

Knowledge for crop disease management: the case of Banana *Xanthomonas* Wilt

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1 SUMMARY

The Banana *Xanthomonas* wilt (BXW) pandemic has spread rapidly in East and Central Africa since the initial outbreak in 2001. Affected banana plantations have had drastically reduced productivity, which has severely affected food and income security, and the attendant quality of livelihoods. It has been recognised that lack of knowledge on disease recognition and management is one of the key factors that have contributed to rapid BXW spread. Therefore, addressing this aspect to increase and improve the knowledge base of banana producers would be an important component in integrated disease management. The regional Crop Crisis Control project (C3P) was developed as a multi-country effort to reduce the spread and impact of BXW, partly through education and training of banana growers and other stakeholders. The participants from each country were selected to represent technical, extension, and policy making institutions. Training involved lectures, field visits, handouts and additional training materials provided in electronic form. Upon return to their countries those trained at regional level were expected to conduct further training, thereby increasing the number of people with knowledge on BXW management up to farmer level. Within one year, the C3P training program managed to significantly increase the number of knowledgeable extension and research staff (>1000) and farmers (>30,000), who have considerably strengthened the human resource base employed against this disease. This paper describes the training strategy developed and captures the challenges encountered in executing it.

2 INTRODUCTION

Banana *Xanthomonas* wilt (BXW) is a severely debilitating disease, caused by *Xanthomonas vasicola* pv *musacearum*. In the last nearly 10 years, this disease has posed a major threat to food availability and stability of income resources for large communities of farmers within the greater East and Central African region. Countries affected by the disease include Uganda, Ethiopia, Tanzania, D.R. Congo, Rwanda, Burundi and Kenya. Although the existence of

the disease has been known since the 1970s in Ethiopia, the current pandemic was heralded by an outbreak of unknown origin in Uganda in 2001 (Tushemereirwe *et al.*, 2003).

Once plants are infected, the leaves wilt rapidly, losing their photosynthetic capacity and use for any other purpose. The fruit ripens prematurely and rots progressively to an inedible state (Fig. 1-3). Over time, infection spreads through all plant tissues leading to eventual

death of the entire mat (Eden-Green, 2004). The disease can spread rapidly to cover large areas within a short period of time (Fig. 4) (Mwangi *et al.*, 2007).

Besides food and income value, bananas have other important uses in East and Central Africa. The plants are used as thatch material, as fodder and in preparing specific dishes, e.g. matooke in Uganda. The roots firm the soil and the broad leaves reduce impact of rain on soil surface, thus collectively minimising potential soil losses through erosion. Along hillsides, the banana plants provide staking support for climbing beans and col shade that is required for growth of other crops, e.g. cocoyam (*xanthosoma* spp.). The banana plant also has great aesthetic value, making terrains attractive for tourism.

The *Xanthomonas* bacterium can be transmitted through numerous means. One major way is through insect vectors that acquire the pathogen while visiting flower and fruit parts of infected plants. The pathogen can also be spread on contaminated farm tools (knives, hoes or machetes) and when infected suckers are transplanted to new fields. Measures for disease management include early removal of male flowers (to avoid spread by insects),

disinfecting farm tools and planting only healthy seedlings, preferably from approved sources (Mwangi & Bandyopadhyay, 2006).

In comparison to other crop diseases, BXW is considered to be a 'new' disease in the region, and nearly all farmers and extension practitioners would need to be trained on the appropriate responses. To effectively manage the BXW pandemic, it has been recognised that stakeholders in the banana sector (farmers, traders, extension and research staff, policy makers) need to acquire new knowledge and skills, especially in community mobilisation.

To address this need, the Crop Crisis Control Project (C3P) was conceived and launched as a collaborative effort between agencies and governments in ECA, partly targetting BXW. The project was funded by the United States Agency for International Development (USAID) and implemented by the Catholic Relief Services (CRS), in partnership with the International Institute of Tropical Agriculture (IITA), Bioversity International, national agricultural institutions and various NGOs in Uganda, Kenya, Tanzania, Rwanda, Burundi and the Democratic Republic of Congo.



Figure 1: Symptoms of *Xanthomonas* infection: fruits ripen prematurely and the pulp rots, rendering them inedible.



Figure 2 (left): Symptoms of *Xanthomonas* infection: ooze comprising of bacterial cells flows from the heavily infected pseudostem.

Figure 3 (right): Infected leaves wilt rapidly and dry up losing their photosynthetic capacity.

3 MATERIALS AND METHODS

A training programme was planned to be executed in a cascade model that would progress through three tiers, starting from regional level (Tier 1), country level (Tier II) to community/farmer level (Tier III). Tier 1 was initiated with a one week long training workshop in October 2006 held at Kampala, Uganda. For training at tier 1 level, five participants were targetted per country (total of 30 for six countries). Among the five trainees, the criteria required representation of at least (1) a technical, (2) extension, and (3) policy making institutions. After the training, and upon return to their countries, those trained at regional level were to organise and conduct in-country training (Tier 2) to increase the number of people (trainers) available within each country, who would then take the

training further down to the community level (Tier 3).

Training at Tier 2 and 3 was to be based on needs and resources available in each country. At Tier 1, half of the participants were from Francophone (Rwanda, Burundi, D.R. Congo) and the other half from Anglophone (Uganda, Kenya, Tanzania) countries. Training modules were structured to involve lectures and visits to selected field locations for practical demonstrations and to ensure interaction with personnel that were actually managing BXW on the ground. Additional training materials were provided including printed handouts and electronic copies (in CD and flash sticks). Progress in implementation of the training program was to be monitored regularly and adjustments done as necessary.

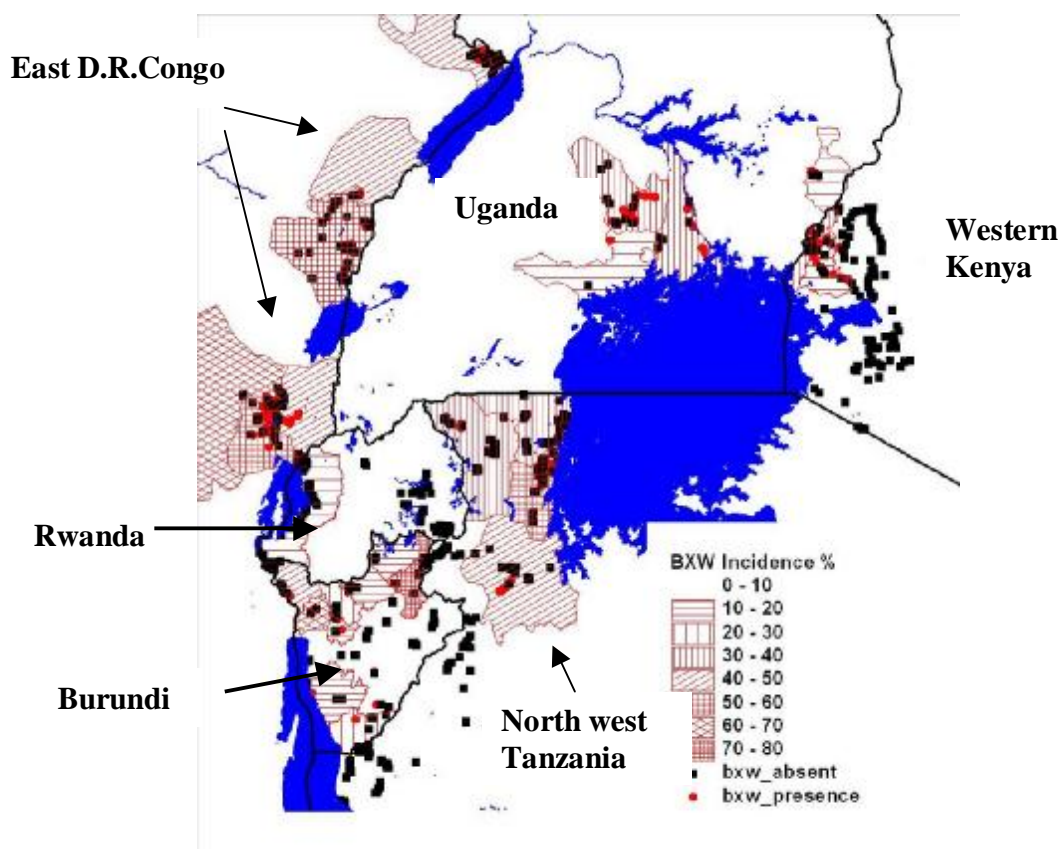


Figure 4: Incidence of banana *Xanthomonas* wilt in six countries in East and Central Africa (data collected in a survey in early 2007).

4 RESULTS

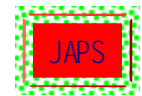
4.1 Outcome and progress achieved: At the time of planning the regional training program (July, 2006) BXW had already been confirmed to be present in Uganda, Rwanda, Tanzania and D.R. Congo. The disease was subsequently confirmed after surveys in Kenya and Burundi towards the end of 2006. However, except Uganda, none of the other countries had the necessary manpower to support rapid response to the disease. A critical gap was noted especially regarding the involvement of extension and policy planners.

By careful selection of participants to the regional training workshop, the C3P initiative managed to increase the number of trained manpower in each country and importantly, also expanded the diversity of trained stakeholders to include extension leaders and policy makers. After further in-country training (Tier 2), the number of knowledgeable stakeholders increased to over 1000 across the region (Table 1), a more than 30 fold increase compared to the number trained at regional

level (Tier 1). At the community level, where more emphasis is needed for effective BXW management, over 30,000 stakeholders had been trained across the region within 10 months.

Considering that an estimated 20 million people are affected or threatened by the BXW pandemic within the six target countries, the 30,000 stakeholders trained at grassroot level was considerable (1 trained per 600 affected/threatened). Although this ratio did not match the required critical mass for effective disease management, it was expected that gains on containing disease spread would be achieved if the knowledge acquired was put to use. There were, however, concerns on whether those trained would effectively apply the knowledge gained.

A previous in Uganda (Kiiza *et al.*, 2006) had indicated significant disparities, with nearly 85% of banana growers trained on BXW management, but with only a minority of about 30% applying the knowledge. This disparity between those trained and



practicing was noted to be increasing as the perceived economic importance of banana reduces (Bagamba *et al.*, 2007). This might justify a need to

prioritise training effort in areas where bananas are a clear priority crop for livelihoods.

4.2 Some challenges encountered and lessons learnt

4.2.1 Communication: Rwanda, Burundi and D.R. Congo are francophone while Uganda, Kenya and Tanzania are anglophone. This required particular attention during joint training sessions to ensure participants followed and understood proceedings fully. This was addressed by providing simultaneous translation services. However, attention needed to be paid to ensure key message was not distorted or lost during translation, especially where technical details are involved. During this training, it was observed that it is generally difficult to find bilingual trainers who are well versed in fairly unique subjects such as BXW. Even where a bilingual trainer may be available, session would take longer since the same information has to be presented in both English and French.

Field demonstration trips were included to reinforce learning through coursework. At the field level, differences in language orientations were also noted to hinder direct interaction between workshop participants and farmers/other stakeholders who wanted to share their experiences on BXW management directly. This was eased by having a translation service during field visits, though this may also not fully address the issue. As an alternative, it was suggested to consider holding separate workshops and training sessions for the French and English speakers.

4.2.2 Absentee trainers: In numerous instances training at Tier 2 (country level) was affected by loss of training capacity since some of those trained at Tier 1 (regional level) were not available to conduct training at tier 2. Notably, most of those selected to participate at Tier 1 were senior extension, research or policy management staff who were not available to participate fully in further training, though they contributed to BXW management in other ways. In retrospect, and following this experience, it would be advisable to consider the ability and availability of trainees to participate in further training.

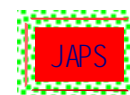
4.2.3 Utilisation of electronic training material: Although all participants received training materials in electronic form (compact or flash disks), a substantial number did not have access to computers and other resources that would enable conversion into print form for translation and

further widespread distribution. This challenge can be addressed by (1) providing most of the learning materials in already printed form; or (2) setting aside specific funds within the project to support equipment and other consumables that facilitate conversion from electronic to other form.

An additional challenge noted was that most of the training notes were originally prepared in English, and thus could not be directly used by most French speaking participants. An effective training program should ensure training material are translated into the main languages of the targeted communities.

4.2.4 Insufficient resources and local capacity: The cascade training model proposed in C3P assumed that each country had a basic functional extension network and infrastructure that would be trained and facilitated to further train farmers. The reality, however, was observed to be that there are considerable differences in capacities and institutional structures between countries, which affected program implementation. Whereas functional systems exist in Uganda and Kenya, they are considerably weak or non-existent in Burundi and D.R. Congo, and moderate in Rwanda. The Francophone countries were especially facing challenges that were associated with civil instabilities experienced in the last decade. Following this experience, differences between capabilities of countries need to be taken into consideration when designing multicountry training programs, and where possible support should be skewed to favor those in greater need.

4.2.5 Perception of BXW as a non-threat: In Africa, farmers react faster to threats that are perceived as current and immediate. The C3P training program was designed to reach communities and stakeholders that were already affected and those threatened but not yet affected by BXW. With no previous experience of the devastating impact of BXW, the threatened communities were unlikely to invest much effort to combat BXW, even though they might have appreciated the lessons imparted through training. This slow response is particularly higher where bananas are not the primary means of supporting livelihoods. Exchange visits between farmers in different regions and



countries could help in deepening appreciation of the threat and potentially encourage implementation of BXW management measures.

Table 1: Number of extension and research staff (Tier 1 and 2) and farmers (Tier 3) trained in BXW management in six countries in East and Central Africa.

Country	Tier 1 Regional level	Tier 2 Country level	Tier 3 Community level
Kenya	5	194	8305 farmers
Tanzania	5	99 (+ 42)*	13764 farmers
Rwanda	5	45	2021 farmers
Burundi	5	184	580 farmers (planned)
D.R. Congo	5	306 (+>20)	1570 brigadiers; >20,000 through markets; >800 school children; 49 university students
Uganda	>5	159	3149 farmers +5397 through PDC +>1600 school children

* Number in parenthesis is specifically for policy makers.

The implemented training program significantly increased the capacity of stakeholders across the region to manage BXW. The training strategy employed enhanced interaction between stakeholders within and between countries, which should contribute to better coordination and

management of BXW through sharing of resources and experiences. However, at the end of the training program, major challenges still remained since the disease was still spreading at a faster rate than could be contained with the resources available.

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