Tools for the management of the banana bunchy top disease in small holder systems

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**Musa spp**: Banana and plantain

Musa-related species:
(PINTEREST, Author unknown)
Banana Bunchy Top Disease

BBTD vector – Banana aphid

Early symptoms of BBTD

Bunchy-top morphology
Rapidly spreading in Africa

- Spreading in banana/plantain area
- Three new country reports in 2020/2021
- Rapid reduction of productivity
- Loss of clean seed in informal sources
- Loss of regional seed business

Bunchy Top Disease in Africa (worldwide)

Jekinoluwa et al., 2020
The Learning Alliance (2013 – 2021)

The community recovery approaches to recovery

Community approaches

- What is the priority?
- How can control be made more efficient?
- How can control be made more acceptable?
- Group dynamics, gender, inheritance, seed systems?
BBTD detection - symptoms

Leaf reference and detection of BBTD

Marginal chlorosis

‘Morse-code’ streaks

‘J-hooks symptom’

Progressive dwarfing – bunchy top

Allen 1987
Detection: Scouting and rogueing

Rapid reduction of disease pressure, need for plant elimination

Declining frequency of new disease detection with time

Omondi et al (2020), *Plant Pathology*
Rogueing: Fidelity and consistency

Lower frequency, lowlands, higher disease pressure > 60% BBTD

Non managed garden: 50% in Y2, 90% Y3, seasonal trends

Highland, high frequency, coordination between gardens

Managed gardens: declining BBTD levels, <1%
Context: Spatial disease risk assessment

Approach

- UAV-based mapping canopy coverage and area
- Ground assessment of canopy and crop management
- Focus: Garden and 100m buffer around
- Association of disease incidence (disease event)

Key correlates to disease prevalence

Al-supported BBTD detection

Consistency of TUMAINI APP

<table>
<thead>
<tr>
<th>Variable</th>
<th>Probability</th>
<th>Interpretation</th>
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</thead>
<tbody>
<tr>
<td>Distance</td>
<td>$P \leq 0.476$ (ns)</td>
<td>AI detection does not vary by distance</td>
</tr>
<tr>
<td>Camera</td>
<td>$P \leq 0.001$</td>
<td>Capacity of device significantly influences detection by TUMAINI</td>
</tr>
<tr>
<td>Camera, 4MP, 16MP, 48MP</td>
<td>$P \leq 0.001$</td>
<td>Capacity of device significantly influences detection by TUMAINI</td>
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<tr>
<td>Time window, 4MP</td>
<td>$P \leq 0.002$</td>
<td>Light significantly influences the detection at 4MP</td>
</tr>
<tr>
<td>Morning/Afternoon, 16MP, 48MP</td>
<td>$P \leq 0.298$ (ns)</td>
<td>Brightness (time) did not significantly influence</td>
</tr>
<tr>
<td>Afternoon, 48MP</td>
<td>$P \leq 0.478$ (ns)</td>
<td>detection using 16 MP or 48 MP camera</td>
</tr>
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Selveraj et al. (2019): TUMAINI APP
Disease detection, epidemiology

Questions
Host-virus interaction, variety specific?
How does infectiousness relate with symptom expression?
How would these affect rogueing practice?

Jeger et al., 2015; Chabi et al., (in preparation)
Results: Diversity in expression of BBTD

**Observations**

- Variety-specific symptom expression
- Asymptomatic plants were generally PCR –ve
- Varietal specific symptom progression
- Varietal differences in infection success and symptom expression
- Soutoumon missed **typical early symptoms**
- Only symptomatic plants were **infectious**

Chabi et al., (in preparation)
Relaxed roguing: Influence of infected plants

Fitness advantages of vectors reared on infected banana, no nutritional difference detected

Disease and vector preference

Increased vector fecundity on diseased plants

Crude protein, Lipid content
Not significantly different

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Reflections

• Modelling BBTV epidemiology: approaches to effective BBTD management

• Cropping mixtures could augment BBTD control approaches to facilitate management.
  • support natural enemies of vectors,
  • reduced dispersal of vectors

• Seasonal variation on infection risk and expression

• Scouting protocols, detection accuracy and fidelity

• Delayed roguing/ asymptomatic hosts could influence the scale of dispersal of disease and aphids: the production of alate generations

• Refining scouting tools to supplement inexperienced human detection.
Thank you!

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