania and Moldova.
6. Test phenological models for management of *Heliothis armigera*, late blight, downy mildew in Moldova.
7. Test pyrethrum + Canola oil against whiteflies in greenhouses.
8. *Trichogramma* in tomato fields against *H. armigera*.

Nematode Management:
Cultural Methods
To use IPM strategies as a means to reduce environmental impacts.

1. Destruction of tomato and cucumber roots after harvest, reduce population densities.
2. Nematode populations on greenhouse tomato and cucumber are controlled 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 2.3: 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.

Tasks for 08-09

1. Determine the dependence of widespread, injurious and symptoms of Late Blight from meteorological conditions and variety of tomato.
2. 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 (Dnipropetrovsk – central region, Lviv – west region, Odessa – south region)
3. Investigate the efficiency of application of fungicide for the protection of tomato from Late Blight in the Dnipropetrovs'k and Moldova conditions.
4. Studies on powdery mildew on cucumbers and Alternaria on tomatoes in Moldova.
5. *Trichoderma* (Preparation Trichodermin BL) against root rots in greenhouses.

6. Mineral oil (summer oil), baking soda, extract from *Reynoutria sachalinensis* (giant knotweed) (Milsana), KH_2PO_4 against powdery mildew on cucumbers in greenhouses and open fields.
7. Evaluation of cultural methods as an alternative means to reduce downy mildews and *Botrytis* grey mold on tomato and cucumber.
8. Combination of biological and synthetic IPM fungicides to control *Botrytis* grey mold on tomato and cucumber.

Activity 2.4: 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.

Tasks for 08-09
1. Evaluate efficacy of modern chemical tools and compare with cultural methods of weed control
2. Examine use of corn gluten as natural herbicide in Moldova.

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 3.1: Statistical/GIS Training

Description
A workshop on statistics and GIS will be carried out in year 3 if supplemental funding can be developed.

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 for 08-09

Funding will be sought in order to hold statistical training workshop

Activity 3.2: Language Translation Technology

Description
Translation software under development will be adapted to our IPM research/technology transfer programs. One manual is complete that will serve as a trial of this technology; a second manual is in late stages of production. The goal is to make versions of these manual available in the language of the project countries. Breeze presentations of technical IPM material will be posted in host country languages along with English.

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

Tasks for 08-09
1. Prepare fruit manuals and translate into Ukrainian, Russian and English versions for web presentation.
2. Technology Create Adobe Presenter (formerly Breeze) presentations with multilingual technical presentations.

Activity 3.3: 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.

Tasks for 08-09

1. Prepare a pest management guide for one of the high-value horticultural crops in Albania and Moldova.
2. Disseminate the two guides from Activity 2.1 in Ukraine and Moldova.
3. 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 4.1: 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 for 08-09

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

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

Wondi Mersie, Director of Research, Virginia State University

Objective 0.1: 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.

Description
A meeting of project participants will be held in Addis Ababa, Ethiopia in October 2008.

Activity 0.1: Organize a meeting of project participants in Addis Ababa, Ethiopia in October 2008.

Start/End Date
October 1 - 31, 2008.

Objective 1: Collect accurate information on the distribution and spread of parthenium in eastern and southern Africa and asses its socio-economic impact in Ethiopia.

Description
Surveys of parthenium were conducted in Botswana, Ethiopia, South Africa**,** Swaziland and Uganda annually during the first two consecutive years. The socio-economic impact of parthenium in Ethiopia was also determined using a structured questionnaire.

Activity 1.1: Collate data from parthenium distribution survey conducted in participating countries.

Start/End Date
October 2008 to March 2009**.**

Activity 1.2: Collate data from the survey on the socio-economic impact of parthenium in Ethiopia.

Start/End Date
October 2008 to March 2009**.**

Objective 2: Determine the effect of parthenium on plant diversity.

Description
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 2.1: Complete the on-going experiments in eastern and northern Ethiopia designed to determine the effect of parthenium on the diversity of native plants found above and below ground.

Start/End Date
December 2005 to March 2009.

Objective 3: Evaluate and release insect agents for the control of parthenium.

Description
This objective is being 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 conditions to determine the impact of bicontrol agents, the stem-boring weevil *Listronotus setosipennis*, and the leaf-feeding beetle *Zygogramma bicolorata,* on major crops of the region, as well as on selected indigenous plants and ornamentals.

Activity 3.1: Continue host range testing of *Z. bicolorata* in Ethiopia

Start/End Date
October 2007 to September 2009.

Activity 3.2: Complete host range testing of *L. setosipennis* and *Z. bicolorata* in South Africa.

Start/End Date
October 2008 to September 2009.

Objective 4: To evaluate and demonstrate pasture management methods for the control of parthenium.

Description
Several beneficial forage species will be inter-sown on fenced pastures heavily infested with parthenium weed and will be evaluated for their ability to suppress it.

Activity 4.1: Continue the field trials to determine effective pasture management systems against parthenium at Jijiga, in eastern Ethiopia.

Start/End Date
October 2008 to September 2009.

Activity 4.2: Continue field trials to determine effective pasture management systems against parthenium at Alamata, in northern Ethiopia.

Start/End Date
October 2008 to September 2009.

Performance Indicators for Monitoring and Evaluation

Milestone Tasks

- A planning, training and reporting meeting of project participants was conducted in Addis Ababa, Ethiopia.
- Database of parthenium localities in selected countries in eastern and southern Africa updated and completed.
- Map showing the distribution of parthenium in selected countries in eastern and southern Africa developed.
- Publication on distribution of parthenium in participating countries in Africa submitted for publication.
- Data on the socio-economic impact of parthenium in Ethiopia become available.
- Data on the impact of parthenium on above and below ground plant diversity become available.
- Testing of *Z. bicolerata* on selected plant species completed in South Africa and Ethiopia.
- Various legume species were tested for their smothering effect on parthenium in eastern and northern Ethiopia.

Table 1. Activities and tasks to be undertaken this fiscal year

ID	Description	Completion Date (mm/yy)	Responsible Agencies
Activity 0.1	Organize a meeting of project participants in Addis Ababa, Ethiopia.		
Task 1	Contact participants, plan meeting, prepare program, make presentations and compile the proceeding.	October, 2008	VSU EIAR
Activity 1.1	Collate data from parthenium distribution survey conducted in participating countries.		
Task 1	Compile, analyze, and interpret parthenium survey data. Prepare maps on current distribution of parthenium in selected countries in eastern and southern Africa. Prepare publication on distribution of parthenium in eastern and southern Africa.	March, 2009	PPRI-South Africa
Activity 1.2	Collate data from the survey on the socio-economic impact of parthenium in Ethiopia.		
Task 1	Submit a manuscript for publication on the socio-economic impact of parthenium in Ethiopia.	October 2008 to March 2009	EIAR VSU
Activity 2.1	Complete the on-going experiments in eastern and northern Ethiopia designed to determine the effect of parthenium on the diversity of native		

	plants found above and below ground. .		
Task 1	Collect data on the impact of parthenium on biodiversity.	October 2008 to September 2009	HU MU
ID	Description	Completion Date (mm/yy)	Responsible Agencies/Countries
Activity 3.1	Continue host range testing of Z. bicolorata in Ethiopia.		
Task 1	Evaluate the safety of *Z. bicolorata* to native plants belonging to the asteraceae family in Ethiopia.	September, 2009	EIAR
Activity 3.2	Complete host range testing of and *Z. bicolorata* in South Africa.		
Task 1	Evaluate the safety of *L. setosipennis* and *Z. bicolorata* to major crops and selected ornamentals in South Africa.	September 2009	PPRI-South Africa
Activity 4.1	Continue the field trials to determine effective pasture management systems against parthenium at Jijiga, eastern Ethiopia.		
Task 1	Repeat field trials at Jijiga, eastern Ethiopia.	September 2009	HU
Activity 4.2	Continue the field trials to determine effective pasture management systems against parthenium at Alamata, northern Ethiopia.		
Task 2	Repeat the field trials at Alamata, northern Ethiopia.	September 2009	MU

Table 2. List of participating countries and institutions

Country	**Institution**
USA	Virginia State University
USA	Virginia Tech
Ethiopia	Ethiopian Institute of Agricultural Research (EIAR)
Ethiopia	Haramaya University (HU)
Ethiopia	Amhara Regional Agricultural Research Institute (ARARI)
Ethiopia	Mekelle University (MU)
South Africa	Plant Protection Research Institute (PPRI)
Botswana	Department of Agricultural Research

	(DAR)
Uganda	Makerere University
Australia	The University of Queensland
Kenya	CAB International, Africa Regional Center (CABI)
Kenya	IUCN World Conservation Union
Benin	International Institute of Tropical Agriculture (IITA)
India	Indian Agricultural Research Institute

Collaborative Assessment and Management of Insect-transmitted Viruses

Sue Tolin, Department of Plant Pathology, Physiology and Weed Science, Virginia Tech

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

Description
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 1.1: Compile an inventory of insect-transmitted and other viruses of vegetable crops in Central America and the Caribbean

Expected Outputs
Population of the commodity virus inventory database with information from existing databases. Collection of available information in at least Honduras and Jamaica, and assembly 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.

1. Task: Complete inventory of viruses specific to each vegetable crop in the project and compare across host countries. (Tolin, VT | 03/01/2009)
2. Task: With the Information Technology Global Theme, populate an on-line database for viruses and vectors for crops in the IPM CRSP (Tolin, VT | 04/01/2009)

Activity 1.2: 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.

Expected Outputs
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 sweetpotato. Expansion of information on other vector-transmitted viruses.

1. Task: Review and assess the inventory of viruses found in sub-Saharan African cropping systems (Brown, U. Arizona | 03/01/2009)
2. Task: With the East Africa Regional Center and the Thrips-Transmitted Virus Global Theme, begin inventory of viruses in Kenya, Uganda, other Eastern African countries (Tolin, VT; Legg, IITA | 06/30/2009)

Activity 1.3: Develop and implement collaboration with Diagnostics Global Theme and Regional IPM Centers to make data on viruses available to the IPM CRSP users

Expected Outputs
Using the existing West Africa and other websites on whiteflies and viruses will make information from this project more widely available, as will linking with the IPDN system developed by the Diagnostics Global Theme in Africa and Central America.

1. Task: Expand linkages with the West Africa Regional IPM Center on virus and vector surveys (Brown, U. Arizona; Gilbertson, UC-Davis | 04/30/2009)

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

Description
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 2.1: Develop, optimize, and implement improved diagnostics of viruses in African vegetable systems

Expected Outputs
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.

1. Task: Continue to build capacity for in-country, begomovirus/vector identification in West African countries (Brown, U. Arizona; Legg, IITA | 09/30/2009)
2. Task: Begin linkage with East Africa regional center to train personnel in virus and vector diagnostic methods (Brown, U. Arizona; Tolin, VT | 12/31/2008)

Activity 2.2: Assess and improve diagnostic capabilities in Central America and the Caribbean

Expected Outputs
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.

1. Task: Conduct and analyze a survey to assess virus diagnostic capabilities and constraints (Tolin, VT | 05/01/2009)
2. Task: Hold workshop in Honduras to transfer tissue blot immunoassay technology for detection of RNA viruses to additional host countries (Tolin, VT; Roca, Zamorano; Melgar, FHIA | 09/30/2009)
3. Task: Continue identification of viruses with emphasis on (a) other important vegetable growing areas, and (b) identification of at least one virus in vegetables that have been negative to tests conducted to date (Roca, Zamorano; Rivera, FHIA, Palmieri, UVG, Gilbertson, UCD, Brown, U. Arizona; Tolin, VT | 09/30/2009)
4. Task: Verify capacity for virus diagnosis in the laboratory in Dominican Republic and provide additional training (Martinez, IDIAF; Deom, UGA; Tolin, VT | 03/31/2009)
5. Task: Provide training on virus and vector identification and explore additional membrane-based methods. (Brown, U. Arizona; Tolin, VT; Palmeiri, UVG; Roca, Zamorano | 09/30/2009)

Activity 2.3: Distribution and genetic characterization of aphid-transmitted viruses infecting solonaceous and cucurbit crops.

Expected Outputs
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 cucurbit and solanceous vegetables in Honduras.

1. Task: Finalize and publish molecular data on the diversity of Tobacco etch virus in Jamaica (McLaughlin, UWI; Tolin, VT | 06/20/2009)
2. Task: Examine incidence and diversity of Cucumber mosaic virus and its aphid vectors. (Tolin, VT; Martinez, DR; Roca, Zamorano, | 06/01/2009)
3. Task: Publish a new method for obtaining genetic characterization data for these viruses (Tolin, VT | 08/31/2009)

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

Description
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-tuned 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 sweet potato 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 3.1: Implement an IPM strategy for viruses in the Salama Valley of Guatemala

Expected Outputs
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.

1. Task: Implement the next phase of a host-free IPM plan, for management of whitefly-transmitted viruses, with periodic monitoring (Gilbertson, UCD; Palmieri, UVG; Brown, U. Arizona | 01/01/2009)

Activity 3.2: Initiate an IPM strategy for the Ocoa Valley in Dominican Republic

Expected Outputs
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.

1. Task: Continue meetings with stakeholders and finalize a plan for IPM systems development (Martinez, IDIAF; Deom, UGA; Tolin, VT | 06/01/2009)
2. Task: Begin confirmation of identification of viruses and vectors of importance in vegetable crops of the Ocoa Valley (Martinez, IDIAF; Deom, UGA; Tolin, VT | 08/31/2009)

Activity 3.3: Ecology and management of insect transmitted viruses in tomato and pepper in the Caribbean

Expected Outputs
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.

1. Task: Monitor for whitefly vectors of TYLCV and other viruses in tomatoes in two areas of Jamaica (McDonald, Myers, MINAG | 09/30/2009)
2. Task: Evaluate and transfer IPM packages for aphid-transmitted viruses in pepper in Jamaica (McDonald, Myers, MINAG, McLaughlin, UWI | 09/30/2009)

3. Task: Evaluate and transfer IPM packages for whitefly-transmitted viruses in tomato in Jamaica (McDonald, Myers, MINAG | 09/30/2009)
4. Task: Evaluation and assessment of CMV and TEV ecology in pepper in Dominican Republic (Martinez, DR; Tolin, VT; Deom, UGA | 09/30/2009)

Activity 3.4: Design and validation of ecologically based virus management practices in diverse cropping systems

Expected Outputs
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.

1. Task: Evaluation of practices in two locations in Honduras, the Comayagua Valley and in Southwestern Honduras under an organic agriculture scenario (Rivera, FHIA; Reuda, Zamorano | 07/01/2009)

Activity 3.5: Appraisal of predominant, problematic viral diseases and vectors in African cropping systems

Expected Outputs
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.

1. Task: Continue appraisals of viral diseases in Burkino Faso and Cameroon, through training programs (Brown, U. Arizona; Koutou, INERA; Leke, IRAD; Legg, IITA | 09/01/2009)
2. Task: Collaborate with West Africa Regional Center in whitefly speciation research and potential as virus vectors (| 09/01/2009)
3. Task: Collaborate with West Africa Regional Center and Diagnostic Hub on diagnosis of viruses (Gilbertson, UCD; Brown, U. Arizona | 09/30/2009)

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 4.1: Identify and deploy vegetable varieties with resistance to prevalent viruses

Expected Outputs
A plan for prioritizing the needs of host countries for germplasm. An inventory of sources of potential germplasm for testing. A system for distribution of germplasm to collaborators. Initial information on performance of selected germplasm for resistance to one or more viruses, identified by screening tests. Performance information for 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.

1. Task: Prioritize needs of host countries for virus resistant germplasm, and assess impact of the availability and use of such germplasm (Deom, UGA | 08/31/2009)
2. Task: Obtain accessions from commercial and germplasm collection sources,and evaluate for response to viral disease pressure. (Rivera, FHIA; Roca, Zamorano; Deom, UGA; Gilbertson, UCD; Green, AVRDC | 09/30/2009)

Activity 4.2: Explore the use of transgenic resistance to viruses

Expected Outputs
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.

1. Task: Review policies for testing transgenic virus-resistant crops in Honduras relative to other countries. (Tolin, VT; Deom, UGA; Roca, Zamorano | 12/31/2008)
2. Task: Develop a strategy to advance and test, in Honduras, tomato with transgenic resistance to TMV (Roca, Zamorano; Deom, UGA; Brown, UAz; Tolin, VT | 12/31/2008)

Activity 4.3: Assess the use of induced resistance for virus disease management

Expected Outputs
Data to indicate whether biorationals can be used in management of pepper viruses in Honduras and Jamaica.

1. Task: Initiate tests of selected compounds and organisms for their ability to induce systemic acquired resistance to viruses in pepper. (Rivera, FHIA; Reuda, Zamorano; McLaughlin, UWI | 08/31/2009)

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 5.1: Development and Implementation of a Survey of Farmers' Current Practices and Perceptions of Potential Problems and Solutions

Expected Outputs
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.

1. Task: Compile information on IPM acceptance by stakeholders (All | 09/30/2009)

Integrated Management of thrips-borne tospoviruses in vegetable cropping systems

Naidu Rayapati, Department of Plant Pathology, Washington State University

Objective 1: Establish a network of institutions in South and 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 virus disease constraints in developing countries of South & Southeast Asia and other regions depending on the resources available 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.

Activity 1.1: Develop linkages with other Global and Regional IPM-CRSP projects

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 different regions 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 'snow ball effect'.

Activity 1.2: Strengthen linkages with Global theme projects and IPM Regional projects

Information on thrips and tospoviruses, and methods for diagnosis of tospoviruses and other viruses will be shared with PIs of Global theme projects on insect-transmitted viruses and diagnostics, and PIs of Regional IPM projects in South Asia, Southeast Asia, Central Asia and East Africa. In addition, scientific expertise for identification of thrips and tospoviruses will be provided for host country collaborators involved in different global and regional projects.

Expected Outputs
Strengthened linkages between IPM CRSP projects.

1. Task: Provide information on thrips and tospoviruses and diagnostic protocols for identification of viruses to global and regional projects (Rayapati).
2. Task: Organize a scientific session "IPM strategies for the management of insect transmitted plant virus diseases" at the 6th International Symposium (March 24-26, 2008) in Portland, OR, with Sue Tolin (Rayapati).
3. Task: Provide training to one host country scientist from Honduras in collaboration with the regional IPM project in Latin America and the Caribbean with Jeff Alwang (Rayapati).

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 sixteen tospoviruses characterized globally so far, at least eight 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 and shifting cropping patterns. 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 throughout 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 (and other regions) 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 2.1: Documentation of viruses in vegetables

During a recent visit to India, the host country collaborators expressed the significance of documentation of different viruses, in addition to tospoviruses, in vegetable crops for building a comprehensive data base to deploy effective strategies for the management of virus diseases. Since symptom-based diagnosis of a specific virus in a given crop may not be accurate due to variability in symptoms, the collaborators felt that it is essential to accurately document virus(es) in different vegetables for developing appropriate management strategies. Such comprehensive information will also be valuable for disseminating science-based information on virus diseases through extension and outreach programs to different stakeholders. For this purpose, we will continue to collect and test samples showing virus-like symptoms or suspected for virus infections at regular intervals during the crop season from major vegetable growing regions of Andhra Pradesh (AP) and Tamil Nadu (TN).

In AP, our focus will be in four districts (Chittoor, Kadapa, Kurnool and Anantapur) of Rayalaseema region and one district (Khammam) of Telangana region. In TN, the focus will be in Dharmapuri, Salem and Coimbatore districts. Our focus for this activity will be on tomato and chile peppers in AP, and tomato and cucurbits in TN. Crops grown in these areas will be visited at regular intervals during the season and plant samples showing virus symptoms or suspected for virus infections will be collected and brought to the laboratory at University of Hyderabad, Hyderabad, and Tamil Nadu Agricultural University, Coimbatore, for further analyses. Plant samples will be tested by mechanical inoculation on indicator hosts (mainly cowpea and tobacco). Field samples will also be tested by serology (ELISA) using commercially available antibodies and RT-PCR or PCR (depending on the type of virus) using virus specific primers. Samples will be tested initially for viruses known to occur in tomato (tospoviruses, geminiviruses, tobamoviruses), chile peppers (tospoviruses, potyviruses and cucumber mosaic virus) and cucurbits (potyviruses and cucumber mosaic virus). In addition, select plant samples will be spotted on FTA cards and shipped to Rayapati's lab for additional molecular analyses and confirmation of virus(es) present in these samples.

Expected Outputs
Preliminary information on viruses in vegetables in Andhra Pradesh and Tamil Nadu available.

1. Task: Conduct surveys for viruses in tomato and chile peppers in Andhra Pradesh (K. Gopinath and N. Rayapati)
2. Task: Conduct surveys for viruses in tomato and cucumbers in Tamil Nadu (G. Karthikeyan and N. Rayapati)

Activity 2.2: Optimization of protocols for thrips transmission of tospoviruses

i. Establish a bioassay for virus transmission. A bioassay for studying transmission of Iris yellow spot virus by *Thrips tabaci* in onions will be conducted by Ms. Anitha Chitturi, a graduate student at UGA, Coastal Plain Experiment Station at Tifton, GA. In this study, onion seeds will be placed in germination trays under standard greenhouse conditions and allowed to germinate. The seedlings are then placed into a test tube wrapped with a wet cotton ball to provide enough moisture for the seedling and the test tube is sealed with parafilm. A single thrips adult from the onion field will be placed into each test tube and allowed to feed for 5 days. After 5 days the thrips will be collected for slide mounting and the seedling will be tested with DAS ELISA for the presence of virus using commercially available diagnostic kit.
ii. Studies on *T. tabaci* feeding behavior in onion. Studies on thrips feeding behavior in onion will provide leads in understanding IYSV transmission by *Thrips tabaci*. For this purpose, three behavioral parameters, namely, settling, feeding and oviposition will be observed by setting up whole plant bioassay in insect cages (dimensions: 47.5×47.5× 47.5 cm). Three developmental stages of onion plant, namely seedling, pre –bulb, and bulb stages will be used for this study. Six individuals of *T. tabaci* will be released on each onion plants at each developmental stage. To quantify the settling behavior, the number of thrips settled at a particular position on the leaf will be recorded up to 2 hrs at 15 min intervals. Thrips feeding will be recorded visually by observing the feeding scars on the leaf tissue. For oviposition, thrips will be allowed to oviposit for 8 days. Oviposition sites as well as the feeding scars will be counted by following the lacto- phenol acid-fuschin staining technique detailed by Nuessly *et. al* (1995) and Parella and Rob (1982). The intact leaf tissues from the plant will be excised from the plant and will be decolorized by boiling 3-5 minutes in the lacto phenol acid fuschin solution under a fume hood by following appropriate safety procedures. Stained leaves will be cooled for 3-5 hrs and excess stain will be removed with warm water. The leaves will be examined under a stereo microscope for oviposition sites indicated by purple rings.

Expected Outputs
Optimized protocols for thrips transmission of IYSV in onion available

1. Task: Establish a bioassay for virus transmission. (David Riley and Anitha Chitturi)
2. Task: Study *T. tabaci* feeding behavior in onion. (David Riley and Anitha Chitturi)

Activity 2.3: Diagnostic methods for the detection of vegetable viruses

Accurate diagnosis of virus is the first critical step in developing management strategies. Previously, we have demonstrated the value of tissue blot immunoassay (TBIA) for the detection of Peanut bud necrosis virus (PBNV). Due to a limited supply of quality antibodies for a wider application of this technology by various institutions in South and Southeast Asia, we intend to produce polyclonal antibodies against PBNV. For this purpose, we will clone nucleocapsid (N) and non-stuctural (NSs) genes encoded by Small RNA segment of PBNV into pET vector. The proteins expressed in *E. coli* (BL 21 (DE3)/pLysS) will be purified by column chromatography and used for injecting rabbits for the production of antibodies. These antibodies will be validated by ELISA for their specificity in diagnosing PBNV in plant samples collected from different places. The antibodies will be tested subsequently for their utility in TBIA for routine diagnosis of PBNV in field samples.

Tobacco streak virus (TSV) is an economically important virus disease in several vegetables and field crops. Overlapping symptoms with PBNV and Okra yellow mosaic virus (a whitefly-transmitted geminivirus) and the lack of quality antibodies accessible to detect TSV is precluding accurate diagnosis of the virus in vegetables like okra. Therefore, we intend to produce TSV-specific antibodies by cloning the coat protein (CP) gene of TSV into pET vector. The CP will be expressed in *E.coli* and polyclonal antibodies produced as described above. These antibodies will be validated by ELISA for their specificity in diagnosing TSV in plant samples collected from different places. The antibodies will be tested subsequently for their utility in TBIA for routine diagnosis of the virus in plant samples.

Expected Outputs
Viral genes cloned into pET vectors and production of polyclonal antibodies initiated for the diagnosis of PBNV and TSV.

Task: Clone PBNV and TSV genes, express in E. coli and initiate production of antibodies in rabbits (K. Gopinath and N. Rayapati)

Activity 2.4: Evaluation of field performance of tomato cultivars and hybrids against Peanut bud necrosis virus

Host-plant resistance has been increasingly recognized as being one of the most desirable and long term strategy for the management of tospovirus diseases. Our studies in recent years have indicated that Peanut bud necrosis virus (PBNV) has become a major limiting factor for tomato production in India. Due to lack of sources of host-plant resistance, evaluation of existing cultivars and hybrids will enable to assess the field performance of commercially available tomato cultivars and hybrids against PBNV, and make recommendations for farmers, in the short term, to grow suitable cultivars and/or hybrids. For this purpose, field trial involving select cultivars and hybrids commonly grown by farmers in Tamil Nadu will be conducted during 2008-09. The trial will be in a randomized block design with five replications to evaluate their performance against natural infection of PBNV. The size of each plot will be 4 meters with row spacing of 60 X 45 cm or 45 X 30 cm, depending on the cultivar/hybrid. The following data will be collected: (i) disease incidence at bi-weekly intervals, (ii) disease severity (1-5 scale) with 1 being no infection and 5 being plants showing leaf/petiole and stem necrosis and death, (iii) number of fruits/plant during the crop period, (iv) total weight of fruits/plant and (v) number of marketable fruits/cultivar and (vi) total yield per cultivar. The data will be analyzed statistically to determine differences in the performance of cultivars/hybrids against PBNV.

Expected Outputs
Preliminary data on varietal responses to PBNV available

Task: Conduct field trial for evaluating tomato cultivars and hybrids (G. Karthikeyan and N. Rayapati)

Activity 2.5: Evaluation of roguing as a management tactic against Peanut bud necrosis virus in tomato

During a recent visit to India, we have observed in several farmers' fields young tomato plants showing symptoms consisting of stunting, bronzing of leaves and necrosis on leaves and stems caused by PBNV. The infected plants were distributed in random indicative of virus being introduced through transplanting virus-infected seedlings from commercial nurseries. Since disease management by controlling thrips vectors using insecticidal treatments is difficult to achieve, an alternative approach would be to eliminate sources of infection in the field. One of the tactics commonly used to eliminate source(s) of virus infection is roguing of infected plants. To verify roguing as an effective tactic for the management of PBNV, we will identify three farmers' fields planted with tomatoes obtained from commercial nurseries. Each field will be selected in such a way that the transplants are about two-three weeks old and some transplants in random are showing virus symptoms. Each field will be divided into two halves. In one half, all infected seedlings will be removed and their location marked. In another half, all infected seedlings will be retained and marked. The three fields will be monitored at two-week intervals and additional plants showing during each visit will be counted. At the end of the crop, disease progress during the crop duration will be estimated and the ratio of infected and healthy plants will be calculated. In addition, total yield from each half of the field will be measured. The results will be analyzed to determine the effectiveness of roguing as a means of managing PBNV infection.

Expected Outputs
Preliminary information on the effectiveness of roguing is available.

Task: Conduct field experiment to study rouging as a strategy for disease control (G. Karthikeyan and N. Rayapati)

Activity 2.6: Genetic resistance against peanut bud necrosis virus in tomato

Host-plant resistance to virus and/or vector has been increasingly recognized as being one of the most desirable and long term strategy for the management of tospovirus diseases. Unfortunately, no natural resistance to Peanut bud necrosis virus (PBNV) is available in cultivated tomato. Of the resistance sources found in tomato, the hypersensitivity gene Sw-5 from *Lycopersicon peruvianum* has proved most useful in developing commercial cultivars of domesticated tomatoes (*L. esculentum*) with resistance against another tospovirus, namely Tomato spotted wilt virus (TSWV). However, resistance among cultivated tomatoes is specific only to TSWV and, therefore, such cultivars are susceptible to 'Asian' tospoviruses like PBNV. Thus, efforts are needed to identify sources of resistance to PBNV and/or thrips vector for developing genotypes with combined resistance as an effective contribution to PBNV management. Initial studies have indicated high levels of resistance in fourteen accessions of *L. peruvianum*, when mechanically inoculated with sap from PBNV-infected tomato plants under greenhouse conditions. However, transfer of resistance genes from *L. peruvianum* to cultivated tomato by traditional breeding approaches is a long-term process. To circumvent this delay, we plan to screen several lines of tomato mutants derived through "tilling" and chemical mutagenesis. Since many of these mutant lines have desirable quality characteristics and acceptable levels of tolerance to abiotic stress factors, evaluating them against PBNV can offer opportunities to rapidly identify virus-resistant/tolerant lines and deploy them in resistant breeding programs. For this purpose, we will initially screen about 50 tomato mutant lines in the greenhouse conditions by mechanical and/or graft inoculation techniques. Inoculated plants will be monitored for symptoms at weekly intervals and tested for the presence of virus by ELISA or RT-PCR. Mutant lines showing promising levels of resistance/tolerance will be selected for further evaluations in the greenhouse and in the field.

Expected Outputs
Information on potential source(s) of resistance in tomato mutant lines available.

Task: Screen tomato mutant lines for possible resistance against PBNV (K. Gopinath and N. Rayapati).

Activity 2.7: Determine seed transmission of tobacco streak virus in okra

During our recent visit to India, okra seedlings in two farmers' fields showed disease symptoms characteristic of Tobacco streak virus (TSV) infections. Since TSV is known to be seed-transmitted in some weed and crop species, we will conduct experiments to determine if TSV can be seed-transmitted through okra seed. This information will be useful to determine if TSV can spread through seed distributed by commercial companies. For this purpose, we will collect okra seeds from symptomatic okra fruits of TSV-infected plants. The seeds will be germinated under greenhouse conditions and the seedlings will be observed for symptoms at two-week intervals after germination. Seedlings showing symptoms will be tested by RT-PCR for the presence of virus. The rate of seed transmission will be calculated by the formula: number of infected seedlings/total number of seedlings x 100.

Expected Outputs
Preliminary information on seed transmission of TSV in okra available.

Task: Conduct experiments to determine seed transmission of TSV in okra seeds (G. Karthikeyan and N. Rayapati).

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 foundations 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
Strong linkages established between the U.S. and developing country institutions for enhanced crop production in developing countries.

Activity 3.1: Facilitate international exchanges of knowledge through long-term and short-term training programs

Funding will be provided for one graduate student (Mr. Janardana Poojari) to pursue higher studies (beginning Spring 2009) leading to Ph.D. at Washington State University under the direction of Dr. Naidu Rayapati. Ms. Anitha Chitturi will continue Ph.D. program at the University of Georgia, Tifton campus, under the direction of Dr. David Riley. Dr. N. Balakrishnan, faculty member from Tamil Nadu Agricultural University (TNAU) will continue receiving training in insect vectors and viruses at Washington State University as part of capacity building at TNAU, India.

Expected Outputs
Improved capacity for research on viruses and vectors

Task: Provide training for graduate students and one visiting scientist (N. Rayapati and Riley, D.)

Activity 3.2: Conduct technology dissemination to various stakeholders on tospovirus diseases in vegetables

Appropriate 'vehicles of knowledge' using a wide range of communication tools is vital for disseminating information on tospoviruses for the benefit of scientists, extension personnel, students, NGOs and other stakeholders. Two farmer field days will be conducted for increased awareness of virus diseases in vegetables in Chittoor district of Andhra Pradesh in collaboration with Dr. Vijay Kumar, Director of Indira Kanthi Pathakam (previously called VELUGU) Program of Government of Andhra Pradesh. Another farmers' field day on virus diseases will be conducted in Dharmapuri area. The proposed leaflet/fact sheet on Peanut bud necrosis tospovirus in India will be published in English, Telugu and Tamil for the benefit of farmers and extension personnel. In addition, (i) at least two scientific articles will be published in peer-reviewed journals and (ii) one presentation made at the IXth International Symposium on Thysanpotera and Tospoviruses to be held in Australia in September 2009. A scientific session "IPM strategies for the management of insect transmitted plant virus diseases" will be organized at the 6th International IPM Symposium at Portland, OR, during March 24-26, 2008.

Expected Outputs
Information on tospoviruses available for the benefit of farmers and extension agents. Increased global visibility for IPM CRSP.

1. Task: Produce leaflets/fact sheet on peanut bud necrosis tospoviruses (K. Gopinath, G. Karthikeyan and N. Rayapati)
2. Task: Submit two peer-reviewed articles for publication
3. Task: Make a presentation at the 9th International Symposium on Thysanpotera and Tospoviruses in Australia.

International Plant Diagnostic Network Global Theme

Sally Miller, Department of Plant Pathology, Ohio State University

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
The unified network of plant diagnostic laboratories [International Plant Diagnostic Network (IPDN)] was established in the first three years of the project 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 was modeled after the U.S. National Plant Diagnostic Network (NPDN). The core of this system consists of three regional plant diagnostic laboratories ("hubs") in Benin, Kenya and Guatemala that have developed a communication and data network with other laboratories ("spokes') in their own regions (West Africa, East Africa and Central America, respectively). Regional laboratories are 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.

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 1.1: Strengthen ties within regional hub and spoke laboratories

Description: Strengthen ties between regional hub and spoke laboratories by completing formal agreements with designated spoke laboratories in (East and West Africa).

Expected Outputs
Structure of hub and spoke laboratory networks will be completed in four countries each in East and West Africa. This has already been done in Central America.
Hub laboratories will coordinate with IPM CRSP regional laboratories on specific plant diseases diagnostic issues.

Objective 2: Develop a communication and data networking system

Continue to 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 and established in Years 1 and 2, will continue. 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, Operations Committees, other personnel of the IPDN, and volunteer subject matter experts.

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 2.1: Continue to populate the IPDN website with diagnostics information

Description
The IPDN website (http://www.intpdn.org) will be populated with additional information related to plant disease diagnostics in Africa and Central America. In addition, internal improvements will be made in the website to make it more accessible to diagnosticians internationally. Publicity pieces for the IPDN will be developed and posted on the site.

Expected Outputs
IPDN website information will be enhanced.
Brochures describing IPDN will be produced and distributed.
Plant disease diagnostic and management technical bulletins (four/region) on priority disease problems will be developed for farmers and extension service providers.
Plant disease documentaries (digital images of new diseases, distribution maps, and new reports of diseases) will be collated, assembled and shared electronically.

Activity 2.2: Establish priority lists of diseases and pathogens of important crops

Expected Outputs
Comprehensive lists of important pathogens will be prepared in each region.

Activity 2.3: Develop new standard operating protocols (SOPs) for the diagnosis/identification of diseases/pathogens, especially those of quarantine importance.

Expected Outputs
SOPs will be developed in all three regions, beginning with *Ralstonia solanacearum* if appropriate to the region. The goal is to develop four per region.

Activity 2.4: Analyze diagnostic capacity in each region

Expected Outputs
The capacity of laboratories for diagnostics in each region assessed during training programs in Years 1-4 will be compiled and developed into a paper for publication.

Activity 2.5: Develop disease management recommendations

Expected Outputs
Disease management recommendations for at least 10 major diseases per region will be developed or accessed from the literature and added to the DDIS/CIMS database.

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 focused 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 was highly focused on laboratory diagnostics utilizing classical and modern techniques. Year 3 training expanded to include insect pest diagnostics in addition to disease diagnostics in each region. Year 4 training will be directed toward increasing plant disease and insect pest diagnostic capacity in regional laboratories. Year 4 training will be conducted in the regions, and will provide in-depth diagnostics information on key target pests appropriate to the regions.

Expected Impacts
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 and insect pest problems, beginning with accurate diagnoses.
Diagnosticians in participating countries will update and improve their skills in plant disease and insect pest diagnostics, resulting in increased capacity and sustainability.
The long-term impact is improved management of plant diseases and insect pests, reduced economic impact of disease, reduced use of pesticides and improved household income.

Activity 3.1: Conduct regional plant disease and insect pest diagnostics training workshops

Expected Outputs
Improved diagnostic capacity in each region resulting from intensive training in plant disease diagnostics.

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 4.1: Complete evaluation of a PCR-based diagnostic assay for banana xanthomonas wilt (BXW)

Expected Outputs
Two papers on the BXW assay (one for development, the second for application) will be submitted for publication in an appropriate journal.

Activity 4.2: Develop, test and deploy assays for detection of whitefly- and aphid-transmitted viruses

Expected Outputs
Assays for whitefly-transmitted and aphid-transmitted virus deployed in hub and spoke labs in each region.

IPM Impact Assessment

George Norton, Department of Agricultural and Applied Economics, Virginia Tech

Objective 1: Develop a common set of methods

Description
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 1.1: Identify minimum data needs, models, and impact indicators at each level.

Refinements of methods to use in each site will continue this year.

Task: Work with graduate student to refine and apply methods for impact assessment (George Norton (Virginia Tech) | 09/01/2009)

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.

Description
Collaborating with 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 2.1: Work with project leaders in each site on collection of budget data from experiments and on collection of survey data

Task: Review data collected and suggest means to improve collection methods and data summaries (George Norton (Virginia Tech) | 09/01/2009)

Activity 2.2: Review impact results across sites and fill in gaps to provide impact assessment summary for the IPM CRSP

Finish reviewing results from previous assessments of impacts of IPM CRSP programs by site and analyze new survey data received from site leaders to produce additional basic impact assessments of IPM strategies by commodity for strategies produced by the CRSP. Economic surplus analyses will be completed for those commodities to provide assessments of the value of the IPM programs. Write up results in a report.

Expected Output
Summary impact assessment report

1. Task: Complete economic surplus analyses (George Norton (Virginia Tech) | 12/15/2007)
2. Task: Write summary report (George Norton (Virginia Tech) | 01/06/2009)

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

Description
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 3.1: Continue collecting data on pest losses by crop and country and analyze potential economic impacts of IPM

Data on production, price, and consumption, crop performance have been collected, but data on losses by pests, by crop, and by region within countries will continue.

1. Task: Continue including in a GIS the global biophysical landscape of insects, diseases, and weeds by country and disaggregated by agro-ecological zone (Phil Pardey (Minnesota) and Stan Wood (IFPRI) | 09/01/2009)
2. Task: Finish survey begun in 2008 of key scientists around the world to fill in gaps on crop losses to specific pests on specific crops by country and agroecological location and apply them with other data in the Climex model to project likelihood of appearance of key pests worldwide. (Phil Pardey (Minnesota) and Stan Wood (IFPRI) | 09/01/2009)

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

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

Activity 4.1: Establish collaborative relationships

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

Task: Interact with IARC (IFPRI, IITA, IRRI, AVRDC, ICARDA, CIFOR) and other economists on impact assessment through email, joint work on impact assessments, and visits when in the countries where they are located (George Norton (Virginia Tech) | 09/01/2009)

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

Description
Host country specialists will be trained in IPM impact assessment. 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 5.1: Train graduate students and other scientists

Expected Outputs
Three students continue graduate programs at Virginia Tech and one at Minnesota.

1. Task: MS level training for one student from Macedonia at Virginia Tech (George Norton (Virginia Tech) | 06/01/2009)
2. Task: MS level graduate training for one student from Benin at Virginia Tech (George Norton | 09/30/2009)
3. Task: Ph.D. level training for one U.S. student at Minnesota (Phil Pardey (Minnesota) | 09/30/2009)
4. Task: MS level training for one student from the Philippines (George Norton (Virginia Tech) | 06/01/2009)

Activity 5.2: Prepare training materials for IPM impact assessment

Expected Outputs
PowerPoint presentations for workshops on IPM impact assessment in English and Spanish

Task: Prepare training materials on IPM impact assessment in PowerPoint and distribute to site chairs (George Norton (Virginia Tech) | 06/01/2009)

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

Description
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 International IPM Symposia.

Activity 6.1: Bring methods and analyses to a broad audience.

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

1. Task: Publish at least one article (George Norton (Virginia Tech) | 09/01/2009)
2. Task: Make presentations at both professional and non-professional meetings including the International IPM Symposium in Portland in March 2009 (George Norton (Virginia Tech) | 09/01/2009)

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

Yulu Xia, NSF Center for Integrated Pest Management, North Carolina State University

Objective 1: Develop Decision Support Tools (to organize, analyze, communicate and store IPM information)

Description
This activity focuses on three major components:

1. The Global IPM Technology Database: This system has four distinctive components: (i) IPM Technology and Expert Database (IPMTED), (ii) Information Submission and Nomination System (ISNS), (iii) Links, (iv) Services and Information Integration.

IPMTED serves three sub-objectives:

(1) Serves as a primary source for obtaining IPM technology information and IPM technology information repository, especially for the developing countries which the IPM CRSP presents

(2) Assists Regional Programs and Global Themes for globalization/regionalization of IPM Technology.

(3) Provides materials for education and training.

See website: http://www.ipmnetwork.net/

To ensure technological soundness, long-term usability, and future integration with other international and national major information systems, it is necessary to use metadata standard such as Dublin Core for categorizing the digital materials. In view of current financial resource for this Global Theme and the broad tasks the proposed project is undertaking, this project is exploring the possibility of obtaining additional funding to pursue this long-term goal.

2. West Africa IPM Network/Whitefly Information System. This system is to provide comprehensive information in the aspects such as whitefly biology, ecology, and pest management. It will integrate with other relevant systems. See website: http://westafrica.ipmnetwork.net/

3. Southeast Asia IPM Network/Cocoa Pod Borer Information System. This system is to provide comprehensive information about pest management and cocoa pod borer. See website: http://seasia.ipmnetwork.net/

Expected Outputs
(See each of the corresponding sections in the activities below.)

Participating scientists and institutions

Scientists	Institution	IPM CRSP Program/Country
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Jeff Alwang	VT	LAC RP
Sue Tolin	VT	LAC RP
Don Mullins	VT	W. Africa RP
Carlyle Brewster	VT	W. Africa RP
James Westwood*	VT	W. Africa RP
Larry Vaughan*	VT	W. Africa RP
Phillip Chung	RADA	Jamaica
Carmen Suarez-Capello	INIAP	Ecuador
George Norton	VT	Assessment GT
Merle Shepard	Clemson	S.E. Asia RP
Michael Hammig	Clemson	S.E. Asia RP

* added recently

Also see our first year workplan for additional participants.

Activity 1.1. Databases and information systems development

Activity Category
Capacity Building and other

Description
This activity focuses on three major components:
1. The Global IPM Technology Database: Please refer the statement above

Expected Outcomes
- Add additional links and databases
- Provide more software services

2. West Africa IPM Network: see statement above

Expected Outcomes
- Complete re-design the web system
- Upload content and data
- Transfer the system to host country institution

3. Southeast Asia IPM Network: see statement above

Expected Outcomes
- Add additional links
- Map cocoa pod borer worldwide
- Transfer the technology to host country

National and International Participation and Presentations.

Description

By the end of this year (2009), the development phase of the three projects stated above will be completed. The future success of these projects depends on the participation of the two participating regions and the global pest management professionals. To facilitate the broad participation and awareness, we plan to present the projects in several national and international meetings during the year and publish papers in national and international journals.

Expected Outcomes

- Presentations on one international meeting (and Second IFIP International Conference on Computer and Computing Technologies in Agriculture (CCTA2008), China), and one or two national meetings such as The Sixth International IPM Symposium, March 24–26, 2009, Oregon.
- Publications in national and international journals.

Tasks

Tasks	Description
Global IPM Database	This is a four-year activity to develop the Global IPM Technology database stated above
Task 1 Additional links	A graduate student will collect world wide IPM information and link it to the database
Task 2 More software service	Work with regional programs to provide additional software such as web programming, interactive database
West Africa IPM Network	This is a four-year task to develop an information system for information sharing and exchange
Task 1 Complete redesign the webpage and internal system	VT, host country institutes, and NC State met (in July 2008) to decide re-design the whole system to provide better services to the needs in the region. Preliminary work has been done. Relevant parties are working together on each of the components (e.g. whitefly system, weeds management)
Task 2 Upload content and data	There still substantial data and webpages need to be loaded to the database such as regional pest distribution etc
Task 3 Transfer the system to host country institution	Work with the staff and scientists in the host country to develop map for transferring the system to the area.
Southeast Asia IPM Network	This is a four-year task to develop an information system for information sharing and exchange
Task 1 Add additional links	There are still significant amount of digital materials in cocoa pod borers and other major pests in the region. Scientists at Bogor Agri. University is working to include additional data and applications
Task 2 Map cocoa pod borer worldwide	We developed a generic mapping software for mapping pest distribution worldwide. Due to the significance of cocoa pod borer worldwide, mapping this pest is valuable regionally and globally.
Task 3 Transfer the technology to host country	We will work with IT professionals and our collaborator to transfer the system to Bogor Agri. Univ. in Indonesia.

Start/End Date
10-01-2008/9-30-2009

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

Description
Interactive cartography of fruit flies in Caribbean systems

Activity 2.1: Web, database, and GIS/ interactive cartography integration and applications

Activity Categories
Research, Capacity Building, Technology Transfer and other

Participating Scientists and Institutions

Scientists	Institution	IPM CRSP Program/Country
Shelby Fleischer	Penn State	ITD GT
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Sue Tolin	VT	LAC RP
Phillip Chung	RADA	Jamaica

Description
Develop interactive cartography for use in monitoring fruit flies and support the transfer of the software. Build from web-mapping tools currently in place (see www.pestwatch.psu.edu, and www.cei.psu.edu/cei/projects/agriculture.html) that use Active Server Pages (ASP) applications for web-based data capture into MS Access relational databases. The data from the database is ported into MySQL, and a MacroMedia Flash application is used to visualize changes over time as animations, while individual dates can be seen as still frames with linked time-series graphics.
Adapt distance education modules to enable users of these interactive cartography tools. Modules will overview basics of the underlying technologies (GIS, web) and instruct those who act as data collectors.

Deploy McPhail traps in Jamaica, and have data from those traps mapped on a regular basis.
Embed maps of fruit fly trap-catches (the MacroMedia Flash application) within webpages that help with species identification and management of soft fruits developed by RADA Jamaica.
Coordinate with the Caribbean Area Safeguarding Officer, USDA APHIS, to help develop the program relative to others working with fruit flies in the regions.

Coordinate this interactive cartography with efforts related to detection of invasive species in the region.

Expected Outputs
- Field survey and sampling: Continued work since 2007
- Specimen Identification and Online Data Entry
- 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.

Tasks

Task	Description
Field survey and sampling	This work has been carried out since 2007. We will continue the work.
Specimen Identification and Online Data Entry	Due the lack of financial and human resource, specimen identification is the bottleneck in the project so far. This global theme has added additional resources to it lately. It is expected that this is a focus in 2009. Penn State has completed the online data submission system. Host country institute will continue online data entry work during the year.
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 webpages.

Start/End Date
10-01-2008/9-30-2008

Objective 3: Establish a human and information technology infrastructure for agricultural pest information storage and pest monitoring

Description
This is a newly added program. As reported, this global theme is working with INIAP (Ecuador) to develop a national pest information system for their extension uses.

Expected Impact
Upon completion, this system will improve agricultural pest extension in Ecuador and beyond.

Participating Scientists and Institutions

Scientists	Institution	IPM CRSP Program/Country
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Jeff Alwang	VT	LAC RP
Sue Tolin	VT	LAC RP
Stephen Weller	Purdue	LAC RP
Carmen Suarez-Capello	INIAP	Ecuador

* added recently

Activity 3.1: Development or improvement of information systems/database will be developed/enhanced in host countries for pest monitoring and information delivering and sharing.

Activity Categories
Capacity Building

Task

Task	Description
Task 1 Data entry	Work with host country institute to load pest management information and data
Task 2 System Programming	Continue working on database and programming
Task 3 Technology Transfer	Transfer the system to host country

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 4.1: Hardware and software readiness, Database design, web browsing, and dynamic web programming.

Activity Categories
Capacity Building and Technology Transfer

Participating Scientists and Institutions

Scientists	Institution	IPM CRSP Program/Country
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Carlyle Brewster	VT	W. Africa RP
Phillip Chung	RADA	Jamaica
John Pickering	U. Georgia	ITD GT

Description
We will provide support to all regions, but with emphasis on Southeast Asia, West Africa, and the Caribbean. In particular, this GT will hold a workshop on Asian network on invasive species information (ASEAN-NIS) and course on database development.

Expected Outputs
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.

1. Added more hardware (computer) and software.
2. Continue providing support for all region

Task

Task	Description
Task 1 Workshop/training	Training on how to use standard technology to share pest information across Asia
Task 2 Hardware/software	Continue to install and purchase new hardware and software for the region
Task 3 IT support	Continue to install and purchase new hardware and software for the region

Start/End Date
10-01-2008/9-30-2009

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 5.1: 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.

Activity Categories
Capacity Building

Participating Scientists and Institutions

Scientists	Institution	IPM CRSP Program/Country
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Carlyle Brewster	VT	W. Africa RP
Phillip Chung	RADA	Jamaica
John Pickering	U. Georgia	ITD GT

Description
Major links include, but are not limited to:
- General international and national IPM information systems such as IPM CRSP reports and the USDA Regional IPM Centers Information System
- Regional information system sites such as CIPMNET in the Caribbean and
    - other regional IPM information systems this program will help to develop
- Major IPM-related technology sites such as GIS tutorials
- Where possible, actual data sharing through web services will be established to allow searching of multiple information sources. At the least, this system will connect in this way with the National System for the USDA Regional IPM Centers, the CSREES IPM Performance, Planning and Reporting System (currently being rewritten) and the IPM CRSP Reporting System (see more below).

The project will develop necessary software to enable all IPM CRSP participants to submit links online directly. All Regional Programs and Global Themes will submit their research data and results, nominate and recommend any IPM technology, and other relevant information to the global IPM technology database for sharing and communication.

If not otherwise specified, MS SQL Server will be used for managing the data in the project, and ColdFusion and Java will be used for programming.

Expected Output
- Add major links for the region
- Integrate major IPM information.

Task

Task	Description
Programming	Using IT to integrate relevant systems together

Start/End Date
10-01-2008/9-30-2009

Objective 6: Impact assessment of this GT on HC

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

Expect 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 6.1: Development of the technique and plan for impact assessment

Activity Categories
Other

Participating Scientists and Institutions

Scientists	Institution	IPM CRSP Program/Country
Ron Stinner	NC State	ITD GT
Yulu Xia	NC State	ITD GT
James VanKirk	NC State	ITD GT
James Harper	NC State	ITD GT
Paul Blackman	Penn State	LAC RP
Jeff Alwang	VT	LAC RP
Sue Tolin	VT	LAC RP
Stephen Weller	Purdue	LAC RP
Don Mullins	VT	W. Africa RP
George Norton	VT	Assessment GT
Merle Shepard	Clemson	S.E. Asia RP
Michael Hammig	Clemson	S.E. Asia RP

Description

Since this program does not deal with the production system directly, we need to develop some novel methods for impact assessment. Based on discussion with the Impact Assessment GT, potential methods include, but not limited to,

1. how does this GT help RPs and GTs to conduct their impact assessment. This includes using the databases provided by this program for their impact assessment.
2. how does this program help to transfer information, therefore, improve agricultural production in these countries
3. impact of this program on technology transfer, decision making, globalization, communication, training etc in HC, through analysis user file and visit information

Quantitative and non-quantitative methods will be developed for the period

Expected Outputs

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

Task

Task	Description
Development of assessment technique	Development of the technique for assessing impact of this global theme on the regions where this global theme collaborate.

Start/End Date

10-01-2008/9-30-2009

Performance Indicators for Monitoring and Evaluation

Progress to Date

Progresses have been made in several fronts. These works can be summarized as:

Collaborators and Partners

This GT has conducted several meeting in the regions and national conferences to monitor progresses and define next steps.

Objectives and Tasks

- The Global IPM Technology Database: User interface is built. And links with some of the major IPM networks are completed.
- West African IPM Network and Southeast Asia IPM Network: substantial progresses have been made for these two networks. We have many features such as online document submission system completed.