IPM CRSP
Global Theme on Plant Virus Diseases
Report to Technical Committee

August 6, 2011

Identify activities in each region and recount collaborative activities with regional projects.

Phase IV IPM-CRSP 2009-2014

Global Theme on Plant Virus Diseases

IPVDN or PVD

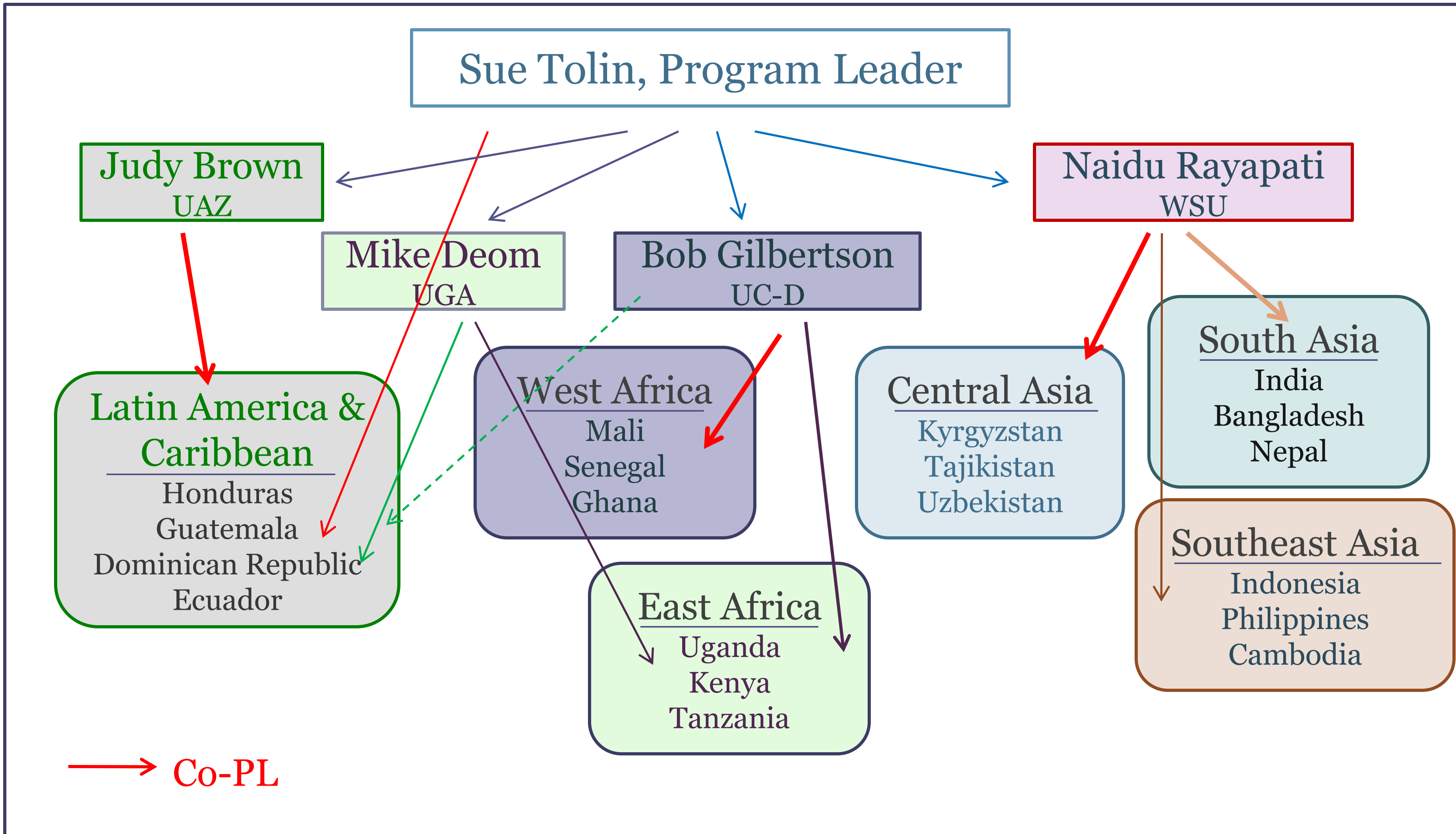
The International Plant Virus Disease Network:

Toward the Effective Integrated Pest Management of Plant Disease Caused by Viruses in Developing Countries: Detection and Diagnosis, Capacity Building and Training, and Formulation of IPM Packages

Phase III - Global Theme on Insect-Transmitted Virus

The IPM CRSP PVD Team

Plant Virus Disease Participants and Regions



IPM CRSP Global Theme Project
Plant Virus Diseases

Obj. 1: Status of Virus Knowledge for each host country/region:

Document the incidence and prevalence of plant virus diseases and their economic importance

What are the vectors or other means of transmission?

What are the associated biological and ecological factors affecting the incidence of these viruses, from a cropping systems perspective?

Activities:

- Cataloging known crop-specific virus diseases
- Improved detection and diagnosis of viruses in major vegetable crops in selected areas
- Epidemiological studies and ecosystem analyses

Needs for Virus Disease Management

- Diagnose virus and identify vector and sources
  - Research with in-country capacity building and training
  - Involve virologists and entomologists
- Predict potential management practices
  - Design experiments to assess success of interventions
- Provide models and approaches to be used by IPM scientists and practitioners
- Technology transfer by host-country scientists to introduce ecologically-based management system practices

Activities in Ecosystem analyses

- Design and validate IPM systems
  - Tobacco etch virus in pepper in Jamaica
    - Transfer technologies to Honduras, Dominican Republic
  - Host-free period for
- Virus diversity: Begomovirus, TEV, CMV
- Spatial-temporal dynamics of vector and virus
    - Aphids; Whiteflies
- Vector identity and diversity - aphid, whitefly, thrips

IPM CRSP Global Theme Project
Plant Virus Diseases

Obj. 2: Develop long-term institutional capacity building and conduct scientist training in host countries for:

- detection and diagnosis of plant virus diseases,
- screening and monitoring for resistance, and
- ecological research of virus-vector-host interactions in selected vegetable cropping systems

Activities: Capacity Building and Training

- Need assessments and appraisals
- Identify knowledge gaps
- Capacity to conduct lab- and field-based research on virus diseases
- Recognize virus diseases in field surveys, conduct field trials and data collection
- Interpret disease symptoms in a crop as caused by a specific virus

IPM CRSP Global Theme
Plant Virus Diseases

Obj. 3: In collaboration with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that result from information obtained in Objectives 1 and 2.

Activities: Design and validation of IPM packages

- Identify priority virus disease and vector systems problems
- Work on projects identified in regions in priority crops

Outcomes and Impacts of the PVD-GT

- Build host country capacity to diagnose and monitor viruses causing major diseases in selected crops.
- Recommend **standard approaches and methods** for ecosystem analysis of virus/vector research.
- Devise **best management practices** through IPM approaches for virus disease management, including resistance, that are acceptable for farmers.
- With regional projects, develop and validate IPM packages, and impact of imposing the management practice
  - Clean seed, clean plants, clean fields
  - Resistant cultivars
  - Avoiding early exposure to virus-carrying vectors
    - Adjust planting time to avoid vector peaks
    - Host-free periods – for virus and vector
    - Mixed Crops, trap crops

IPM Packages

Strategy: Resistant crop plants

- Varietal resistance through genetics - LAC, EA, WA, SA
  - Evaluation of varieties and germplasm for response to virus(es)
- Induced resistance\biocontrol
  - SA-India – Tomato IPM practice being tested vs. farmer practice
    - Seed treatment with *Pseudomonas* plus *Trichoderma*, soil application of *Pseudomonas*, removal of infected seedlings at the time of planting, roguing until 45 days after transplanting, soil amendment of neem cake at the time of land preparation, yellow sticky traps and neem-based pesticide application, as necessary, compared to farmer's practice of cultivation. Observe bi-weekly for virus by TNAU collaborators, and record harvest data.

IPM Packages

Strategy: Clean seed, seedlings, propagules

- Applied research to devise practices to eliminate source of virus, assess impact
  - Monitoring seedling production areas – tomato
    - Necrotic tomato viral diseases through clean seedling production, roguing (SA-India)
  - Reducing viruses in vegetative propagules
    - Potato seed as source of PVY ? (CA-Tajikastan)
    - Develop clean sweetpotato cuttings to reduce viruses (LAC-HO, GU)
  - Reducing seed-transmitted viruses
    - Bean yellow mosaic virus in Yard-long bean(SEA-Indonesia)
    - Pepper mild mottle virus in pepper (LAC-HO, DR)
    - Tobacco streak virus in okra (SA – India)

IPM Packages – vector-borne

Strategy: Target vector populations and virus source

- Applied research to devise, validate, and assess impact
  - Monitor host-free period for tomato WTG viruses management efficacy. (LAC-DR, GT; WA-Mali, Ghana, Senegal)
  - Psyllid vector dynamics to target insecticide use to manage zebra chip pathogen in tomato and potato (LAC-HO, GT)
  - Aphid vector dynamics, interference, and virus source for CMV, TEV, PVY management in pepper (LAC-DR)

Implementing Change for Plant Protection

Management of Insect-Transmitted Plant Virus Diseases in the Tropics

Organizers: Naidu Rayapati, WSU, Prosser; Sue Tolin, Virginia Tech, Blacksburg

Sponsors: IAPPS; APS Virology; APS Tropical Plant Pathology

Financial Sponsors: The Samuel Roberts Noble Foundation, Inc., APS/APHIS Working Group

Moderator: Sue Tolin, Virginia Tech

2011 APS • IPPC Joint Meeting August 6–10 Honolulu, Hawaii

APS

IAPPS

Speakers in the Symposium
Sunday 1:00 – 3:30 Room 323B

- Roger Jones
- Robert Gilbertson
- Margarita Palmieri

Break

- Judith Brown
- Naidu Rayapati
- Sue Tolin

Discussion

South Asia

- Programs with Tamil Nadu Agriculture University, collaborating with SA-RP
- Held a virus workshop at TNAU July 12-16,2010
  - Two and a half day program, 1.5 day hands-on exercises in virus detection/diagnosis, 1 day field trip.
  - Tolin and Naidu gave lectures; all participants spoke at beginning and end of the workshop. Also attended by Pfeiffer, SA-RP India Chair.
  - Participants from India, Indonesia (2), Cambodia (2), Uzbekistan (1), but not from Bangladesh or Nepal

Tamil Nadu Agricultural University, Coimbatore, India

Workshops for capacity building in plant virus diseases

IPVDN Global Theme
July 2010

Participants:
South Asia – India

Southeast Asia – Cambodia, Indonesia

Central Asia – Uzbekistan

Asia Virus Workshop at TNAU: Detection and Diagnosis: Hands-on Activities

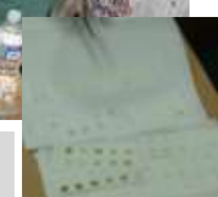
Symptom Observation

Biological Detection

Mechanical Transmission

See results 4 days later

Diagnostic Immunoassays



TBIA

2010 Virus Workshop - Tamil Nadu Field trip Components of IPM Packages - Tomato

1. Are seedlings the source of the thrips-transmitted *Peanut bud necrosis virus*?

2. Can losses from PBNV be reduced by roguing early-infected seedlings in fields?

Dr. G. Karthekeyan

Roguing as a management tactic for PBNV control demonstrated in Tamil Nadu, India

BUT

A woman-operated farm, planting a new crop next to field heavily damaged by Peanut bud necrosis virus

Bhendi yellow vein mosaic virus confirmed in Bangladesh

Sequenced Common Region using universal primers for begomoviruses

Shows 98% sequence identity with Bhendi yellow vein mosaic virus (BYVMV) from India

Significance: Cultivars/hybrids from India showing tolerance to BYVMV can be deployed in Bangladesh in collaboration with SA Regional project.


Collaboration with
SEA Regional Project
An epidemic of virus disease in yardlong bean in Indonesia

Collaboration with

SEA Regional Project and Indonesia

Identified the virus as Bean common mosaic virus through research and scientific exchange of host country scientist. Aphid vector; seed-borne.

Significance: Indonesian scientists are using this research-based knowledge for mitigating the virus spread and its impact

Management: Select seeds not carrying virus or resistant varieties. Analyze key aphid vectors; Develop IPM to manage – insecticides won't work.

Improving virus diagnosis

Muni distributing virus sampling cards to scientists at IVEGRI – FTA cards. Send to PVD collaborator labs to complete diagnosis PCR analysis.

Central Asia

- Workshop held June 6-11, 2010 at Tajik National University in Tajikistan, CA Regional project funded **Naidu Rayapati** to attend for IPVDN. IPDN also participated.

- Naidu concluded there is a strong need for increased effort by the IPVDN for capacity building in diagnosis and management of virus diseases in the CA countries, and a need for building virology teaching for undergraduate students at their universities.

Central Asia

Viruses in potato

- Immunostrips and RT-PCR used to confirm Potato virus Y in Tajikistan
- Further tests needed to document other viruses at the regional level

Central Asia

Showing potato symptoms to a farmer in Tajikistan

IPM team with a farmer family in Tajikistan discussing potato viruses

Latin America and Caribbean

- Capacity better, we've been there before
  - Guatemala, will train a student in J. Brown lab on sweetpotato virus diagnosis
    - Short-term visit to J. Brown lab for DNA sequencing
  - Dominican Republic - Lab completed, will gain additional short-term training in Univ del Valle
  - Honduras – enhanced capability for diagnostics, but Zamorano lab dropped
  - Ecuador – no direct interaction yet

LAC planning meetings

Dominican Republic - IDIAF

Evaluación de prácticas culturales sobre la diseminación del virus Y de la papa (PVY) y el virus del grabado del tabaco (TEV) en el cultivo de tomate

Several other activities - LAC

- Zebra chip disease of potato, also in tomato
  - Not a virus, but vector-transmitted
  - Foliar symptoms are like those caused by viruses
- Protected agriculture – tomato and pepper production in large mesh greenhouses
  - Eliminates whitefly-transmitted viruses
  - New problems with seed-borne and readily mechanically transmitted viruses
  - Thrips are sometimes increased in greenhouses

East Africa

- Diagnostic Global Theme and EA project workshop
  - Designated regional coordinator – Peter Sserawaga, Uganda
  - Passion fruit – some work with OSU on virus ID
  - As yet, no collaboration other than discussions
    - Unable to attend planning meetings
  - Gilbertson and Deom to visit in near future to look at viruses in tomato and pepper
  - Hope to participate in diagnostics workshop in Year 3

West Africa

- Diagnostic Global Theme Workshop in Ghana
  - Gilbertson participated in June 2011
- WA Regional Project Objective:
  - Improve tomato production in Mali through IPM

Implementation of host free period in Mali for management of whitefly-transmitted viruses of tomato

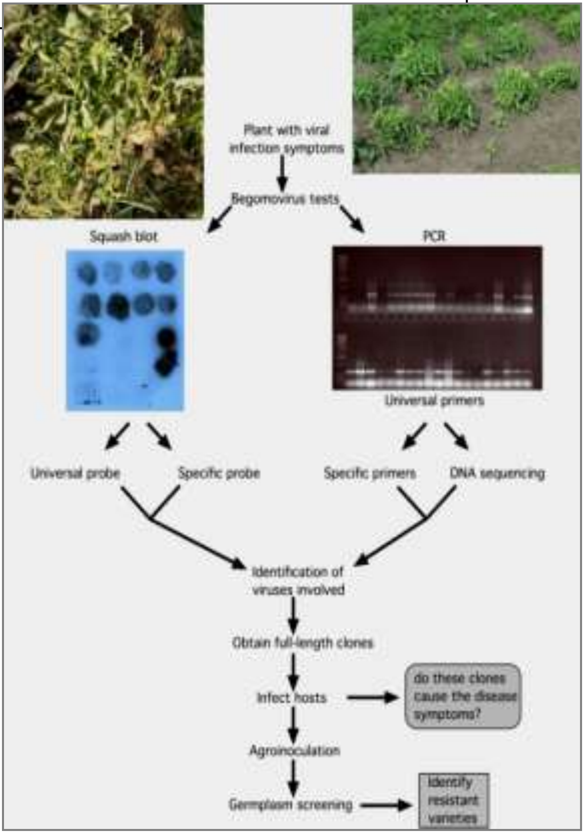
- Activities

  -Identify the viruses involved:

  Completed in Mali and nearly done for Senegal a nd Ghana (PVD-GT in collaboration with West African Regional Project)

  -Develop understanding of virus biology (host range, vector relations, etc.):

Research through PVGT and WA-RP has revealed the Mali tomato begomoviruses have a narrow host range and are primarily found in tomato. Led to idea the idea that a host free period could be implemented.



Identify by PCR and DNA hybridization in ‘squash’ blots performed at UC-D. Clone infectious DNA, agroinoculate tomato:
Are the same symptoms caused?
Can resistance be identified?

R. L. Gilbertson, UC-Davis

Implementation of host free period in Mali for management of whitefly-transmitted viruses of tomato

- Accomplishments

✓ Host free period implemented in Mali:

- In Baguineda (June-Aug) and Kati (April-June) were selected based on discussions with farmers and extension agents
- Combined HFP with a program of extensive sanitation and early maturing hybrid seeds

✓ Has resulted in dramatic reduction in virus incidence and increased yields of tomato

✓ Selected by IICEM for scale-up in Baguineda because of increased tomato production in this irrigated rice-vegetable area

✓ In Kati, the virus incidence has decreased and farmers are seeing increased yields

Baguineda tomato field following host free period

Moussa with one of our best farmers

Implementation of host free period in Mali for management of whitefly-transmitted viruses of tomato

Farmers in Kati are happy with results of the host free period and improved varieties

Farmers in Kati show their gratitude by giving Dr. Gilbertson a chicken

Identification of other viruses in West Africa: The first step toward disease management

- Through the PVD-GT and the WA-RP viruses causing diseases in other crops have been identified or are in the process of being identified
  - ZYMV and CYSDV in cucurbits
  - Begomoviruses causing okra leaf curl
  - Begomovirus causing pepper yellow vein
  - ACMV in cassava
- This information can be used now in the development of management strategies for these diseases
- In particular, the okra leaf curl warrants attention as it is found throughout West Africa and the viruses could 'jump' into cotton, a very important crop in the region

Identifying ACMV in Mali

Okra leaf curl is a major constraint on okra production in West Africa

Challenges in Managing Plant Virus Diseases in West Africa

- Need for development and access to improved diagnostics
- Lack of information on biology of many of the important viruses
- Lack of good facilities for diagnostics (especially in Mali and Senegal, better in Ghana)
- Lack of well-trained individuals to work on plant viruses
- Lack of access to improved germplasm (seeds)
- Challenges getting the information on viruses and virus IPM to growers

Newly built IER biotechnology building in Sotuba, Mali

Providing seeds of improved varieties to growers in Kati, Mali

Virus Disease Management

What can be done varies greatly depending on the sophistication and value of the agricultural system. R. Jones

- Affect source of the virus
  - Complex and continuous cropping systems pose a challenge
  - Benefit from simple interventions such as early roguing
  - Clean seed, transplants, etc.
- Intervene with vector populations
  - Extensive monitoring research required
- Alter host plant's response to infection
  - Genetic, induced

- Reduce initial inoculum
- Delay time of infection
- Decrease rate of spread

Challenges for IPM Packages for Plant Virus Diseases

- There is no ‘one-size-fits-all’ approach
- Strategies depend on the virus, the hosts, the vectors, and cropping system
  - Must be **virus-specific**, location specific
- Requires multidisciplinary approaches
  - Pathology, entomology, plant breeding
- Multi-institutional partnerships