Abstract
Cassava is considered a food security crop in drought-prone regions. The goals of our work are to determine which traits contribute to its maintenance of yield in water stress environments. Our studies in controlled environments indicate that cassava stomata close in response to slight decreases in leaf water status and maintain leaf water potential at values near those of well-watered controls. This is associated with rapid and large increases in abscisic acid (ABA). Also, as stress continues, a substantial fraction of leaves abscise, thereby decreasing transpirational surface area and further conserving water during stress periods. New leaf production and expansion growth is also highly sensitive to water deficit, due to inhibition of leaf cell division, and cell expansion. However, growth recovers rapidly after renewed water supply, thereby permitting rapid re-establishment of leaf area. Carbon use is down-regulated by limiting growth. Accumulation of sugars and other osmotically active solutes is not substantially stimulated by stress. Also, petiole and stem carbohydrate reserves are gradually utilized and translocated to sinks throughout the plant. The amount of starch stored in stems is considerable, representing a large share of the total non-structural carbohydrate in a plant at the initial period of storage root growth.

Summary
Mechanisms used by cassava to tolerate water deficit episodes include:
1) rapidly limit transpiration such that its tissues are not exposed to injurious low water potential stress,
2) down-regulate growth and carbon consumption in leaves and storage roots
3) supply metabolic needs via remobilization from reserves in petioles and stems.

What functional traits does cassava use to achieve its drought tolerance and yield performance?

Stomata are responsive to small decreases in water status

ABA is rapidly produced at an early phase of turgor loss
Stomata close on Day 4 after soil water is depleted

Flexible leaf growth: responsive to water loss, but capable of rapid recovery

Stems can contain >30% DW in starch
Representation leaves were examined during each of three phases in leaf development

Fibrous root proliferation decreases during water stress, but depth growth tends to be maintained

Representative leaves were examined during each of three phases in leaf development

Osmoticum accumulation, primarily K+, is limited

Stressed during leaf initiation

Stressed during cell division

Stressed during final phase of expansion

Stressed during water deficit

Leaf area, s cm²

Starch (iodine stain)
Cassava stem
Substantial amounts of starch are stored in stems and petioles which is remobilized during stress

Cassava stem

Stems can contain >30% DW in starch

Leaf area, s cm²

Plant height, cm

Total dry weight, g

Fibrous root proliferation decreases during water stress, but depth growth tends to be maintained

Cell proliferation halted during stress
Resumption of cell division after rewatering (delayed)
Eventual expansion growth (partial)

Leaf initiation delayed
After rewatering, cell division and expansion recover fully