Recovering banana production in banana bunchy top disease (BBTD)-affected areas: Strategies to reduce infection pressure prior to, and after replanting


Contact for more information: L.kumar@cgiar.org
Banana bunchy top

- Causes severe stunting and affects bunch production
- Eradication and replanting with clean planting is the best control method
Banana bunchy top virus

- Genus *Babuvirus*, family *Nanoviridae*
- Infects members of *Musaceae* and *Ensete*
- Vectored by banana aphid
- Spread through vegetative propagation

One host, One vector, One virus

**BBTV Genome (six ssDNA)**
Bunch at the top

Bunchy top
### BBTV: worldwide distribution

<table>
<thead>
<tr>
<th>Continent</th>
<th>BBTV type</th>
<th>Countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asia</td>
<td>SEA group</td>
<td>Taiwan, China, Japan, Philippines, Indonesia, Vietnam, Thailand</td>
</tr>
<tr>
<td>Asia</td>
<td>PIO group</td>
<td>India, Iran, Pakistan, Sri Lanka, Myanmar, Bangladesh</td>
</tr>
<tr>
<td>Australia</td>
<td>PIO group</td>
<td>Australia</td>
</tr>
<tr>
<td>Africa</td>
<td>PIO group</td>
<td>Angola, Benin, Burundi, Cameroon, CAR, Congo, DRC, Egypt, Equatorial Guinea, Gabon, Malawi, Nigeria, Rwanda, South Africa and Zambia</td>
</tr>
<tr>
<td>South Pacific</td>
<td>PIO group</td>
<td>Hawaii and South Pacific islands (Fiji, Tonga, etc)</td>
</tr>
</tbody>
</table>

Source: Lava

A = Asian group
SP = South Pacific group
BBTV is an introduced disease in Africa (two separate events)

One event of introduction in central SSA expanded to 14 countries

Threatening 35% of Musa production in Africa

>50% production area affected in DRC, Congo, Gabon, Burundi, Equatorial Guinea, and Malawi.

<10 - 20% production area in Cameroon, Nigeria, Benin, Zambia, South Africa, Angola, Rwanda, and CAR.
• Host resistance is not available
• Controlled through containment, eradication and use of clean seed

**BBTD control: RTB partners leading the way in Africa**

**BBTD containment and recovery:** Building capacity and piloting field recovery approaches through a learning alliance

• Incepted in 2014
• Eradication and replanting fields with healthy planting material
• Benin, Burundi, Cameroon, Congo Brazzaville, DR Congo, Gabon, Malawi and Nigeria
• Partners: 12 NARES & NPPOs, 3 Universities
Challenges

- Disease spreading through movement of planting material (aphid vectors contributing local spread)
- Lack of awareness about the disease (inconspicuous symptoms at early stage / disguise attention) – resistance to eradication
- High inoculum presence in disease-affected areas
- Lack of clean planting material
Factors influencing reinfection rate

• Inoculum pressure in a region (incidence within the field; and frequency of infected fields)
• Distance between the newly replanted and disease-affected field
• Density of aphid population
• Aphid vectoring efficiency
• Host-susceptibility (virus titer)
• Environmental conditions (temperature, rainfall and wind)
Natural eradication of infected plants
Cavendish banana production declined in central and southern Malawi. Farmers shifted to maize.

Perineal production
About ~70% decline in production
High inoculum sources in the field
Central Africa
Recovery strategy

- Awareness creation
- Community engagement (social and gender analysis)
- Disease mapping
- Selection of champion farmers
  - Eradication of infected plants in the fields and neighboring farms (isolation distance at least 10 m)
  - Fallow period (1 to 2 months)
  - Replanting with clean planting material
- Scouting for reinfection, aphid infestation, extraction of suckers from replanted fields for planting material
- Demonstration / training sites
Seed multiplication

<table>
<thead>
<tr>
<th>Aloga: Plantain</th>
<th>Litete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goukouekoue: Plantain</td>
<td>Akoto</td>
</tr>
<tr>
<td>Osun: Plantain</td>
<td>Tala lola</td>
</tr>
<tr>
<td>Oyin vlan: Plantain</td>
<td>Blugoe</td>
</tr>
<tr>
<td>Goukouekoue: Plantain</td>
<td>Harare</td>
</tr>
<tr>
<td>Planta: Banana</td>
<td>Zeru</td>
</tr>
<tr>
<td>Gboguive: Banana</td>
<td>Agbagba</td>
</tr>
<tr>
<td>Glinsi: Banana</td>
<td>Paranta</td>
</tr>
<tr>
<td>Guinee: Banana</td>
<td>False horn</td>
</tr>
<tr>
<td>Yagambi km5: Banana</td>
<td>True horn</td>
</tr>
<tr>
<td>Gros Michel</td>
<td>Bubi</td>
</tr>
<tr>
<td>Pisang Awak</td>
<td>Hybrids (FHIA)</td>
</tr>
<tr>
<td>Adili</td>
<td>Desert a' cuire</td>
</tr>
<tr>
<td>Ambulu</td>
<td></td>
</tr>
</tbody>
</table>

• 27 varieties being multiplied (Banana, Plantain and Hybrids)

Micro and macro propagation

Source plants from in vitro labs Invitropic, IITA, ISABU
BBTV diagnostic tools

ELISA

LAMP

Rapid and quick diagnostics for off-lab use established

RPA Amplification curves
Drones for mapping

- Crop area
- Disease risk
- Epidemiology
- Crop area monitoring

### CIP Data from Tanzania

<table>
<thead>
<tr>
<th>Crops</th>
<th>Estimated Area (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>381.193</td>
</tr>
<tr>
<td>Sweetpotato</td>
<td>429.143</td>
</tr>
<tr>
<td>Cassava</td>
<td>362.233</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Polygon</th>
<th>From Image Measured</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>744.032</td>
<td>734.875</td>
</tr>
</tbody>
</table>

Slide: E. Cheruiyot, CIP; STARS Workshop
Community engagement

Cross-sectional study carried out by gender specialists using standard protocol in all pilot sites

Gender Division of Labor
- Land clearing: Mostly men (Burundi 64%)
- Weeding: Mostly women (DRC 87%)

Knowledge of BBTD
- Very low among both men and women
- In Gabon over 80% men and women not able to accurately identify BBTD

Access, Use and Control of Productive Resources
- Land ownership: Mostly men (56%) while land use is mostly joint (83%)
Communication and advocacy

• Information sharing (mass media)
• Engagement with quarantine officials
• Gaining support of government officials and policymakers

‘Stop Bunchy Top’ campaign
Eradication of infected plants

- Uprooting
- Cocktail of insecticide and herbicide
Mapping disease farms

- Mapping disease farms
- Gaining farmer consent
- Eradication of infected plants
- Replanting healthy planting material
- Isolation distance of at least 50 m

Nkhota-kota site in Malawi
## Replanted field in Nkhotakota (Malawi)

<table>
<thead>
<tr>
<th>Date planted</th>
<th>Number of plants</th>
<th>Cultivars planted</th>
<th>Current age</th>
<th># plants rogued</th>
<th>Distance to nearest bananas (meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 Aug, 2014</td>
<td>2,000 (133)</td>
<td>1,000 Williams and 1000 Grand naine</td>
<td>1 year 8 months</td>
<td>14</td>
<td>NC 120</td>
</tr>
<tr>
<td>30th December 2014</td>
<td>500 (200)</td>
<td>1,000 Williams and Grand naine</td>
<td>1 year 5 months</td>
<td>8</td>
<td>SC 11</td>
</tr>
<tr>
<td>11th January, 2015</td>
<td>895 (601)</td>
<td>Williams</td>
<td>1 year 4 months</td>
<td>4</td>
<td>EC 31</td>
</tr>
<tr>
<td>31st December 2015</td>
<td>247 (95)**</td>
<td>Grand naine</td>
<td>5 months</td>
<td>15</td>
<td>WC 16</td>
</tr>
<tr>
<td>16th April 2016</td>
<td>567 (?)</td>
<td>Grand naine</td>
<td>Less than 1 months</td>
<td>NA</td>
<td>NC 16</td>
</tr>
</tbody>
</table>

**Note:** Numbers in parentheses indicate rogued plants.
# Post planting monitoring in Nkhotakota

<table>
<thead>
<tr>
<th># times aphids observed</th>
<th># plants observed</th>
<th>% plants with aphids</th>
<th># times BBTV scouted</th>
<th># plants observed</th>
<th># times ELISA test</th>
<th># plants tested</th>
<th># BBTV positive</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>22</td>
<td>&gt;10</td>
<td>32</td>
<td>21</td>
<td>10</td>
<td>450</td>
<td>14</td>
</tr>
<tr>
<td>12</td>
<td>32</td>
<td>&gt;10</td>
<td>24</td>
<td>4</td>
<td>8</td>
<td>450</td>
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<td>24</td>
<td>14</td>
<td>8</td>
<td>450</td>
<td>32</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>1</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

Evidence of reinfection
Lessons

• Farmers participation in the meetings and training sessions depends on other priorities

• Poor adoption of eradication methods because of labor constraints

• Reluctance for total eradication with a hope of eventual next harvest among different shoots within the symptomatic mat

• Poor participation of government extension services

• Supply of clean planting material motivates farmers to participate in the control efforts

• Success of the eradication depends on sponsored programs

• New knowledge on genotype x virus x vector interactions offering a hope for selection of ‘tolerant clones’ for use in endemic areas to reduce inoculum pressure
Acknowledgments
Thank you

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www.bbtvalliance.org

ALLIANCE for Banana Bunchy Top Disease Control in Africa