

# Systemicity of *Xanthomonas campestris* pv. *musacearum* in inflorescence-infected banana plants in Uganda

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## Introduction

*Xanthomonas campestris* pv. *musacearum* (*Xcm*) is an African pathogenic bacterium known to naturally affect Enset and banana causing *Xanthomonas* wilt disease (XW). XW is highly destructive and causes total yield loss in affected plants. Since its first scientific recording in Ethiopia in 1968 (Yirgou and Bradbury, 1968 and 1974), it has in recent years been reported in Uganda (Tushemereirwe *et al.*, 2003), the Democratic Republic of Congo (Ndungo *et al.*, 2004), Rwanda and Tanzania (Mgenzi *et al.*, 2006). It affects banana at all stages of plant development and the visible symptoms are wilting of male bud bracts, drying of the rachis, premature fruit ripening, bunch rotting, leaf wilting and death of the plant.



Internal symptoms: yellow bacterial ooze from cut stem (E & F) and rusty brown stains on cut banana fingers (G)

External symptoms: shriveled male bud bracts (A), pre-mature fruit ripening (B), dried/rotten bunch (C) and wilted leaves (D)



Internally, a yellow bacterial mass oozes out of pseudostem cross-sections in the positions of the vascular bundles, while cross-sections through banana fingers show rusty brown stains. These internal symptoms are diagnostic of the disease in Africa (Tushemereirwe *et al.*, 2003) since other bacterial wilts with similar symptoms are absent. XW is primarily spread in banana by insects, from one oozing male bud to a healthy one (Buddenhagen, 1962; Tinzaara *et al.*, 2006) and also by contaminated cutting garden tools (Yirgou and Bradbury, 1974). The control package for the disease includes early de-budding, use of clean garden tools and total uprooting of affected mats. Farmers prefer single diseased plant removal instead of the more laborious whole mat uprooting.

## Materials and methods

Inflorescence-infected plants exhibiting 4 symptom stages were sampled from Luwero and Mpigi districts for the cv's 'Kayinja' ('Pisang Awak' - *Musa* AABB group) and 'Matooke' (EAHB- *Musa* AAA group). The symptom stages are: wilting of male bud (1<sup>st</sup> stage), decay of rachis (2<sup>nd</sup> stage), premature fruit ripening (3<sup>rd</sup> stage) and rotting bunches (4<sup>th</sup> stage). With the help of a surface disinfectant (95% ethanol), and a sterile knife, the corm, the 5 innermost leaf sheaths, the inner inflorescence stalk (*i.e.* real stem) and a lateral shoot were aseptically separated without cross contamination. 10g transverse sections were cut out from each part (samples obtained at a 1ft interval along the length of inner inflorescence stalk) and suspended in 1ml sterile water to obtain a bacterial suspension. The suspension was serially diluted (suspension: water, 1:9); a drop (10µL) of each dilution spread plated on an isolation medium containing yeast (5g<sup>-1</sup>), peptone (5g<sup>-1</sup>), glucose (10 g<sup>-1</sup>) and Agar (14g<sup>-1</sup>), and incubated for 5 days at 25-28°C. Plates were observed for growth of *Xcm* colonies. For fear of possible contamination from soil, corm suspensions were plated on a semi-selective medium: 5-fluorouracil - Cephalixin Agar (FCA) containing: yeast extract (1g<sup>-1</sup>), glucose (1g<sup>-1</sup>), peptone (1g<sup>-1</sup>), NH<sub>4</sub>Cl (1g<sup>-1</sup>), MgSO<sub>4</sub> · 7H<sub>2</sub>O (1g<sup>-1</sup>), K<sub>2</sub>HPO<sub>4</sub> (3g<sup>-1</sup>), agar (14g<sup>-1</sup>), cephalixin (40 mg<sup>-1</sup>), 5-fluorouracil (10mg<sup>-1</sup>) and cycloheximide 120 mg L<sup>-1</sup> (Mwebaze *et al.*, 2006a). The data on percentage real stem free of *Xcm* and percentage of plants that were positive for presence of *Xcm* in different plant parts was analyzed using the Statistical Analysis System (SAS) computer software (SAS institute, 1999).

## Results and discussion

In 'Pisang Awak' 62% of the real stem from the base was free of *Xcm* in plants with 1<sup>st</sup> stage symptom. This was significantly (P<0.05) different from plants with advanced stage symptoms where the bacteria had reached the corm. This suggests that if plants with 1<sup>st</sup> stage symptoms are carefully cut at the base, transmission of the bacteria from the mother plants to the suckers may be prevented. However, in 'Matooke' bacteria were isolated from the plant's base even at the 1<sup>st</sup> disease symptom stage (Table 1) suggesting that *Xcm* moves slower in 'Pisang Awak' than 'Matooke'. The slow movement of bacterium in 'Pisang Awak' may be attributed to the relatively hard true stem. Related findings indicate that 'Pisang Awak' was among the varieties with resistance to weevil damage due to biophysical corm hardness. At the 2<sup>nd</sup> symptom stage, bacteria have not yet colonized the lateral shoots in both cultivars and this suggests that if single affected mother plants are uprooted at the corm level, the remaining lateral shoots may be protected.

Table 1: Percentage of plants recorded for presence of *Xcm* in the different parts assessed at different disease development stages

Disease symptom stage	% plants with <i>Xcm</i>									
	Mother plant					Attached sucker				
	Real stem		Leaf sheaths		Corm	Corm		Leaf sheaths		
	PA	EAHB	PA	EAHB	PA	EAHB	PA	EAHB	PA	EAHB
1 <sup>st</sup> stage	100	100	46	33	0	33	0	0	0	0
2 <sup>nd</sup> stage	100	100	48	50	27	33	0	0	0	0
3 <sup>rd</sup> stage	100	100	50	83	29	67	14	0	0	0
4 <sup>th</sup> stage	100	100	52	33	53	67	28	33	9	33

# PA: 'Pisang Awak'; EAHB: East African Highland Banana *i.e.* 'Matooke'.

## References

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## Conclusions and recommendations

In inflorescence-infected plants, *Xcm* moves downwards through the real stem, into the leaf sheaths attached to the real stem, into the corm and leaf sheaths attached to the corm. Ultimately the bacteria invade the lateral shoots attached to the infected mother plant (Figure 1).

For both cultivars, bacteria have not yet colonized the lateral shoots at the 2<sup>nd</sup> symptom stage suggesting that the attached lateral shoots may be protected if affected mother plants are uprooted from the mat at this stage. However, cutting off inflorescence-infected 'Pisang Awak' mother plants at the pseudostem base at the 1<sup>st</sup> symptom stage may also prevent *Xcm* from affecting the attached lateral shoots.



Figure 1: Movement of *Xcm* in an inflorescence-infected plant.