THE EFFECT OF BANANA BACTERIA WILT ON THE SOCIO-ECONOMIC WELFARE OF FARMERS IN RUHINDA SUB-COUNTY RUKUNGIRI DISTRICT

BY

TAYEBWA RAMEKA

17/A/BAED/1806/F

A RESEARCH REPORT SUBMITTED TO THE FACULTY OF EDUCATION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AW ARD OF A BACHELOR DEGREE OF ARTS WITH EDUCATION

OF KABALE UNIVERSITY

JANUARY, 2021

DECLARATION

I, Tayebwa Rameka, declare that this research report is my original work and it has never been presented for the award of a bachelor degree or Diploma in any institution.

Signature:..... *Date:26/01/2021*

TAYEBW A RAMEKA

STUDENT

APPROVAL

This research report has been carried out under my supervision and it is now ready for submission for the award of bachelor's degree of arts with education of Kabale University.

Signature..... Date: *26/01/2021*

MR. TWINAMATSIKO JULIUS TUMWINE

SUPERVISOR

DEDICATION

I dedicate this report to my beloved parents Mr. Makuru Eldard and Mrs. Tumuhairwe Roset for their parental love they shown me, brothers and sisters for their support throughout my studies.

ACKNOWLEDGEMENT

I want to first thank the Almighty God who has brought me this far and for the gift of life and wisdom he has given me.

Sincere gratitude goes to Mr. Twinamatsiko Julius Tumwine my supervisor and on a special note I credit him for his guidance, moral and support he has shown me. May God reward him abundantly.

Appreciations goes to my sisters Niwampire Ritah, Aimomugisha Amina and my brothers Amanya Medard. Taremwa Emmanuel and Tashobya Albart for their continuous support during my academic study.

Great thanks and appreciation go to my relatives and friends, Mr.Mulangira Frank, Mrs. Nyendwoha Jovia, Ms. Atuhaire Melda for their love, care and guidance throughout my academic study.

Sincere appreciation goes to my course mates Niwabiine Franco, Arinaitwe Fred, Twinamatsiko Paul, Atamba Peter for their co-operation, guidance and support they extended towards me during my academic study. May the lord reward them abundantly.

I also wish to extend sincere thanks to all well-wishers including those who would help me on my way to and from campus. May the lord grant you all your desires.

Finally, I wish to extend great thanks to the lecturers and other staff members of Kabale University for the love, patience and great support they gave me during the course of my academic study.

May the Almighty God bless you all.

LIST OF ABBREVIATIONS

BBW	Banana Bacteria Wilt
coo	Community Development Officer
EAHB	East African highland banana
FAO	Food and Agricultural Organization
MASL	Metres Above Sea Level
NGOs	Non-governmental Organizations
NAADS	National Agriculture Advisory Services
URT	Underwater Recovery Team

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

The study examined the effect of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda sub-county Rukungiri district. The objectives of the study were to identify the importance of banana production, to assess the impact of banana bacteria wilt on socio- economic welfare of the farmers and to examine the possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district. The researcher employed a descriptive research design and data was collected using interview, observation and questionnaire methods. The study results on importance of banana production in Ruhinda sub-county Rukungiri district indicated that, the highest number of the respondents mentioned food security while the least number of the respondents mentioned source of mulch for maintaining and improving soil fertility. The study went ahead on the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county. The highest number of respondents mentioned source of mulch for maintaining and improving soil fertility, the lowest number of respondents mentioned that the disease has led to increased poverty among households and the study continued on possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district, the highest number of respondents mentioned heating garden tools such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch is also effective in killing the bacteria, the lowest number of respondents talked of timely removal of male buds with a forked stick is important in where insect vector that visit the diseased flower parts carry the pathogen. The study recommended that there should be quarantine enforcement by the government agencies to prevent spread of banana bacteria wilt to non-infected areas, there should be policies on the use of clean planting materials and regular inspection/screening for the approved banana nurseries to dispense banana bacteria wilt disease free materials and there should be production of free banana bacteria wilt such as banana tissue culture, train and encourage more banana nurseries producers/tissue culture hardening nurseries to avail clean banana planting materials.

CHAPTER ONE
INTRODUCTION

1.0 Introduction

This chapter covered the background of the study, statement of the problem, objectives of the study, research questions, scope of the study, significance of the study and the definition of key terms.

1.1 Background of the Study

Banana farming is grown different from other forms of crops produced globally in that the farmers use suckers in planting compared to other crops, the Bantu people practiced slash and burn shifting cultivation and grew finger millet (Eleusinecoracana), yams (Dioscoreasp) and Coleus (Coleus spp) for about two millennia. Bananas and plantains are the worlds fourth most important food crop after rice, wheat and maize (Tripathi, 2013). The biggest Banana producing country in 2016 was India producing almost 30 million tons- , followed by China and Indonesia. Brazil and Ecuador complete the top five. While India is currently producing about 28% of all Bananas, it only exports about 0.1% of their harvest, (Nguthi, (2016)).

Cooking and dessert banana cultivars are grown in different regions of Kenya (Yako et al., 2011). The distribution of banana cultivars is influenced by factors such as local taste, eating habits and marketing conditions (Rice et al., 1990; Nguthi, 2008); Bioversity International, 2009). Western and Nyanza regions of Kenya produce 64% of the total national production and predominantly the East African highland cooking banana, the Apple banana and the Cavendish (Onyango et al., 2011). The presence of the devastating banana bacteria wilt disease in Kenya causes an alarm since the disease can cause absolute yield loss of 80-100% (FAO, 2007;Ocimati et al., 2013a; Kubiriba et al., 2014). Banana is a major food security crop in developing countries where Uganda is inclusive and is an important source of nutrition. It is estimated to supply 75 % 0f the carbohydrates needed by more than 20 million people in these countries (Tripathi and Tripathi, 2009).

Sub- Saharan Africa produces 35% of the world banana and plantains (Tripathi et al., 2008). In East and Central Africa, the great lakes region covering Uganda, Tanzania, Rwanda, Kenya, Burundi and Congo, produces 15 million tons per year (Tripathi, 2013).

Banana bacteria wilt does not appear to have the ability to gain entry into the plant unless there is injury (Tripathi et al., 2013). Bacteria cannot enter plants via intact cuticles and entry is either through wounds or natural openings such as hydathodes and stomata (Kidist, 2003). Successful infection of a host plant by a bacterium involves the movement of the bacterium towards the host, contact between the two and penetration of the host by thebacterium and proliferation of the bacterium inside the host immediately following ingress (Gnanamanickam et al., 2009). Once the bacteria enters into the plant, they multiply in the intercellular spaces and move through the tissues. Cell death of the plant may follow due to toxins or pectolytic enzymes produced by the bacteria (Agrios, 2005).

The disease has since spread throughout the major banana producing districts of western Uganda including Ruhinda Sub-county, Rukungiri district, causing losses of up to 100% in poorly managed banana plantations (Mgenzi et al., 2006). Yield losses are associated with early ripening and rotting of fruits even in the absence of apparent external symptoms of the disease, and wilting and death of the banana plants (FAO- Rugalema and Mathieson, 2009). Consequently, due to the banana bacteria wilt spread in most of the districts of Uganda, several farmers have abandoned banana cultivation as the result of low production of banana. To rescue high loss of banana yield, appropriate bacteria wilt intervention measures need to be taken very soon in order to ensure food security, poverty reduction and sustainable livelihoods of the farmers (FAO - Rugalema and Mathieson, 2009).

1.2 Statement of Problem

Banana bacteria Wilt is the most devastating disease affecting bananas in the entire Great lakes region of Africa. It has contributed to decreased household and national food security and income (Tushemereirwe et al 2004). In Tanzania and Uganda in particular, banana bacteria wilt has negatively affected the livelihoods of the people by significantly contributing to food insecurity and decreasing the incomes of the smallholder farmers. The disease has already depleted several hundreds of acres of banana plantations mostly in south western Uganda districts. The most affected families include those headed by orphans and the elderly who have no other alternative means of survival, (URT, 2012).In Rukungiri District, the authorities show that bacteria wilt has affected the district economy such that most families who depended on banana are no longer as wealthy as they used to be. "Almost 65% of the farmers in Ruhinda sub-county Rukungiri district take one meal a day due to the loss of food (banana), while 35% who take more than one meal have other sources of income like businesses and the district economy has dropped tremendously within a few years. The outbreak of disease has caused desperation and disaster to the natives of this area. The

dwindling income from banana production can no longer allow them to take their children to school, they cannot afford health care expenses and most importantly, food security at family level is not assured. This prompted the researcher to go to the field to assess the effects of banana bacteria wilt on the socio-economic welfare of famers in Ruhinda sub-county Rukungiri district.

1.3 Objectives of the study

1.3.1 General Objective

The general objective of the study was to examine the effect of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda sub-county Rukungiri district

1.3.2 Specific objectives

The study was guided by the following objectives

1. To identify the importance of banana production in Ruhinda sub-county Rukungiri district
2. To assess the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county
3. To examine the possible measures to control banana bacteria wilt in Ruhinda subcounty Rukungiri district

1.4 Research Questions

1. What is the importance of banana production in Ruhinda sub-county Rukungiri district?
2. What is the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county?

iii. What are the possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district?

1.5. Scope of the study

1.5.1 Geographical Scope

The study was carried out in Ruhinda sub-county Rukungiri district. Ruhinda sub-county boarders with Bugangari sub-county in the East, Buhunga sub-county in the West, Kagunga sub-county in the North and Bwambara sub-county in the South in Rukungiri District. Rukungiri District is bordered by Rubirizi District to the North, Mitooma District to the East, Ntungamo District to the Southeast, Kabale to the South, Kanungu District to the West and the Democratic Republic of the Congo to the Northwest.

1.5.2 Time Scope

The study considered information within a period of eight years (2010 to 2018) following the effects of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda subcounty Rukungiri district.

1.5.3 Content Scope

The study was limited to the effects of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda sub-county Rukungiri district.

1.6 Significance of the Study

The study will help the entire community to learn and get possible measures to control banana bacteria wilt in their banana plantations.

The study will help the government bodies, to obtain the relevant information about the effects of banana bacteria wilt on the socio-economic welfare of farmers.

The results from the proposed study will be useful to the local government and Non-governmental Organizations (NGOs) in Ruhinda sub-county Rukungiri district by giving out the measures to control banana bacteria wilt.

The study will provide literature and findings that will help other researchers. It will thus acts as a temporary or permanent source of reference by future researchers.

1.7 Definition of key terms

Bacteria wilt is a lethal fungal disease caused by the soil-borne fungus Fusarium oxysporum.

Socio-economic welfare refers to the level of-living conditions of populations that is defined by the set of resources (goods & services) possessed at a given time.

A farmer is a person engaged in agriculture, raising living organisms for food or raw materials.

Welfare of a person refers to their health, comfort, and happiness of an individual

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter provided the related literature reviewed for the study that is extracted from various publications from libraries and the websites. It covered the importance of banana production, the impact of banana bacteria wilt on socio- economic welfare of the farmers and the possible measures to control banana bacteria wilt.

2.1 Importance of banana production

Bananas belong to genus Musa, family Musaceae and order Zingiberales. Bananas are believed to have originated from South East Asia and Indochina (Simmonds, 1962) where the earliest domestication of bananas is also believed to have happened. From there, they were introduced to all tropical and subtropical regions of the world, gaining great importance as a food crop. It is suggested that edible bananas originated from two wild seed forming species, Musa acuminate Colla (2n = 2X= 22) and Musa balbisiana Colla (2n=22), and provide "A" and "B" genomes of bananas, respectively. Bananas were introduced into East Africa by the Arab traders on their journeys between India and East Africa, or could have reached East Africa via the west coast of Africa. It is believed that somatic mutations gave rise to the large variability in the East African highland banana (EAHB) cultivars, making East Africa the secondary center of diversity for this group.

Banana is a major food security crop in developing countries and is an important source of nutrition. It is estimated to supply 75 % of the carbohydrates needed by more than 20 million people in these countries (Tripathi et al., 2005; Karamura et al., 2008; Tripathi and Tripathi, 2009). Bananas and plantains are the worlds" fourth most important food crop after rice, wheat and maize (Kwach et al., 2000; Tripathi et al., 2005 and 2009; Viljoen, 2010; Yako et al., 2011; Tripathi, 2013). Sub- Saharan Africa produces 35% of the world banana and plantains (Tripathi et al., 2008). In East and Central Africa, the great lakes region covering Uganda, Tanzania, Rwanda, Kenya, Burundi and Congo, produces 15 million tons per year (Bioversity International, 2009; F AO, 2009; Odipio et al., 2009; Jogo et al., 2011; Kubiriba et al., 2012; 20 I 4). The region has the highest per capita consumption of bananas of 200250 kg annually (Tushemereirwe et al., 2002; Jones et al., 2007; Biruma et al., 2007; Nguthi, 2008; Tripathi and Tripathi, 2009; Tripathi, 20 I 3). in Kenya banana is a major crop covering

74,000 hectares equivalent to 2% of arable land with production of over 510,000 tons per year (MoA, 2008; Yako et al., 2011). Bananas are grown in a wide range of altitudes from 0 to slightly over 1800 mas!. Cultivation of banana is largely carried out under rain fed conditions by small scale farmers with an average banana land holding of 0.3 hectares in Kenya. The production and yields per hectares vary within the regions of Kenya.

Banana has many qualities that make it an essential crop in East Africa. Bananas are preferred to be consumed as fruits due to their progressive conversion of starch into sugars after harvest (Bagamba et al., 2006), while others like plantains are considered to be a carbohydrate staple.

Depending on the juice yield, some fruit type cultivars are used to produce wine and gin. East African highland bananas are mainly produced as a starch staple that compete with other crops such as cereals (like maize and millet) and tubers (like sweet potatoes and cassava) (Bagamba et al., 2006). In addition to providing a reliable source of food, banana is an essential source of income with excess production sold in local markets.

In Africa, Tanzania ranks fourth in banana production and produces some 3.7 million tons peryear from some 403,000 hectares. Kilimanjaro and Kagera are the most famous banana growing regions in the country, producing 1,383,800 and I, 150,000 tons respectively, in 1998. (http://www.dailynews.co.tz/home/?n=l 5934). Bananas are consumed as fruit, prepared bycooking, roasting or drying, used for production of banana juice and fermented for production of alcoholic beverage (beer, wine and gin) (Edmeades et al., 2006). Bananas are also a source of animal feeds (fresh pseudostems, male buds, banana peelings and by-products of fermentation), wrapping material for produce in storage, construction materials (thatch and binding ropes) and handicrafts (mats, baskets, hand bags, necklaces and decorations) (Karugaba and Kimaru, 1999).

Banana leafs provide soil surface cover, reduce soil erosion on steep slopes, and are used as a principal source of mulch for maintaining and improving soil fertility (FAO- Rugalema and Mathieson, 2009). However, studies show that culturally, banana has more than 100 uses and benefits in Kagera Region.

2.2 Impact of banana bacteria wilt on socio- economic. welfare of the farmers

The bacterial wilt disease of banana is a biotic factor affecting banana production and has contributed to the diminishing of landrace diversity in some growing areas, exposing farmers to food shortage (Yemataw et al., 2016).

Compared to pre-infection levels, the total banana yield loss due to BBW infection is estimated at 30-52 % between 2001 and 2004 (Karamura et al., 2006). This has caused a reduction in the amount of banana harvested by households which has impacted livelihoods negatively. Many households have switched to other crops while others have abandoned banana cultivation.

Although an economic analysis of Banana Bacteria Wilt (BBW) has to be based on findings from Central Uganda, where the disease has occurred first and is presently most common, it is possible to forecast that poverty has resulted due to a BBW pandemic in Uganda following the observations made in this region. BBW has now been reported in 34 districts in Uganda, apparently spreading from Central Uganda, where banana production is less intensive and mainly subsistence oriented to the high-production areas in Western Uganda. However, whereas in Central Uganda infestation rates reach levels of 18- 27% the major banana producing areas in the South-West of Uganda still show little or no infection (Tushemereirwe and Opolot, 2005).

The fact that in Western Uganda, mainly cooking banana is cultivated, which is susceptible to insect-borne BBW than the exotic varieties that are primarily planted in Central Uganda. Kayobyo et al. (2005) reported that if uncontrolled BBW spreads at an infection rate of 8% per annum in cooking bananas has resulted into low income earning by the farmers and the total production loss of bananas is expected to be about 56% over a ten year period, translating into a reduction from 4.5 million tons to eventually 2.1 million tons per year. Such a conformity leads to a reduction in banana market, therefore the new varieties should be introduced whenever obsolete plants have to be replaced on farmers' fields, according to farmers' decisions on how to most profitably introduce new cultivars to replace the old ones.

When the bacteria enters through floral parts of the banana plant, there is wilting of male bud bracts, followed by drying of the rachis leading to premature fruit ripening and drying and eventually death of the entire infected plant (Kubiriba et al., 2014). Infected flowered plants show leaf wilting and eventual death of the plant. Infected banana fruit are characterized by brown internal colorations (Tripathi et al., 2013). When excised, pockets of pale yellow bacterial ooze appears within five to 15 minutes from cut banana tissue. Internally, cross-sections of pseudostems show yellow bacterial ooze, while the cross sections of the fruits show rusty brown stains and the disease is devastating, completely kills the plant and affects the income levels of the farmers which retards the socio- economic welfare of the farmers.

The Banana bacteria Wilt (BBW) disease, caused by the bacterium Xanthomonas campestris pv. Musacearum, jeopardizes the livelihoods of millions of farmers in East Africa (Tushemereirwe et al., 2004). It has threatened banana production in the Great Lakes region of Eastern Africa including Burundi, Rwanda, the Democratic Republic of Congo, Uganda, Kenya, and this has led to low banana production and poor banana markets leading to poverty among the communities.

Culturally people regard bananas as the best food and the banana plant as a blessed plant due to its more than 100 uses. The outbreak of BBW has changed this perception, causing desperation and disaster to the natives of this area. The dwindling income from banana production can no longer allow them to take their children to school, they cannot afford health care expenses and most importantly, food security at family level is not assured (F AO Rugelema and Mathieson, 2009).

Banana production is threatened by various biotic hindrances including pests such as banana weevil and nematodes and diseases (Ortiz et al., 2002). The significant diseases include Black Sigatoka, Fusarium wilt and Banana Banthomonas Wilt (BBW) which cause yield losses of up to 90% in the farmers' fields and this has drastically lead to low income per household (Aritua et al., 2007).

The effects of BBW are both extreme and rapid as compared to other diseases which have caused gradual losses over years. The economic impact of BBW is due to the death of the mother plant that would otherwise contribute to the ratoon plant production cycles (Tripathi et al., 2007).

2.3 Possible measures to control banana bacteria wilt

Banana bacteria wilt spread to other areas in East and Central Africa is a threat to banana product that requires some control measures thus calls for specific research to generate data on its management and control. The measures may include integrated disease management methods (Eden-Green, S. (2004)).

Routine disinfection of garden tools after use on each mat using sodium hypochlorite assists in killing the bacteria and thus reduces the spread rate from one plant to the next (Green, 2006; Jones et al., 2007). Alternatively heating garden tools, such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch is also effective in killing the bacteria (Biruma et al., 2007; Karamura et al., 2008). Where contaminated tools are the main means of pathogen dissemination, disease spreads in a systematic manner starting from the

}

infected mat and expanding outward thus disinfection to have clean farm operation tools is vital (Karamura et al., 2008; Tripathi et al., 201 0; Ocimati et al., 2013a).

The fields can also be kept clean by spot checking any banana bacteria wilt symptoms and can be reinforced by having a suspended mechanical weeding/operations for at least three months to observe the latent symptoms during the period weeding can be done by herbicides (Karamura et al., 2008; Okurut et al., 2006).

Use of clean planting banana material like tissue culture plantlets and or conventional rapid field macro propagated banana suckers in disease free areas checks banana bacteria wilt spread from farm to farm (Ndungo et al., 2003; Onyango, 2009; Mbaka et al., 2008; Tripathi et al., 2009; Tripathi et al., 2010; Tripathi, 2013; ProMusa, 2014). Entire infected mats which have not flowered can be removed to ensure that no infected suckers reach flowering, avoiding sources of inoculum for insect vectors (Muchunguzi et al., 2007).

Timely removal of male buds with a forked stick is important in where insect vector that visit the diseased flower parts carry the pathogen mechanically from one flower to the next (Tinzaara et al., 2009; FAO, 2009; Tinzaara et al., 2013). The disease can be contained in fields where de-budding is effectively practiced (Green, 2006; Tinzaara et al., 2009; Tripathi, 2013; Ocimati et al., 2013a; Ocimati et al., 2013b; Kubiriba et al., 2014). The practise should be carried out just after the female flowers have been formed three to four weeks after flowering.

Rehabilitation of previously affected banana orchards *by* removal of the infected plants within a mat reduces the disease spread from one plant to other plants mostly for the infection by insects through flower buds at initial stages before the disease has advanced to the soil (Tripathi et al., 2009; Kubiriba et al., 2014). Cutting down and burying whole mats with disease symptoms kills the pathogen as they cannot survive without banana. The use of herbicides to kill the affected banana plants has also been effective (Ssekiwoko et al., 2006a; Blomme et al., 2008; Addis et al., 2010). Once banana bacteria wilt occurs in a field, the recommended remedy is to rougue out all infected plants, completely dig out the rhizomes and leave the field fallow for a period thereby killing the pathogen,which eventually reduces the pathogen build up (Karamura et al., 2008; Blomme et al., 2008; Tripathi et al., 2009; Kwach et al., 2012; Kubiriba et al., 2014).

bacteria wilt and similar bacterial diseases of banana depends on the prevention of disease spread (containment), reduction of disease impact in affected farms (management), and rehabilitation of previously affected areas. In Uganda, banana bacteria wilt is mainly controlled by improved cultural practices in well organized banana production areas (Tushemereirwe et al., 2003). Cultural practices that have been used so far include the use of clean planting materials, clean tools which are sterilized in fire or diluted sodium hypochloride, de-budding by breaking the male buds with a forked stick, cutting and burying of the diseased plants, and crop rotation (Tushemereirwe et al., 2004 and FAO-Rugalema and Bijukya, 2009).The management of diseases in tropical perennial crops such as bananas is a challenge due to continuous association of host and inoculum over a long period of time (Ploetz et al., 2007).

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

In this Research Methodology chapter, the following were presented: research design, study area, study population, sample size and selection, Data source, data collection methods, research procedure, data analysis and interpretation and limitations to the study.

3.1 Research Design

The researcher employed a cross sectional study design that helped in gathering information where little knowledge was known. Both quantitative and qualitative data was collected and this enabled the researcher to draw valid and dependable conclusion and recommendation of the study.

3.2 Study Area

The study was carried out in Ruhinda sub-county Rukungiri district. Rukungiri District is bordered by Rubirizi District to the North, Mitooma District to the East, Ntungamo District to the South East, Kabale to the South, Kanungu District to the West and the Democratic Republic of the Congo to the Northwest

3.3 Study Population

The study considered 4 1 16 households of Ruhinda sub-county Rukungiri district according to UBOS report 2014.

3.4 Sample Size and Selection

The study population considered family heads, sub-county chief, NAADs coordinator, CDO and parish chief. The sample size of 96 out of 4116 family heads from Ruhinda Sub County Rukungiri district was considered and the sample was got Using simple Raosoft formula.

n= N

1 +Ne)°

n = 4116

I +4116x (0.1

n = 96 respondents

n = Desired sample size, N= Population size, e= Error (I 0%)

Simple random sampling was used to select the ninety six (96) family heads. The researcher visited the villages and introduced himself to the local council chairman and after the local council chairman gave him a list of names of house hold heads in which the researcher chose the respondents. From Katookye village, he chose fifty respondents from a list of one hundred family heads by choosing names on even numbers while forty six respondents from Kajwomushana village were got from ninety two family heads by choosing odd numbers. Purposive sampling was also use to select four (4) key Informants from Ruhinda sub county Rukungiri district. That is one (1) sub-county chief, one (I) NAADs coordinator, one (I) COO and one (I) parish chief. This sampling method was used to select respondents who were believed to be more informed and updated with the content of the study. The researcher visited villages in Burombe parish in Ruhinda sub-county Rukungiri district which included Kajwamushana and Katookye to collect data for the study and this was done by the researcher through writing numbers on the pieces of papers from one to six and were put in a box which was shaked up and down and he pick two papers representing those villages.

3.5 Data Source

The data for the study was gathered from both primary and secondary sources to enable easy comparability of secondary data available with responses from the primary data sources that was generated from the field in order to drive to meaningful interpretation of findings.

3.5.1 Primary Data

The primary data was gathered from the respondents that were selected for the study. The researcher used observation guide, questionnaires and interview guide to gather data from respondents.

3.5.2 Secondary Data

The secondary data/information was obtained through an extensive literature review on the effect of banana bacteria wilt on the socio-economic welfare of farmers. Secondary data was gathered from the information resources and reports, Newsletters, and books/publications from different Libraries in Rukungiri District and from the websites.

3.6 Data Collection Methods and their Instruments

Data collection is the scrutiny, measurement and recording of information (Gary *et al*, 2007). The qualitative techniques of data collection, that is, document review, interviewing and participant observation, was used to obtain the relevant data needed for the study. For the purpose of this study, data refers to the facts, figures and other relevant materials, past and

present, serving as bases for study and analysis. The following methods and tools were used for this research during data collection:

3.6.1 Interviewing

Interviews were used as informal conversations that allowed the researcher to extract rich and detailed information from interviewee(s) and this was used on banana farmers who practice farming. In so doing, the researcher first prepared an interview guide to remember what was required to raise during the interview. This method was quite important whereby the well informed and illiterate respondents provided the researcher with rich and detailed information on the subject of inquiry.

3.6.2 Observation

During the study, the researcher employed participant observation to assess the banana farmers. The researcher actively participated during the study in order to become familiar with the respondents within the study area. The researcher observed bananas affected by banana bacteria wilt, how the wilt had impacted the area and the measures the farmers were putting to overcome the bacteria wilt.

3.6.3 Questionnaire Method

The researcher constructed an easy, clear, and straight-forward questionnaire to be used on the key informants from the Staff of Ruhinda sub county Rukungiri district for the comfort of respondents' understanding, interpretation and feedback. A structured questionnaire consisting of both open-ended and close-ended questions based on a set of questions in relation to the study objectives were administered in order to gather relevant in-depth information. This enabled the researcher to use distant respondents and helped respondents to think more about the questions and give well explained and clear answers.

3.7 **Research Procedure**

The researcher requested for a letter of introduction from the Research Coordinator of Kabale University to assess the effects of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda sub-county Rukungiri district. A copy of this letter was presented to the respondents that were approached during data collection. Questionnaires were distributed to the selected literate respondents; observation was done; and interviews were held; and check list field diaries were used and kept to record events that were very important during the interpretation and analysis of the results.

3.8 Data Analysis and Interpretation

Data analysis is the process of organizing the data retrieved, in order to provide a clear meaning of the information (De Vos, 2005: 333). Gary *et al* (2007: 2) explain that data analysis is when a researcher organizes and arranges the data collected in order for others to gain significant meaning out of it.

Both qualitative and quantitative data was gathered during the study, the detailed classifying, comparing, weighing and combining empirical material from the questionnaires, observation and interview guides and field notes to extract the meaning for an understanding of the subject under study in a coherent explanation.

The data units were sorted according to the study objectives in order to produce coherent meaning. The data was then organized, entered into the computer and analyzed using Microsoft Excel a computer-based statistical application program, where both inferential and descriptive analysis was carried out. The study results were later presented in form of tables, for easy interpretation. Conclusion and recommendation were further drawn in the same arrangement with the study objectives accrued from the study findings.

3.9 Limitations and delimitations of the study.

The researcher expected failure of respondents to reveal the truth of their information and even others to dodge answering some critical questions an incident which resulted into the researcher missing very important information. However, the researcher made sure that he used all the ways possible to convince and entice respondents to provide relevant information in its fullness.

The researcher also expected to face the challenge of limited funds. However, the researcher used all efforts and fundraise from well-wishers and optimally use his personal savings and achieved to the stated study budget so as to avoid unexpected expenses that could hamper the research process.

CHAPTER FOUR

ANALYSIS, PRESENTATION AND DICUSSION OF THE FINDINGS

4.0 Introduction

This chapter presents analysis, presentation and discussion of findings. The findings are based on the information collected from the respondents using the research instruments that were designed in the methodology section. Data was presented basing on the research objectives of the study.

4.1 Demographic characteristics of respondents

A total of one hundred (100) respondents were selected for the study. The researcher considered the age, sex, education level and marital status of respondents. This biographic data was very essential for the researcher and the study in order to describe the best respondents that were selected for the study as presented below.s

4.1.1 Age of the respondents

In a bid to record the bio data of respondents, the researcher considered the age of respondents and the results in Table 4.1. l below were recorded:

Table 4.1.1: Showing the age of the respondents

Age	**Frequency**	**Percentage**
21-30	20	20
31-40	22	22
41-50	28	28
51-60	16	16
61 and above	14	14
Total	**100**	**100**

Source: Primary Data 2020

According to the results presented in table 4.1.1 above, 28% the highest numbers of the respondents had 41-50years of age and these had much information about the study while 14% is the least numbers of respondents who had 61 years and above and these had enough information about the study though some of them were no long active farmers of bananas due

to the old age they had but they had experience in banana plantations. The rest of the respondents included 20% who had 2 l-30years of age and these had information for the study because most of them were involved in banana farming and had information for the study and the remaining 22% had 3 l-40years of age and these also had information for the study because their source of income was agriculture and they had enough information on banana bacteria wilt and 16% had between 51-60years of age and these had information because they had experience in banana farming. The researcher considered the age of respondents with the view of acquiring data from respondents in relation to their lifetime experiences and understanding.

4.1.2 Sex of the respondents

The researcher considered the sex of respondents and the results presented below in table 4.1.2 were recorded.

Table 4.1.2: Sex of respondents

Sex	**Frequency**	**Percentage**
Female	40	40
Male	60 a	60
Total	**100**	**100**

Source: Field data, 2020

From the study, data collected shows that most of the respondents were males represented by 60% of the total population because they were heads of the families and had full ownership of the land therefore were very responsible in making decisions in farming whereas females were only 40% of the respondents because these were under their husbands restrictions who were decision makers. This shows that the males play different roles from females. This shows males were more involved in banana farming and were much knowledgeable.

4.1.3 Marital status of the respondents

The researcher considered the marital status of respondents and the results presented below in

Table 4.1.3 were recorded.

Table 4.1.3: Showing the marital status of the respondents

Marital Status	**Frequency**	**Percentage**
Widowed	12	12
Married	88	88
Total	**100**	**100**

Source: Primary Data 2020

As reflected in the study results presented in table 4.1.3 above, 88% the highest numbers of the respondents were married and they were involved in banana farming much to get food for their families while 12% the least number of respondents were widowed in this case meaning that they had lost their spouses through death and they were few compared to the married population. This implies that much of the information was provided by the married people since they were many and were much involved in the banana farming practice.

4.1.4 Highest level of educational attained by the respondent

The researcher further considered the highest levels of education attained by respondents and

the results presented below in table 4.1.4 were recorded.

Table 4.1.4: Showing the highest level of educational attained by the respondents

Level of education	**Frequency**	**Percentage**
Non formal Education	**06**	**06**
Primary	**46**	**46**
Secondary	**28**	**28**
University	**20**	**20**
Total	**100**	**100**

Source: Field data, 2020

According to the results presented in table 4.1.4 above; 46% the highest numbers of the respondents had attained primary level and had opted for banana farming to get income therefore they had knowledge about banana bacteria wilt and they made the biggest number of thy literate respondents whereas 6% the lowest number of respondents had non formal education but they were involved in banana farming using the local knowledge acquired from their parents and grandparents. The other respondents included 28% who had attended secondary education were also farmers of banana plantations and understood well the banana

bacteria wilt and they had to provide information while those who had university education were represented by 20% since most of these graduates had not found jobs and they decided to engage in banana farming because of its high productivity in the area.

4.2 Importance of banana production in Ruhinda sub-county Rukungiri district

The researcher attempted research question one to record the importance of banana production in Ruhinda sub-county Rukungiri district and the results are presented below in Table 4.2 were recorded.

Table 4.2: Showing respondents' views on the importance of banana production in Ruhinda sub-county Rukungiri district

Importance of banana production in Ruhinda sub-county Rukungiri district	**Frequency**	**Percentage**
Food security	30	30
Income generation	28	28
They are used to produce wine	9	9
Source of animal feeds	20	20
Banana leafs provide soil surface cover and reduce soil erosion	10	10
Source of mulch for maintaining and improving soil fertility	3	3
Total	**100**	**100**

Source: Primary Data 2020

The results presented in table 4.2 above indicated that 30% the highest number of the respondents mentioned food security,3% the least mentioned source of mulch for maintaining and improving soil fertility, 10% of the respondents mentioned that banana leaves provide soil surface cover and reduce soil erosion, 20% of the respondents mentioned source of animal feeds, others(9%) mentioned that they are used to produce wine and this was done through fermentation for production of alcoholic beverage like wine and the remaining 28% of the respondents mentioned income generation.

The results presented in table 4.2 above indicated that 30% the highest number of the respondents mentioned food security because almost all households in Ruhinda sub-county

Rukungiri district had banana plantations because they relied on them as a source of food for supporting their livelihood as in line with Tripathi et al., (2005) who stated that Banana is a major food security crop in developing countries and is an important source of nutrition. It is estimated to supply 75 % of the carbohydrates needed by more than 20 million people in these countries.

The least number of the respondents (3%) mentioned source of mulch for maintaining and improving soil fertility because after cutting down the banana plant, its fibers and the entire body of the plant was used in mulching the other gardens or the same garden which later would improve on the fertility of the soil as agreed by Odipio et al., (2009) who stated that banana production helps to improve on the farming activities as the peelings can be used in mulching which adds fertility to the soil. This was in line with what the researcher observed because the farmers who carried out mulching had good banana plantations especially in Kajwomushana village in Burombe parish Ruhinda sub-county.

According to table 4.2, 10% of the respondents mentioned that banana leaves provide soil surface cover and reduce soil erosion because when the banana plant is cut down it acts as the mulch and controls soil erosion in that area as in line with (F AO- Rugalema and Mathieson, 2009) who stated that banana leaves provide soil surface cover, reduce soil erosion on steep slopes, and are used as a principal source of mulch for maintaining and improving soil fertility, 20% of the respondents mentioned source of animal feeds because the people of Ruhinda sub-county were farmers and they practiced farming and rearing of animals where the animal feeds were got from the banana peels and this was observed in Kicwamba village.

Others(9%) of the respondents mentioned that they are used to produce wine and this was done. through fermentation for production of alcoholic. beverage like wine and the remaining 28% of the respondents mentioned income generation because bananas were used as the source of income to the people of Ruhinda sub-county in Rukungiri district to get school fees for their children and to use that money also for other purposes as agreed by Edmeades et al., 2006) who stated that bananas are consumed as fruit, prepared by cooking, roasting or drying, used for production of banana juice and fermented for production of alcoholic beverage (beer, wine and gin). This was observed in Kicwamba village.

From the interviews the researcher held with the household heads, it was mentioned that banana farming helped to get income among the household heads and improve on their housing and living standards, banana farming was a source of employments to people most especially those who buy and sell bananas. However one of the respondents stated that

"banana farming was a source of animal feeds since the community was also rearing animals that generated income to them".

4.3 Impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county

The researcher also attempted and sought for the concerns of research question two with the aim of documenting the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county and the results are presented below in Table 4.3 and Table were recorded.

Table 4.3 Respondents views on the impact of banana bacteria wilt on socio-economic welfare of the farmers in Ruhinda sub-county.

Impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county	Frequency	Percentage
Leads to a reduction in the amount of banana harvested	40	40
This has lead to increased poverty among households	10	10
Resulted into shortage of animal feeds	16	16
Resulted into poor markets of bananas	12	12
Leads to low income earning by the farmers	22	22
Total	**100**	**100**

Source: Primary Data 2020

Respondent's views on the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county are contained in the table 4.3 above where 40% the highest number of respondents mentioned that it leads to a reduction in the amount of banana harvested and I 0% the lowest number of respondents mentioned increased poverty among households. The respondents represented by 16% mentioned that it has resulted into shortage of animal feeds. The respondents represented by 12% mentioned poor markets of bananas whereas other 22% mentioned low income earning by the farmers.

According to table 4.3 above, 40% the highest number of respondents mentioned that banana bacteria wilt leads to a reduction in the amount of banana harvested due to the fact that the existence of the banana bacteria wilt leads to yellowing of the leaves and dying off of the young banana plant, the amount of bananas harvested becomes low because the banana plantations that survives the conditions are very few as in line with Karamura et al., (2006) who stated that a reduction in the amount of banana harvested by households has impacted livelihoods negatively.

The respondents represented by 10% the lowest number of respondents mentioned that the disease lead to increased poverty among households because the yellowing of banana plants due to banana bacteria wilt had left many farmers unemployed which resulted into poverty among them as Tripathi et al., (2005) stated that the social economic welfare of the farmers has declined due to the existence of banana bacteria wilt which has claimed a big number of banana plantaions leaving farmers in a sorry state. This is in line with what the researcher observed because many households had switched to other crops while others had abandoned banana cultivation since the bacteria wilt had affected their farming activities and this was especially in the villages of Kajwamushana and Katookye in Ruhinda sub-county.

The respondents represented by 16% mentioned that banana bacteria wilt has resulted into shortage of animal feeds because those banana farmers who had animals were benefiting from the banana peels which were used to feed their animals but due to the existence of the banana bacteria wilt there was a shortage of the banana peels which lead to low production in animals also as Kayobyo et al. (2005) who reported that if uncontrolled BBW spreads at an infection rate of 8% per annum in cooking bananas. This has resulted into low income earning by the farmers and the total production loss of bananas and hence shortage of animal feeds. The researcher agreed with the respondents because most of the people who had animals abandoned them because they lacked enough feeds to enable them manage the rearing activity. This was largely observed in Katookye village .

The respondents represented by 12% mentioned poor markets of bananas because before the existence of the disease there was ready markets for bananas and after the outbreak of the disease the markets were low since people were not sure of quality of the bananas people were selling.

Other respondents(22%) mentioned low income earning by the farmers and this was because most of the income was generated from banana farming and as the result of the wilt most of the farmers were left un employed which affected their earnings as agreed by Kayobyo et al. (2005) who reported that if uncontrolled BBW spreads at an infection rate of 8% per annum in cooking bananas has resulted into low income earning by the farmers and the total production loss of bananas is expected to be. about 56% over a ten year period, translating into a reduction from 4.5 million tons to eventually 2.1 million tons per year.

From the interviews that the researcher held with the respondents, one of the respondents mentioned that before the outbreak of banana bacteria wilt his banana farm could sustain the livelihood of his family abundantly. However, after the outbreak of this deadly disease his

farm lost its productivity to the extent that he cannot even afford school fees for his children and the grand children.

Some other respondents stated that *"some farmers did not take the disease control and management measures seriously as they thought that the measures were tasking and labour intensive which lead to increased spread of the wilt in Ruhinda sub-county"*.

4.4 Possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district

The researcher also attempted and sought for the concerns of research question three with the aim of documenting the possible measures to control banana bacteria wilt in Ruhinda subcounty Rukungiri district and the results are presented below in table 4.4.

Table 4.4 Possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district

Possible measures to control banan bacteria wilt in Ruhinda sub-county Rukungiri district	**Frequency**	**Percentages**
Beating garden tools such as hoes, machete, knivesand slashers over a fire until the metal is too hot to touch is also effective in killing the bacteria	34	34
Routine disinfection of garden tools after use and single stem rouging options	30	30
The fields can also be kept clean by spot checking any banana bacteria wilt symptoms	20	20
Use of clean planting banana material like tissue cultur plantlets	10	10
Timely removal of male bud with a forked stic is important where insect vector that visit the diseased flower parts carry the	6	6
Total	**100**	**100**

Source: Prima,y Data 2020

Respondent's views on possible measures to control banana bacteria wilt in Ruhinda subcounty Rukungiri district are contained in the table 4.4 above where 34% the highest number of respondents mentioned heating garden tools such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch while the lowest number of respondents

represented by 6% mentioned of timely removal of male buds with a forked stick is important where insect vector that visit the diseased flower parts carry the pathogen. The respondents represented by 20% mentioned that the fields can also be kept clean by spot checking any banana bacteria wilt symptoms. Whereas other 30% mentioned of routine disinfection of garden tools after use and single stem rouging options and this should be done on each mat using sodium hypochlorite to assists in killing the bacteria and thus reduces the spread rate from one plant to the next and lastly l 0% of the respondents mentioned use of clean planting banana material like tissue culture plantlets and conventional rapid field macro propagated banana suckers in disease free areas can also check banana bacteria wilt spread from farm to

farm.

According to table 4.4 above, 34% the highest number of respondents mentioned heating garden tools such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch is also effective in killing the bacteria because when the garden materials are heated after every use in the garden, the bacteria wilt can· be· controlled instantly as in line with (Kwach et al., 2012) who stated that destroy banana plants that are affected by the disease and make sure you dig up and bury the whole plant roots and all in your fields. This is in line with the researcher's observation because this enables the farmer to have banana plantations free ·from the disease as some people of Kajwamusha were doing.

The lowest number of respondents represented by 6% mentioned timely removal of male buds with a forked stick is important where insect vector that visit the diseased flower parts carry the pathogen because this can be done mechanically from one flower to the next since the disease can be contained in· fields where de-budding is effectively practiced and the practice should be carried out just after the female flowers have been formed three to four weeks after flowering as (Kubiriba et al., 2012) reported that destroy the sick plants by chopping them, then sun-dry them. Also, make sure you use clean suckers when planting.

The respondents represented by 20% mentioned that the fields can also be kept clean by spot checking any banana bacteria wilt symptoms because this can be reinforced by having a suspended mechanical weeding for at least three months to observe the latent symptoms during the period weeding can be done by herbicides as in line with Viljoen, (2010) who stated· that banana bacteria wilt can be eradicated by always checking the field garden to ensure that any suspected plant can be removed from the garden to avoid easy spread of the

banana bacteria wilt.

The respondents represented by 30% mentioned routine disinfection of garden tools after use and single stem rouging options and this should be done on each mat using sodium hypochlorite to assists in killing the bacteria and thus reduces the spread rate from one plant to the next as agreed by Nguthi, (2008) who stated that disinfect your farm tools before using them and you must also stop sharing farm tools.

The respondents represented by 10% mentioned use of clean planting banana material like tissue culture plantlets and conventional rapid field macro propagated banana suckers in disease free areas checks banana bacteria wilt spread from farm to farm as in line with (Odipio et al, 2009) who stated that the famer needs to test soil and amend to a pH of 6.2 to 6.5 for bananas and most farm lands to ensure that the banana plantations are free from the wilt.

From the questionnaire the researcher held with the subcoanty staff on possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district, some of the respondents mentioned that the farmers could adopt plating of new banana sackers to completely eradicate the bacteria and even cleaning of the tools that are used in the garden to avoid bacteria transmition in case another farmer may wish to use the same tools in his or her garden, community participation in creating awareness on the negative effects of bacteria wilt so that the disease can be controlled. Another respondent mentioned *"planting of new banana species which are resistant to bacteria wilt if they are to continue in line of banana farming"*.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter contains summary of findings, conclusions and recommendations based on analysis of the results and in the order according to the objectives of the study.

5.1 Summary of findings

The study considered a total number of 100 respondents from the study area, considering the age of respondents, the highest numbers of the respondents had 41-51years of age with 28% while the least numbers of respondents had 61 years and above of age with 14%. In relation to the sex of respondents, the study results indicated that the highest numbers of respondents were males with 60% whereas the least number of respondents were females with 40%. With regard to the marital status of the respondents the highest numbers of the respondents were married with 88% while the least number of respondents were widowed with 12%. The highest number of the respondents had good levels of education for they were educated and can formally read and write.

The study results on importance of banana production in Ruhinda sub-county Rukungiri district, the highest number of the respondents mentioned food security while the least number of the respondents mentioned source of mulch for maintaining and improving soil fertility. Other respondents mentioned that banana leafs provide soil surface cover and reduce soil erosion, source of animal feeds and are used to produce wine.

The study went ahead on the impact of banana bacteri_a wilt on socio- economic welfare of the farmers in Ruhinda sub-county, the highest number of respondents(40%) mentioned that banana bacteria wilt leads to a reduction in the amount of banana harvested, the lowest number of respondents(10%) mentioned that the disease has lead to increased poverty among households. Other respondents mentioned that the disease has resulted into shortage of animal feeds, resulted into poor markets of bananas and leads to low income earning by the farmers.

The study continued on possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district, the highest number of respondents(34%) mentioned heating garden tools such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch

is also effective in killing the bacteria, the lowest number of respondents(6%) mentioned timely removal of male buds with a forked stick is important in where insect vector that visit the diseased flower parts carry the pathogen. Other respondents mentioned that the fields can also be kept clean by spot checking any banana bacteria wilt symptoms, routine disinfection of garden tools after use and single stem rouging options and use of clean planting banana material like tissue culture plantlets.

5.2 Conclusion

In conclusion therefore, banana bacteria wilt disease was present in the study area and had spread in Ruhinda sub-county Rukungiri district. Banana bacteria wilt disease affected banana plantations and has reduced the banana productivity. If this disease is not controlled by carrying out certain options, such as removal by uprooting, cutting at the base, injecting with Glyphosate herbicide (Roundup), in three years to come, there will be no banana production and hence there will be famine and no income from bananas. The researcher collected data using interview because this method was quite important whereby the well informed and illiterate respondents provided the researcher with rich and detailed information on the subject of inquiry, he used observation because the researcher observed bananas affected by banana bacteria wilt, therefore the wilt had impacted the area and the measures the farmers were putting to overcome the bacteria wilt included, routine disinfection of garden tools after use and single stem rouging options, use of clean planting banana material like tissue culture plantlets, Timely removal of male- buds with a forked stick is important where insect vector that visit the diseased flower parts carry the pathogen and heating garden tools such as hoes, machete, knives and slashers over a fire until the metal is too hot to touch is also effective in killing the bacteria. The questionnaire method was used and this enabled the researcher to use distant respondents and helped respondents to think more about the questions and give well explained and clear answers.

5.3 Recommendations

There should be quarantine enforcement by the government agencies to prevent spread of banana bacteria wilt to non infected areas.

There should be awareness creation among banana farmers in banana bacteria wilt endemic areas on management of banana bacteria wilt by use of cultural control methods, sterilization of farm implements in infected orchards, rouging of infected banana plants and removal of male banana flower buds to be encouraged by banana farmers, Agricultural extension agents, other trained stakeholders on banana bacteria wilt control, use of mass media, posters, during Agricultural shows and field days.

There should be policies on the use of clean planting materials and regular inspection/screening for the approved banana nurseries to dispense banana bacteria wilt disease free materials.

There should be production of free banana bacteria wilt such as banana tissue culture, train and encourage more banana nurseries producers/tissue culture hardening nurseries to avail clean banana planting materials.

REFERENCES

Addis et al., (2010). *Impacts of BBWepidemic on the Livelihoods of rural communities in Uganda. Abstracts of the 4th International Bacterial Wilt Symposium,* 17- to 20th July 2006. Central Science Laboratory York, UK, pp57.

Agrios, (2005). *Agrobacterium-mediated transformation of embryogenic cell suspensions of the banana cultivar 'Rasthali' (AAB).* Plant Cell Reports, 20: 157-162.

Bagamba et al., (2006). *Banana Bacteria wilt in Uganda; Control Strategy. Banana Research Programme,* NARO-Uganda report.

Bioversity International, (2009). *Characterization of Bacteria sp. Causing wilt of enset and banana and its proposed reclassification as a strain of X.* vasicola. Plant pathology, 57: 170-177

Biruma et al., (2007). *Impacts of BBW epidemic on the Livelihoods of rural communities in Uganda. Abstracts of the 4th International Bacterial Wilt Symposium,* 17- to 20th July 2006. Central Science Laboratory York, UK, pp57.

Blomme et al., (2008). *Survey and identification of Bacterial diseases on banana in Ethiopia. In: Scientific Phytopathological Laboratory of the state Agro-Industrial Committee of the USSR.* Progress Report for the period 1986/87. Ambo, Ethiopia, pp
387-390.

Eden-Green, S. (2004). *A hypersensitive response was induced by virulent bacteria in transgenic tobacco plants over expressing a plant ferredoxin-like protein (PFLP).* Physiological Molecular Plant Pathology, 64: 103-110.

Edmeades et al., (2006). *Plant amphipathic proteins. Delay hypersensitive response caused by hairpins and Pseudomonas syringae pv. syringae.* Physiological Molecular Plant
Pathology, 51: 367-376.

F AO- Rugalema and Mathieson, (2009). *Kibanja size and coffee production in BukobaRural District. Farming Systems Research Programme, Field Note No. 39.* Bukoba, Tanzania, Lake Zone ARI-Maruku.

FAO. (2007). [http://faostat.fao.org] site visited on 5/3/2020.

Gary et al, (2007). *Genetic transformation of Cavendish banana (Musa spp. AAA group) cv 'Grand Nain' via micro projectile bombardment.* Plant Cell Reports, 19:229-234.

Gnanamanickam et al., (2009). *Banana Bacteria wilt: a review of the disease, management strategies and future research directions.* African Journal of Biotechnology Vol. 6 (8), pp. 953-962.

Green, (2006). *Designing and Conducting Health system Research projects, Proposal Development and Fieldwork, Mauristikade 63m1090 HA,* Amsterdam, 35pp.

Gary *et al,* 2007). *Characteristics of banana growing households and banana cultivars in Uganda and Tanzania.* Central Science Laboratory, Lory, T, pp 107.

De Vos, (2005: 333). *Characterization of Bacteria sp. Causing wilt of enset and banana and its proposed reclassification as a strain of X.* vasicola. Plant pathology, 57: 170-177

Jogo et al., (2011). *Characterization of Bacteria sp. Causing wilt of enset and banana and its proposed reclassification as a strain of X. vasicola.* Plant pathology, 57: 170-177.

Jones et al., (2007). *Kibanja size and coffee production in Bukoba Rural District. Farming Systems Research Programme, Field Note No. 39, Bukoba,* Tanzania.

Karamura et al., (2006). *Overview of banana Bacteria wilt in Tanzania. In:* G. *Saddler, J. Elphinstone, and I. Smith, (eds) Abstract Book of the 4th International Bacterial Wilt Symposium, I* 7- *20 July 2006.* Central Science Laboratory, Kork, T, pp 107.

Karamura et al., (2008). *Disease, Vulnerability and Livelihoods on the Tanzania-Uganda Interface Ecosystem to the West of Lake Victoria.* Edited by Rugalema, G and Mathieson, K. Diagnostic Survey of North-Western Tanzania.

Karugaba and Kimaru, (1999). *"Banana disease with strange symptoms hits the Lake Zone".* [http:/ /thecitizen.co. tz/sunday-c itizen/ 40-sunda y-ci tizen-news/8 810-banana-diseasewi th-strange-symptoms-hits-the-lake-zone.html] site visited on 20/3/2020.

Kayobyo et al. (2005) *Characteristics of banana growing households and banana cultivars in Uganda and Tanzania.* Central Science Laboratory, Lory, T, pp 107.

Kidist, (2003). *The effectiveness of different herbicides in killing BEW infected banana mats.*

Proceedings of the 4th International Bacterial Wilt Symposium. Central science Laboratory, UK.

Kubiriba et al., (2012; 2014). *Preliminary assessment of root systems morphology in Musa.*

Proceedings of the International Conference on Banana and Plantain for Africa.

Kwach et al., (2000). *On-farm assessment of banana bacterial wilt control options.* African Crop Science Society Conference Proceedings, Entebbe, Uganda.

Kwach et al., (2012). *Survey and identification of Bacterial diseases on banana in Ethiopia.*

In: Scientific Phytopathological Laboratory of the state Agro-Industrial Committee of the USSR. Progress Report for the period 1986/87. Ambo, Ethiopia, pp 387-390.

MoA, 2008; Yako et al., (2011). *Centrifugation Assisted Agro bacterium tumafaciens.*

Mgenzi et al., (2006). *Preliminary assessment of root systems morphology in Musa.*

Central Science Laboratory, York, UK, pp 107.

Proceedings of the International Conference on Banana and Plantain for Africa.

Ndungo et al., (2003). *Banana Bacteria wilt in Uganda; Control Strategy. Banana Research Programme,* NARO-Uganda report.

Nguthi, (2008). *Banana production in Uganda.* An essential food and cash crop. Regional Land management unit (RELMA) Technical Hand book Series 18.

Nguthi, (2016) *Abstract Book of the 2" International Bacterial il.* Central cience Laboratory, UK.

Ocimati et al., (2013a). *Banana production in Uganda. An essential food and cash crop.* Regional Land management unit (RELMA) Technical Hand book Series 18.

Odipio et al., (2009). *Farmers' awareness of Banana Bacterial wilt and its Control in Uganda.* African Crop Science Journal, 14: 157- 165.

Okurut et al., (2006). *Survey and identification of Bacterial diseases on banana in Ethiopia.*

In: Scientific Phytopathological Laboratory of the state Agro-Industrial Committee of the USSR. Progress Report for the period 1986/87. Ambo, Ethiopia, pp 387-390.

Onyango et al., (201 1). *Focus on bacterial wilt. How can the advance of Banana Bacteria Wilt be halted.* NARO-Uganda report.

Onyango, (2009). *Plant amphipathic proteins. Delay hypersensitive response caused by hairpins and Pseudomonas syringae pv. syringae.* Physiological Molecular Plant Pathology, 51: 367-376.

Ploetz et al., (2007). *Banana production in Uganda.* An essential food and cash crop. Regional Land management unit (RELMA) Technical Hand book Series 18.

Rice et al., (1990). *Characteristics of banana- growing households and banana cultivars in Uganda and Tanzania.* Kampala.

Simmonds, (1962). *Farmers' awareness of Banana Bacterial wilt and its Control in Uganda.*

African Crop Science Journal, 14: 157- 165.

Ssekiwoko et al., (2006a). *Centrifugation Assisted Agro bacterium tumafaciens.* USA

Tripathi and Tripathi, (2009). *On-farm assessment of banana bacterial wilt control options.*

African Crop Science Society Conference Proceedings, Entebbe, Uganda.

Tripathi et al., (2008). *Designing and Conducting Health system Research projects, Proposal Development and Fieldwork, Mauristikade 63m 1090 HA,* Amsterdam, 35pp.

Tripathi et al., (2005). *Focus on bacterial wilt. How can the advance of Banana Bacteria Wilt be halted.* New York

Tripathi et al., (2013). *Controlling banana Bacteria wilt through de-budding.* Nigeria

Tushemereirwe and Opolot, *(2005).Controlling banana Bacteria wilt through de-budding.*

Regional Land management unit (RELMA) Technical Hand book Series 18.

Tushemereirwe et al (2004). *Characteristics of banana- growing households and banana cultivars in Uganda and Tanzania.* African Crop Science Society Conference Proceedings, Entebbe, Uganda.

URT, (2012). *Genetic transformation of Cavendish banana (Musa spp. AAA group) cv 'Grand Nain' via micro projectile bombardment.* Plant Cell Reports, 19:229-234.

Viljoen, (20 l 0). *A hypersensitive response induced by virulent bacteria in transgenic tobacco*

plants over expressing a plant ferredoxin-like protein (PFLP). Physiological Molecular Plant Pathology, 64: 103-110.

Yako et al., (2011). *Designing and Conducting Health system Research projects, Proposal Development and Fieldwork,* Mauristikade 63m I 090 HA, Amsterdam, 35pp.

Yemataw et al., (2016). *Generation of transgenic banana (Musa acuminata). Plants via Agro bacterium-mediated transformation.* Biotechnology, 13: 486- 492.

APPENDIX I: QUESTIONNAIRE FOR STAFF RUHINDA SUB COUNTY Dear respondents,

My name is Tayebwa Rameka; a student of Kabale University. I am doing this study as a partial fulfillment for the Award of a Bachelor of Arts with education. This questionnaire is drafted to the researcher to examine the effects of banana bacteria wilt on the socio-economic welfare of farmers in Ruhinda sub-county Rukungiri district. Please answer all the questions with honesty. The information you will give is purely academic and it will be treated with a lot of confidentiality. I am requesting you to kindly participate in this study by responding to the following questions

Section A: Back ground information

I. Age

a)21-30 ~
b)31-40 ~
c) 41-50 >> ~
d) 51-60
e) 6land above

2. Sex

a) Female ~
b) Male ~

3. Marital Status

a) Widowed ~
b) Married ~

4. Highest level of Education attained

a) Non formal Education ~
b) Primary >>
c) Secondary ~
d) University ~

Section B: Information about objectives of the study.

5. What is the importance of banana production?

6. What is the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county?

7. What are the possible measures to control banana bacteria wilt?

Thank you very much

APPENDIX II: INTERVIEW GUIDE FOR HOUSE HOLD HEADS

I. What is your sex?

2. What is your marital status?
3. How old are you?
4. What is your education level?
5. What is the importance of banana production in Ruhinda sub-county Rukungiri district?
6. What is the impact of banana bacteria wilt on socio- economic welfare of the farmers in Ruhinda sub-county?
7. What are the possible measures to control banana bacteria wilt in Ruhinda sub-county Rukungiri district?

APPENDIX III: OBSERVATION CHECKLIST

1. Bananas affected by banana bacteria wilt
11. How the wilt has impacted the area
111. Measures the farmers are putting to overcome the bacteria wilt