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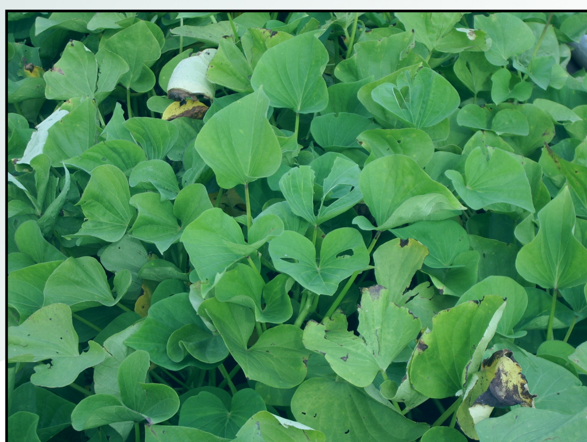
Development of fast screening methods to identify drought tolerant sweetpotatoes

R Laurie, SM Laurie & ME Malebana

INTRODUCTION

- Sweetpotato production is affected by climate variability
- Availability of plant material as well as vine survival are key characteristics for successful varieties in drought prone areas
- Quick screening methods needed to select drought tolerant lines/varieties developed



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INTRODUCTION (cont)

- It is important to understand the mechanisms of drought tolerance in sweetpotato
- Progress on screening for drought tolerance has been slow due to the complex nature of drought tolerance in plants
- More rapid progress can be aided by prior knowledge of the physiological basis of traits associated with WUE and drought tolerance

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INTRODUCTION (cont)

- ARC-VOPI has been screening varieties for drought tolerance at an early stage in the screen-house and correlated the results with drought tolerance at later stages of development in rain out shelters

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OBJECTIVES

- To subject various sweetpotato cultivars/lines to water stress conditions
- To study the mechanisms of drought tolerance in popular OFSP and cream-fleshed varieties
- To evaluate varieties/lines for drought tolerance, including landraces in the sub-region reputed to be drought tolerant
- To identify effective quick screening methods for drought tolerance using a combination of physiological, morphological and biochemical methods

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MATERIALS AND METHODS

Trial establishment

- Rain-out shelters (large)
  - 4 OFSP x 3 reps x 3 water regimes = 36 plots
  - 18 plants/plot (3 ridges, 1.8 m long spaced 0.8 m apart and 0.3m in row spacing)
  - 3 water regimes (100%, 60% & 30%)
  - Winprobe conductance measurements to monitor soil water depletion
  - Irrigation took place once a 40% depletion of plant available soil water (PAW) at 300 mm depth was detected at the 100 % treatment
  - The 60 % and 30 % treatments received only 60 and 30 % respectively of the amount of water supplied to the 100 % treatment

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MATERIALS AND METHODS

Trial establishment (cont)

- Small rainout shelter and adjacent field
  - 35 lines/accessions x 2 reps x 2 water regimes
    - Rainout shelter (small) – 30% & 60% stressed treatments
    - Adjacent field - Irrigated at 100% as soon as 40 % of PAW was depleted
  - 5 plants/plot (1.5 m x 1 m ridge)
  - Watered to allow establishment for 2 weeks, after which water stress was introduced

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MATERIALS AND METHODS

Trial establishment (cont)

Stressed treatment

Adjacent field trial
(abnormal high seasonal rain)

Drought stress trial in RS1 3
regimes 100% - 30% left to right

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MATERIALS AND METHODS

Physiological measurements

- Large rainout shelter
  - The following measurements were taken monthly:
    - photosynthetically active radiation with a ceptometer whereby LAI is calculated
    - Plant growth analysis was done on 3 plants/plot by measuring stem length and branch formation
    - Leaf samples harvested : ±30 leaves/plot harvested before sunrise for biochemical analysis
  - Leaves frozen at -70°C

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MATERIALS AND METHODS

Physiological measurements (cont)

- Small rainout shelter and adjacent field
  - End of Feb and April 2010 same measurements done as in large rain out shelter
  - Chlorophyll content and stomatal conductance were measured on the 5th leaf of a selected plant in each replicate
  - Leaf samples harvested : ±30 leaves/plot harvested before sunrise

MATERIALS AND METHODS

Agronomical analysis

- Large rainout shelters
  - Harvesting at 5 months after planting: May
  - 4 plants/plot used for the wet/dry mass of top growth
- Small rainout shelters and adjacent field
  - Harvested after 4 months due to late planting: June
  - Wet and dry mass of the top growth were determined for all the plants

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MATERIALS AND METHODS

Agronomical analysis

- Roots were harvested from all plants and the storage root yield determined
- Wet/dry mass was also determined on the roots

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MATERIALS AND METHODS

Biochemical analysis

- All the leaf material was freeze-dried to prevent decomposition
- Freeze dried material to be used to determine the absence/presence of antioxidants (Malan, *et al.* 1990; Dalton, *et al.*1986; Elstner & Heupel, 1976)
  - Antioxidants are usually detected in stressed plants

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MATERIALS AND METHODS

Biochemical analysis (cont)

- The carbon isotope ratio will also be determined
  - Stressed plants develop a preference for carbon 13 over 12
  - Determination of isotopes – mass spectrometry
  - Department of Archaelogy (University of Cape Town)

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MATERIALS AND METHODS

Biochemical analysis (cont)

- Presence of abscisic acid
  - Drought stress increases the abscisic acid content in leaves
  - The stomata close – higher concentrations of abscisic acid
  - ELISA (Abscisic Acid Competitive ELISA Assay Kit from Biofords)

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MATERIALS AND METHODS

Biochemical analysis (cont)

- Root samples to be homogenized and frozen at -70°C to determine the total carotenoid content
  - Total carotenoid contents were shown to increase under stress condition (Bartoli, *et al.*, 1999)
- A larger sample (20 – 30g) of both leaves and roots will be freeze dried and send to CIP, Lima for NIRS calibration

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RESULTS AND DISCUSSION

Trial is still in initial stage with the following results

- Yield decreased with increased water stress
  - Data is being processed for analysis
- Measurements on morphological and physiological parameters have been taken
  - Data is being processed
- Biochemical analysis have not been done
  - Leaf and root tissue are still being dried
- Samples to CIP for NIRS analysis
  - samples still dried

RESULTS AND DISCUSSION

Typical root size at 30% Treatment

Typical root size at 60% Treatment

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Way forward

- Complete all the data analysis
- CIP NIRS measurements – reference data from 50 samples used for the calibration
- Trials to be repeated for the second year from Sept 2010 with the same layout
- All measurements to be taken as in Year 1

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Thank you!!!

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