Roguing for control of *Peanut bud necrosis virus* disease in tomato

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Topics

Introduction
- Peanut bud necrosis virus
- Impacts
Challenges in managing the disease
Roguing as a control tactic
Peanut bud necrosis virus (PBNV)

Genus: *Tospovirus*

Type member: *Tomato spotted wilt virus*
PBNV

South Asia: India & Bangladesh
Southeast Asia: Indonesia
PBNV = *Peanut bud necrosis virus*
CaCV = *Capsicum chlorosis virus*
WBNV = *Watermelon bud necrosis virus*
IYSV = *Iris yellow spot virus*
PYSV = *Peanut yellow spot virus*

(Kunkalikar et al., 2011 Phytopathology 101:367-376)
PBNV

Electron micrograph of virus particles

Drawing of virus particle

SDS-PAGE of virus particle proteins

Pleomorphic particles = 80-120 nm size
Three genomic RNA segments, negative sense
**Thrips palmi**
the principal vector of PBNV

<table>
<thead>
<tr>
<th>Thrips species</th>
<th>% Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Thrips palmi</em></td>
<td>38</td>
</tr>
<tr>
<td><em>Frankliniella schultzei</em></td>
<td>2</td>
</tr>
<tr>
<td><em>Scritithrips dorsalis</em></td>
<td>0</td>
</tr>
</tbody>
</table>

Source: ICRISAT, India
Interdependency between vector life-stage and virus transmission

- symptom expression, larval eclosion
- dispersal, inoculation & oviposition

Unique among plant viruses

1st instar larva

Virus acquisition

2nd instar larva

Prepupa

Circulative & propagative mode of transmission

1st instar larva

2nd instar larva

Prepupa

Pupa

quiescent & non-feeding

Pupa

Adult

Unique among plant viruses

symptom expression, larval eclosion

dispersal, inoculation & oviposition

Circulative & propagative mode of transmission
PBNV

- First reported in peanut
- Estimated value in peanut in India (1990s)
  - US $89 million/year
PBNV

Current status
broad host range - expansion to several field crops and vegetables
Broad host range of PBNV

Crop plants
Leguminosae
Peanut (*Arachis hypogaea*)
Soybean (*Glycine max*)
Cowpea (*Vigna unguiculata*)
Black gram (*V. mungo*)
Green gram (*V. radiata*)
Pea (*Pisum sativum*)
Solanaceae
Tomato (*Lycopersicon esculentum*)
Eggplant (*Solanum melongina*)
Chili pepper (*Capsicum annum*)
Potato (*Solanum tuberosum*)
Cucurbitaceae
Cucumber (*Cucumis sativus*)
Muskmelon (*Cucumis pepo*)
Watermelon (*Citrullus vulgaris*)
Pedaliaceae
Sesame (*Sesamum indicum*)
Cruciferae
Carrot (*Daucus carota*)
Malvaceae
Cotton (*Gossypium hirsutum*)

Weeds
Bristly stalbur (*Acanthospermum hispidum*)
Acalypha indica
Ageratum conyzoides
Alysicarpus longifolia
A. rugosus
Amaranthus sp.
Borreria hispida
Commelina bengalensis
C. jacobi
Corchorus trilocularis
Crotalaria sp.
Euphorbia geniculata
Lantenna camera
Lochnera pusilla
Physalis minima
Sesbania rostrata
Vigna triloba
Cynoptis cuculetta

Source: ICRISAT, India
T. palmi

- polyphagous
- shows habitat infidelity
- has superior reproductive output
- has propensity to ‘overwinter’ on a broad range of plant species

Devastation caused by PBNV in tomato

A farmer’s field near Coimbatore, India
PBNV
Symptoms
PBNV
Symptoms on fruits
PBNV

a major threat to tomato sustainability in India
**Impacts of PBNV on fruit quality**

<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>
</tr>
<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 PBNV

- Traders discard poor quality fruits
- Farmers incur loses
Impacts of PBNV

A summary

- yield losses
- poor nutritional quality
- short shelf life
- loss of income
IPM strategies for management of PBNV in tomato
Integrated management of PBNV

- Thrips vector management
- Manipulating cropping patterns
- Deploying tolerant/resistant cultivars
- Cultural practices
  (clean seedlings, roguing, weed control, etc.)
Use (or overuse) of pesticides to control thrips

Efforts to control vector thrips with insecticides have been mostly unsuccessful
Indiscriminate use of insecticides is leading to the development of resistance in thrips *T. palmi*.

Pesticides are not the solution.
Challenges in controlling PBNV

Host plant resistance

- Sw-5 resistance gene in tomato for TSWV – not effective for PBNV
- No source(s) of resistance against PBNV available
Challenges in controlling PBNV

Manipulating cropping patterns

- Multiple crops grown continuously throughout the year
- Imposing host-free period not possible
- Synchronizing planting date(s) not possible
- Maintaining optimum crop density not feasible
- Reservoir hosts survive throughout the year
Production of seedlings in nethouses
Production of seedlings in nethouses
Are tomato seedlings in nethouses a source of virus inoculum?
Are tomato seedlings in net houses a source of virus inoculum?

Healthy  Infected
Spread of PBNV via infected transplants
Spatio-temporal spread of PBNV via infected transplants

14th July 2008 (7.1%) → 25th Sept 2008 (29.9%)
Aggregation/clustering of infected plants
Spread of PBNV via infected transplants

Infected transplants
- carry the virus & thrips eggs/larvae
- a source of initial inoculum

Clustering of infected plants indicate secondary spread
Roguing as a management tool?
Roguing as a management tactic

**No roguing**
Transplant all seedlings
(no removal of symptomatic seedlings)

**Roguing**
Remove symptomatic seedlings before transplanting & upto 45 days post-transplanting
Roguing as a management tactic

Disease incidence

No roguing
Roguing

Fruit yield

Location

%
Roguing

Benefit-cost ratio

Cumulative yield of tomato fruits:
With no roguing: 11.1 tons/ha (30.5% decrease)
With roguing: 16.45 tons/ha

Revenue gained with roguing = Rs. 21,400/ha
(using a low market price of Rs. 4/kg)

Better quality fruits produced

Additional savings from no pesticide sprays
Roguing as a management tactic for management of PBNV being adopted by farmers

- Remove symptomatic seedlings before transplanting
- Remove symptomatic transplants in the field up to 45 days post-transplanting
Thanks to:

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Host Country Collaborator
Thank You