

Initiatives to Mitigate Banana Diseases in the Great Lakes region

(ECHO EAST AFRICA HIGHLANDS SYMPOSIUM - 28-30TH OCTOBER, 2014)

Emmanuel NJUKWE et al.,

IITA Burundi

E.NJUKWE@CGIAR.ORG

+257-79331024

Presentation outline

- ✓ Introduction
- Importance of Banana
- Challenges
- Opportunities
- ✓ Cultural practices
- ✓ Quality of seeds and seed systems
- ✓ Genetic improvement
- ✓ Linkages and Capacity development
- ✓ Progress made and Achievement
- ✓ Conclusion and Perspectives

Introduction

The Great Lakes region is a major production area of banana (*Musa* ssp.), with higher per capita consumption levels than anywhere else in the world,

The region is home to the East African highland bananas (EAHB), which are an important food and cash crop for more than 30 million people in the region,

In Burundi, banana is an important source of economic and social capital for the farming population with annual production estimated at 1.850.000 tons (230 kg/person/year) on average,

Its cultivation is practiced by more than 90% of the farming household,

It is cultivated in nearly all agro-ecological zones with multi-purpose use and high agronomic potential.



Research to Nourish Africa

Introduction Ctd

Banana is produced all year round,

Relatively not sensitive to climatic risks,

Intervenes during long drought period when other food crops are unable,

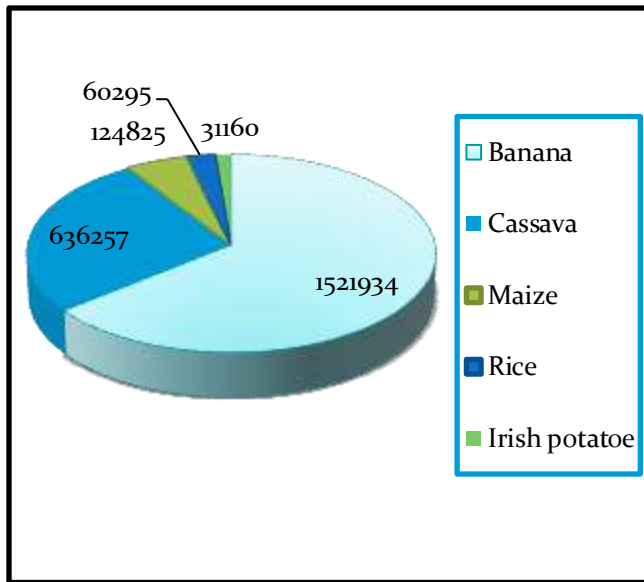
Regular source of income for smallholders,

Producers sell banana beer/wine throughout the year,

In Rwanda and in DR Congo, banana is the second major food crop mostly cultivated in subsistence systems,

About 213,000 ha of 23% arable land devoted to banana with yields of 14 tons/ha/year.

Importance of Banana



Source: FAOSTAT, 2009



Banana subgroup and importance (%)

Location	Dessert	Cooking	Beer	Plantain
Burundi	4	38	57	1
Rwanda	10	22	67	1
South Kivu	16	5	73	6
North Kivu	All cultivar groups evenly distributed with several alternative names (synonyms)			

The Great Lakes region constitutes one of the secondary centres of *Musa* diversity especially for the East African highland bananas (*Musa* spp. AAA-EA subgroup).

Beer cultivars generally dominate the *Musa* landscape in the region except in North Kivu.

Challenges

The difference between attainable and actual banana yields is often large due to several factors including pests and diseases.

Banana *Xanthomonas* wilt (BXW) caused by the bacterium *Xanthomonas campestris* pv. *Musacearum* (Xcm) and Banana bunchy top disease (BBTD) caused by banana bunchy top virus (BBTV) (genus *Babuvirus*, family *Nanoviridae*) are two most important banana diseases threatening food security in the Great Lakes region.

The first outbreak of BXW in Africa was reported in Central Uganda and North Kivu, eastern DR Congo in 2001. Since then, the disease has spread into Rwanda, Tanzania, Burundi and Kenya while BBTD is currently present in parts of Burundi and Rwanda, as well as some provinces in DR Congo.

BXW and BBTD



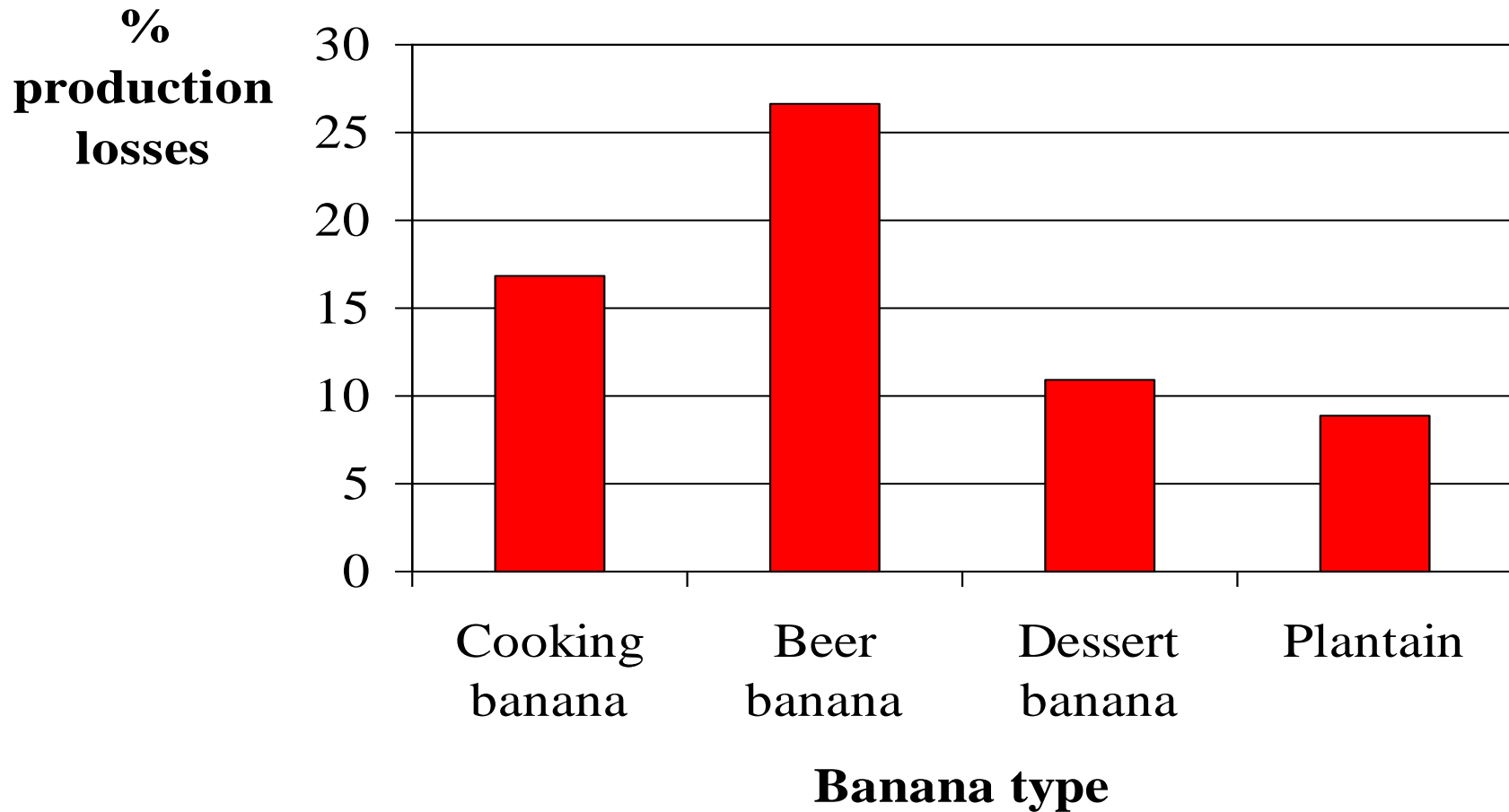
BXW



BBTV

Overcoming BXW and BBTD have been a great concern and require urgent attention as they have the potential to wipe out whole fields, which in turn can cause environmental damage with economic impacts on household.

BXW impact on banana production



Source: ACF-CIALCA survey; 2008

Opportunities

Secondary centre of *Musa* diversity

Existence of International research institutions

Existence of NARS and Universities

Existence of International and Local NGOs

Existence of research infrastructure and facilities

Enabling policy environment

Existence of various government and local initiatives

Dynamic youth and working age group

Existence of diverse products and market (national and regional)

Organized farmers association and community based organizations

Existence of micro-finance scheme

Existence of specialized training and vocational centres

Premature yellow wilting

Symptom

Yellow pus oozes from cut stem

Fruits ripen when the bunch is still young

Male bud wilts and rots

Cut fruits show brown stains

Insects

Agents and Mode of transmission

Tools

Infected planting material (suckers)

Animals

Birds

Cultural practices

Removal of male bud

Removal of infected plant and Eradication

Use of clean tools

Use of healthy suckers

BXW Management practices



Improved agronomic practices (IPM, Best cultivar, Planting density, Mulching, Weed control)

Improved banana production:
Regular planting density,
Mulching of soil, 100% weed control



IITA

Research to Nourish Africa

Incakara (cooking)

Frequently requested varieties

FHIA 17 (dessert
+ cooking)

FHIA 25 (juice)





Research to Nourish Africa

Quality of seeds and seed systems

Good crops start with good seed.

The situation for banana is worse by the lack of formal systems for producing and distributing quality planting material.

If farmers are short of planting material, they usually resort first to neighbours, relatives and others in the same social group and do not normally buy planting material.

National governments are responsible for important elements of seed security.

They need policies and various types of infrastructure in place that promote seed security and play a vital role in providing quarantine services.

Apart from preventing the accidental introduction of new pests, quarantine has a direct bearing on variety testing and seed supply.



Research to Nourish Africa

Quality of seeds and seed systems Ctd

Burundi for example has functional tissue culture laboratories but not all are fully functional or appreciated, usually for reasons of limited financial and human resources.

These facilities are made to facilitate germplasm multiplication, movement and to regularly replenish stocks of disease-free planting material.

Various regional and international organizations contribute to planting material security.

It is at this level that strategic interventions in reducing vulnerability and increasing seed security can be effective.

Important problems that are common but beyond the resources of individual nations can be tackled regionally.

Seed regulation (Key issues)

- **Varieties:** Are released varieties available?
- **Constraints:** Are Data available?
- **Quality-Theory:** Do institutional systems exist for quality control?
- **Quality-Practice:** Are there any quality control schemes operating? Using which methods?
- **Community Phytosanitation:** Collective action: can it be achieved?
- **Commercial Seed:** Are private sectors involved?
- **Sustainability:** Do farmers buy seed?

Quality planting material production techniques (Tissue Culture)



Transfer of tissue on to the medium



Growth room



Tissue culture plants ready for potting or inoculation with biological pest control agents

Macro-propagation



Germination chamber of a rapid propagation facility



Plantlets from Chambers in Shade-house (background) and acclimatized for 2-4 weeks (foreground) before field establishment.



False Decapitation



A small hole/window is cut on the pseudostem of a 6 to 8 months old plant, 15cm above the ground to destroy the meristem.

The plant is left standing and active to produce suckers.



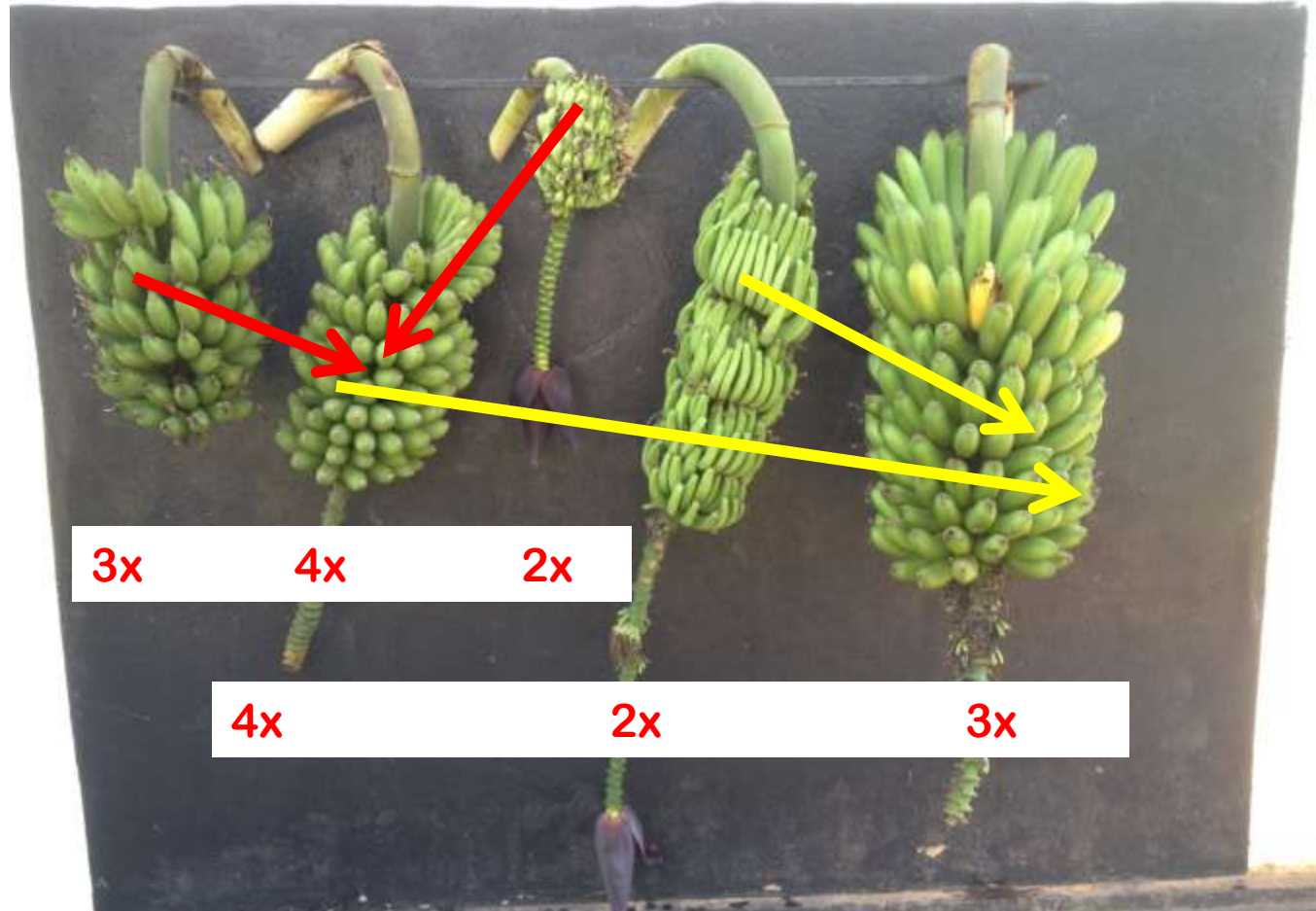
Sucker treatment in boiling water (100°C for 30sec.) to kill Nematode & Weevil.

Banana planting material type: advantages, disadvantages and challenges

Planting material	Advantages	Disadvantages	Challenges
Suckers from the field	<ul style="list-style-type: none"> - Easy to obtain - Cheap - Ease of transport - Easy to manage - Little field care required 	<ul style="list-style-type: none"> - Carrier of pests and diseases - Bulky to transport - Low multiplication rate - Risk of variety mix-up 	<ul style="list-style-type: none"> - Limited quantity to satisfy need - Spread of pathogens if not treated - Lack of improved cultivars resistant to endemic pests and diseases
Macro-propagation	<ul style="list-style-type: none"> - Minimum skills to set up germination chambers and weaning facilities - Easily operated - Acceptable multiplication rate - Uniform growth - Good for an agricultural enterprise 	<ul style="list-style-type: none"> - Risk of diseases - Requires clean substrate - Initial investment - Quality control - Transport of pots - Moderate care in the field required 	<ul style="list-style-type: none"> - Lack of improved cultivars resistant to endemic pests and diseases
Tissue culture	<ul style="list-style-type: none"> - Healthy planting material - High quantity - Uniform growth 	<ul style="list-style-type: none"> - Planting material is costly - Instability of electricity - Require aseptic conditions - Requires skilled and competent personnel - Sensitive to adverse factors - Easily damaged during transport - High level of field care - High cost of installation and functioning 	<ul style="list-style-type: none"> - Virus indexing - Lack of improved cultivars resistant to endemic pests and diseases

Genetic improvement

Objective: Breed high yielding banana with good consumer acceptability



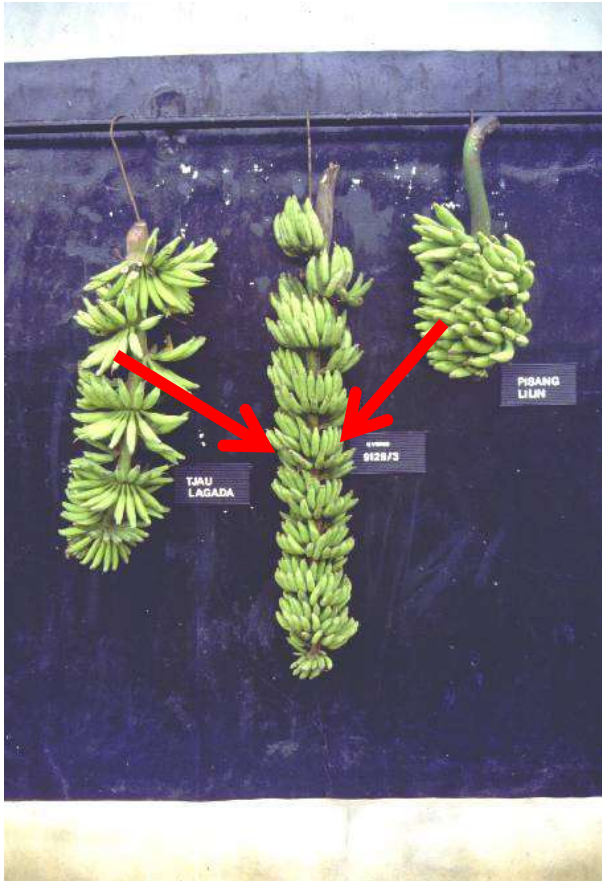
Matooke (3x), 660K-1 (4x), Calcutta (2x), TMB2x 8075-7 (2x), 12468.S6 (3x)

Musa Breeding Scheme

3x landrace X 2x improved/wild

4x hybrids X 2x improved

3x secondary triploids



Partnerships and Linkages

IITA can contribute to solving hunger and poverty but its efforts alone are not enough.

Partnership with other institutions and organizations lead to complementarities of efforts-

share resources (finance, material and personnel),

facilities (laboratory and office),

materials (germplasm and equipments) and

knowledge (experience) for the purpose of generating research outputs (new technology) or fostering innovation.

Partnerships and Linkages Ctd

To combat major diseases such as BXW and BBTD and achieving food security require collective effort from stakeholders in;

technology development, adaptation and out-scaling and a platform for participatory planning and experience sharing.

Thus, in 2012,

IITA and partners (comprising national and international organizations, policy and private sector) initiated stakeholders' platform to;

provide science based information for concerted action to sustainably manage banana diseases in the Great Lakes region.

Partnerships and Linkages Ctd

In order for farmers to access new and improved varieties, the development of the formal seed sector is essential.

At moment, the use of conventional planting material is gradually been replaced with adapted and affordable techniques such as macro-propagation and false decapitation.

This is major component in the partnership project with FAO, NARS, NGOs and CBOs

“the effectiveness of improved planting materials as part of field rehabilitation initiatives”.

Partnerships and Linkages Ctd

The effectiveness of interventions at each level, from household to international.

For example, the impact of national efforts depends on the amount and quality of support at regional and provincial or community levels.

Successful agricultural development projects have been those that engineer quality support from networks of stakeholders at all levels.



Farmers receiving tissue culture banana plants of improved varieties

Key partners in Banana disease management

IITA: Coordination, Genetic improvement, Seed systems, Crop management

Bioversity International: Extension material, Single diseased stem removal

FAO: Regional mandate with regional projects

CRS, FH DRC, NGOs: Technology out-scaling

Policy makers: Awareness, Sensitization, Quarantine, Financial support, Infrastructure

NARS: Advocacy, National surveys, Technology implementation

Bilateral Cooperation Agencies: Institutional issues, Financial support, Variety catalog

Private sector: Healthy planting material (tissue culture) provision

Farmers: Technology adoption and use

Towards sustainable cultivation

Collective effort by stakeholders to manage BXW



BXW infected fruits

Policy makers

Private sectors

NARS & Univs

CG Centers

Regional Centers

NGOs (loc & Intl)

FA & CBO



Healthy plants



Partners' field visit



Healthy field

Awareness/Sensitization and Field visit



Awareness and Sensitization campaign



Open day and Field visit



Hope restored

Capacity Development



Macro-propagation training in North Kivu



Macro-propagated plantlets in Rwanda

Training manuals are developed and disseminated to strengthen the capacity of extension workers and farmers.

As the demand for healthy planting material of improved varieties increase, farmers showed interest to move from production to agric enterprise development .

Training also focused on Integrated Crop and Pest Management (ICPM)

Progress made

Nationwide diagnostic study and survey conducted

Vulnerability assessment and Socio-economic studies conducted

Introduction of appropriate replacement crop as coping mechanisms

Approximately 3600 farmers in Burundi received BXW videos with daily radio messages on FM radio stations and broadcasting on national television

Effort has been made to harmonize the outreach activities with over 30 mother gardens established and single diseased stem removal practiced where BXW infection is severe

Over 2480 agricultural producers and communal agricultural assistants are trained and able to recognize BXW and BBTD as well as carry out best-practices for banana cultivation

BXW and BBTD training videos are disseminated in Youth Centres in 14 Provinces in Burundi alone.

Over 5000 factsheets disseminated and border officials sensitized

Achievement

Effort has been made with policy makers as actors in the fight against banana diseases. By this, there exists;

Ministerial decision preventing the movement of planting material;

National committee to fight against plant pests and diseases;

National office for seed certification and control (ONCCS);

Integrated seed sector development project in Burundi (ISSD);

Technical guide on BXW control and management in North and South Kivu;

Institution of stakeholders' platform;

Collection and cleaning of preferred landraces and reintroduction;

Introduction of improved varieties resistant/tolerant to major pests and diseases;

Establishment of tissue culture mother gardens ;

Development and dissemination of tools for technology out-scaling.

Out-reach approaches

Communication tools and approaches used include FFS, factsheets, posters, videos and radio programmes.

Videos developed that cover a number of topics on bananas from banana seed multiplication and integrated pest and disease management, to novel soil and crop management systems.

Videos produced in English, French, Kiswahili, Kinyarwanda and Kirundi and broadcasted on TV and radio stations focusing on symptoms recognition, transmission pathways, prevention and control measures.

Traditional use of suckers has been replaced with macro-propagation and false decapitation techniques.

Tissue culture mother gardens are established and has bridged the gap between the farmer and private suppliers of tissue culture planting material.

Conclusion and Perspectives

Cultural control methods have led to the disease becoming a manageable problem.

Stakeholders' workshop raised awareness and on policies governing banana diseases.

It also enabled partners to identify and address their real needs and constraints for collective action.

GM bananas with resistance to Xanthomonas wilt is now under development in East Africa



**THANK YOU FOR YOUR
ATTENTION**