

# TRAITS RELATED TO DROUGHT TOLERANCE MECHANISMS IN CASSAVA\*

Alfredo Alves<sup>1</sup>; Tim Setter<sup>2</sup>; Martin Fregene<sup>3</sup>; Morag Ferguson<sup>4</sup>; Luis Duque<sup>2</sup>; Rosemary Mutegi<sup>4</sup>; Geoffrey Mkamilo<sup>5</sup>

<sup>1</sup>Embrapa Cassava & Tropical Fruits (CNPMPF), Cruz das Almas, Brazil (aalves@cnpmpf.embrapa.br); <sup>2</sup>Cornell University (CU), Ithaca, USA; <sup>3</sup>International Center for Tropical Agriculture (CIAT), Cali, Colombia; <sup>4</sup>International Institute of Tropical Agriculture (IITA), Nairobi, Kenya; <sup>5</sup>Agricultural Research Institute (ARI), Mtwara, Tanzania.

\* GCP SP3 Project G3005.03: Identifying the physiological and genetic traits that make cassava one of the most drought tolerant crops

## INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is:

- one of the most important staple food in the human diet in the tropics;
- mainly cultivated in areas considered marginal for other crops;
- a great contributor to food-security against famine for drought prone areas of Africa, Asia and Latin America.

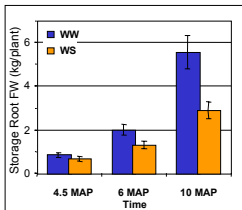
**Objective:**

Drought tolerance contrasting cassava varieties have been screened and evaluated in four representative semi-arid environments in Brazil, Colombia, Tanzania and Ghana to identify traits related to drought tolerance mechanisms in cassava

## RESULTS AND IMPACTS

### 1. Effect of water deficit on root yield in different harvest times

Average of 22 varieties, 2 water treatment (WW, WS), 3 reps.

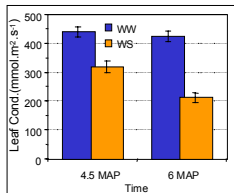


Significant variety and interaction effects on tuber roots yield under stressed and control conditions

Source	ANOVA	4.5 MAP	6 MAP	10 MAP
Variety	MS	1.614	3.524	26.025
	F	16.93	19.01	8.89
	P	<0.001	<0.001	<0.001
Water treatment	MS	0.844	18.732	222.703
	F	8.86	101.04	76.10
	P	0.004	<0.001	<0.001
Interaction	MS	0.229	2.351	14.998
	F	2.41	12.68	5.12
	P	0.002	<0.001	<0.001
Error	MS	0.095	0.185	2.927

### 2. Traits behind the mechanisms that make cassava a famous drought tolerant crops

#### 2.1. Stomatal conductance



water deficit  
↓  
close stomata  
↓  
water loss

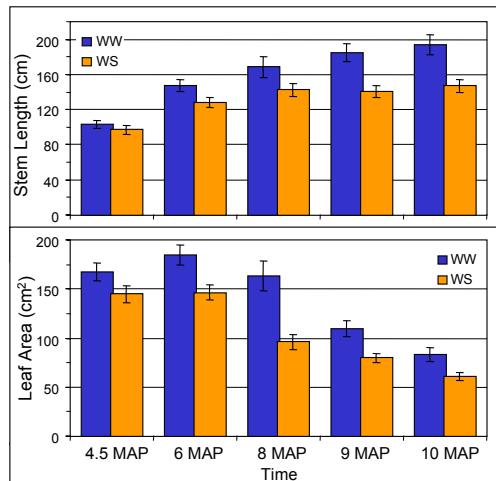


Stomatal conductance	Storage Root FW (10 MAP)	
	WS	WW
4.5 MAP	0.41	0.30
6.0 MAP	0.41	0.28

#### 2.2. Plant and leaf growth



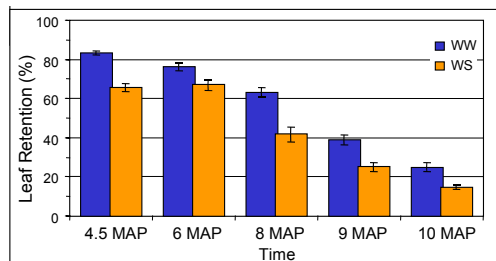
### 2.2. Plant and leaf growth (Cont.)



Correlations

Parameter	Storage Root FW (10 MAP)	
	WS	WW
Stem length (6 MAP)	0.45	0.54
Stem length (8 MAP)	0.67	0.53
Stem length (9 MAP)	0.69	0.51
Leaf area (4.5 MAP)	0.58	0.59
Leaf area (6 MAP)	0.43	0.44
Leaf area (8 MAP)	0.47	0.45

### 2.3. Leaf retention



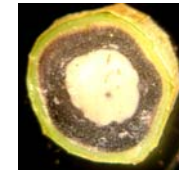
Leaf retention	Storage Root FW (10 MAP)	
	WS	WW
4.5 MAP	0.51	0.40
6.0 MAP	0.60	0.43
8.0 MAP	0.47	-0.14
9.0 MAP	0.61	-0.09
11.0 MAP	0.40	-0.12

### 2.4. Carbohydrate accumulation in the stem

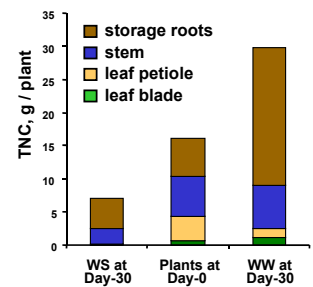
Storage carbohydrate in the stem

use to sustain tissue metabolism under stress

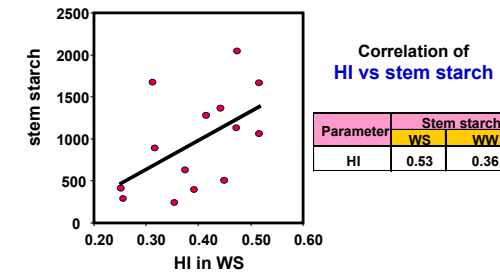
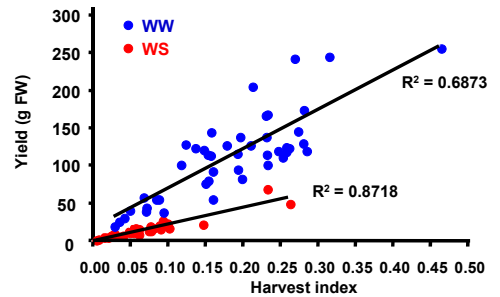
Cassava stem



Starch (iodine stain)



### 2.5. Harvest index (HI)



## CONCLUSIONS

- 1) Better yielding genotypes have more open stomata, indicating they have deeper roots and access soil water.
- 2) Genotypes that accumulate substantial stem starch reserves may be more able to sustain meristems and other respiring organs during a prolonged stress.
- 3) Genotypes that maintain partitioning to storage roots and have high harvest index yield better in drought.