Plant Virus Diseases and Diagnostics

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2009-2014

The International Plant Virus Disease Network (IPVDN)

Global Theme on Plant Virus Diseases
The International Plant Virus Disease network
IPM-IL Global Theme in 2009-2014
One Project - 6 Regions - 15 countries

Latin America and Caribbean
West Africa
South Asia
Southeast Asia
Central Asia
East Africa
Should we be Concerned about Virus Diseases?
Devastation caused by peanut bud necrosis virus in tomato in India
Devastation caused by viruses in cucurbits in Bangladesh
Affects family income
Epidemic of virus disease in yardlong bean in Indonesia

Source: Aunu Rauf, IPB
Bhendi yellow vein mosaic is a serious virus disease in India & Bangladesh.
Devastation caused by Peanut bud necrosis virus (PBNV) in tomato in India
PBNV
Symptoms
PBNV

Symptoms on fruits
PBNV
a major threat to tomato sustainability in India
Impacts of PBNV
<table>
<thead>
<tr>
<th>Component</th>
<th>Healthy</th>
<th>PBNV infected</th>
<th>% increase (+) or decrease (-) over healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (mg/100g)</td>
<td>30.19</td>
<td>25.72</td>
<td>-14.81</td>
</tr>
<tr>
<td>Iron (mg/100g)</td>
<td>0.80</td>
<td>0.82</td>
<td>2.50</td>
</tr>
<tr>
<td>Zinc (mg/100g)</td>
<td>0.26</td>
<td>0.16</td>
<td>-38.46</td>
</tr>
<tr>
<td>Sodium (mg/100g)</td>
<td>25.86</td>
<td>24.66</td>
<td>-4.64</td>
</tr>
<tr>
<td>Potassium (mg/100g)</td>
<td>156.18</td>
<td>148.12</td>
<td>-5.16</td>
</tr>
<tr>
<td>Vitamin A (IU)</td>
<td>9.61</td>
<td>6.69</td>
<td>-30.39</td>
</tr>
<tr>
<td>β- Carotene (mg/100g)</td>
<td>5.77</td>
<td>4.02</td>
<td>-30.33</td>
</tr>
<tr>
<td>Lycopene (mg/100g)</td>
<td>6.20</td>
<td>3.63</td>
<td>-41.45</td>
</tr>
<tr>
<td>Carbohydrate (%)</td>
<td>4.27</td>
<td>3.81</td>
<td>-10.77</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>0.67</td>
<td>0.66</td>
<td>-1.49</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>0.09</td>
<td>0.10</td>
<td>11.11</td>
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<tr>
<td>Fibre (%)</td>
<td>0.68</td>
<td>0.70</td>
<td>2.94</td>
</tr>
<tr>
<td>Total Sugars (%)</td>
<td>3.34</td>
<td>2.68</td>
<td>-19.76</td>
</tr>
</tbody>
</table>
Impacts of viruses

A summary

- Yield losses
- Poor nutritional quality
- Short shelf life
- Loss of income
Toward the Effective Integrated Pest Management of Plant Disease Caused by Viruses in Developing Countries

Detection and Diagnosis
Capacity Building and Training
Formulation of IPM Packages
Objective - 1

Document the prevalence of the most economically important plant virus diseases and their vectors in the region of interest through surveys, and investigate the associated biology and ecology with a cropping systems perspective.
Objective - 2

Develop long-term institutional capacity building and conduct scientist training in host countries for detection and diagnosis of plant virus (and virus-like) diseases, in screening and monitoring for resistance, and in ecological research of virus-vector-host interactions in selected vegetable cropping systems.
In cooperation with regional projects, design and implement applied research on specific virus diseases in selected crops in order to develop or improve IPM packages that employ results obtained in Objectives 1 and 2.
DN-Asia component
Priority vegetable crops

**India:** Tomato, Okra, Chili peppers, Cucurbits, other crops as needed.

**Bangladesh:** Tomato, Okra, Cucurbits, Chili peppers, other crops as needed.

**Nepal:** Tomato, Cucurbits, other crops as needed.

**Indonesia:** Tomato, Chili peppers, Yard long bean, other crops as needed.

**Cambodia:** Vegetables

**Tajikistan:** Potato, Tomato, other crops as needed
IPVDN-Asia

South Asia
- India
- Bangladesh*
- Nepal*

Southeast Asia
- Indonesia
- Cambodia*

Central Asia
- Tajikistan*

*FTF Countries

- Geographic & agro-ecological heterogeneity
- Common as well as distinct vegetable crops
- Common as well as distinct virus problems
- Different levels of institutional maturity in dealing with virus diseases
Partnership Approaches

Tajikistan  Nepal  India  Bangladesh  Indonesia  Cambodia

Facilitates South-North-South collaborations
Partnerships with
IPM IL Regional Programs

- South Asia
- Southeast Asia
- Central Asia
- IPVDN-Asia

(IPM IL stands for Integrated Pest Management International)
International Plant Virus Disease Network (IPVDN)

Objective - 1

Document the prevalence of the most economically important plant virus diseases and their vectors in the region of interest through surveys, and investigate the associated biology and ecology with a cropping systems perspective
A foundation for designing IPM strategies for management of virus diseases

- Knowledge about the virus and its transmission biology
- Method(s) for reliable detection of the virus
- Information on ecology and epidemiology
- Multidisciplinary collaboration
Why detection & diagnosis of viruses important?

How do you know that a particular symptom in a given plant species is caused by a specific virus?
Symptom-based diagnosis of a virus disease is not always reliable. Symptoms are variable due to:
- crop species & cultivar
- strain of a virus
- age of the crop
- environmental conditions
- mixed virus infections
- symptomless infections

Different viruses can produce similar symptoms
- mosaic symptoms
- necrotic symptoms

Accurate diagnosis of a virus is critical.
Issues for consideration

Â Make a clear distinction between symptoms of a virus disease and name of a virus
e.g. bud necrosis in tomato
   Tomato spotted wilt virus
   Peanut bud necrosis virus
   Capsicum chlorosis virus
   Impatiens necrotic spot virus

Â Limited institutional capacity in virus diagnosis
   - expertise & facilities
   - reagents

Â Innovative strategies needed
Detection of vegetable viruses using FTA® Classic Card technology

Diagnosis by RT-PCR/PCR

Tested for several DNA and RNA viruses from different countries in Asia and Africa
Building epidemiologic intelligence of vegetable viruses using FTA® Classic Card Technology
Chili peppers

Chilli veinal mottle virus
Chili peppers

‘Symptoms’ due to thrips feeding damage
Tomato

Two viruses - highly similar to:
Tomato leaf curl New Delhi virus
Bean common mosaic virus
Cowpea

Bean common mosaic virus
Beans

Bean yellow mosaic virus
Squash

Zucchini yellow mosaic virus
Pumpkin

Zucchini yellow mosaic virus
Cucurbits

A cucurbit field devastated by virus
Source of seed ??
Mosaic in pepper

a seed-borne problem?
Virus diseases of chili peppers

Cucumber mosaic virus
Chilli veinal mottle virus
Peanut bud necrosis virus/Capsicum chlorosis virus
Others???
Peanut bud necrosis virus
Symptoms
Cucurbits

More complex problems
Cucumber mosaic virus
Potyviruses
Others???
Variable symptoms
Mixed infections
Many are seed-borne
An epidemic of virus disease in yardlong bean in Indonesia

Collaboration leads to rapid identification & deployment of control measures
Bean common mosaic virus (BCMV)

92-97%

98-90%

cylindrical inclusion gene (partial)
Potato virus Y

Pengalengan, West Java

Tuber necrosis strain of PVY – a quarantine strain that could impact the production of virus-free potatoes
Objective - 2

Develop long-term institutional capacity building and conduct scientist training in host countries for detection and diagnosis of plant virus (and virus-like) diseases, in screening and monitoring for resistance, and in ecological research of virus-vector-host interactions in selected vegetable cropping systems.
Work with farmers
Capacity Building in Viruses & vectors, their management
Workshops/Training courses
July 2010

India
Indonesia
Tajikistan
Cambodia
Workshops/Training courses
July 2010
Workshops/Training courses
July 2010

India, Indonesia, Tajikistan, Cambodia
Knowledge dissemination

Interactions with scientists

(Images of people interacting in a field and at a market.)
Knowledge dissemination

Interactions with farmers

India

India

Bangladesh

Tajikistan
Thanks to: USAID

Collaborators from
 India
 Bangladesh
 Nepal
 Cambodia
 Tajikistan