Feed the Future Food Security Innovation Labs:
Collaborative Research Programs

Innovation Lab: CRP IPM

Key to Green Agriculture

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VirginiaTech
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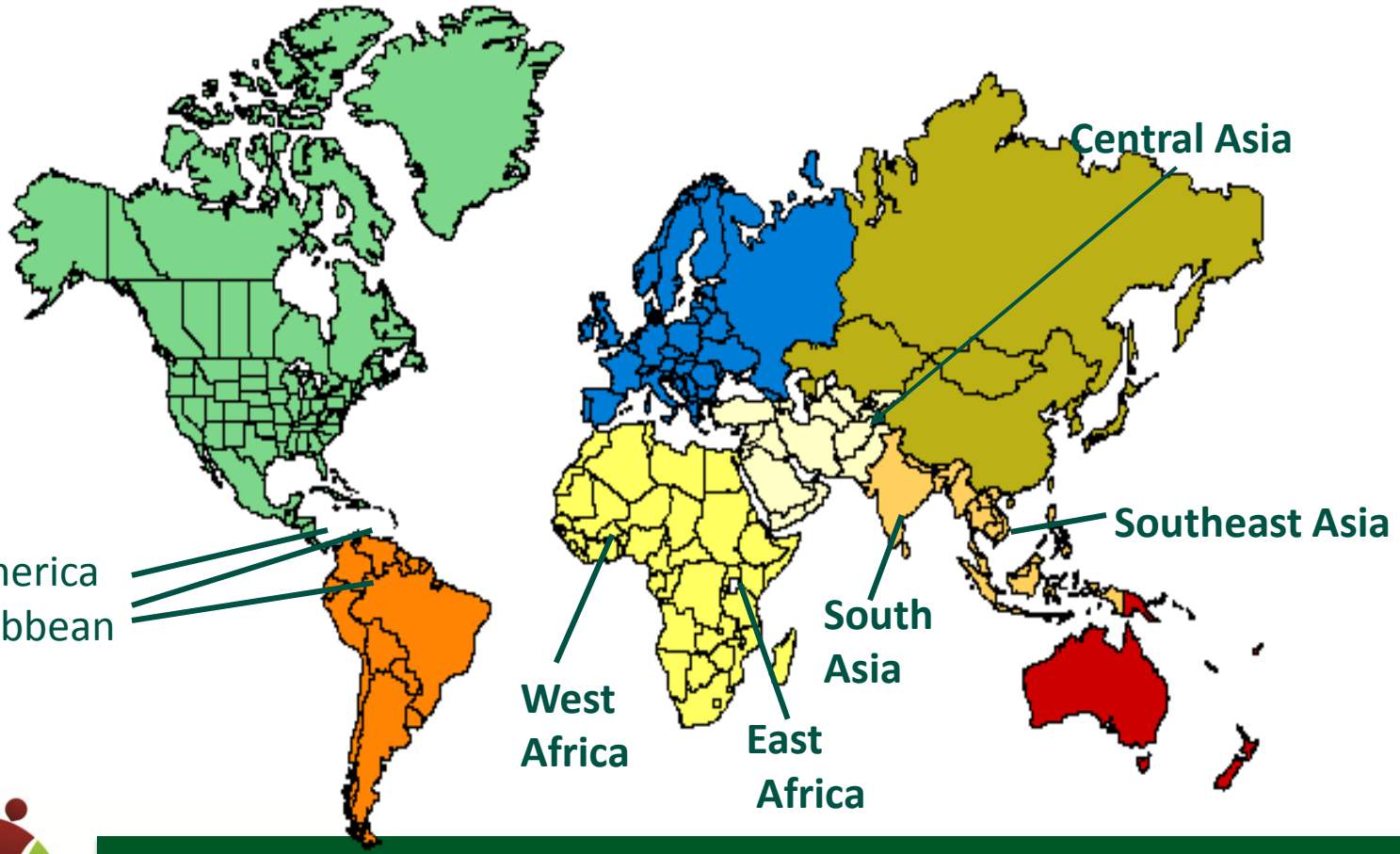
USAID
FROM THE AMERICAN PEOPLE

Integrated Pest Management
IPM CRSP
Collaborative Research Support Program

IPM CRSP Host Country Regions in 2009–2014

6 Regions



East Africa Project

- Ethiopia: Biological control of the invasive weed *Parthenium*
- Kenya: IPM packages for tomato, passion fruit and onion
- Tanzania: IPM packages for tomato, onion and coffee
- Uganda: IPM packages for tomato, onion and coffee

Eggplant and tomato grafting in Bangladesh

Eggplant grafting in Bangladesh

- Eggplant yield ↑ 249% in Bangladesh
- Income ↑ 305% in Bangladesh
- Technology transferred from Bangladesh to Ohio
- Technology transferred to India, Nepal, Philippines, Uganda, Honduras, Ecuador, and Kenya

Farmers Grafting Tomato for Bacterial Wilt Control

Eggplant killed by bacterial wilt

Farmers practicing solarization in high tunnel tomato production

Farmers practicing solarization for bacterial wilt control in tomato by covering with clear polythene sheet for 6 weeks

Development and use of Biopesticides

- *Trichoderma*
- NPV
- *Beuaveria*
- *Metarhizium*
- *Pseudomonas*
- *Bacillus subtilus*

Trichoderma Production and Use

Trichoderma Production and Use in Indonesia and Bangladesh. It is being introduced to Kenya and Senegal.
Will be introduced to Uganda, Tanzania and Ghana next year.

Passion fruit Virus Diseases

Fruit woodiness, ring spots and leaf curl and roll, mosaics and crinkling

Gemini virus control in tomato

Transmitted by white flies
Primarily *Bemisia tabaci*

Healthy tomato

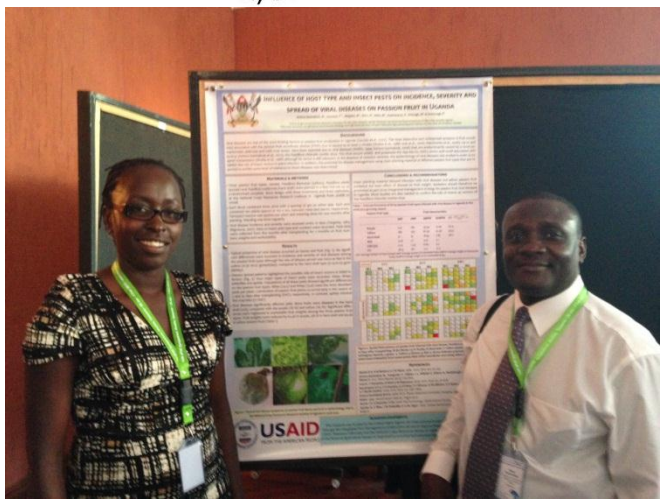
Virus infected tomato

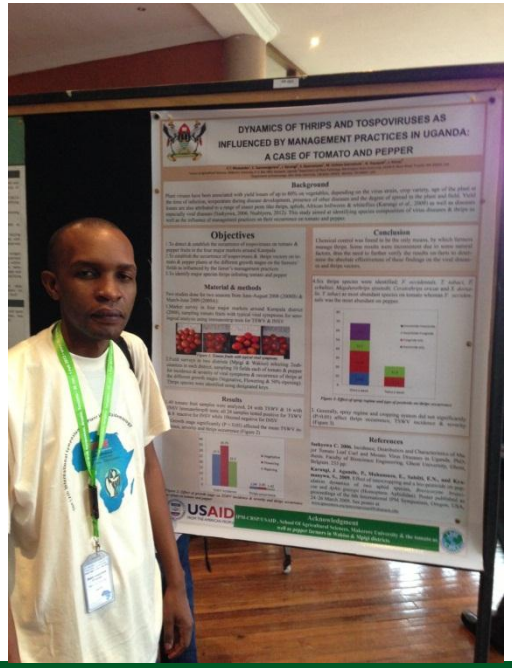
Host free period for 3 months is effective in reducing the incidence

12th International Symposium on Plant Virus Epidemiology

January 29, 2013 Arusha, Tanzania

- **Participants:** more than 220 virologists from more than 43 countries
- **IPM CRSP Special Session**
- **Partnership for strengthening capacity building development in Africa:**
- **Four IPM CRSP students presented posters.**





Coffee Pests in East Africa

- Coffee berry borer
- White stem borer
- Mealybugs
- Scales
- Antestia bug
- Coffee wilt disease
- Coffee rust

IPM Packages

IPM package for vegetables delivers food security and biodiversity

Use of bio-pesticides is one of the major components of IPM. The result is a significant increase in plant health and yield, a dramatic reduction in pesticide use, improvement in biodiversity, and an increase in farmer income.

IPM plays a major role in the management of Invasive Alien Plants and especially to manage Invasive Alien Arthropods and Microbes.

An IPM vegetable package is a set of technologies that can be applied to a given crop to obtain increased yield and reduce pesticide use.
It includes the following elements:

Soil Preparation
Techniques to enhance the soil—such as soil solarization and the addition of growth enhancers such as neem cake, VAM, and fertilizers—provide vegetables with the nutrients they need and deter pests such as weeds and nematodes.

Seed Treatment
Seed treatments such as *Trichoderma spp.*, *Pseudomonas fluorescens* and *Bacillus subtilis* protect the seedlings from pests.

Seed Selection
Quality seeds should be chosen according to need and availability. Pest resistance, yield, marketability, and suitability to the environment are important considerations.

Seedling Selection and Grafting
All seedlings in the nursery should be closely examined for viral and other diseases, and infected seedlings should be eliminated from the planting material. Grafting for pest resistance should be done when needed.

Biological Control
Adoption of biological control is a major component of IPM. Local natural enemies such as parasitoids can significantly decrease the need for pesticides.

Traps and Biopesticides
Sticky traps, pheromone traps, and bait traps may be used for both monitoring and reducing pest populations. When these populations reach an economic threshold, biopesticides such as NPV can be used.

Supplemental Tactics
Supplemental tactics including physical management techniques, such as using stakes, nets, and planting trap crops or nectar plants can be used to reduce pest damage.

Strategic Action
Strategic action, such as irrigation and rogueing, should be taken to keep plants healthy, reduce re-infection, and discourage pests. While this step is very effective, it is often labor

The Integrated Pest Management Collaborative Research Support Program (IPM CRSP) is managed by Virginia Tech at the International Affairs Office Building, 526 Prices Fork Road (0378), Blacksburg, VA 24061. Phone: (540) 231-6338

IPM for Tomato

- Seed or seedling treatment with *Trichoderma*, *Pseudomonas fluorescens,* and *Bacillus subtilis*
- Solarization of seed beds and greenhouses
- Use of VAM, neem cake and other organics
- Selecting virus-resistant varieties
- Grafting on resistant rootstock for bacterial wilt, Fusarium and others
- Staking and mulching
- Yellow sticky traps for thrips, leafminers etc.
- Pheromone traps for *Helicoverpa* and *Spodoptera*
- Host-free period and rogueing for control of virus diseases
- Use of Biopesticides such as neem
- Use of microbial pesticides such as NPV, *Metarhizium*, and *Beauveria*

Invasive Species in Africa

- Tomato leaf miner – *Tuta absoluta*
- Spiraling Whitefly – *Aleurodicus dispersus*
- Nesting Whitefly – *Paraleyrodes minei*
- Papaya mealybug – *Paracoccus marginatus*
- Solenopsis mealybug – *Phenacoccus solenopsis*
- Cassava mealybug – *Phenacoccus manihoti*

Papaya mealybug, *Paracoccus marginatus*

Order: Hemiptera, Suborder: Sternorrhyncha, Family: Pseudococcidae

- Native to Mexico
- First described in 1902
- Caribbean: 1995-2000
- Pacific: 2000-2005
- Asia: 2008
- West Africa: 2009

Papaya Mealybug Damage

Acerophagus papayae, A Parasitoid Used for Papaya Mealybug Control in West Africa

Tuta absoluta in Senegal and Ethiopia

A native of South America.
Introduced to Spain in 2006.
Now it is in Senegal and Ethiopia.
it will spread to West and East
Africa in next one or two years.
West Africa Regional Workshop – May 7-9, 2013
in collaboration with CORAF and USDA/APHIS
East Africa Regional Workshop – in planning stage
with ASARECA and USDA/APHIS

Cassava Mealybug – *Phenacoccus manihoti*

Native of South America
Introduced to Congo in early 1970s
Spread to Rest of Equatorial Africa
Thailand – 2009
Indonesia - 2010

Parasitoid: *Anagyrus lopezi*

Native of Paraguay and Brazil
Introduced to Africa – 1981

Thailand - 2009

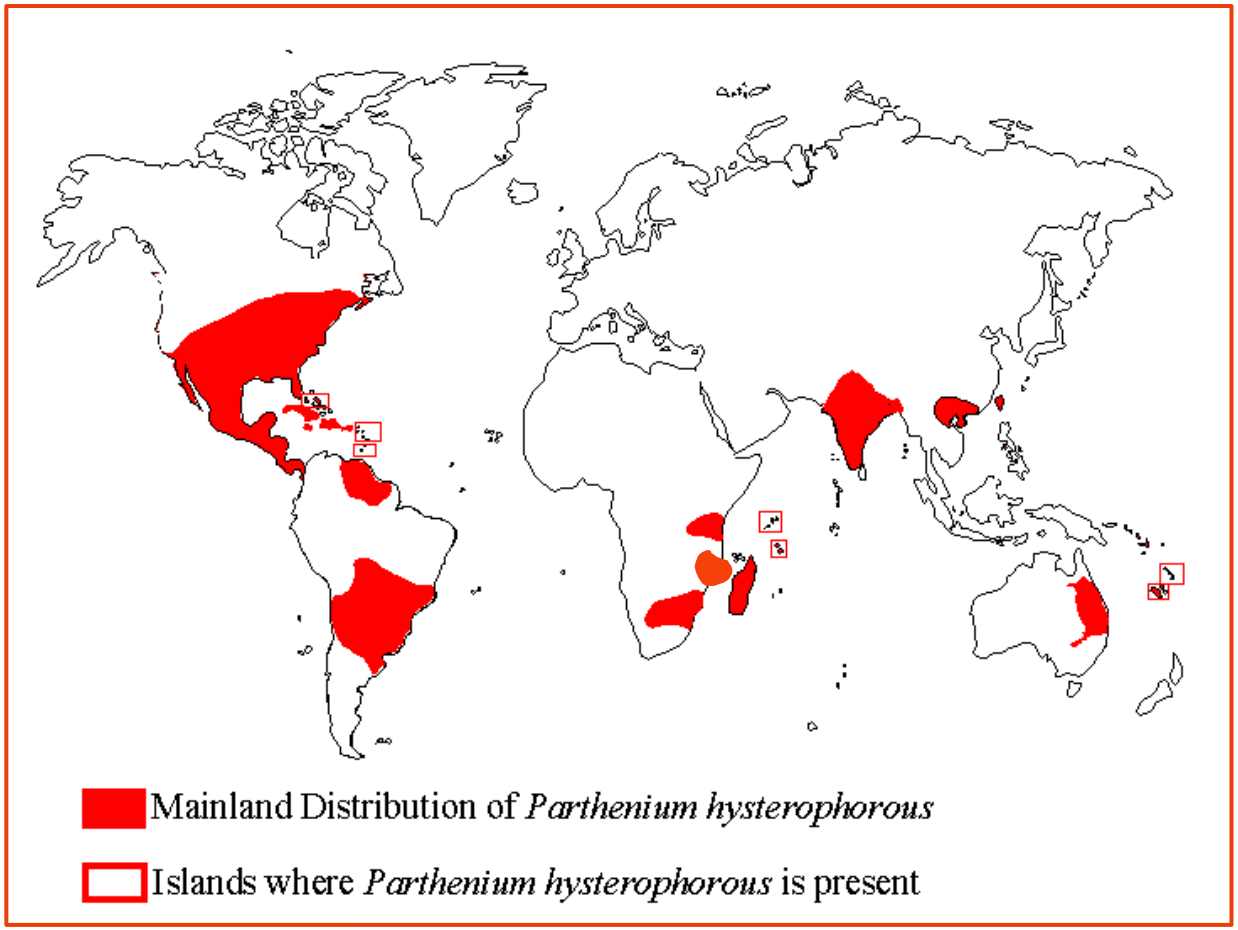
Benefit of Introduction of this Parasitoid into Africa : $200 to 500 for Each Dollar Spent

Invasive Weed - Parthenium

North American/Central American native plant threatening:

- Cultivated land
- Range land
- Natural biodiversity

Worldwide distribution of *Parthenium hysterophorus*



Source: Modified from University of Queensland's Centre for Biological Information Technology

Parthenium hysterophorus

Spreading in Eastern and Southern Africa

- For Biological Control of Parthenium
- Built a Quarantine Facility in Ethiopia
- Trained Personnel in Quarantine
- Host Specificity Tests Completed
- USAID Permit Received for Field Release

Zygogramma bicolorata (Coleoptera: Chrysomelidae)

- Introduced to Australia in 1980
- Introduced to India in 1984
- Ready to be released in Ethiopia

a

International Conference on Parthenium organized in Kenya

Plant Disease Diagnosis Training Tanzania- Sokoine University of Agriculture, May, 2012

Ghana 2011: Tomato Disease and Insect Pest Diagnostics

- Overviews -major diseases and pests
- Bacterial diseases
  - Culture, HR, serology
- Virus diseases
  - Sap transmission, serology, PCR
- Insect pests and vectors identification
- Fungal disease identification
  - Culturing, microscopy, serology
- Root knot nematode identification
- DDIS-CIMS training
- Diagnostics and IPM implementation

Long-term training

- Ethiopia – 3
- Kenya – 4
- Senegal – 3
- Tanzania – 7
- Uganda - 12

Selected Impacts of the IPM CRSP

Country and Authors	Crop	IPM Practice(s)	Net Benefits (millions)
Uganda, Moyo et al, 2007	Peanuts	Virus resistant variety	$33-36
Mali, Nouhoheflin, et al, 2011	Tomato	Cultural	$21-24
Uganda, Debass, 2000	Beans and maize	Cultural	$36-202
Bangladesh, Debass, 2000	Eggplant, cabbage	Cultural practices	$26-29
Bangladesh, Rakshit et al, 2011	Cucurbits	Pheromone traps	$3-6
Ecuador, Baez, 2004	Plantain	Cultural	$59-63
Ecuador, Quishpe, 2001	Potatoes	Resistant variety	$50
Albania, Daku, 2002	Olives	Cultural	$39-52
Honduras, Sparger, et al, 2011	Eggplant, onion, tomato, and pepper	Cultural practices	$17
India, Selvaraj, 2012 (preliminary analysis)	Mulberry, papaya, cassava	Papaya mealybug parasitoid release	$500

IPM CRSP Cost: Benefit Ratio

- IPM CRSP Budget for 20 Years

  $50 Million
- Benefits from IPM CRSP

  $788 to 983 Millions
- Cost:Benefit

  1:15 to 20

(This ratio is based on impact assessment of 10 IPM technologies implemented in 10 countries. Over 100 more technologies implemented are yet to be assessed. Assessing these may lead to a ratio of **1:150 to 200**)

Thank You

INNOVATION LABS
COLLABORATIVE RESEARCH