Ramu stunt: an important biosecurity threat to the Australian sugarcane industry

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Sugar Research Australia and Ramu Agri-Industries Ltd.
Papua New Guinea is the home of several wild and cultivated sugarcane species:

<table>
<thead>
<tr>
<th>Wild canes:</th>
<th>Traditional village gardens:</th>
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<tbody>
<tr>
<td><em>Saccharum robustum</em> (roadsides and river banks)</td>
<td><em>Saccharum officinarum</em> (noble or chewing cane)</td>
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<tr>
<td><em>Saccharum spontaneum</em></td>
<td><em>Saccharum edule</em> (pit pit, vegetable)</td>
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<tr>
<td><em>Miscanthus</em></td>
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<tr>
<td><em>Erianthus</em></td>
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</table>
And home to one commercial sugar estate

• Based at Gusap on the Ramu River in Madang Province
• Ramu Sugar Limited 1978
• PNG government major shareholder
• Ramu Agri-Industries Limited (RAIL)
• Sime Darby Plantation (Malaysia)
• Sugar, oil palm, beef, ethanol
History of Ramu stunt

- Ramu Sugar started production in 1982 with 4 commercial varieties
- Good progress until 1985
- Ragnar (88% crop) 25% drop in yield
- 3 varieties (96% crop) susceptible: poor yields, stool death and stunting
- Identified as Ramu stunt
- Cadmus was resistant and used to replant the estate
Leaves: Various chlorotic stripes and flecks
  • a rough-edged stripe of mid and light green

Whole plant: Stunting
  • Stools can also be yellow, trashy and grassy
Vector

- Island sugarcane planthopper: *Eumetopina flavipes*
- High risk to Australia because *Eumetopina* occurs on many Torres Strait islands and northern tip of Australia
Australian and PNG collaborative research

1. Causal agent
   • Unknown during the 1980s: a virus or phytoplasma
   • In the 2000’s: shown to be a Tenuivirus
   • Entire viral genome (6 fragments) was recently sequenced

2. Diagnostic test
   • Based on major non-capsid protein coding region

3. Resistance screening
   • 25% of Australian varieties are susceptible

4. Host-vector transmission experiments

5. Surveys throughout PNG
Offshore biosecurity activities

Diagnostic test validation + sampling strategy
For Australian quarantine: Leaves dried over CaCl₂ and irradiated

Resistance screening trials
To assess reaction of Australian varieties

Caged insect transmission experiments
To understand vector biology
Surveys: Why?

• Belief that Ramu stunt is “everywhere” in PNG
• The biosecurity risk to Australia is higher if the disease is widespread and common
• Especially if it also occurs in grasses and weeds
• Surveys target:
  • Roadsides: wild canes and grasses
  • Gardens: noble canes and pit pit
- Ramu Agri-Industries, Ramu Valley, Madang (Madang Province)
- Goroka (Eastern Highlands Province)
- Alotau (Milne Bay Province)
- Alotau isolates known to be different since an early 2001 PNG-wide survey

- Infected canes were only found around Ramu and Alotau
- All were noble canes in gardens
- Some *Eumetopina* also tested positive

- Ramu stunt is present outside of the estate but NOT common
- No Ramu stunt detected in: *S. robustum*, *S. edule*, blady grass, elephant grass, guinea grass, itch grass
Isolate variation:
• Fragment 6 (1.2kb): major non-capsid coding region
Genome sequencing of more isolates underway

<table>
<thead>
<tr>
<th>Who?</th>
<th>Isolate/Host</th>
<th>Location</th>
<th>Year</th>
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</thead>
<tbody>
<tr>
<td>SRA</td>
<td>PN97-54 (commercial)</td>
<td>RAIL estate</td>
<td>2012</td>
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<tr>
<td></td>
<td>Wamba-4 (noble cane)</td>
<td>Home garden, RAIL estate</td>
<td>2012</td>
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<tr>
<td></td>
<td>Alotau-26 (noble cane)</td>
<td>Home garden, Bitu Village, Alotau</td>
<td>2013</td>
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<tr>
<td>Beltsville</td>
<td>R570 (commercial)</td>
<td>RAIL estate</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Asas-26 (noble cane)</td>
<td>Home garden, Asas, Ramu Valley</td>
<td>2016</td>
</tr>
</tbody>
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• Collaborating with Dimitre Mollov (USDA National Germplasm Resources Laboratory, Beltsville, Maryland USA)
• Viral genome from Ragnar sequenced in 2016
• Sample quality → RNA quality poor but proceeded
• Results confirm that Alotau isolate is different
• Existing diagnostic test required modification
Thanks to:

- **SRA projects**
  1. Preparing the Australian sugarcane industry for threats from exotic pests and diseases 2009 – 2015
  2. Securing Australia from PNG biosecurity threats 2015 – 2017
- **Funding SRA, QDAF** (and previously BSES, SRDC, ACIAR)
- **Dimitre Mollov** (National Germplasm Resources Laboratory, USDA-ARS, Beltsville Maryland USA)

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<tr>
<th>SRA staff</th>
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<th>Ramu staff</th>
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<tr>
<td>Nicole Thompson</td>
<td>Judi Bull</td>
<td>Kaile Korowai</td>
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<tr>
<td>Rob Magarey</td>
<td>Lisa Derby</td>
<td>Wamba and Baina</td>
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<tr>
<td>Peter Samson</td>
<td>Liz Wilson</td>
<td>Simeon Yamang</td>
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<td>Nader Sallam</td>
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<td>Pathology field team</td>
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