



BANANA XANTHOMONAS WILT SURVEY REPORT

RWANDA

April 2007



Introduction

Rwanda is one of the leading growers of bananas in the world with an estimated per capita output of 270 kg per year. Much of the country lies around 1500m above sea level where bananas yield well and only a small area in the east of the country is too dry for their production. Total acreage under banana is at about 13%, having declined from a high of 20% in the 1980s. Bananas are key food and income sources in Rwanda, and also play important roles in cultural ceremonies and protecting soil from erosion on the countries' hilly terrain. Banana *Xanthomonas* disease presents the most serious threat to sustainability of the banana sector in Rwanda. Outbreaks of the disease were reported in the north western districts along Lake Kivu in 2005. In spite of management efforts, the disease has continued to spread.

A survey was planned to assess the extent of disease spread in the country and also identify the key factors responsible for disease spread that can be considered in an effective management strategy. The survey was carried out in two phases. The first phase was carried out in August 2006 by ISAR team (targeting only the northwestern districts). A second survey was done in January 2007, covering a much wider area of key banana producing districts. The team was led by Nakato Gloria Valentine (IITA) and Muhinyuza Jean (ISAR). The districts/communes covered in the surveys were Rugerero, Nyundo, Cyanzarwe, Nyamyumba, Nyakiriba, Rubavu, Rulindo, Karongi, Kayonza, Kirehe, Ngoma, Nyamasheke, Rubavu, Rulindo, Rusizi, Rutsiro and Rwamagana. A total of 196 farmers were randomly selected and presented with a questionnaire to obtain information on BXW presence, banana production practices and other cultural practices that have relevance in BXW management. Further data were observed by examining a total of 30 plants randomly selected within each farm that was sampled. Age distribution of respondents was as shown in Figure 1.

The surveyed areas were in altitudes ranging from a low of 975m above sea level at Bugarama rising to a high of 2134m above sea level at Rwimbogo commune in Rusizi province. A total of 8.9% of the farms were on steep slopes, 48.9% on gentle slope, 5.9% on valley, 5.2% on hilltops and 31% were on flat ground. Land ownership in the area is

modest with 49.3% of respondents indicating ownership of at least 2 acres (Figure 2) and bananas are important as indicated by substantial portions of farm area committed to the crop. Almost half of the respondents (49.6 %) have 0.5 – 2 acres under banana, while 22% indicated having over 2 acres under banana (Figure 2).

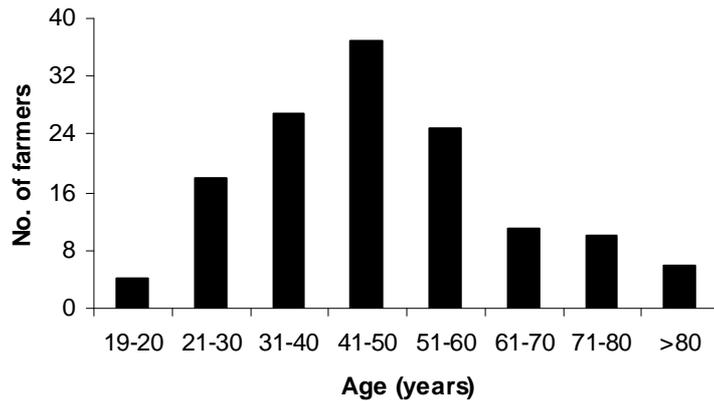


Figure 1: Age distribution of respondents in Rwanda BXW survey

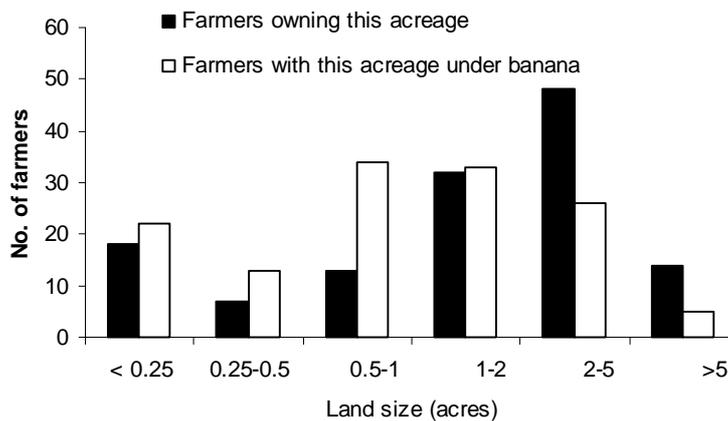


Figure 2: Comparison of land ownership and area committed to banana in Rwanda.

BXW status

BXW was found in 22.9% of all the surveyed fields and the disease is so far largely contained within Rubavu area. The highest number of infected farms was in Rubavu district (61.5%), also with a high disease incidence per farm, reaching 86% of some parts of the district (Figure 3). The high levels of disease incidence in Rubavu would be expected since the pandemic hit the district almost two years ago, and efforts to contain the disease have had mixed results, with partial success. In Rugerero, Nyundo and Cyanzarwe communes, over 50% of the surveyed farms were diseased but the disease incidence per farm was relatively low, between 5-30%, which is indicative of early stages or slow spread of the pandemic in these areas. After establishing in Rubavu district the disease has continued to spread to the neighboring Rutsiro and Karongi districts. There is a very high possibility that the disease will spread to Nyamasheke further down along Lake Kivu, as well as to Nyabihu and Ngororero districts to the north unless preventive measures are taken.

Within the eastern area of Rwanda, the districts neighboring Tanzania are exposed to an even higher risk of BXW spreading from the Kagera region where the disease is already present. The frontier districts of Kirehe and Kayonza, and further inwards in Rwamagana and Ngoma are quite close to Ngara and Biharamuro districts within Kagera, where BXW has been present and spreading over the past 1.5 years. In the recent past there have been significant numbers of refugees returning from camps in the Kagera region who could potentially bring along the disease into more interior regions of Rwanda. This particular group might need specific targeting with sensitization to reduce the risk of disease introduction. However, some eastern parts of Rwanda are dry and unsuitable for banana production, and may present an ecological barrier to natural spread of BXW through insect vectors.

On the northern flank the districts of Nyagatare, Gicumbi, Burera and Musanze could be facing significant exposure to disease introduction from the neighboring Kabale district of Uganda where BXW outbreaks have been spotted recently. The spread of disease by insect vectors in this region may be significantly low given the high altitude which may

present unfavorable ecological conditions. However, Kabale is along the major route linking Uganda and Rwanda and has considerable movement of people back and forth across the border. Bananas taken across the border usually from the Ugandan side heading to markets in Kigali could potentially take along the disease. There is also considerable migration and movement of people between Rutshuru area in east DR Congo where BXW is present and the northern districts of Rwanda. Within Rwanda itself there is considerable movement of people from the north western areas towards Central Rwanda (Kigali), thus an increased likelihood of disease spreading from Rubavu southwards along the Kigali route. Placing sensitization messages on billboards along the highway could help in raising awareness and reducing disease spread. In the recent past a BXW outbreak was reported in one of the villages along the highway where trucks enroute from the north to Kigali make a stop. Besides migration of people, significant volumes of banana are traded from DR Congo into Rwanda. To manage this risk it would be important to find a way to sensitize transporters on the risk posed by long distance transportation of bananas particularly from the areas in eastern DR Congo that are already affected by BXW. Along the border BXW has been observed recently in Goma on the DR Congo side of the border from where some of bananas coming into Rwanda through Gisenyi are harvested.

Within the country, spread of the disease from western to eastern districts will most likely be slower, partly because of the high altitude ecological barrier along the Ngororero-Nyamagambe axis (which could reduce insect transmitted infections) and also, because there is less direct human flow between these districts. Within the eastern districts disease spread might be faster due to the lower altitudes, which could present more favorable conditions for insect vectors to thrive.

It would appear a significant level of awareness has been achieved since BXW outbreak in Rwanda and farmers are taking into consideration some of the recommended management measures. For example 43.8% of farmers whose farms had not been attacked indicated awareness of the disease, 31% indicated they had intensified debudding as a measure to prevent disease introduction, 29.6% were restricting

Crop management practices of relevance to BXW management

Cultural practices that require intensive use of tools can significantly accelerate spread of BXW. In Rwanda 88% of respondents indicated they harvest green leaves from bananas, with 64 % indicating they regular leaf removal. This practice could significantly increase disease spread within a farm because bacteria can be transmitted more easily through fresh wounds left when green leaves are cut. Upon inspection of the fields it would seem farmers have to keep removing leaves to reduce shading of plants. Although over 80% of farmers indicated they regularly remove excess suckers to maintain spacing, plant densities are still higher than agronomically recommended in most farms, which increases shading and necessitates leaf removal.

Although much of Rwanda is in the mid to high altitude agroecological areas where insects vectors of BXW may have reduced relevance, it would still be advisable to remove male flowers to reduce incidence of vector transmitted infections. At least 74% of respondents indicated they remove male buds, though only 33% debud regularly. There does not seem to be any consistent method of removing the male bud, and this is identified as one of the areas where training and sensitization needs to be strengthened to ensure farmers are debudding at the right time and using the right method (breaking with a forked stick).

In general, farmers like to keep their fields clean and hence remove dry leaves and fiber as well as weeding regularly. Majority of the farmers use both hoes and machetes for farm operations, and tools are usually owned by the farmer household and are rarely borrowed or exchanged between neighbors. In most cases (79%) labor for farm operations is provided by the farmer or members of his/her household, except in 15.5% cases who hire external labor. Use of own tools as well as labor sourcing from the household reduces the possibility of introducing the disease from outside the farm. At least 79% of the farmers indicated they would consider removing infected plants promptly, though most do not as long as something can be harvested. Prompt removal of infected materials is identified as one area that needs reinforcing in sensitization and community training for BXW management.

When planting new fields all farmers utilize suckers or corms harvested from their old plantations or from neighbors. At least 60% indicated they pare corms to remove associated soil and external corm portions for pest and disease management but only 2.8% utilize any kind of chemical pesticides at planting time. About 39% of farmers are concerned about soil fertility and usually separate topsoil from subsoil at time of planting, usually returning the top soil first close to the planted sucker, so the suckers can have access to the nutrients available in the top soil. Although this is a desirable practice, it can jeopardize rehabilitation efforts in areas where BXW is present, since bacterial population tends to be higher in the top layers of soil, and the pathogen can quickly attack newly planted corms if infested top soil is placed adjacent to the corms. This risk can be reduced by recommending a curing period of 2-3 days after uprooting or paring a sucker, before it is placed in the hole and covered with soil.

In Rwanda it is common practice to grow bananas in mixed culture with other crops. The crops mostly mixed with bananas are beans (42%), maize (22%) and cocoyam 10.3% (Figure 4). In areas with BXW, these alternate crops serve an important function as sources of food and income, and can also be used as break crops to allow for BXW inoculum to reduce before bananas are replanted. However, some intercrops require intense management and use of tools within the farm which can have an impact on BXW management. Frequent weeding using hoes can create injuries on banana roots that could be used as penetration by any soil borne *Xanthomonas* cells. This risk is increased further because sometimes weeding labor might be hired from outside the household. Laborers work in many different farms and are likely to carry along their own working tools as they move between farms farms, which can considerably increase disease spread within a locality.

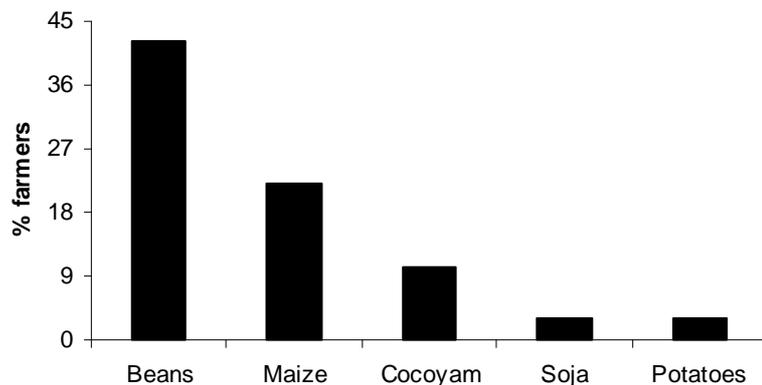


Figure 4: Crops intercropped with banana in Rwanda

Other diseases

Other diseases that were observed include Fusarium wilt and Black leaf sigatoka disease (Figure 5). Most of the diseases were present in many farms but at low incidence levels and hence are not considered to be of much significance. Banana streak virus and cigar end rot were not observed in any of the surveyed fields, though they have previously been reported as production constraints, especially cigar end rot in the north western districts.

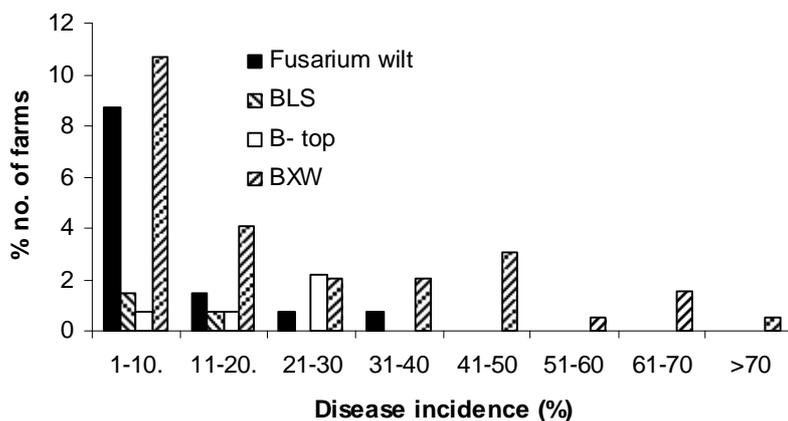


Figure 5: Incidence of Fusarium wilt, Black leaf sigatoka, bunchy top virus and banana *Xanthomonas* wilt in Rwanda

Banana production

Cooking banana

The most popular cooking variety is Inyamunyo (37%), followed by Injagi and Incakara at 25.4% and 22.2 %, respectively (Table 1). In some recent reports Injagi was reported to be the most widely grown cultivar but it seems to have been overtaken by Inyamunyo. Other key cooking cultivars include Barabeshya, Mbwazirume, Inkazikamwa, Intokatoki and Kiryumukunga grown by between 2 – 7% of farmers. Over 28% grow more than one variety of cooking bananas, though some cultivars such as Umushaba, Bakurara, Enkakala, Gisenyi, Ituntu, Kiribwa, Ncola, Igisahira, and Nyakitengwa are grown by few people.

Most of the cooking cultivars have exposed rachis, which makes them more susceptible to insect transmitted BXW infections. Only Inkazikamwa and Mbwazirume have persistence bracts and hermaphrodite flowers and can escape insect transmitted infections, but these are grown by about 5% of the population. To have impact on BXW spread, the density of these cultivars would have to be significantly increased above the current levels. Cultivar Incakara also has semi-persistent flowers and this could have potential use in BXW management as it is already being grown by over 22% of the population. Cultivar Barabeshya is preferred due to high yields while Incakara and Inyamunyo have big bunches. Approximately 6% of the respondents indicated that they do not grow any type of cooking bananas.

Brewing cultivars

The most popular brewing cultivar is Intuntu grown by 29.7% of the respondents, followed by Inzizi, Ingame and Kayinja (Kisubi) at 16.7, 15.2 and 15.2 %, respectively (Table 1). Other brewing cultivars are Intokatoki, Amazizi, Imbire, Imizibo, Indaya and Kampala, grown by between 2 - 5% of the population. There are several other brewing varieties including Kivuvu, Bugoyi, Intobe, Fhia 25, Gisukari, Incakala, Inkashi, Inkunde, Bakubonyisa, Gyaburega, Imiziba, Homa and Kasengere that are grown by less than 1% of farmers, each. All the brewing cultivars have exposed rachis except the recently introduced cultivar FHIA 25, which is yet to gain widespread acceptance and is being

grown by a paltry 0.7% of the population. Approximately 17.5% of farmers indicated that they do not grow any type of brewing bananas.

Dessert banana cultivars

The most popular dessert cultivar is Kamaramasenge, grown by 48% of the population, followed by Gros Michel and Poyo, with 24.6% and 13.8% farmers, respectively. Other dessert cultivars include Sindika, Ibinyagurube, Imbaragara and Bogoya (Table 1). There are no dessert cultivars with persistent male flowers and hermaphrodites for escaping insect transmitted infections. Some cultivars have dual purpose, and are grown for cooking, juice extraction or dessert, but these are few. About 30 % of the respondents indicated they do not grow any type of dessert cultivar.

Table 1: Top ten most popular cooking, brewing and dessert banana cultivars in Rwanda.

| Cooking cultivars | % growers | Brewing cultivars | % growers | Dessert cultivars | % growers |
|--------------------------|------------------|--------------------------|------------------|--------------------------|------------------|
| Inyamunyo | 37 | Intuntu | 29.71 | Kamaramasenge | 48.55 |
| Injagi | 25.4 | Inzizi | 16.67 | Gross Michel | 24.64 |
| Incakara | 22.2 | Ingame | 15.22 | Poyo | 13.77 |
| Barabeshya | 7.97 | Kayinja/Gisubi | 15.22 | Sindika | 2.90 |
| Mbwazirume | 5.8 | Intokatoke | 6.52 | Ibinyangurube | 1.45 |
| Inkazikamwa | 4.35 | Amazizi | 5.07 | Imbaragara | 1.45 |
| Intokatoki | 2.96 | Imbire/imbihire | 3.62 | Mbwazirume | 1.45 |
| Kiryumukunga | 2.9 | Imizibo | 3.62 | Inzirabahima | 1.45 |
| Banabazala | 2.17 | Indaya | 2.90 | Bogoya | 0.72 |
| Umushaba | 1.4 | Bakumba | 2.17 | | |

Utilization of banana plant parts

In Rwanda, every part of the banana plant has some value. The fingers are cooked, brewed or consumed when ripe. Fruits are also sold for cash or battered in exchange of other household goods. Peels from fruits are used as fuel, manure or to feed animals

while peduncles and pseudo stems are mostly decomposed into manure, but can also be fed to animals. Leaves are used for construction, making mats or bedding, and provision of mulch material. Male bud is used for fodder and to cover jerry cans.

Conclusion

The BXW pandemic has so far remained largely within the northwestern district of Rubavu and spread has been at a relatively slow pace within the district. It is not clear what factors have contributed to the relatively slow spread, as compared to Uganda or Tanzania. It could be indicative of a vigilant population, probably fairly well sensitized and aware of the measures to take to prevent disease spread, or less involvement of natural factors e.g. insect vectors. These observations support a conclusion for a positive outlook that the disease can be brought under control if management efforts initiated to could be sustained.

As noted, Rwanda faces exposure to BXW on various fronts from Kagera in Tanzania, Rutshuru and Goma in DR Congo and from the Kabale border with Uganda. A coherent strategy needs to be developed to ensure disease does not slip in through these areas while attention is presently focused on the Rubavu area. Attention needs to be paid to ensure returning populations do not bring along infected banana materials from any of the neighboring countries where BXW is present. An additional factor that may be important for BXW spread in Rwanda is intense pressure on land and the need to return affected areas to banana production quickly. A strategy is needed for certifying areas where infected mats are removed to be free of the disease before bananas are allowed back.

Positively, it would seem earlier initiatives by the government to raise awareness have had an impact since a significant size of the respondents was found to be aware of the BXW threat. Significant achievements have been made and these should be capitalized on as efforts intensify to keep manage the disease. An important aspect for consideration will be to determine areas where awareness is low and put more sensitization effort there. Rwanda already has a responsive research and extension system with fairly good capacity that should be more engaged on the BXW issue.