International Potato Center

Capacity Building in sweetpotato research

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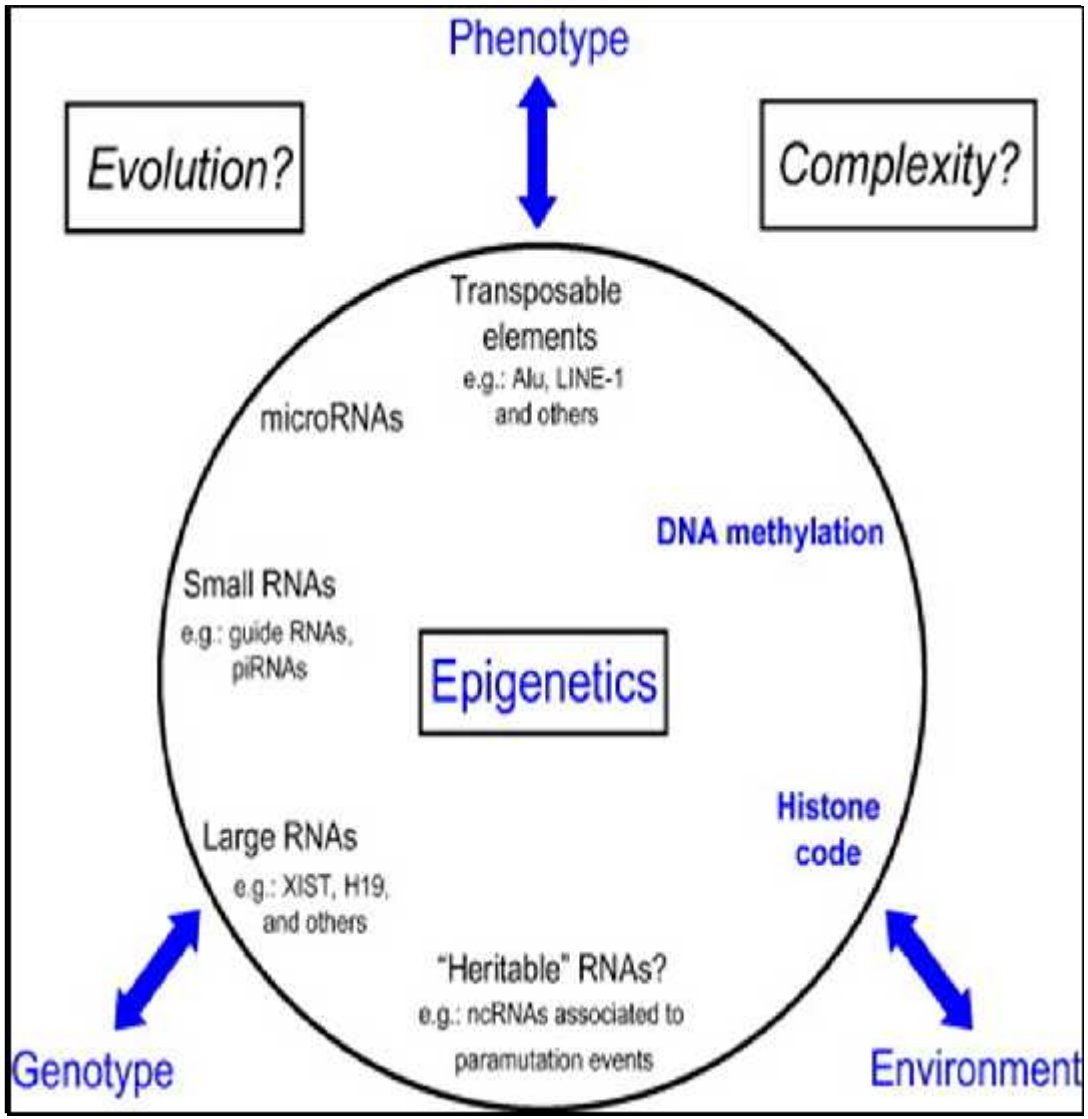
14th Annual Sweetpotato Breeding meeting Colline Hotel, Mukono, 2nd -5th June 2015

Introduction

- PhD in plant genetics
  - Genetic diversity, evolutionary history and epigenetic analysis of the East African highland bananas
  - National University of Ireland, Galway (2010-2014)
  - Analysis of DNA markers (SSR, AFLPs, SNPS) data for a polyploid crop
  - Molecular data Softwares and Statistics packages
  - Use of sequencing data (GBS- Tri-allelic SNPs and GWAS!)
  - Epigenetics; DNA methylation polymorphism and Inheritance in meiotic and mitotic context
- Work experience
  - Capacity building research associate-plants (BecA –2008-2010)

More importantly…..



Source: goggle images

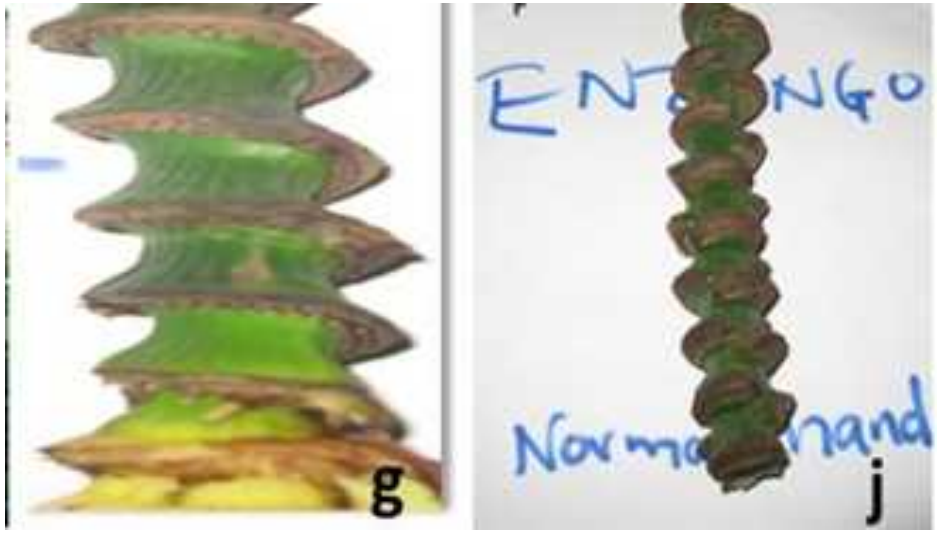
Varying phenotypes in assumed clones; who is to blame, genetics ?

- 90 EAHB cultivars
- 100 SSR
- 13 AFLP primer combinations
- 14K SNPs

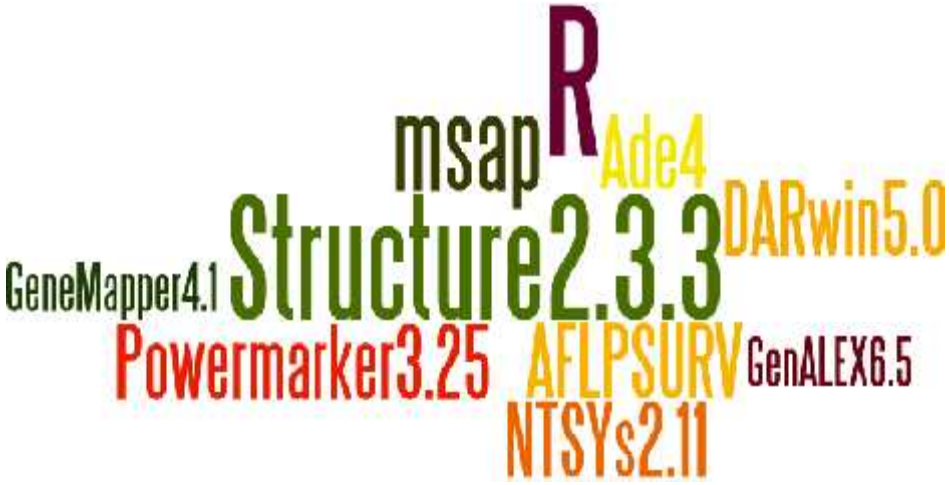
Morphological variations in East African highland bananas (EAHB)

Or Epigenetics?

Clones with different phenotypes



- DNA methylation using Methylation sensitive AFLP (MSAP)
- Hpa2 and Msp1 isoschizomers
- Are they heritable?- 3 EAHB maternal parents, 1 (AA-wild) paternal, 4 (AAAA hybrid -F_1s) and 55 (AAA F_2s)



Key Findings

Genetics…not me!

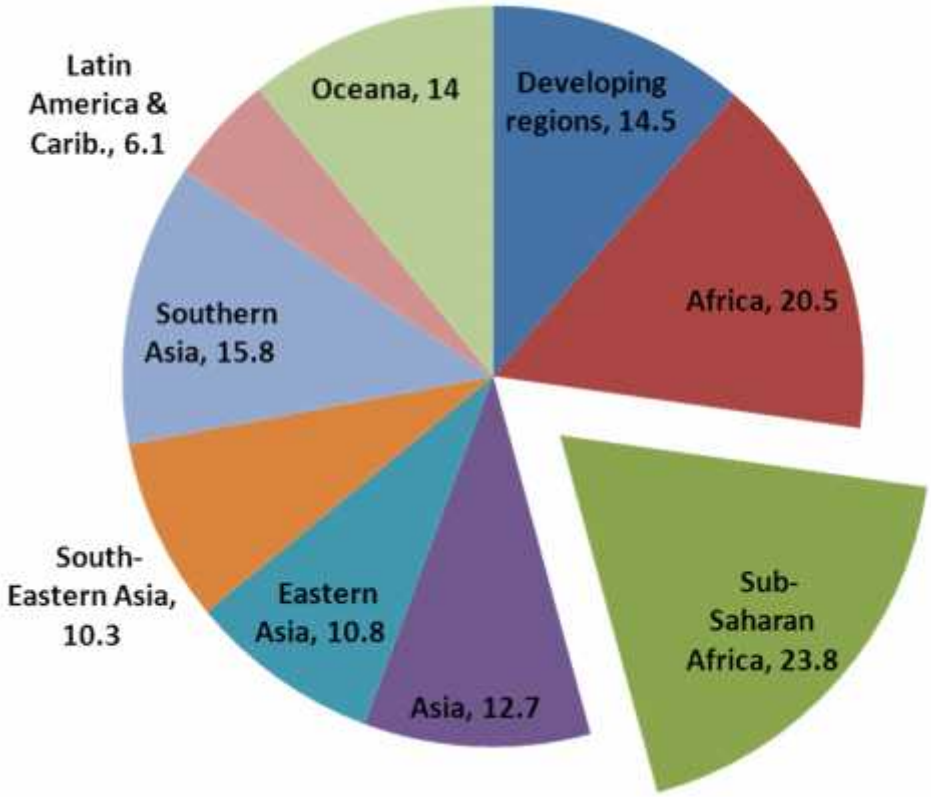
- Single seed origin
- Genetic variation did not reflect the large variation in morphological characteristics
- Significant genome wide association of SNPs with 13 traits
- Linkage disequilibrium
- Signatures balancing and negative selection

Epigenetics…not entirely

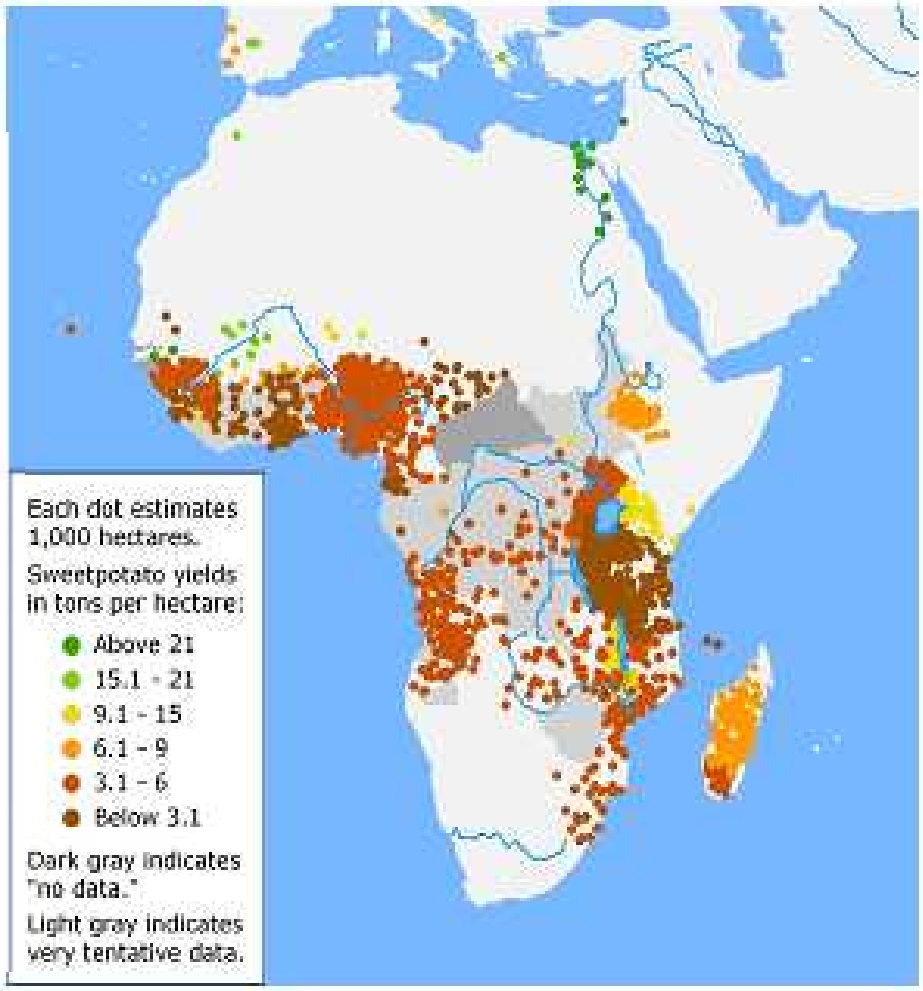
- No discrete phenotypic groups
- High epigenetic polymorphism compensates for lack of genetic diversity
- High correlation of epigenetic and genetic profiles
- Differences in 'Soft inheritance` compared to “hard inheritance” through developing lineages

Sweetpotato and hunger

Prevalence (%) of undernourishment around the world 2012-2014



Source: FAO The State of Food Insecurity in the World 2014 p. 8



Sweet potato production in Africa

Sweetpotato production challenges

Viruses

Insect pests

Bacterial diseases

Fungal diseases

Courtesy of Goggle images

Abrupt climate changes

Varying phenotypes in assumed clones; who is to blame ?

Genetics

Co-dominance of genes in Camellia cultivar

Epigenetics

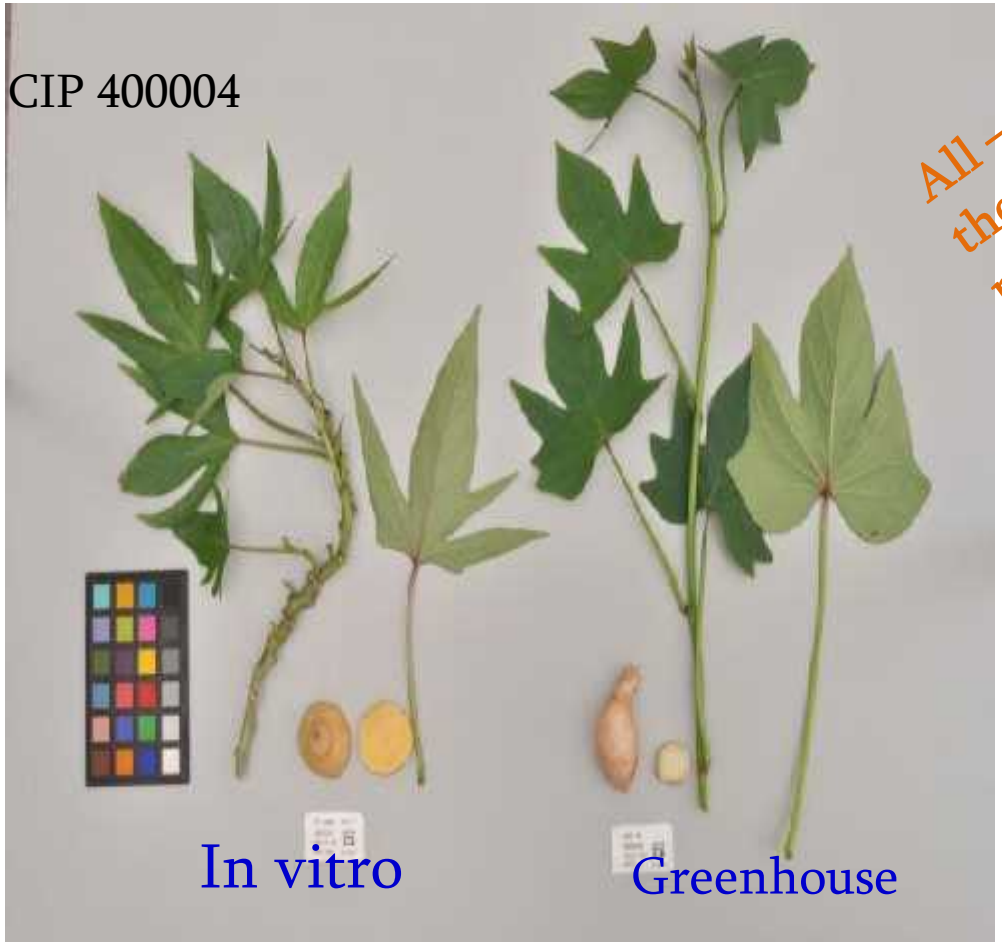
DNA methylation of genes in Azalea flower

Neither or both

East African Highland banana clones

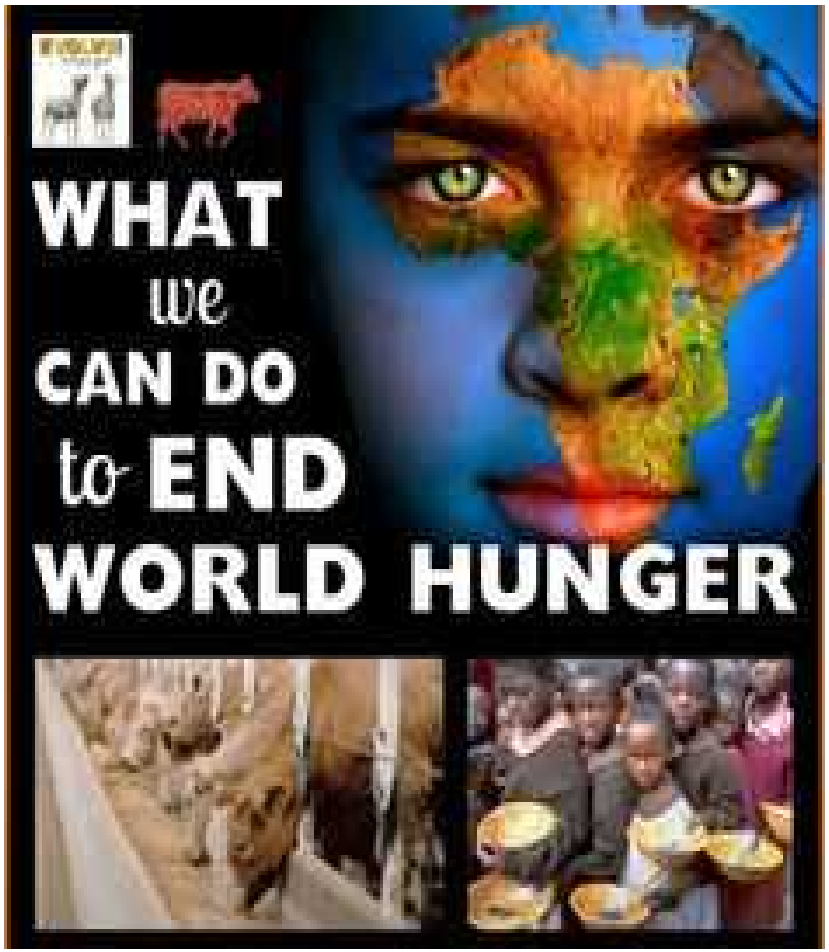
A ghost in the genes?

All – we wanted to shed some light on the CIP 400004 mystery and why we are not shipping it out from the genebank. As most of you know, we are doing a thorough confirmation of identity of the material we have in vitro



Why plant 'clones' aren't identical – Science news 2011

What can we do ?



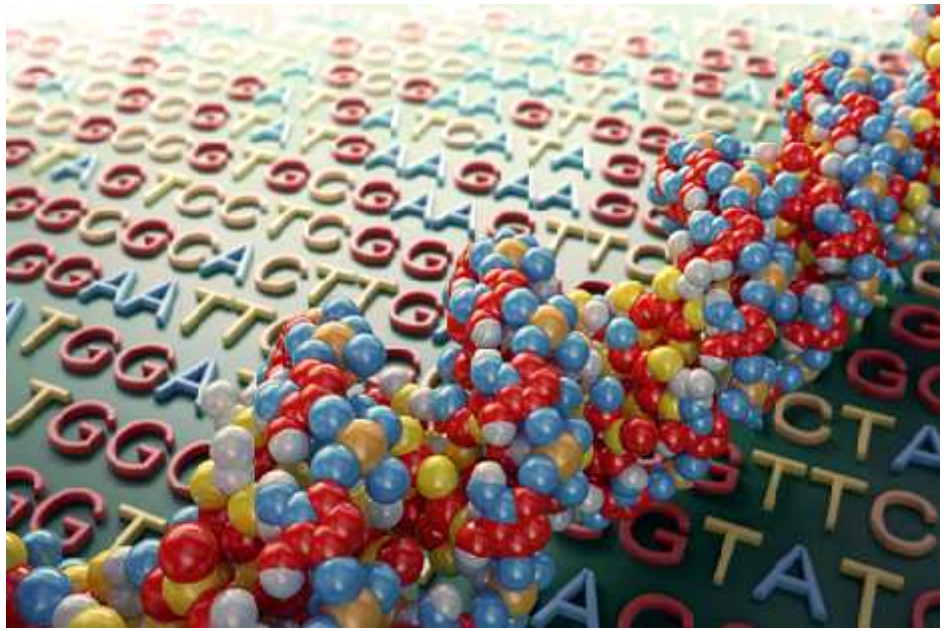
Courtesy of Goggle images

- Accelerate sweetpotato breeding improvements and implement new management strategies
- Sustainable yield increases without further expanding farmland or damaging the environment
- Breed smart and with speed!

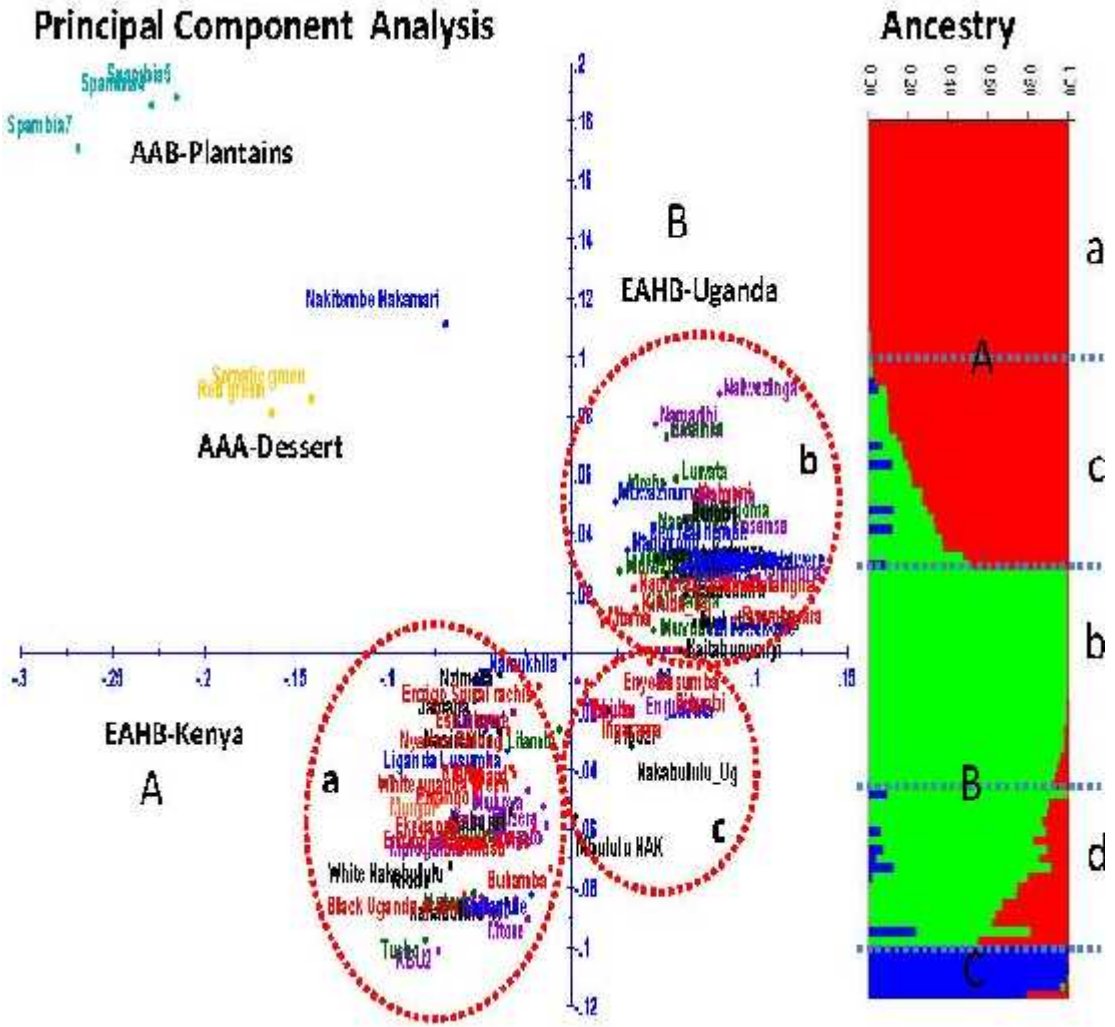
Genomics Assisted Breeding-Harnessing available technology

- Integrated genotyping support services…at BecA
- New sequencing technologies…Elshire et al

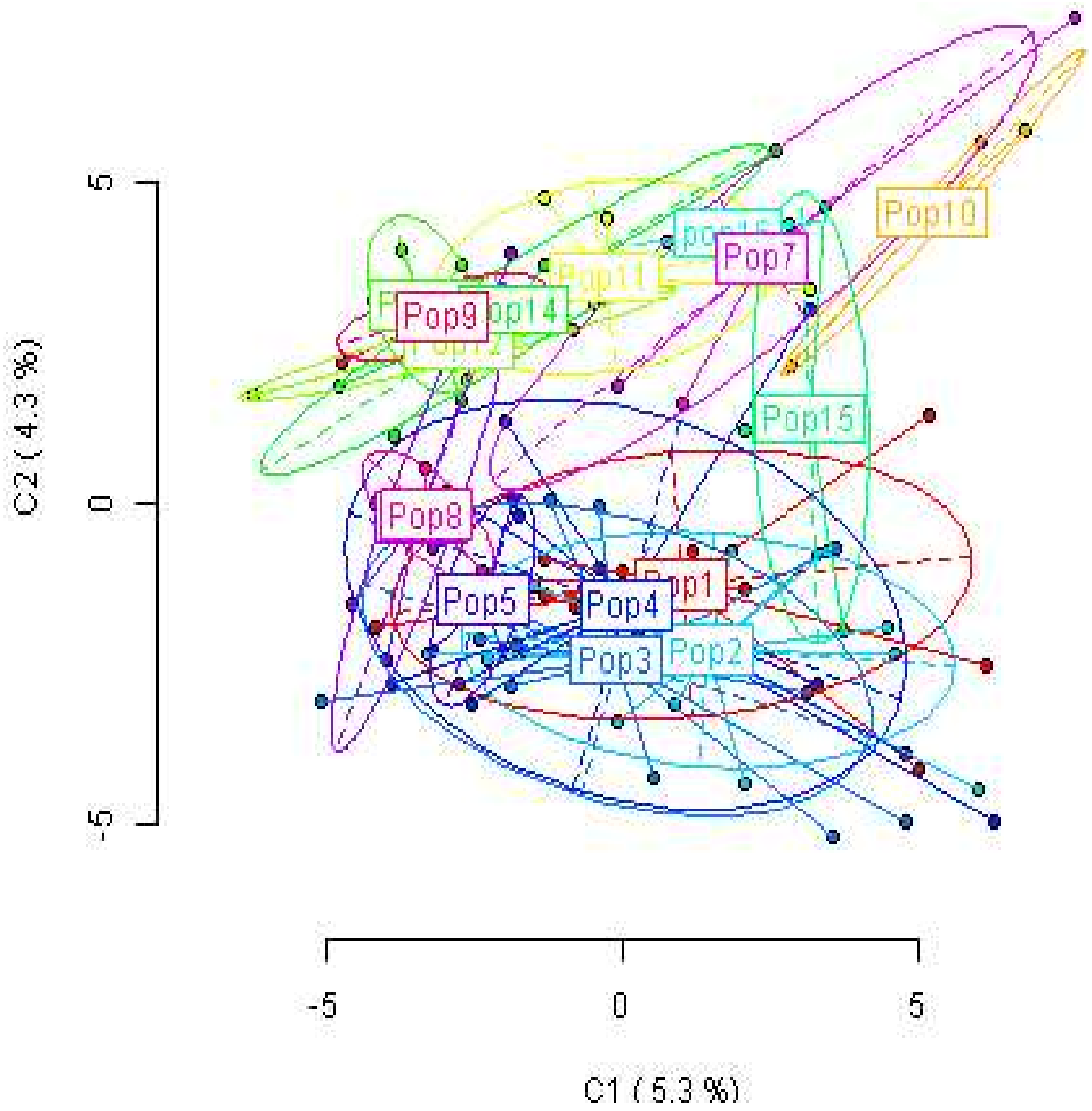
- Fingerprinting all the germplasm
- Marker Assisted Selection (MAS)
- Marker assisted Backcrossing
- Marker assisted Recurrent selection
- Genomic selection
- QTL analysis
- Genome Wide Association Study
- Epigenetic analysis of populations



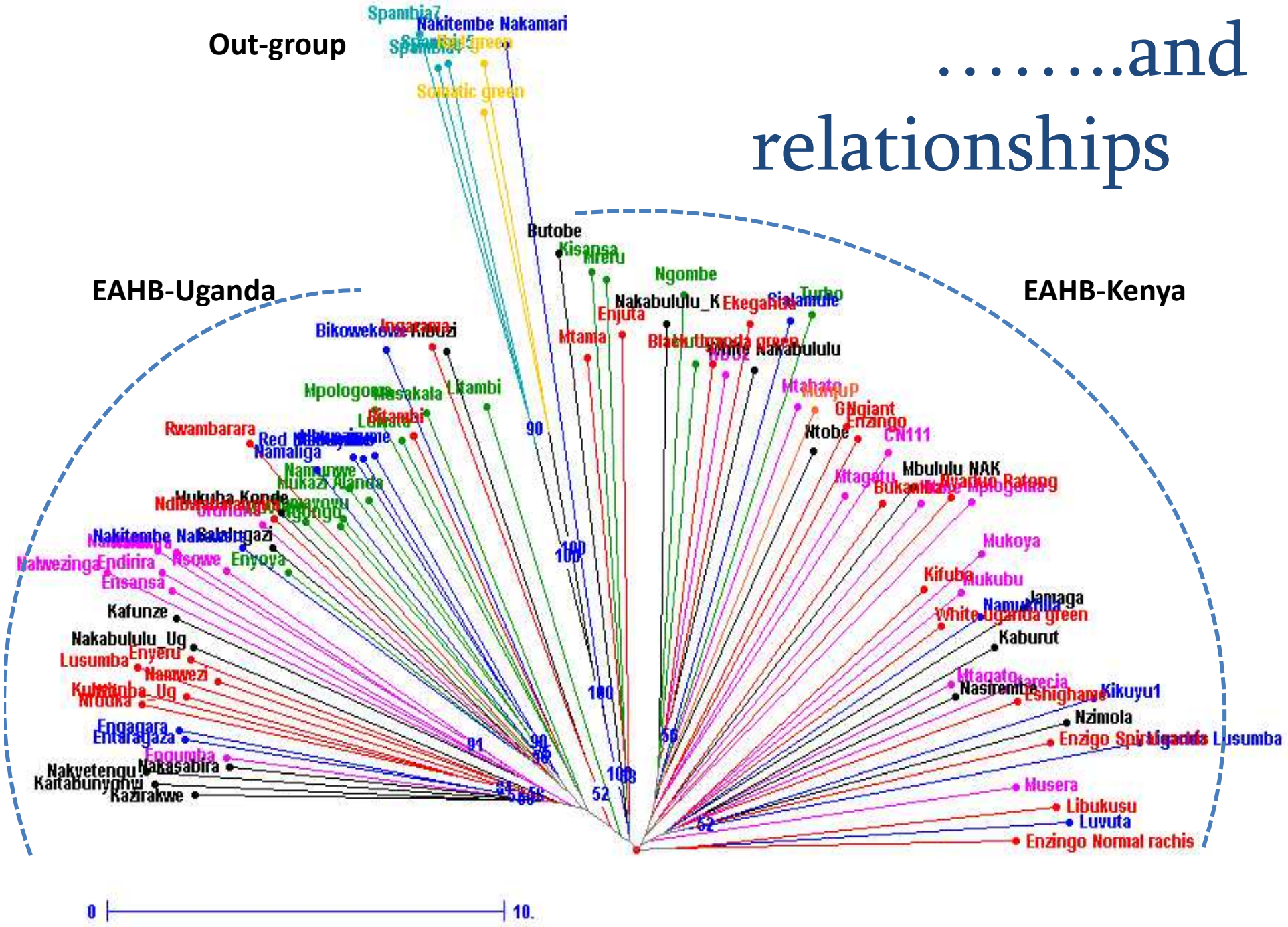
Molecular Markers; How and where can we apply?



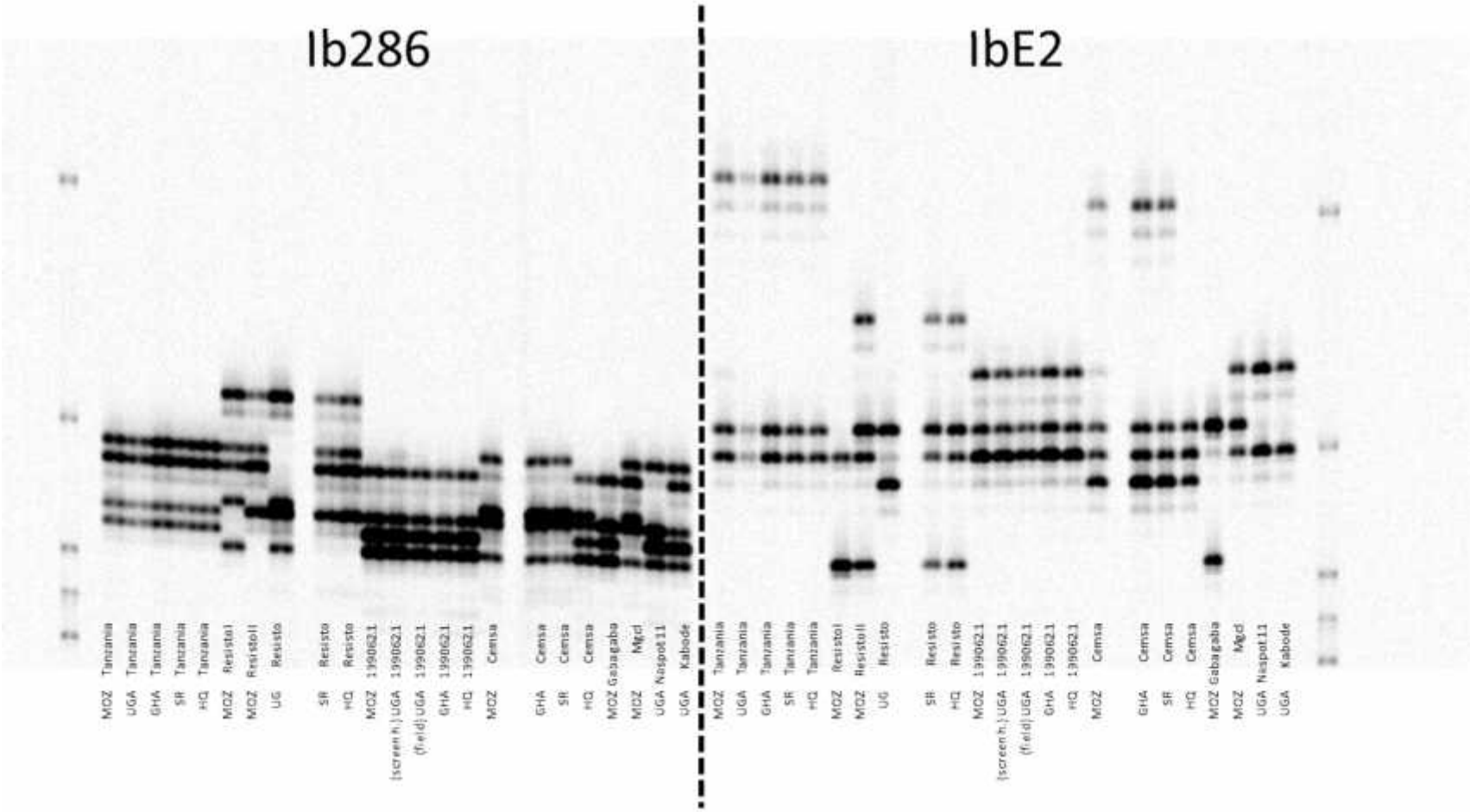
Analysis of populations

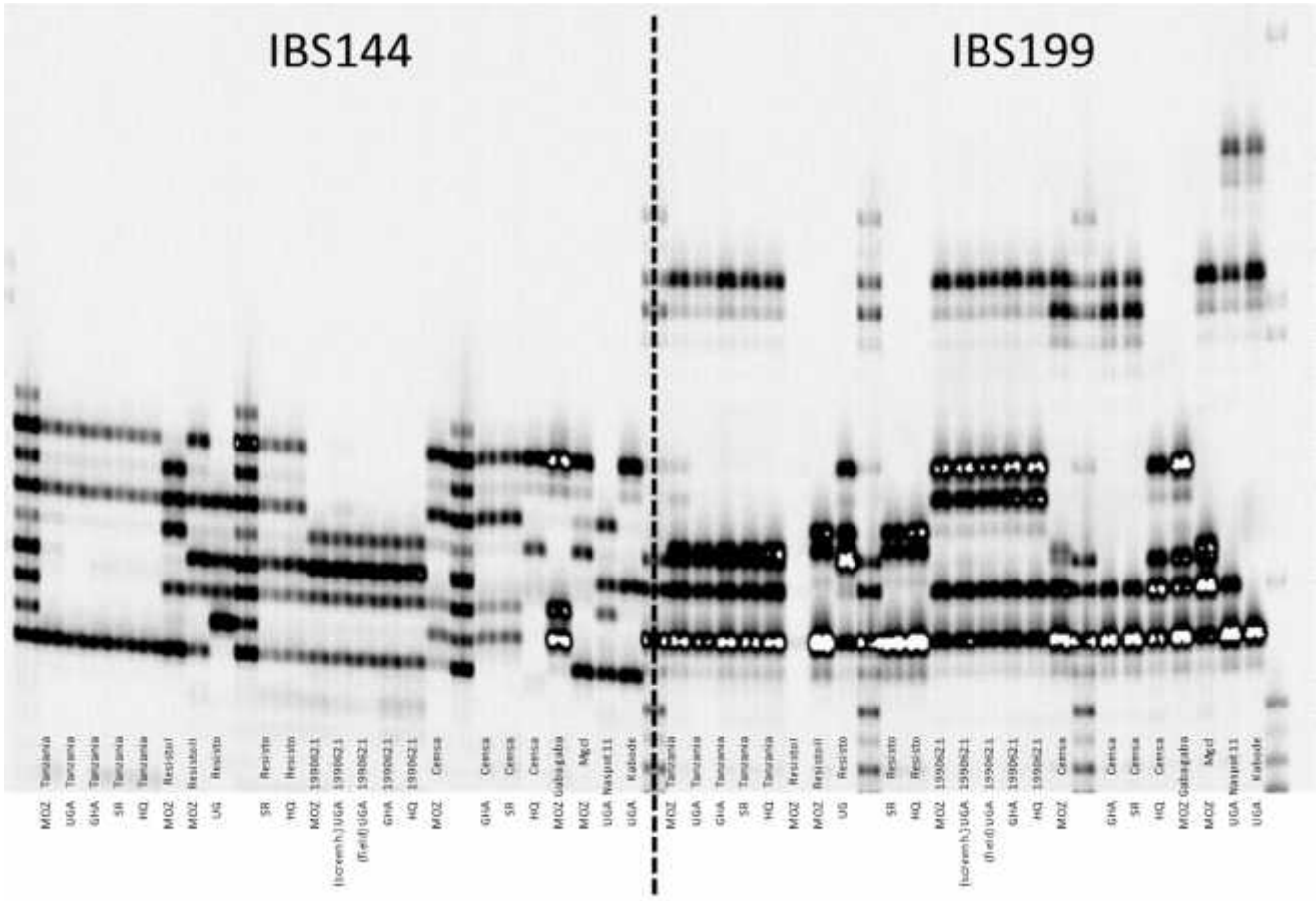


.....and relationships



……the check clones

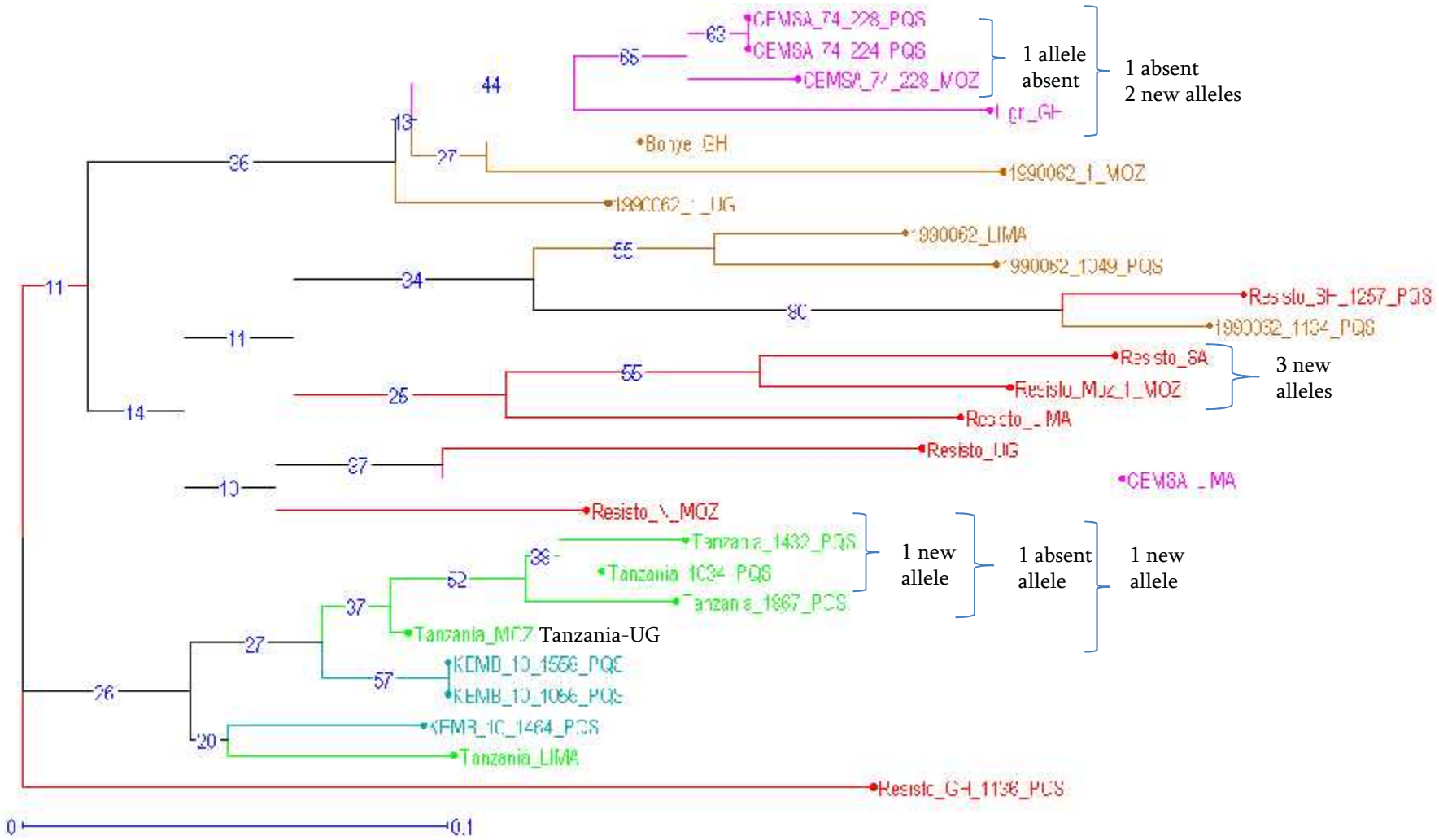




- So we can say:
- Tanzania is okay
- 199062.1 is okay
- Resisto is okay as long as Mozambique uses Resisto II as check clone
- Cemsa is okay but different from genebank (the question is what clone was taken from the genebank - they have two and the light orange was consider as not true to type – I hope we used the one not true to type from the genebank).
- What remains is: We have again to think about Cemsa and the genebank Cemsas

Clone	1990062.1_1049	1990062.1	1990062.1	Bohye_GH	1990062.1	1990062.1_1134	CEMSA_74_224	CEMSA_74_228	CEMSA_74_228	Ligri	CEMSA	Resisto_LIMA	Resisto_N	Resisto_Moz_1	Resisto_SH_1257	Resisto_GH_1136	Resisto	Resisto	Resisto	Tanzania	KEMB_10_1464	KEMB_10_1558	Tanzania	Tanzania_1034	Tanzania_1432	Tanzania_1867	KEMB_10_1056
origin	PQS	MOZ	UG	MOZ	LIMA	PQS	PQS	PQS	MOZ	GH	LIMA	LIMA	MOZ	MOZ	PQS	PQS	UG	SA	SA	MOZ	PQS	PQS	LIMA	PQS	PQS	PQS	PQS
IBS 18_252	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IBS 18_256											X			X			X			X	X	X	X	X	X		X
IBS 18_260										X																	
IB R16_219																	X										
IB R16_228			X	X			X	X	X	X	X			X	X					X	X	X	X	X			
IB R16_232	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IB R16_238																				X	X	X	X	X	X	X	
IB SSR09_220	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
IB S07_198	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X			X	X	X	X			X	X
IB S07_252					X	X	X	X			X	X	X	X				X	X			X	X	X	X		
IB S07_256												X	X	X										X			
IB R 19_217											X				X												
IB R 19_220	X	X	X	X	X		X	X	X	X		X		X		X	X			X	X	X	X	X	X	X	X
IB R 19_228			X	X			X	X	X	X		X	X														
IB R 03_266				X			X	X	X	X								---	---	X	X	X	X	X	X	X	X
IB R 03_271	X	X	X	X	X	X					X	X	X	X	X	X	X	---	---	X	X	X	X	X	X	X	X
IB R 03_274				X			X	X	X	X								---	---								
IB R 03_280	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	---	---	X	X	X	X	X	X	X	X
J175_139	X	X	X	X	X		X	X	X	X				X	X		X			X	X	X	X	X	X	X	X
J175_144											X																
J175_146																	X										
J175_148																		---	---								
J175_150							X	X	X	X		X	X	X	X	X											
J175_152	X	X	X		X	X					X																
J175_154												X				X											

Clustering the clones



Origins
MOZ = Mozambique; PQS=Kenya; UG= Uganda; SA= South Africa; GH= Ghana; LIMA=LIMA

Capacity building in Research

Capacity building is an ongoing process through which individuals, groups and organizations enhance their ability to identify and meet development challenges

Objective of capacity building

Strengthen capacity of individuals & institutions to harness the latest biosciences technologies to improve sweetpotato production in Africa

- That means;
  - Improving breeders' skills and their access to research information and resources
  - Supporting them in playing a more regular and effective role in policy-making
  - Paying special attention where there are skills gaps

What do we mean by capacity building?

- CB involves individual and organizational learning, its inevitably long term, and should be demand driven
- Geared to enhance the abilities of individuals, organizations and systems to undertake and disseminate high quality research efficiently and effectively
- Aimed at research managers, team leaders and breeders who need to familiarize themselves with the concepts and practices of the use of genomic tools in sweetpotato breeding

3 levels of Capacity Building

❑ Individual

Development of researchers and teams via training and scholarships, to design and undertake research, write up and publish research findings, influence policy makers, etc

❑ Organizational

Developing the capacity of research departments in universities, thinks tanks and so on, to fund, manage and sustain themselves

❑ Institutional

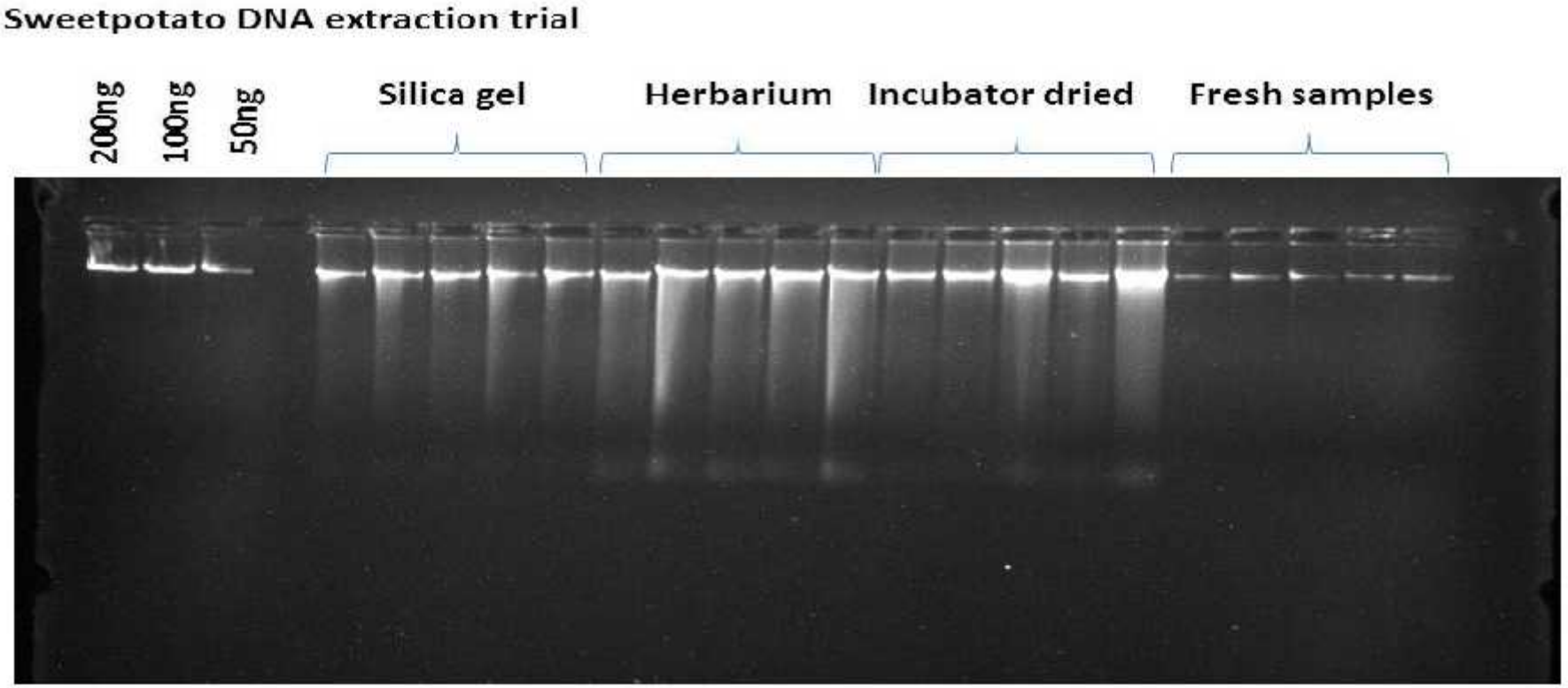
Changing, over time, the 'rules of the game' and addressing the incentive structures, the political and the regulatory context and the resource base in which research is undertaken and used by policy makers

How we shall do it

- Research placements
  - Graduate students
- Short term trainings (3-6 months) on use of sweetpotato genomics for applied breeding at BecA and NCSU
- Individual/ small group training
- Institutional capacity building

- Training workshops
- Conferences
- Linkages, information, creating awareness
- Capacity building through the African Biosciences Challenge programme (ABCF)
- AGRA

e.g Protocols that work in various lab situations



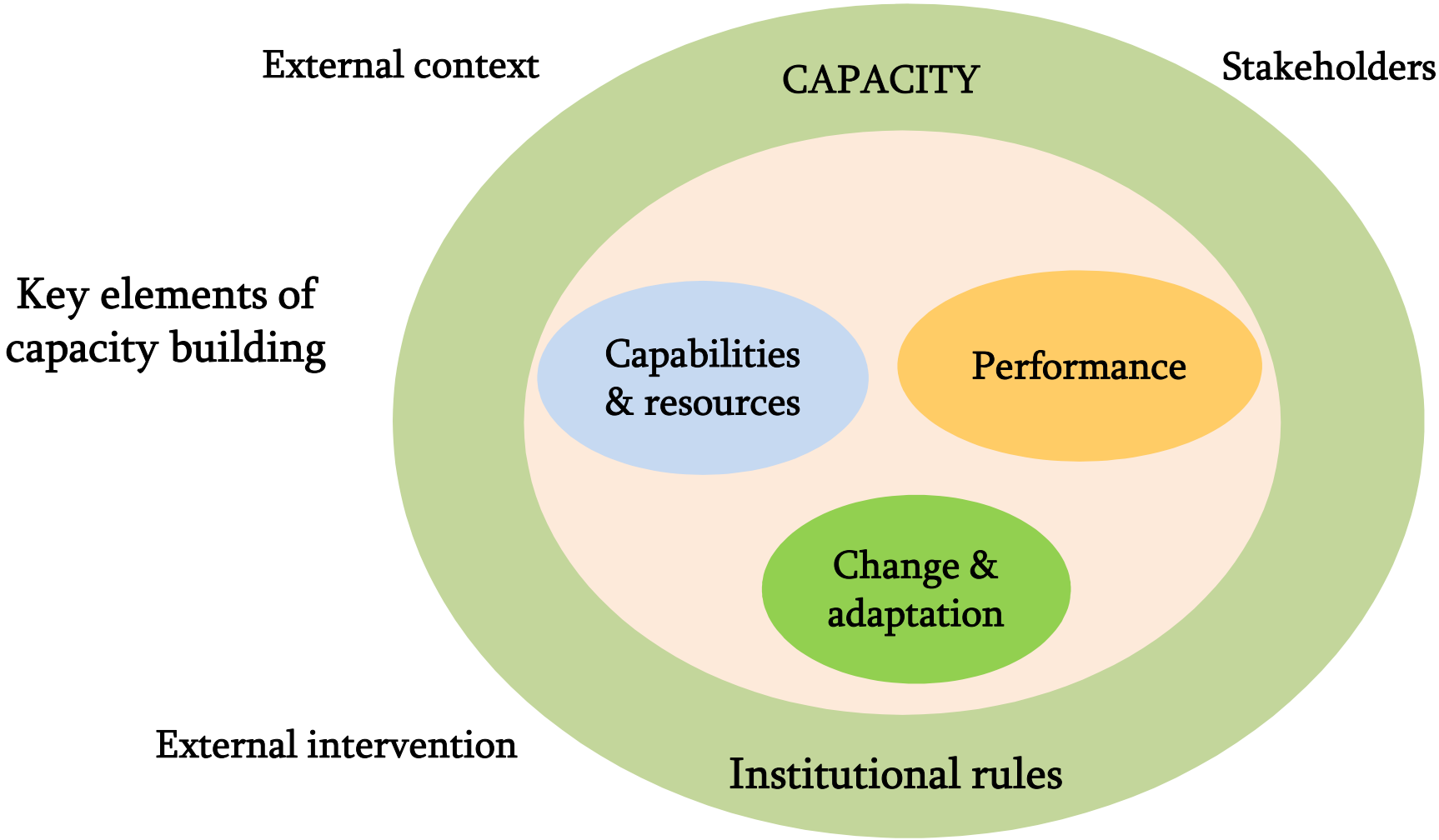
Herbarium samples

- were placed on an absorbed paper & pressed hard against carton papers until dry.
- Ideal for field sampling where there is no ice packs/access to a freezer

Incubator dried samples

- Dried for 72hrs in an incubator at 37°C

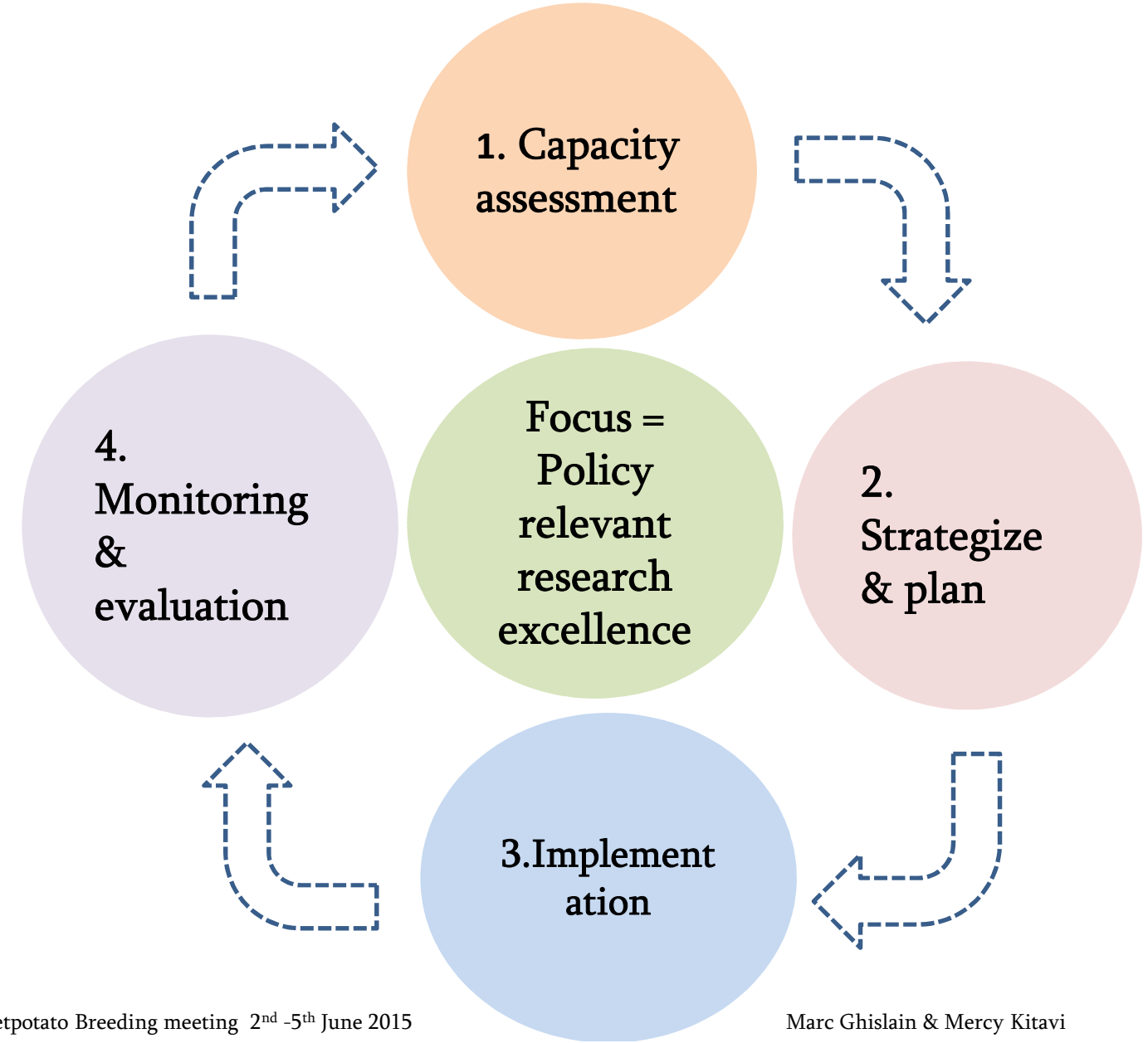
Conceptual framework underpinning capacity building



Principles of good CB

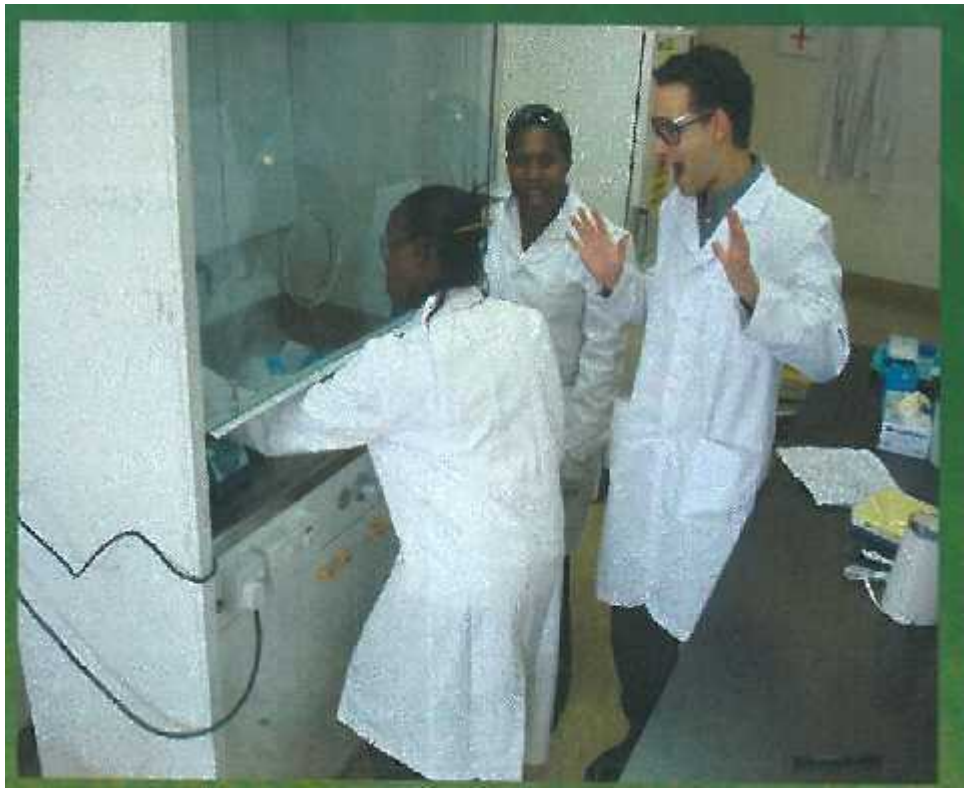
1. Capacity building is a process; not a 'bolt on' extra, nor is there a simple 'tool kit' to make it happen
2. Strengthen existing processes; suggests an iterative and flexible process that focuses on building on existing strengths and assets and enhancing local ability to solve problems, define and act upon development needs
3. Ensuring full local ownership
4. Role of external expertise; catalyze and support internal change agents and leaders in developing expertise
5. Skills and resources; core research capacity building blocks (of skills and resources) that need to be in place, such as academic writing skills, exposure to new research methods , IT infrastructure
6. Group development; Forming, Norming, Storming & Performing
7. Collaboration and partnership

Capacity building process



Few generic suggestions on CB

- CB depends on the relationships between the actors, the context and the measures chosen; What works in one context will not necessarily work in another!



- Find ways to unleash the potential for capacity building
- Effective leadership is critical
- Emphasize learning and adaptation
- Put more emphasis on understanding country context, identifying appropriate partners and building relationships
- Ensuring full local ownership

Thanks and good luck, Mercy!

Currently……

Keep walking……

The future of sweetpotato is here!

Many Thanks!