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Assessing farmers knowledge and perceptions on incidence and management of Banana bunchy top disease

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Abstract

A survey was conducted to assess the farmers' knowledge and perceptions on the incidence and management of the banana bunchy top disease (BBTD). A semi- structured questionnaire was administered to 76 randomly selected farmers in Mulanje and Nkhatabay districts of Malawi. The data collected included: dominant crops over the previous five years, banana cropping systems, type of fertilizer used, knowledge of BBTD and its recommended control measures, and challenges faced in banana production. Most farmers (30.8% in Mulanje and 50.0% in Nkhatabay) stated that banana was the dominant crop over the previous five years. Majority of the farmers (88.5% in Mulanje and 80.0% in Nkhatabay) planted their bananas in mats and most of the farmers in Mulanje (88.5%) and Nkhatabay (20%) had less than 20 mats each. Recommended plant spacing (3m by 3m) was followed by most of the farmers (76.9% in Mulanje and 50.0% in Nkhatabay). Majority of the famers (55.4% in Mulanje and 63.0% in Nkhatabay) had knowledge of the disease. Furthermore, 30.7% of the farmers in Mulanje and 48.0% in Nkhatabay reported that they controlled the disease by uprooting the infected plants. The study also revealed that the yield of banana had reduced by 15 to 30 tons per hectare due to BBTD.

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Introduction

Banana (*Musa* species) is a staple food for over 70 million people in Africa and one of the most important fruits in the world (Frison and Sharrock, 1998). In Malawi, the crop is ranked sixth in importance after maize, rice, groundnuts, vegetables and beans (Gondwe and Banda, 2002). The banana industry is one of the target areas in Malawi's crop diversification program because of its role in household food security and poverty alleviation. Despite its importance in food security and income generation in most of the households, the yield of banana has been decreasing due to challenges of pests, diseases and low fertility. Soko *et al.* (2012), reported that banana bunchy top disease reduced banana production from 35t/ha to 8t/ha in the districts of Nkhatabay and Nkhotakota. Banana bunchy top disease (BBTD) is one of the devastating viral diseases of banana. The disease was first reported in Fiji Islands in 1889 (Magee, 1927) while in Malawi, the disease was first reported in 1994 but confirmed by Kenyon *et al.* (1997). The banana bunchy top disease (BBTD) is caused by BBTV of genus *Babuvirus*, in the family Nanovirade. It is spread by banana aphid (*Pentalonia nigronervosa* Coq) and vegetative planting materials (Qazi, 2015).

Land degradation which is resulting to poor soil fertility is one of the challenges that is leading to poor crop productivity in Malawi (Njoloma *et al.*, 2016). Fertility loss in Malawi continues to increase, which is not good for a country whose economy is dependent on agriculture (FAO, 2011). Njoloma *et al.* (2016) reported that Malawi loss over of 30 Kg of N and 20 Kg of P per hectare per year through erosion. Banana bunchy top disease spread may be accelerated by poor plant nutrition because most smallholder farmers in Malawi do not apply fertilizer to the crop. James (2011) reported that banana bunchy top management practices in Malawi include uprooting and burning infected banana plants, application of pesticides to control aphids, instituting a quarantine to prevent new infection. Uprooting of diseased banana plants has proved to be labor intensive for farmers (Kumwenda, 2013).

Despite the challenges that the disease has caused to banana production industry in Malawi, there is limited information regarding the farmers' knowledge and perception on incidence of BBTD. A study was set up to assess the farmers' knowledge, perception on incidence and management of the banana bunchy top in order to develop management practices that will help to reduce spreading of the disease.

Materials and methods

Study site

A survey was carried out in Milonde extension planning area (EPA) in Mulanje district and in Mpamba and Chintheche EPAs in Nkhatabay district. Nkhatabay district lies on 11.6086°South, 34.2949°East. It has total land coverage of 4,071 sq. km and it is located at 485 m above sea level. The district receives an annual rainfall of 1500 mm and the highest rainfall is experienced in the months of February to April. It is dominated by clay-loam, sandy-loam and clay soils. It also experiences minimum temperature of 18°C and a maximum temperature of 35°C (SEP for Nkhatabay, 2012). Mulanje district is located in the southern region of Malawi. The district covers 2056 square kilometers and is located at 764 m above sea level (SEP for Mulanje district, 2014). The predominant soils in the district are clay-loam, sandy clay- loamy, sandy-loam and clay soils (SEP for Mulanje district, 2014). The district experiences an average temperature of 27°C and average rainfall of 1150 mm annually. It lies on 15.9346° South and 34°35.5220° East.

Sample size and sampling method

The study targeted banana farmers from three different Extension Planning Areas (EPA) in the districts of Nkhatabay and Mulanje. The formula below was used to determine the sample size (Slovin, 1960):

$$n=\frac{N}{1+N(e)^2}$$

Where n is the sample size, N is population size and e is the level of precision. Ninety five percent (95%) level of precision was used in this survey.

Systematic random sampling was used because a sample obtained by this method tends to be more

representatives (Bellhouse, 2005). The population size (N) for each EPA was divided by sample size (n) to determine the sampling ratio (K^{th}). The first farmer to be selected was the K^{th} in each EPA and every K^{th} farmer was selected for the survey. In total 76 farmers were selected, 50 farmers from Nkhatabay district and 26 farmers from Mulanje district. The study was done in the month of November, 2016.

Data collection

Data collected included: demographics, dominant crops over the previous five years, banana cropping systems, type of fertilizer used, knowledge of banana bunchy top disease and its recommended control measures, severity of banana bunchy top disease and challenges faced in banana production.

Data Analysis

The data was cleaned; coded and descriptive statistics generated using the Statistical Package for Social Scientists (SPSS).

Results

Demographic and social-economic data

In Mulanje, majority of respondents (76.9%) were female while in Nkhatabay majority (52.0%) were male (Table 1). Majority of the respondents (72.0% in Mulanje and 68.0% in Nkhatabay) were married. Age of the respondents varied with the majority (38.5% in Mulanje and 38.0% in Nkhatabay) being aged between 32 and 40 years. Level of education for the respondents also varied with majority of the respondents having attended primary school (54.0% in Mulanje and 62.0% in Nkhatabay). Only 15.0% and 14.0% of respondents in Mulanje and Nkhatabay respectively had not gone through any formal education.

Dominant crops over the previous five years (2010-2015) and farmers' source of income in Mulanje and Nkhatabay districts of Malawi

The top three crops in a descending order in the previous five years were banana, maize, and sweet potato in Mulanje district and banana, rice and maize in Nkhatabay district (Table 2). Banana was the most dominant crop (30.8% in Mulanje and 50.0% in Nkhatabay) in both districts. Majority of the farmers in both Mulanje (65.4%) and Nkhatabay (94.0%) reported that crop production was their source of income followed by casual labor and small scale businesses.

Table 1. Gender, marital status, age, and education level of respondents (%) in Mulanje and Nkhatabay district of Malawi.

	District	
	Mulanje	Nkhatabay
Gender		
Male	23.1	52
Female	76.9	48
Marital Status		
Single	12	4
Married	72	68
Divorced	8	6
Windowed	8	22
Never married	0	0
Age		
Below 20	3.8	4
21-30	30.8	24
32-40	38.5	38
Above 40	26.9	34
Education level		
Primary	54	62
Secondary	31	22
Tertiary	0	2
No formal education	15	14
sample size =76		

Table 2. Dominant crops over the previous five years (2010-2015) and farmers' source of income in Mulanje and Nkhatabay districts of Malawi (% respondents).

	Districts	
	Mulanje	Nkhatabay
Dominant crops over the five years		
Banana	30.8	50.0
Oranges	3.8	0.0
Avocado	3.8	2.0
Maize	30.7	16.0
Cassava	3.8	8.0
Tea	3.8	0.0
Sweet potato	19.5	6.0
Rice	0.0	18.0
Groundnuts	3.8	0.0
Source of Income		
Crop production	65.4	94.0
Casual labor	30.8	0.0
Small scale business	3.8	6.0
Sample size= 76		

Banana cropping systems in Mulanje and Nkhatabay districts of Malawi in 2016

In Mulanje and Nkhatabay Districts, banana was grown either in mats or orchards (Table 2). The majority of the farmers in Mulanje (88.5%) and Nkhatabay (80.0%) district planted their banana in mats. Few farmers in Mulanje (11.5%) and in Nkhatabay (20.0%) reported to be growing banana in orchards.

Majority of the farmers in Mulanje (88.5%) and Nkhatabay (50.0%) who planted in mats had less than 20 mats each. Majority of the respondents in Mulanje (76.9%) and Nkhatabay (82.0%) had 0.1-0.25 acres of land under banana. No farmer had over 240 mats and no farmer had more than 0.4 acres under banana in the two districts. Farmers in Mulanje used plant spacing of 3m by 3m (76.9%), 4m by 4m (15.5%), 2m by 4m (3.8%) and 2m by 2m (3.8%). In Nkhatabay, farmers used plant spacing of 3m by 3m (50%), 3m by 2m (2%), 6m by 2m (2%) and 4m by 4m (2%). Forty four percent (44%) of the farmers in Nkhatabay had no specific plant spacing. Six banana varieties namely Zambia, Mpama, Mulanje, Grandnaine, Mzeru and Kabuthu were grown in Mulanje and Nkhatabay district. The top three varieties grown in Mulanje district were Grandnaine (42.3%), Kabuthu (30.8%) and Zambia (15.3%). In Nkhatabay, the top three grown varieties were Kabuthu (36.0%), Zambia (34.0%) and Grandnaine (24.0%). Mzeru was the least (2%) grown variety in Nkhatabay district and it was not grown in Mulanje district.

Table 2. Banana cropping systems in Mulanje and Nkhatabay districts of Malawi in 2016 (% respondents).

	District	
	Mulanje	Nkhatabay
Banana cropping system		
Mats	88.5	80.0
Orchard	11.5	20.0
Number of mats per farmer		
≤ 20	88.5	50.0
21-121	7.7	40.0
122-240	3.8	10.0
≥ 241	0.0	0.0
Acreage under banana orchards		
≤0.09	11.5	10.0
0.1-0.25	76.9	82.0
0.26-0.4	3.8	8.0
≥0.4	0.0	0.0
Plant spacing		
2 m* 2 m	3.8	2.0
2 m*4 m	3.8	2.0
3 m* 2 m	0.0	2.0
3 m *3 m	76.9	50.0
4 m* 4 m	15.5	2.0
5 m* 5 m	0.0	0.0
6 m* 3 m	0.0	2.0
No specific spacing	0.0	40.0
Banana varieties being grown		
Kabunthu	30.8	36.0
Mpama	7.7	2.0
Zambia	15.3	34.0
Mulanje	3.9	2.0
Grandnaine	42.3	24.0
Mzeru	0.0	2.0
sample size= 76		

Agronomic management of banana fields in Mulanje and Nkhatabay districts of Malawi

Majority of farmers in Mulanje (69.2%) and Nkhatabay (64%) reported that they did not apply fertilizer in banana (Table 3). Of the farmers who applied fertilizers, majority in both districts (80.8% in Mulanje and 90.0% in Nkhatabay) used organic fertilizers. Majority of the farmers weeded their banana mats or orchards twice and three times a year.

Table 3. Agronomic management of banana fields in Mulanje and Nkhatabay districts of Malawi (% respondents).

	Districts	
	Mulanje	Nkhatabay
Fertilizer application		
Applied	30.8	36.0
Did not apply	69.2	64.0
Type of fertilizer used		
Organic	80.8	90.0
Inorganic	19.2	10.0
Frequency of weeding		
Once a year	7.7	10.0
Twice a year	46.2	44.0
Three times a year	42.3	46.0
Four times a year	3.8	0.0
sample size =76		

Challenges faced by farmers in banana production in Mulanje and Nkhatabay districts of Malawi

The leading challenge for the interviewed farmers in both districts was BBTV (100%) (Table 3.5). In Mulanje farmers also reported that lack of improved varieties (80.1%), theft (61.5%), lack of knowledge in banana production (40.8%), unreliable markets (30.7%), poor soil fertility (15.3% and pests (7.7%) as major constraints. In Nkhatabay, farmers reported lack of improved varieties (42.0%), theft (32.0%), lack of knowledge in banana production (24.0%), unreliable markets (16.0%), poor soil fertility (8%) and pests (8%) as some of the challenges to banana production.

Knowledge of farmers on strategies for improving the management of banana bunchy top disease in Mulanje and Nkhatabay districts of Malawi

Majority of the respondents reported that they had knowledge on BBTD recommended control measures in both districts (55.4% in Mulanje and 63.0% in Nkhatabay) (Table 36). Majority of the farmers in both districts listed sharing of suckers (96.0% in

Mulanje and 83.0% in Nkhatabay) and insects (46.0% in Mulanje and 56.0% in Nkhatabay) as ways in which BBTV spread. A large proportion of the farmers sourced information on recommended BBTD control measures from extension workers (80.0% in Mulanje and 54.0% in Nkhatabay).

Majority of the respondents listed training on best management practices (46.2% in Mulanje and 36.0% in Nkhatabay) and uprooting and burning of infected plants (30.7% in Mulanje and 48.0% in Nkhatabay) as the top strategies for improved BBTD management.

Table 4. Challenges faced by farmers in banana production in Mulanje and Nkhatabay districts of Malawi (% respondents).

	District	
Constraints to banana production	Mulanje	Nkhatabay
BBTD	100.0	100.0
Lack of improved varieties	80.1	42.0
Theft	61.5	32.0
Lack of knowledge in banana production	40.8	24.0
Unreliable markets	30.7	16.0
Poor soil fertility	15.3	8.0
Pests	7.7	8.0
BBTD- Banana bunchy top disease, Sample size-76		

Banana bunchy top disease severity, yield reduction and impact of banana bunchy top virus on banana production

Majority of the farmers (80.6% in Mulanje and 80% in Nkhatabay) reported yield reduction in banana after noticing BBTV symptoms (Table 3.7). Most respondents in Mulanje (75.8%) and Nkhatabay (60%) estimated loses of banana yield of 16- 30 tons per ha due to BBTD.

The BBTD severity was considered mild (50.6% in Mulanje and 42.0% in Nkhatabay) and severe (40.6% in Mulanje and 34.0% in Nkhatabay) by majority of the respondents. Few farmers (8.8% in Mulanje and 24% in Nkhatabay) reported no infection in their orchards and mats. Most farmers listed low rate of income (100% in Mulanje and 75% in Nkhatabay) and yield reduction (96.2% in Mulanje and 100% in Nkhatabay) as the impacts of BBTD.

Table 5. Banana bunchy top disease severity, yield reduction and impact of banana bunchy top disease on banana production in Mulanje and Nkhatabay districts of Malawi (% respondents).

	District	
	Mulanje	Nkhatabay
Yield reduced after noticing BBTD symptoms		
Reduction	80.6	80
No reduction	19.4	20
Quantities of yield reduction		
0-15 tons/ha	24.2	32
16-30 tons/ha	75.8	68
BBTD severity		
Mild	50.6	42
Severe	40.6	34
None	8.8	24
Impacts of BBTD		
Low rate of income	100	76
Yield reduction	96.2	100
Lack of quality suckers	7.9	0
BBTD- Banana bunchy top disease, sample size- 76		

Availability of alternative sources of BBTV-free suckers and preferred banana varieties in Mulanje and Nkhatabay districts of Malawi

Majority of the farmers in Mulanje (80.0%) reported that they had no alternative source of BBTV-free suckers (Table 3.8). In Nkhatabay district, majority (81.0%) reported to have an alternative source of BBTV free suckers. Those who responded to have an alternative source of BBTV free suckers in Nkhatabay, majority (38.0%) indicated that they sourced the planting materials from research institutions. The most preferred banana varieties in Mulanje were Kabunthu (45.6%), Zanda (23.6%) and Sukali (14.0%) whereas in Nkhatabay the most preferred banana varieties were Williams (30.0%), Mpama (24.0%), Zambia (24.0%) and Grandnaine (22.0%).

Challenges faced by farmers in controlling banana bunchy top disease in Mulanje and Nkhatabay districts of Malawi

The leading challenge in controlling BBTD for the interviewed farmers in Mulanje district was labour intensiveness in uprooting and burning of the infected plants (32.0%) followed by poor management skills (28.6%) (Table 3.9). In Nkhatabay, the leading challange was labour intensiveness (40%) followed by resistance by other farmers to uproot and burn infected plants (28%).

Table 6. Availability of alternative sources of BBTV-free suckers and preferred banana varieties in Mulanje and Nkhatabay districts of Malawi (% respondents).

	District	
	Mulanje	Nkhatabay
Availability of alternative source of BBTV-free banana suckers		
Available	20.0	81.0
Not available	80.0	19.0
Sources of BBTV-free planting materials		
Research institutions	0.0	38.0
Government extension workers	48.2	22.0
Other farmers	30.2	35.0
Own source	21.6	5.0
Preferred banana varieties in Mulanje and Nkhatabay		
Kabuthu	45.6	0.0
Kholobowa	6.3	0.0
Sukali	14.0	0.0
Zanda	23.6	0.0
Ngerezi	7.0	0.0
Kashunga	3.5	0.0
Mpama	0.0	24.0
Zambia	0.0	24.0
Grandnaine	0.0	22.0
Williams	0.0	30.0
Mzeru	0.0	4.0
Mbingidola	0.0	2.0
Gweru	0.0	2.0
Tondiamu	0.0	2.0
BBTV- Banana bunchy top virus, sample size =76		

Table 7. Challenges faced by farmers in controlling banana bunchy top disease in Mulanje and Nkhatabay districts of Malawi (% respondents).

	District	
	Mulanje	Nkhatabay
Challenges in controlling BBTD		
Labour intensive to uproot and burn infected plants	32.0	40.0
Resistance by other farmers to uproot and burn infected plants	20.4	28.0
Poor management skills	28.6	18.0
Lack of improved varieties	19.0	14.0
BBTV- Banana bunchy top disease, sample size =76		

Discussion

The survey revealed that majority (58%) of the interviewed farmers attended primary school hence they were able to understand the issues related to banana bunchy top disease. Respondents (14.5%) who did not attend any formal education were all women. The majority of the Malawians employed in agriculture sector comprise of women and youth yet they are disadvantaged in multiple ways including access to education, limited access to ownership and control of finances and productive assets (Malawi National Agriculture Policy, 2016). The majority of respondents (62.5%) were women in both districts. This shows that the banana production industry in the two districts is dominated by women. In a similar study conducted in Thyolo district it was reported that female farmers dominated banana production (Kumwenda, 2013). The results also agree with Malawi population and housing census report that stated that Malawi population is dominated by females (51%) (Malawi Population and Housing Census, 2018). Kumwenda (2013) also reported that 70% of the females were full-time farmers and contributed about 71% of agricultural labour.

The study also revealed that banana (40.4%) was the dominant crop grown in the previous five years in Mulanje and Nkhatabay districts. It was followed by maize (23.4%) and sweetpotato (12.6%). These results show that banana is an important crop in both districts. Gondwe and Banda (2002) reported that banana is ranked among the six important crops in Malawi. The crop is used as a fruit as well as a source of income in the central and southern Malawi (Laisnez, 2005).

Crop production was the highest source of income among the farmers of Mulanje and Nkhatabay followed by casual labor (15.4%) and small scale businesses (4.9%). In previous studies, Kumwenda (2013) reported that banana was the main source of income for farmers in Thyolo district. Thyolo district is among the banana growing districts in Malawi which includes Mulanje and Nkhatabay. Gondwe (2000) reported that 50% and 43% respectively of farmers' income in Nkhatabay and Mulanje districts came from banana. Therefore, any support to these districts should consider up scaling banana production which can significantly increase income to the smallholder farmers.

Most of the interviewed farmers in Mulanje and Nkhatabay districts did not follow the recommended management practices.

This might be one of the reasons why it is proving very difficult to manage BBTD. This was proven by the fact that 84.3% of the farmers reported that they did not grow their banana in an organized orchard. Hence in case of BBTD appearance in the field is it very difficult to uproot the infected plants because the plants grow into big mats. The study also showed that 36.5% of the farmers did not follow the recommended spacing of 3m by 3m. Thus, there is little utilization of land or overcrowding of plants which results in low production. It was also revealed that 66.6% of the smallholder farmers did not apply fertilizer to their bananas. Orissa Review (2007) reported that the current management practices of BBTD include quarantine measures, eradication, biological measures and chemical control. These BBTD management practices cannot be effective where farmers are practicing poor agronomic practices as revealed by the survey. Plant nutrition plays a role in enhancing natural resistance of crops (Armstrong, 1998). Lack of fertilizer application as revealed in the study might be one of the factors accelerating the spread and adverse effects of BBTV.

The study showed that BBTD was the biggest challenge among the interviewed smallholder farmers in Mulanje and Nkhatabay districts (100%). Kumwenda (2012) also reported that BBTV was the biggest challenge to banana farmers in Thyolo district. The results are also in line with Ploetz (1998) who reported that BBTD is the most dangerous disease of banana. The study revealed that majority of the smallholder farmers in the districts of Mulanje and Nkhatabay were aware of the banana bunchy top disease. The farmers reported that they got the information from government extension workers and fellow farmers. These results show that there is a good extension system in the two districts as the farmers are able to get information from extension workers as well as fellow farmers. Masangano *et al.* (2012) reported that government extension services are the largest in terms of coverage to farmers in Malawi.

The results show that majority of the smallholder farmers were aware of the symptoms of the disease as they were able to mention some of the symptoms such as small sized bunches, and stunted growth. This shows that smallholder farmers can be able to identify an infected banana plant. This finding is similar to that by Kumwenda (2013) who found that 95% of farmers in Thyolo district had knowledge of BBTD symptoms. Most smallholder farmers (77.63%) in the two districts of Mulanje and Nkhatabay controlled the disease by uprooting the infected plants. This shows that farmers in the two districts recognize the importance of banana in their daily livelihood. It was also revealed that the farmers were aware of the recommended control measures, suggesting the effectiveness of extension system in the two districts.

Most smallholder farmers in the study sites were aware on how the disease spread. Majority of the farmers (70.8%) were able to explain that the disease is spread by a vector (aphids). Knowledge of how the virus is spread may help to manage the disease. Improved information flow to farmers in banana production and disease management can help in managing diseases and improving production (Beed and Markham, 2008).

Majority of the interviewed farmers indicated that BBTD had reduced the income in their households due to low yields. Aïtchédji *et al.*, 2010 reported that banana is a source of income and food to most households. The BBTV causes a significant decline in banana yields. Studies indicate that BBTV can cause yield losses of over 60% (Muengula *et al.*, 2014). The study revealed that banana production has reduced dramatically following the spread of banana bunchy top disease. Soko *et al.* (2012) reported that banana bunchy top disease reduced banana production from 35t/ha to 8t/ha in Malawi. Therefore, there is need for agronomic strategies to control the banana bunchy top in order to save the industry.

The study also revealed that most smallholder farmers (64.5%) did not have alternative sources of clean planting materials other than sourcing from fellow farmers. This shows that most farmers access planting materials from fellow farmers which could also be infected. This system of sharing planting materials among farmers could encourage spreading of the virus.

A report by FAO (2009) indicates that BBTV continues to spread across Malawi due to sharing of planting materials between farmers. Jooste (2013) reported that most horticultural crops in Malawi such as banana, potato, sweetpotato and pineapples are propagated through vegetative planting materials and a major problem with these materials is that pests and virus can be transmitted to succeeding crops. Access to disease free banana planting material is limited in Malawi but South Africa is the closest source of clean banana planting materials. However, the cost of importing planting materials from South Africa is prohibitive to most smallholder farmers (Jooste, 2013). Jooste (2013) reported that there are quality concerns about the imported planting materials as some are not free from diseases. Most farmers in Mulanje and Nkhatabay preferred Kabunthu, Zambia and Mulanje and Williams. The varieties were preferred because of their sweetness and high yielding capacity. Similarly, Kumwenda (2013) also found the same varieties as the preferred varieties in Thyolo district. Banda and Mwenebanda (2004) reported giant Cavendish (Mulanje) and dwarf Cavendish varieties (Kabunthu and Zambia) showed the highest yields among the six local banana varieties which were collected country wide.

The interviewed farmers indicated that poor management skills and labor intensiveness of the current management practices were the major challenges they faced when controlling the disease. Kumwenda (2013) observed in Thyolo district that the current recommended control practices involve a lot of labor. Labour intensiveness involved in the current recommended control measures may result in less adoption by farmers hence the disease will continue to spread. AAïtchédji, (2010) reported that farmers' decision to adopt a technology is influenced by how easy or difficult it is to implement it. Establishing a buffer zone from the infected banana to a new field can be an alternative management option that farmers can easily adopt.

Conclusion

This survey has shown that banana bunchy top was a major challenge to banana production in the two districts of Mulanje and Nkhatabay. Most farmers in the two districts were aware of the disease and its recommended control practices which include uprooting of the infected plants. The farmer's perceived the recommended control measures to be labour intensive.

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