

BRAINSTORMING

PREPARATION I: Root and Tubers

Which populations for combining crop improvement and genetic analysis?

- **Cassava**
- **Potato**
- **Sweet Potato**
- **Yam**

CASSAVA

Cassava (CIAT, IITA, NRCRI, CRI, MOATZ, EMBRAPA)

Trait	Available Populations Cassava/Where					
	F ₁	S ₁	ABC	GA	Rank	
CMD	IITA, NRCRI, CIAT, CRI, MOATZ			F1	1	
CBSD	MOATZ	MOATZ		F1	1	
Drought	IITA, CIAT, EMBRAPA	IITA, CIAT		F1, Ref set	1	
PPD		CIAT	CIAT		1	
CGM	CIAT, NRCRI, IITA		CIAT		1	
Starch quality (DH)		CIAT			2	
Cyanide	IITA, CIAT					
Protein	CIAT, NRCRI		CIAT		2	
Carotene	NRCRI, CIAT, IITA, CRI	IITA, CIAT	CIAT		2	
Dry matter	NRCRI, CIAT, IITA, MOATZ				2	
CBB	CIAT, NRCRI				2	
Root rot	IITA		CIAT		3	

POPULATIONS

Available

- **F_1**
- **Advanced backcross**
- **S_1**

Proposed

- **F_1 (4-parent cross)**
- **Multi-trait pop.**
- **Association mapping pop.**
- **Modified MAGIC**

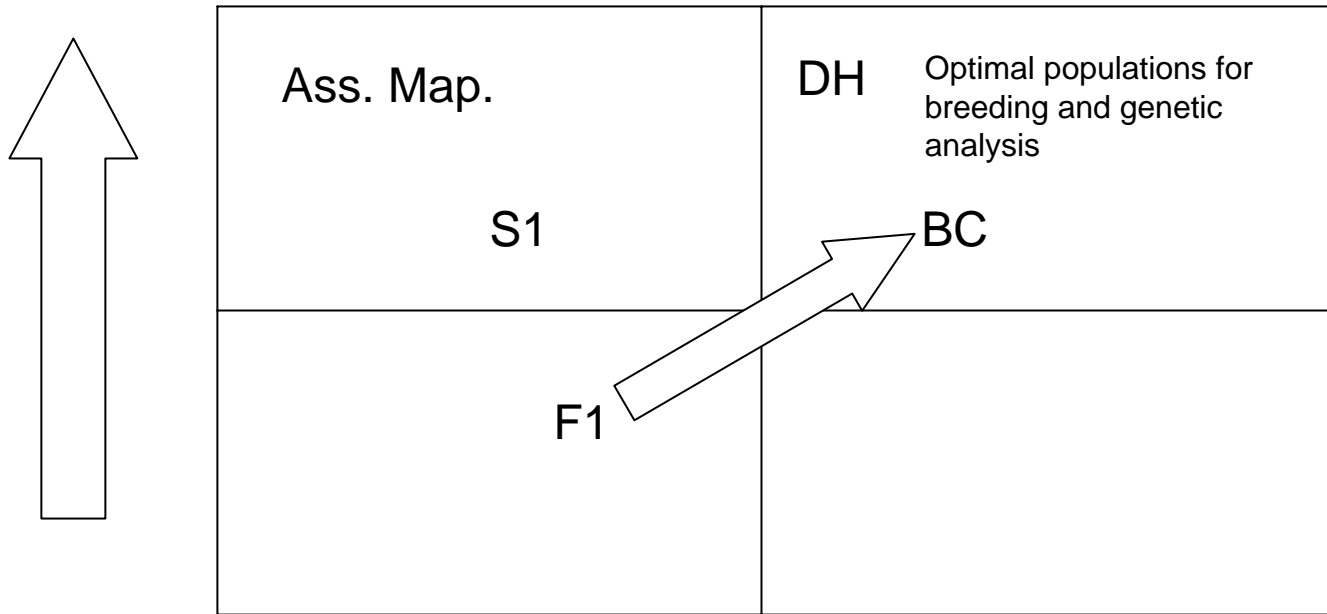
Desirable and feasible scenario

Traits

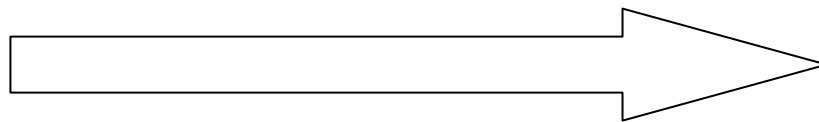
	Single genes	Few genes	Complex
High heritability	F1	F1	
Low heritability	F1, S1	BC, S1	S1, BC, Association

- **Some countries not represented in the meeting might still have other types of populations**
- **Breeding values of the traits depends on traits**
- **No reference population exists in cassava for complex traits such as drought tolerance or for association mapping**
- **Some mapping populations already have more than one desirable traits for the original ones desired**
- **Genotyping and Association mapping for all the prioritized traits**

- **F₁: used for most breeding and genetic analysis (Conventional vs Linkage mapping (Genetic load, confounded genetic effects, etc.))**
- **Traits were selected based on the farmers' preferences**
- **ABCs for high value traits not identified in cultivated varieties**
- **S1 for recessive traits and high value traits with little variation in the germplasm**



Breeding value for certain traits



POTATO

Trait	TUBEROSUM	AND	DIPLOID	WILD
Leaf Blight	X	X		X
BW				X
Virus	X	X		
Drought	O	O	O	
Heat	X			
Insects	X			
Nematodes	X			
Quality P	X	X	X	
Nutrition (Fe, Zn, B-carotene)		O	X	
Earliness	X	X		
Starch				

Desirable:

Tuberosum: LB, Viruses, Earliness, Heat, Drought, Nutrition

Diploid: LB, Viruses, Earliness, Heat, Drought, Nutrition

Feasible

Diploid: Intercrossing + Selection of half-sibs = Magic Potato (Promiscuity)

SWEET POTATO

Sweetpotato (CIP / NARS)

Trait	Intercrossed parents
B-carotene, Fe, Zn	X
Virus	O
Insect	
Dry matter	X
Earliness	X
Drought	

Desirable + Feasible

Earliness, Nutrition, Virus, Dry matter, Drought

YAM

Yam (IITA)

Trait	F ₁
Virus	X
Anthracnose	X
Drought	X
B-carotene, Fe, Zn	X
Earliness	

Desirable + Feasible

Virus, Anthracnose, Drought, B-carotene

BRAINSTORMING PREPARATION II: Root and Tubers

GCP research bottlenecks towards crop improvement

- **Cassava**
- **Potato**
- **Sweet Potato**
- **Yam**

CASSAVA

- **Global comprehensive centralized repository cassava database –**
 - MASCas, IITA database
- **Global cassava partnerships**
- **NSF – Plant survey, images, mapping sequences**
 - Need to start now so that cassava can be built in
- **Dense genetic maps**
 - SNPs, physical contig maps
 - 17,000 EST (2000 EST-SSR; 1000 EST-SNPs)
- **Conversion of SNPs to low cost markers**
- **Service provider in different regions**
- **Upgrade tools for cassava in DArT**
- **DArT for mapping**
- **MAS in breeding**
 - GSS vs Rapid service
 - Reagents for MAS
 - Small scale vs. large scale genotyping
- **Access to germplasm (e.g. orange flesh cassava)**
- **Laboratory lacking in NARs (e.g. Mozambique)**
- **Phenotyping -fast and cheap approaches**
 - Example: NIR (for cyanide, protein, moisture, starch, fibre content)**
 - Budget for installation in key labs**
 - CIAT/IITA calibrate and standardize**

- **Research teams are not harmonized**
- **Integration of research activities (avoid similar request: GSS experience)**
- **NARS competing for limited funds**
- **Available or existing networks - needs to be strengthened**
- **Breeders of different NARs need to meet together**
- **Fair expertise exist, but can be expanded**
- **SP5 and Rockefeller synergies in capacity building (long term training)**
- **Markers (best for what? simple vs. complex traits)**
- **Cost of MAS vs. Conventional breeding**
- **Breeders and molecular breeders – Should meet to agree on what should be priority**

One Breeding group (MAS vs. classical)

- **Demand driven research – Molecular biologists need to meet with breeders and farmers on what is required**
- **No channel between upstream and downstream**
- **Access to resources (markers, diversity kit, germplasm for drought)**
- **Capacity building for molecular breeding**
- **Public database on germplasm data**
 - **how easily available**
 - **consolidate germplasm data base (update on phenotypic and genotypic data)**
 - **GCP to engage an expert specifically for this responsibility to handle**
- **database for phenotypic and genotypic**
- **- update (SP3); disseminate (SP5)**
- **IP issues**

Yam

- **Orphan crop**
- **Low profile for donors on world perspective**
- **Difficult to get resources for this crop**
- **Low markers: 25 yam SSR markers, 2 not polymorphic across species; AFLP mainly used**
- **Marker development a priority**
- **No breeding populations – One F_1 pop. for multiple tuber production, none for disease or drought). Perhaps there are populations in NARs.**
- **Breeding constrained by one year growth cycle: complicates breeding; time consuming**
- **No teams**

- **Expertise in region, but limited**
- **IITA developing proposal to involve Ghana and Benin**
- **Facilities unavailable at NARs. IITA has facilities. ITA platform available in Ibadan, East Africa. GSS can also offer services**
- **Conventional breeding:**
 - **time consuming**
 - **Long breeding cycle**
 - **Flowering difficulties**
- **Molecular breeding**
 - **if markers are available, may improve breeding and save time**
 - **to identify male and female flowers**

- **Germplasm distribution**
- **Lack of information on germplasm**
- **Planting material (infected)**
- **Cost of distribution and production of planting material**
- **More markers needed**
- **Comparative mapping – use markers from monocots e.g rice, millet, save cost on marker development**
- **Association studies with reference collection**
- **Assessment of germplasm for diversity studies in NARs.**

Sweet potato

- **Demand**

- Virus
- beta carotene
- Insect
- Drought
- Earliness
- DM
- Storability?

GCP bottlenecks

- X
- Harvest plus
- X
- X
- X
- x

Research bottlenecks

- **Access to new alleles and germplasm (Breeding populations)**

Virus resistance: no population for breeders

narrow source (land race, wild species)

- **Markers (DArT, SSR)**

- **Detection limitation for SPUD: No PCR-based detection for chlorotic stunt virus (CS virus), sweet potato virus disease (SPUD)**

- **No phenotypic variation of CGS for drought tolerance, earliness, and storability**

- **Lack of genetic tools for hexaploid mapping**
 - **Software developed at ARC Seibersdorf- Austria**
 - **Mapping population for diploid –useful as a framework map assuming synteny with *T. trifolia***
- **Lack of GCP trait related ESTs (only 15,000, available in Gene bank for developing functional arrays as genomic resources**
- **CGS (composite genotype set) uncompleted: Missing breeding lines, Brazil germplasm**

Capacity building

- **Pathogen detection using PCR based techniques**
- **Drought tolerance- field design and trial**
- **Marker technology in general**

POTATO

Demand

- **PVY, PCRV resistance**
- **BW**
- **Drought tolerance**
- **Heat tolerance**

Research bottlenecks

- For BW, wild species, the inheritance, remains largely unknown**
- **Not enough knowledge in the CGS**
 - **phenotypic variation for heat and drought tolerance**

Access

- **No potato SNP detection platform (some under development)**
- **No markers for the PLRV loci (identified in 2006)**

Capacity Building – training

- High throughput marker assay for PVY resistance**
- **MAS for PVY virus resistance breeding**
 - **Evaluation of BW resistance, drought/heat tolerance**

Participants

Cassava

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- Humberto Gomez
- Morag Ferguson
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- Alfredo Alves
- Pablo Rabinowicz
- Mark Laing
- George Norton
- David Mariote

Yam

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Potato/Sweet potato

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