Journal of Development and Agricultural Economics Vol. 4(5), pp. 125-131, 12 March, 2012
Available online at http://www.academicjournals.org/JDAE
DOI: 10.5897/JDAE11.098
ISSN 2006- 9774 ©2012 Academic Journals

Full Length Research Paper

Community mobilization: A key to effective control of banana xanthomonas wilt

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Accepted 10 February, 2012

Banana xanthomonas wilt (BXW) remains a major threat to banana, an important food and income crop for 12 million poor small-holder farmers in Uganda. Although, BXW has been controlled to some extent in parts of South-western Uganda, it is still a big problem in banana growing areas of Central and Eastern Uganda. We hypothesized that differential success in BXW control is mainly due to approaches used in the BXW control. This paper therefore, evaluates stakeholder mobilization approaches used in promoting technologies for BXW control in Uganda between 2006 and 2009. Results showed that farmer field schools host communities had more farmers (33%) that had low or no BXW infection (<10 infected plants) as compared to smaller proportions (23.5%) of farmers from communities that were using community action or that were mobilised using the traditional approach (22.9%) to control BXW. There was higher BXW prevalence in communities that were using community action (68.8%) or were mobilised traditionally (66.3%) than in those that hosted farmer field schools (43.4%). Consequently, there was higher (53%) banana production recovery on farms that hosted farmer field schools than those that used other institutional approaches (22%). BXW was better controlled by farmers mobilised using farmers field schools than those mobilized through community or traditional approaches.

Key words: Banana Xanthomonas wilt, stakeholder mobilization, control, technology promotion approach.

INTRODUCTION

In the tropics, bananas and plantains provided a major source of food and income for about 400 million people of whom about 30 million live in East Africa (Swennen et al., 1995). Uganda's banana annual production is estimated at about 10 million tonnes, accounting for 15% of the total world banana/plantain output (Karamura, 1993). Over 12 million people, including 65% of the urban population, depend on the crop as their staple food (Karamura et al., 1993). It is estimated that 75% of Ugandan families grow the crop, on a total of 1.5 million hectares, which accounts for over 38% of utilized arable land (Karamura, 1993). The bananas produced are mainly consumed locally, with an estimated per capita consumption of over 200 kg which is the highest rate in the World (Karamura, 1993).

Xanthomonas wilt (*Xanthomonas campestris* pv. *musacearum* (*BXW*)) has continued to threaten banana production in East African, endangering the livelihoods of the poor, small-holder farmers. Many countries now regard it as a major priority constraint to banana production. BXW can clear the entire crop holdings, where highly susceptible genotypes dominate the farming systems. In East and Central Africa, the disease caused 80 to 100% crop loss in especially ABB beer bananas (Ndungo et al., 2005; Tushemereirwe et al., 2006; Mbaka et al., 2008). Over the last 6 years, a lot of efforts have been devoted to controlling BXW in Uganda. The cultural control package used and promoted countrywide included; avoid introducing the disease into new areas; break the malebuds using a forked stick immediately after the bunch has formed the last cluster; cut all infected plants; clean all used tools using JIK or fire flame. BXW control technologies were promoted using a mix of top-down extension and participatory approaches. Mixed levels

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of success in controlling BXW have been reported in various parts of Uganda. In this study, we hypothesized that the partial success in BXW control was mainly due to varying levels of mobilization of stakeholder partnerships, to exploit stakeholders' synergies at local and national levels. A study was conducted in Uganda in 2010 to evaluate community mobilization approaches used in BXW control for their effectiveness for BXW control.

Specifically, the study aimed at evaluating the effectiveness of the different approaches in mobilizing farmers with regard to: 1) access to agricultural information, 2) farmers' knowledge about BXW control practices and its application and 3) effectiveness of BXW control in terms of BXW incidence and banana yield recovery.

METHODOLOGY

Approaches

Stakeholder mobilization approaches for BXW technology promotion previously used in Uganda include:

Traditional

It involved raising stakeholders' awareness about the disease and its control through trained extension service providers and multiple communication channels such as mass media, posters, brochures and bill boards. It is assumed that the information will reach target farmers through the media and farmers will hopefully use the information to control BXW. There is no direct interaction between researchers and farmers and interaction between researchers and extension-agents and extension-agents and farmers is very limited. This approach is instrumental in swiftly raising the awareness of stakeholders about the disease across a large area.

Community action

The Scientist team facilitates dialogue among the different stakeholders around a common problem that is, BXW, with the aim of developing and implementing an action plan to solve the problem. It starts at community level through sensitization of the community, including local extension staff and local leaders, about the problem. The community is then facilitated to formulate a community action plan for BXW control together with the research team. All community members commit themselves to implementing the action plan. Key elements of the action plan may include community by-laws and participatory monitoring and evaluation. Stakeholders at higher levels (Local and National Government) are then mobilized to support the communities in implementing their plan. For example, the sub-county chief can help the community to enforce community by-laws. The community then shares information about its successes in controlling BXW for upscaling or outscaling the efforts and draw lessons for improving the process. The level of interaction between extension and the farmer in this approach is relatively high in comparison to the traditionally promoted technology set up (as described earlier). The main role of research in this approach is kicking off the process with the community members and monitoring the level of BXW control. Researchers also work closely with the local leaders and extension-agents to ensure support of the communities but also for the extension-service to replicate the process elsewhere in their area of operation.

Farmer field schools

Farmer Field Schools (FFS) is a community based approach. It empowers farmers to make logical crop management decisions, exposes farmers to new ways of thinking and problem solving, and encourages them to implement and discuss solutions on their own. FFS also shortens the time between research stations to adoption and facilitates the building of coherent farmer groups that are able to demand for services. The Scientist team is involved in the training of trainers who are usually local extension officers. They learn about identification of BXW, spread mechanism and BXW control but also management of other pests, diseases, and soil nutrition and water conservation within the banana cropping system. The trainers are additionally trained in setting-up and running farmer field schools. FFSs normally consist of 30 farmers. When FFSs have been set up, the trainer visits the group of farmers weekly or bi-weekly to train the farmers for up to 25 times following a set curriculum from planting to harvesting. The Scientist team backstops this training only once in a while. The idea is that information about matters learned and experiences gained fuses to the surrounding communities through field days where the success may be packaged and disseminated in songs and plays. These field days bring together stakeholders from the community (including other farmers), higher levels of administration of the local government and of national level, to share the experiences of farmers. Sometimes, these days are covered on local radios for wider audience and experiences feed back to future research agendas.

Sampling frame

In each of the two cropping systems described earlier, communities were mobilized to control BXW using different institutional approaches: 1) there were over twenty (20) farmer field schools in each of the cropping systems, three of these were randomly selected for this study; 2) there was a minimum of twenty communities per cropping system using community action, and there were also three sites randomly selected per cropping system; 3) all the banana farming communities in Uganda were mobilized using the traditional approach. In the majority of these communities this meant that they were reached only by mass media. Also for this approach, three communities were randomly selected per cropping system (Table 1). The study was conducted in 2010.

Data collection and analysis

It was realized that only a small proportion of the communities which were provided with information on control measures and BXW spread mechanisms was actually using this information for effective control of BXW. Data was therefore collected on selected variables; 1) source of information, 2) whether farmers actually knew about the disseminated information, 3) whether they actually used the information to control BXW and 4) BXW incidence or prevalence, 5) banana yield 6) acreage, 7) food security and 8) income. The farmers were the unit of data collection because although farmers were mobilized as communities with FFS and community action, the decision to attend meetings and use the acquired information to control BXW was taken based on the resources and circumstances surrounding the individual farmer. Most data collected was subjected to descriptive statistics (frequencies, cross tabulations) and Chi-square tests were used to analyse such data.

In estimating the impacts of the stakeholder mobilization approaches on different outcome variables, such as banana production before, at peak of BXW and recovery from BXW, self-selection bias is a major challenge in attributing impacts to these technology-

Table 1. Sampling frame.

Cropping system	Institutional approach	Number of communities selected	Number of farmers samples
East African highland Banana (EAHB)	Farmer field schools	3	35
	IR4D	3	80
	Traditional	3	57
Beer banana (Kayinja)	Farmer field schools	3	60
	IR4D	3	58
	Traditional	3	60

promotion interventions given that communities and households made their own decisions about their participation in the three stakeholder mobilization approaches. To control for co-founding factors in assessing the impacts of the innovation approaches, this study used a quasi-experimental approach (Smale et al., 2008; Davis and Nkonya, 2008). Selection of the comparable participants and non-participants was done using the propensity score matching (PSM).

As collection of panel data (with data on outcome variables before and after intervention) was not possible since some of the interventions were implemented a long time ago, we resorted to cross-sectional data for the PSM and impact analysis.

RESULTS

Importance of banana in the two banana cropping systems

Mean acreage under banana proportion of household income invested in banana production and the number of times banana products were consumed per week were not significantly different in both cropping systems before and after BXW attack (Table 2). However, the proportion of farm size allocated to banana production and that of monthly household income obtained from banana were significantly higher in the EAHB system. Although, banana was a main crop in both systems, a significantly higher proportion of farmers in EAHB system (91%) considered it a main crop than in Kayinja system (66%). Approximately, 83% of the farmers in EAHB grew bananas for both food and cash as compared to 66% in the Kayinja system. The importance of banana in each of the cropping systems may influence farmers' decision to protect banana from serious epidemics such as BXW.

Source of information

Across all stakeholders' mobilization approaches, the main sources of information on BXW were neighbours, radio and extension (Table 3). Other minor sources of information were newspapers, churches, schools and research. However, more farmers under farmer field schools (72.6%) accessed information from radio than those using the other two approaches. Radio was the main channel of communication for disseminating information on BXW identification, spread and control to all banana growing communities of Uganda.

Farmers' knowledge and application of BXW control measures

In general, the majority of farmers across the three community mobilization approaches knew about the key practices for controlling BXW (Table 4). However, not all of them used the knowledge to control BXW. The proportion of farmers from FFS, community action or traditional approaches who applied individual practices varied. More farmers under FFS and community action knew and utilized rouging the whole mat of affected plant, buried plant remains, and left plant remains on ground and removal of male buds with a forked stick than those mobilized traditionally.

BXW incidence on farms that used different stakeholder mobilization approaches to control BXW

The proportion of fields that had low BXW infection (<10 infected plants) was higher on sites that hosted farmer field schools (68%) than in sites with farmers that employed community action (51%) or accessed information and technologies for BXW control traditionally (38%) in EAHB cropping system (Table 5). Similarly, the proportion of fields that had low BXW infection(<10 infected plants) was higher on sites that hosted farmer field schools (62%) than in sites with farmers that employed community action (56%) or accessed information and technologies for BXW control traditionally (37%) in Kayinja cropping system. Villages or parishes that hosted farmer field schools had lower proportion of fields infected with BXW (39.7 and 47.1% respectively) than those that employed community action or accessed information and technologies for BXW control traditionally (ranged from 65 to 71%). Similarly, at village or parish level, more farmers under farmer field schools had low levels of BXW infection.

Table 2. Importance of banana in the two banana cropping systems.

Variable	Kayinja system	EAHB system	T-test
Mean farm size under banana (acres)	2.05	2.38	1.21
Proportion of farm size allocated to banana (%)	30.96	63.18	11.72***
Proportion of monthly household income from banana (%)	16.60	43.28	7.06***
Proportion of household income invested in banana production (%)	14.23	14.66	0.24
Mean number of times banana products are consumed per week per household[a]	9.65	9.21	0.55
			χ^2
Grow banana as (%): Main crop	55.6	91.3	57.23***
Secondary crop	44.4	8.7	
Grow banana as (%): Food only	30.9	16.3	18.29***
Cash only	3.4	0.6	
Both	65.7	83.1	

Table 4. Proportion of farmers that know and applying control measures by innovation approach on matched sample.

Practice	% of farmers knowing the practice				% of farmers applying the practice			
	FFS	IR4D	Traditional	χ^2	FFS	IR4D	Traditional	χ^2
Single stem removal of affected plant	76	67	84	0.17	64	62	76	8.99**
Rouging the whole mat of affected plant	74	59	49	11.48***	40	44	37	12.10***
Bury plant remains	56	58	39	12.01***	33	44	19	11.08**
Heap affected plant remains and leave on ground	40	32	39	9.88**	33	30	29	8.59**
Remove male buds of affected plant with fork stick	92	89	71	26.54***	80	73	54	7.78**
Remove male buds with cutting tools	44	45	43	1.12	21	36	37	7.26*
Clean cutting, tools (JIK/fire)	88	82	73	7.78**	64	72	61	3.85

Table 5. Farm level BXW incidence by cropping system and institutional approaches (% of households).

BXW incidence at farm level	EAHB system			Kayinja system		
	FFS (n=35)	Community (n=80)	Traditional (n=57)	FFS (n=60)	Community (n=58)	Traditional (n=60)
no infection	54	38	14	42	20	10
1-10 mats infected	14	23	24	20	36	27
11-20 mats infected	3	13	17	18	6	13
>20 mats infected	29	26	45	20	38	50

Banana bunches harvested monthly at different BXW epidemic levels by innovation approaches

Period from time of first infection to peak of infection varies from farm to farm. Period from the peak of infection to the current level of banana production recovery mainly depends on control practices being implemented. Therefore, these two periods are not standardised, however, they can still give a picture on BXW effect and farmers' control practices on banana production especially, when data is collected over a large sample.

Overall, banana bunches harvested per month reduced from 77.9 bunches at the time of first infection to 32.7 bunches at the peak of BXW epidemic. At the time of data collection, number of banana bunches harvested were 47.8 per month indicating banana production recovery from BXW of 33.4%. Mean number of banana bunches harvested monthly both at the time of BXW first infection and peak of BXW epidemic were largely similar across the farming communities mobilized using the three institutional approaches (Table 6). Banana production recovery varied depending on the approach used to mobilize stakeholders for BXW control. Banana production

Table 6. Comparison of impact of innovation approaches on different outcome variables on matched sample.

Variable	FFS Vs. traditional(with traditional as control group) (n=148)			FFS Vs. Community (with community as control group) (n=153)			Community Vs. traditional(with traditional as control group) (n = 214)		
	FFS	Traditional	ATT	FFS	Community	ATT	Community	Traditional	ATT
A. Banana harvest before BXW (bunches/month)	75.65	87.78	12.13	75.65	112.38	-24.58	89.24	65.14	44.10***
B. Banana harvest at peak of BXW (bunches/month)	40.32	43.31	2.99	40.32	41.90	1.41	24.71	24.91	-0.20
Banana harvest at current (bunches/month)	60.20	55.88	-4.32	60.20	67.72	-11.84	53.23	30.15	13.08*
Banana production recovery from BXW (%)	56.3	28.3	117.92***	56.3	36.6	51.5*	45.6	13.0	56.79**

Average treatment effect of the treated = ATT from nearest neighbor matching; N = the number of matched observations.

recovery was higher in communities hosting FFS (56.3%) than in the communities mobilized traditionally (28.3%) or using community action (36.6%). There was higher banana production recovery on fields where farmers were mobilized to use community action (45.6%) as compared to those mobilized traditionally (13.0%).

DISCUSSION

Although, the same cultural package was promoted to control BXW in Uganda using a mix of traditional, community and FFS approaches, mixed levels of success in controlling BXW have been reported in various parts of the country (Tushemereirwe et al., 2006). Partial success in BXW control was attributed to varying levels of mobilization of stakeholder partnerships through different community mobilezation approaches.

Access to agricultural information

The main sources of information were neighbours, radio and extension. Research and newspapers were sources of information for very few farmers across all the three approaches. Traditional approach was used to disseminate information on BXW diagnosis, spread and control through mass media and training of trainers. It was assumed that information would get to the farmers directly or through extension staffs and then, farmers would in turn use the information to effectively control BXW. However, as reported in Birner and Anderson (2007), extension service has often failed to effectively deliver information partly because farmers may undervalue the benefits of extension due to insufficient information or practical difficulties of providing information to spatially dispersed and poorly organized farmers. Although, farmers in farmer field schools and those using community action had more contact time with research and extension teams, the proportion of farmers accessing information from these sources were similar across approaches. Sources of information may not explain any differences in the control of BXW in communities mobilized using different approaches. The BXW control programme in Uganda expected this and used this approach for its strength in swiftly raising awareness of stakeholders about the disease across the whole country but was aware that it was ineffective in triggering actions to control the disease (Tushemereirwe et al., 2006).

Farmers' knowledge about BXW control practices and its application

Relatively higher proportion of farmers from FFS and community approaches knew and utilized the recommended practices for controlling BXW in comparison to that of farmers from traditionally mobilized communities. This could be attributed to higher level interaction between research and extension teams with the farming communities hosting FFS and using community action for BXW control. Extension agents may not have the know-how to advice farmers on some specific issues that significantly affect agricultural performance because of poor co-ordination of interaction of extension with knowledge generation (Mureithi and Anderson, 2004). Extension agents rarely attempt to explain disease life cycles to farmers, the key to unlocking the mystery of plant disease management (Sherwood and Bentley, 1986). During the formulation and implementation of action plans, stakeholders (from research, extension, political leadership, farmers) involved in community action, intensity interaction achieve better understanding of the problem and how to solve it (Hawkins et al., 2009). It is a social learning process with stakeholders learning from the experience of working together. The FFS approach is based on participatory training methods to convey knowledge to field school participants, with the extension agent-trainer expected to act not just as a transmitter of information but mainly as a facilitator encouraging the farmers'own discovery and discussion of their

experiences and observations (Feder et al., 2004a). Through group interactions, participants sharpen their decision making abilities and are empowered by learning leadership, communication, and management skills (van de Fliert, 1993). Some of the participating farmers may be selected to receive additional training to be qualified as farmer-trainers, who then take up training responsibilities with backup support such as training materials. The participants are expected to contribute to the wider community through dissemination of knowledge and follow-up activities such as field experiments and collective actions.

In the various meetings of extension teams and of farmers' communities, various control practices are explained to the farmers with an attempt to unmask the underlying epidemiological features of the recommended practices. For example, early removal of a malebud with a forked stick was to exclude insect vectored spread of BXW from neighbouring affected fields and plants. A few farmers were in the process equipped enough to continue disseminating information in the community about BXW control. These trained farmers were the ones who worked on BXW control committees in communities using community action or farmer facilitators and group leaders in communities with FFS. This would feed into the community's information flow and decision making system. There is no time for the information delivery system to develop to this level in communities mobilized using traditional approach.

Effectiveness of the approaches on BXW control

The proportion of fields that had no or low BXW infection (<10 infected plants) was higher in communities that hosted farmer field schools and community action than in communities of farmers that accessed information and technologies for BXW control traditionally. Consequently mean recovery of banana production from BXW epidemic on farms hosting FFSs and community were higher than those using traditional approach for the promotion of BXW control. One of the advantages of community based extension system is that difficulties of monitoring and attributing impact and assessing relevance are reduced, as the services are focused on issues reflecting farmers' demand, and farmers are involved in providing feedback or even in assessing the service (Feder, 2010). Davis et al. (2010) reported that participation in FFSs led to increased production, productivity, and income in nearly all cases: Kenya and Tanzania. FFS also caused relatively more progress and changes have occurred at the provincial and district government levels in rice growing areas of Indonesia (Fakih et al., 2003). This is probably because FFS and community action have particular comparative advantages to facilitate extension for activities that require collective action, such as natural resource management and pest management (Anderson and Feder, 2004).

Conclusion

Farmer field schools were the most effective in imparting knowledge about BXW control to farmers and mobilising farmers to use the practices for BXW control followed by community approach. Consequently, there was a reduced BXW infection on a higher proportion of farms hosting FFS and/or where community action was used, resulting in the recovery of banana productivity at community level in Uganda. This may be attributed to the higher level of interaction between research, extension agents and farmers. However, it is necessary to examine closely the costs of implementation of these approaches. A set of individual, organizational and institutional capacities that support these approaches in practice need to be developed for wider applicability. At an individual level, competencies need strengthening in systems thinking, knowledge management, strategic planning, effective communication and networking. Organizations need to provide the performance and incentive systems that encourage inter-disciplinary teamwork, partnerships with other stake-holders, in a manner that foster mutual learning and effective knowledge management to promote change. Challenges of scaling out community based extension system (Hayami, 2009) need also to be addressed for them to have full benefits to more farming communities.

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