Evaluation of disinfectants and agrochemicals for potential use in the management of banana Xanthomonas wilt

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Introduction

Banana Xanthomonas wilt (BXW) spreads rapidly infecting banana and plantains. The disease is caused by *Xanthomonas campestris* pv *musacearum* (Xcm) and induces wilting of leaves, premature ripening and rotting of fruits (Fig. 1) and eventual death of entire mats. The pathogen can be spread by insect vectors, on contaminated tools and/or infected planting suckers. Recent surveys indicate BXW is present in Uganda, Kenya, Tanzania, Rwanda, Burundi and the Democratic Republic of Congo. In addition to yield loss, additional challenges are encountered due to bacterial cells that remain in the soil for prolonged periods of time thereby slowing down rehabilitation efforts.

Key recommendations for managing BXW include disinfecting tools using chemicals or heat. The most commonly recommended disinfectant is Jik®, containing NaOCl as the active ingredient. One objective of this research was to evaluate more disinfectants available in the market for effectiveness against *Xcm* (thus increase choice available to farmers) and to identify products that could kill *Xcm* cells in soil (Fig. 2) and thus reduce the waiting period before replanting of bananas.

Materials and Methods

Eight disinfectants (Table 1) marketed in Uganda with potential antibacterial effects were evaluated for effect against *Xcm*. Three different concentrations of each disinfectant were prepared by diluting the commercial preparation in sterile distilled water. Suspensions of *Xcm* (10^8cfu/ml) were mixed with each disinfectant solution and 100 µl aliquots spread on Yeast-Peptone-Glucose Agar (YPGA) after 5-10 minutes. Colony growth was observed after 3 days incubation at 25°C. In a separate study six agrochemicals (Table 2) used routinely in agriculture were evaluated for potential ability to suppress *Xcm*. Bacteria cells were inoculated onto culture medium (YPGA) and soil samples containing varying concentrations of the pesticides. Colony growth was monitored on YPGA while *Xcm* populations were monitored in soil over a two week period.

Leaves of infected plants wilt (Fig 1A) while fruits ripen prematurely and rot (Fig 1B).

The pathogen can be spread through injuries created by tools during farm operations (Fig 1C).

Tools can be disinfected by dipping in disinfectant solutions (Fig 2A) while pesticides with antibacterial effects could be applied as a drench to kill *Xcm* in the soil within the planting hole (Fig 2B) or be applied by dipping suckers or corms (Fig 2C) in the solutions.

Table 1: Disinfectants evaluated for potential effect against *Xcm*

Product trade name & *Manufacturer*	Active ingredient (a.i)	% a.i. evaluated (Min- Max)	Effect on Xcm
Jik (*Reckitt Benckiser East Africa Ltd)*	3.5 %Sodium hypochlorite	0.07-0.13	Yes
Chemico Multipurpose (*Wispro Uganda).*	Benzalkonium chloride 1.5%	0.0003-0.0006	Yes
Protect & Clean Antibacterial (Tower House, *Leeds, UK)*	Triclosan 2%	0.75-1.09	No
Shine (*Orbit Industries Uganda).*	Antibacterial gel 100%	37.50-54.55	No
Savlon (*Johnson & Johnson, S. Africa)*	Chlorhexidine gluconate 0.3%	0.0030-.0087	Yes
Dettol (*Reckitt Benckiser, East Africa Ltd).*	Chloroxylenol 4.8%	0.05-0.14	Yes
Roberts (*Cussons and Co. Ltd, Kenya).*	Parachloro- meta-xylenol 5%	0.05-0.15	Yes
Instakleen (*MARS Life Sciences Ltd, India).*	Ethyl alcohol 66.5%	5.49-11.08	No

Table 2: Pesticides evaluated for effect against *Xcm* in soil

Pesticide name	Active Ingredient	Trade purpose	Dilution rates range tested (min-max)
Paraquat	Paraquat 24 %	Herbicide	2 - 4 µl/ml
Agrozeb	Mancozeb 80%	Fungicide	0.0006 - 0.0018 g/ml
Furan	Carbofuran 5%	Nematicide, insecticide	0.4 -1.2 g/ml
2,4-D	Amine salt	Herbicide	20 -100 µl/ml
Round up	Glyphosate	Herbicide	8 -18 µl/ml
Dursban	Chlorpyrifos	Fungicide	2 - 3.6 µl/ml

Results

- Chemico® is cheaper and was more effective against *Xcm* than Jik®, and only 0.0003% a.i was required. This is the most suitable alternative to Jik®.
- When tools are dipped >5 min Jik® killed *Xcm* at nearly a tenth of the currently recommended 0.58-0.70%, thus cost can be reduced by using less.
- Savlon®, Dettol® and Roberts® can also replace Jik® but these are more costly.
- When added into YPGA Paraquat®, Agrozeb® and 2,4D® effectively suppressed Xcm at minimum concentrations of 3.2ml/L, 1g/L and 20ml/L, respectively.
- 2,4D® suppressed *Xcm* only in sterile soil, while Agrozeb reduced *Xcm* populations in both sterile and unsterile soil, but with activity diminishing with preparations below 0.6g/L water.

Conclusion: The findings of this study show there are cheaper and more effective alternatives to Jik® [NaOCl] for disinfecting tools as well as pesticides with potential antibacterial effects that could be exploited for BXW management.

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