2023 ANNUAL REVIEW MEETING

February 22 – 27, 2023
Durable Adaptation to Aphid and Drought

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New Updates

1. Initiate a Genomic Selection program (and show that it works)

2. Gain knowledge on Sorghum Aphid resistance (how to best use it? genetic architecture? what is the mechanism?)

3. New toolbox to convert populations to Sorghum Aphid resistance - update on Photoperiodic sorghum
Some of our priorities in sorghum for the coming years

- Improve transferability for the resistance to aphids to other programs (molecular and physiological characterization) (SMIL)
- Development of photoperiodic (gwo pitimi) SA resistant varieties (SMIL)
- Enhanced drought tolerance (SMIL)
- Integration of GS and physiological breeding for yield stability (CACCIA - ILCI)
- Development of new SA resistant multipurpose sorghum (CACCIA - ILCI)
- Development of new SA resistant semi-dwarf sorghum for intensification (CACCIA - ILCI, Brana Pitimi Lakay)
- Sustainable Intensification and appropriate mechanization (WKKF - Kellogg Foundation, Haiti’s Central Bank - BRH)
- Improved seed systems (ILCI)
- Product development (extrusion - instant Ju Kole) (WKKF - Kellogg Foundation, Haiti’s Central Bank - BRH)
A. Update on Genomic Selection

Initiated under SMIL - Now running under ILCI
Rapid cycling
Without GS

We did not wait for GS to initiate a rapid cycling breeding strategy.
Rapid cycling with GS

one season = one recurrent cycle

Make crosses between best ind ⊂ best families

We can do 2 to 3 cycles per year

Variety development
Genomic Selection - Haiti

VISION: Novel approaches and technologies CAN bring an increase in the rate of genetic gain (rapid breeding)

...... for contrasting environments with enhanced biotic and abiotic stresses ???
Measuring Genetic Gain - new updated results
We have increased yield

- GS is giving great results with >125 to 150 kg / cycle we can make 250 kg / year

- Yield difference between GS4 and Base Population, and increase of yield over time, is significant in both environments
B. Knowledge on Sorghum Aphid resistance
a) No-choice Assay

b) Choice Assay

RMESI

Carl VanGessel et al
Morris Lab
**RMES1** is rare among landraces

**RMES2** is common among landraces
Many QTLs in Chibas population vs Sorghum Diversity Panel
Different QTL ... adding up to the resistance

RMES1 (NBS-LRR?): late survivability
RMES2 (SbWRKY): early survivability

with our different populations ... additional QTLs should be validated in the next months (Flywheel Genomics & Genetics) independent populations... common sweeps

Detecting QTLs.. detecting sweeps / QTLs under selection
Aphid Numbers / Count

Resistant Genotype

Susceptible Genotype

Experiment underway to see differences between resistant varieties
Studying the “timing” of resistance to the sorghum aphid
Papesek (Sureno - Centa-S3)

Appears resistant at an early stage
But if (latter) infestation prior to flowering…
It can suffer a huge yield penalty
QTL mapping … new results coming

As we are converting the Photoperiodic population…
We should be able to confirm additional QTLs

…(Strong) Aphid resistance is oligogenic or possible even polygenic
C. Conversion of the Photoperiodic population to Sorghum Aphid Resistant
Resistant versus susceptible varieties

35 F1 crosses resistant F1 genotypes x Haitian photoperiodic caudatum => F2

selected 57 genotypes out of >25,000 individuals
Development of aphid resistant photoperiodic sorghum

Responding to farmer demands in marginal areas: intercropping, relay cropping (mountains and plateaux) - they did not adopt the non photoperiodic sorghum varieties
Semi-dwarfs and photoperiodic

Dual Use
D. Drought work
Jemay Salomon is testing the role of Dhurrin (HCNp) on yield stability.

Thierry Tovignan will measure yield gain under drought, measure drought tolerance of our inbreds, hopefully characterize the genetic architecture of performance under drought conditions.

Thierry and Jean Rigaud the genetic correlation between HCNp, staygreen, stomatal conductance, etc. . . . , and drought tolerance.
Test NILs for STG-5 (staygreen and Dhurrin content QTL) role in stress and drought tolerance - John
STG/Dhurrin and drought on the global association diversity panel - Kristen Johnson
On track to reach our goals and objectives

▪ OBJECTIVE 1: Better understand the genetics of resilience traits and effects on varietal development:

▪ OBJECTIVE 2: Better understand the physiology of resilience traits and effects on varietal development:

▪ OBJECTIVE 3: Marker technology and breeding strategies for resilience traits
OBJECTIVE 1: Better understand the genetics of resilience traits and effects on varietal development:

- Mapping and validation of new QTLs.
- We should be able to validate some extra QTLs with next batch of genotyping (photoperiodic population) - results soon (genotyping in March)
- Developing and validating markers
OBJECTIVE 2: Better understand the physiology of resilience traits and effects on varietal development:

- Testing various hypothesis for SA resistance: SA, JA, HCN, TAA, Lignin,... + Metabolomics
- Testing role of Dhurrin (HCNp) and Staygreen on drought resistance
OBJECTIVE 3: Marker technology and breeding strategies for resilience traits

- Markers have been developed for RMES1 and RMES2
- Appropriate breeding strategy both for phenotypic selection and marker based selection to convert novel populations (developed and implemented)
Expected variety (pre)release

- Photoperiodic varieties (population) will be entering participatory trials this year (SMIL & PITAG)
- New Semi-Dwarf advanced lines evaluated (> checks) - ILCI
- New improved GS2, GS3 and GS4 advanced lines (SMIL & ILCI) for the dual purpose sorghum
Expected papers in 2023

- Flywheel genomics (Brian Rice - Morris lab)
- Dissection with NILs of RMES1 and RMES2 (C VanGessel, Morris lab)
- Dhurrin assay (K Johnson, Morris Lab)
- Prediction across environments (JR Charles, submitted, SMIL)
- Factors affecting genomic prediction accuracy (JR Charles-SMIL)
- Retraining for Genomic Prediction (JR Charles -ILCI)
- .... cherry on the cake ...
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AND ALSO TO OUR OTHER DONORS
PLANT BREEDING TAKES LONG,
ITS A PROGRAM… NEVER A PROJECT

Photoperiodic sorghum with SCA resistance

Development and release of *Papèpichon*, the first Haitian SCA resistant variety, with support of Akosaa and funding from Canada Global Affairs

Establishment of our sorghum breeding program and our rapid cycling strategy with support from CIRAD and funding from the French Agence Nationale de la Recherche (appel Flash Haiti)