The Banana Xanthomonas wilt epidemic in East and Central Africa: current Research and Development efforts

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Banana: Importance

- Component of food security
- Important cash and food crop
- Accelerated yield declines

Brewing Bananas

Kayinja, Kisubi
(ABB, AB)

Dessert Bananas

Gros Michel (AAA)
Sukali Ndizi (AAB)

Cooking Bananas

Highland Bananas (AAA-EA)
Plantains (AAB)

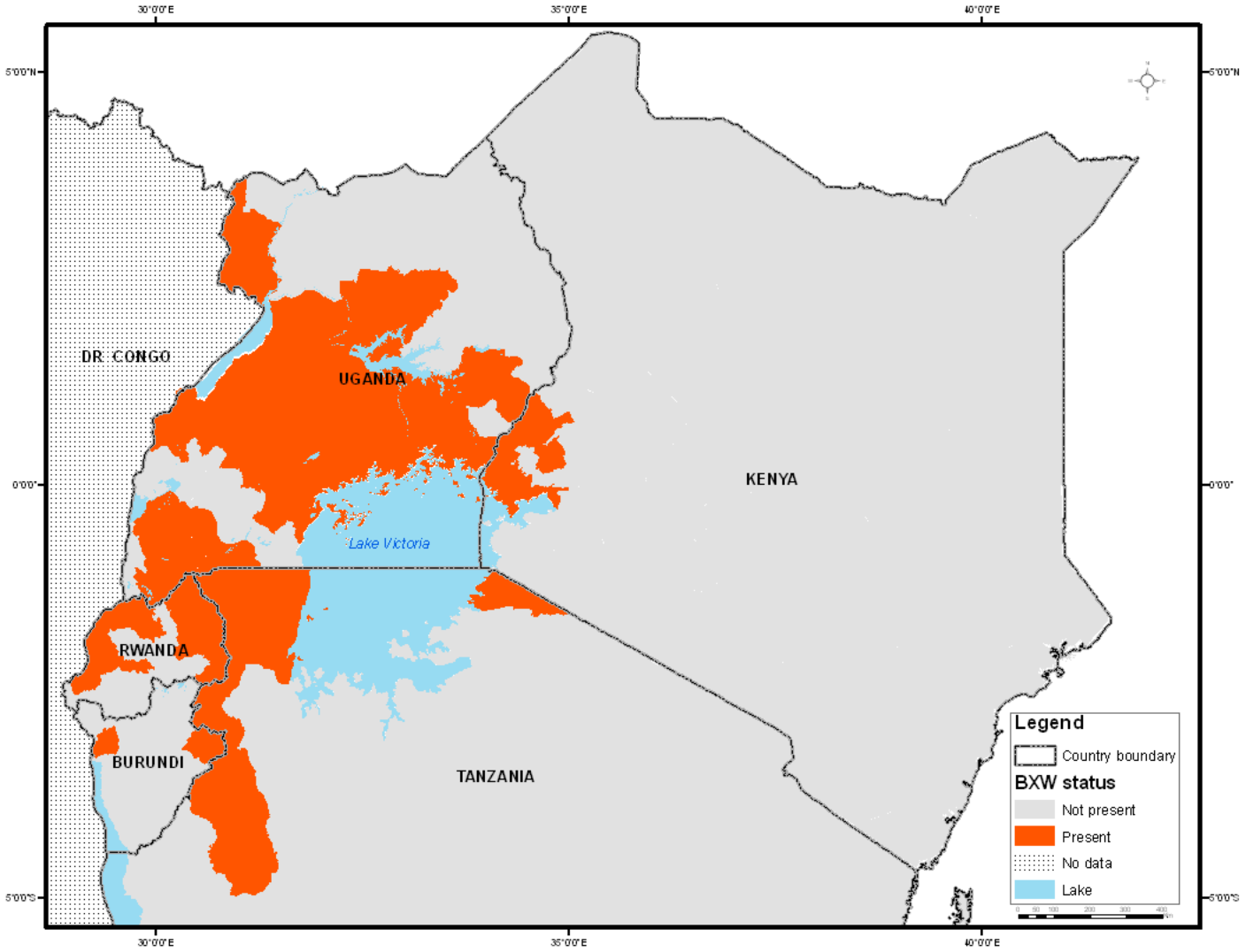
Challenges to banana production

- Limited generation and uptake of demand driven technologies and innovations for bananas (pests, **diseases** and declining soil fertility)
- Limited policy analysis and harmonization for enhancing the performance of bananas
- Weak stakeholder capacity to implement research on banana
- Limited capacity for collection, analysis and sharing of information

BXW disease problem

- Banana *Xanthomonas* wilt (BXW) disease caused by a bacteria *Xanthomonas campestris* pv. *Musacearum was first reported in Uganda* in 2001
- Currently endemic in all countries in ECA causing significant banana production
- BXW spreads rapidly, causes total yield loss and no resistant varieties yet.

BXW distribution in ECA



BXW disease: Managements efforts

- Available management options include cultural controls
  - ✓ Debudding
  - ✓ Removing infected plants
  - ✓ Disinfecting tools
  - ✓ using clean planting material
  - ✓surveillance
- Sensitization about disease diagnosis, spread and control is key to success of management options
- National, regional and international R & D efforts promoted use of cultural practices and surveillance which helped to keep the disease at low incidence in most parts of ECA




Research efforts: Epidemiology

- **Host range**: infects only monocot plants belonging to two families (Musaceae and Cannaceae) (Ssekiwoko et al., 2006)
- **Systemicity studies** (Ocimati et al.,2012; Ochola et al., 2014)
- Elucidating **mother-to-sucker transmission** mechanisms of BXW in field conditions: transmission is random
- **Incubation period**: ranges from 30 (Welde-Michael, 2008) to 16 months (Ocimati *et al.,* 2012)
- The **survival period** of Xcm bacteria strongly depends on the soil moisture content and it does not survive long (< 35 days) in soil or plant debris (Mwebaze et al., 2006)
- **Transmission/spread**: vectors (insects and bats), planting material (Tinzaara et al., 2006, Buregyeya, et al., 2014)

Insect vectors and Transmission

Species (Family)	Common name	No./flower/sample
Chloropidae (undet. Sp)	**Grass fly**	30
Drosophilidae (Undet. Sp)	**Fruit fly**	12
Apis mellifera (Apidae)	Honey bee	3
Meliponula nebulata (Apidae)	Stingless bee	2
Plebeina hildebrandti	Stingless bee	2

Species/family	Common name	Mean no. bacterial colonies per plate	
		Asymptomatic plants	Symptomatic plants
Plebeina denoiti (Apidae)	Stingless bee	9.1	53.3
Apidae (undet. sp)	Stingless bee	1.5	5.7
Chloropidae (undet. Sp)	Phorids	0.0	6.2
Drosophilidae (Undet. Sp)	Drosophilids	0.9	2.1
Apis melifera (Apidae)	Honey bee	0.0	10.0

Tinzaara et al., 2006

Bats

(Buregyeya et al., 2014)

Escaping Germplasm

- Germplasm was accessed from ITC and evaluated for agronomic performance at Kifu Forest (Uganda), KARI-Kisii (Kenya) and at ARDI- Maruku (Tanzania)
- Evaluated culinary qualities: fruit size for all cultivars was found to be very small (mean 5kg) and pulp adheres to the peel making it very difficult to eat.
- Potential for use in breeding programmes
- Selected cultivars with persistent neuter flowers, bigger bunch sizes and pro vit A are being evaluated

Transgenic Research

- *Musa balbisiana*, a wild and inedible relative of banana has been identified as a potential source of resistance to Xanthomonas wilt (Ssekiwoko et al., 2006)
- Current studies are focusing on understanding the mechanisms of resistance and pinpointing the genes responsible for this resistance
- If identified, the gene(s) can then be incorporated, through genetic engineering approaches, into commercial cultivars to impart resistance to the disease.

Detection Tools

- Various diagnostic methods have been developed ranging from relatively high tech molecular based methods (Adikini et al. 2011; Adriko et al. 2011) to more simple and practical serological diagnostics (Nakato et al., 2013).
- Recently, Bioversity international, NARO- Uganda and FERA UK conducted polyclonal diagnostic studies that successfully developed a lateral flow device which is suitable for disease detection in banana
- Results are currently being tested under field conditions
- Employed in determining the efficacy of the diagnostics in testing material suspected of infection, as opposed to employing visual symptoms

On-going research

- Modeling the epidemiology of Xanthomonas wilt of bananas in smallholder systems
- Understanding the mechanisms of resistance and identifying the genes responsible for this resistance.
- Technology adoption and impact studies

Development strategies: Community mobilization approaches

- Farmer field schools (FFS):
  - ✓Susuccessfully used to manage BXW in Western Kenya: reducing disease incidence to from 80% less 10% than within 12 months
  - ✓In Uganda, farmers who hosted FFS (68%) compared to those that accessed information for BXW control traditionally (38%) had low disease incidence (< 10 plants)
- Learning and experimentation approach for farmers (LEAFF): being evaluated on benchmark sites in Uganda
  - ✓Farmers learn by experimentation and are linked to each other with the phone system

Conclusion

- Significant research and development efforts by regional stakeholders
- Sustainable management of the disease is still elusive
- Need for innovative approaches such as LEAFF

- Bioversity International
- Conference organizers

Thank you

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