GENE EXPRESSION ASSOCIATED WITH 'STAYGREEN' TRAIT FOR DROUGHT TOLERANCE IN CASSAVA (*Manihot esculenta* Crantz) .

Charles Orek[1,3,5] , Peng Zhang[1,2], Wilhelm Gruissem[1], Morag Ferguson[4] & Hervé Vanderschuren[1]

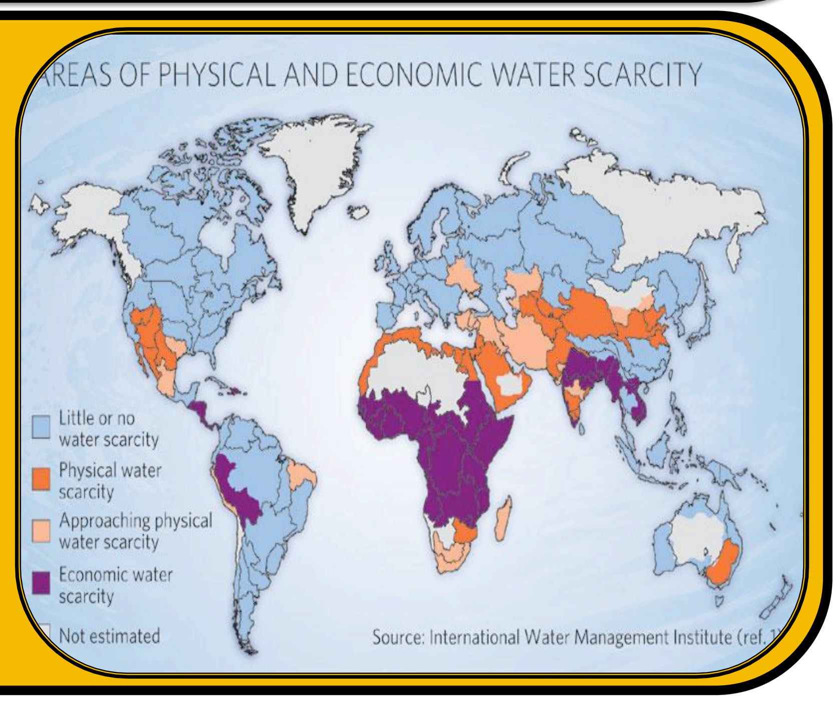
[1]Swiss Federal Institute of Technology (ETH), Institute of Plant Sciences, Zurich, Switzerland, [2]Shanghai Centre for Cassava Biotechnology, Institute of Plant Physiology and Ecology, Shanghai Institutes for Biological Sciences, Chinese Academy of Sciences [3]Biosciences eastern and Central Africa (BeCA) & [4]International Institute of Tropical Agriculture, c/o, ILRI, Nairobi, Kenya and [5]University of Nairobi, Kenya.

INTRODUCTION

Cassava ranks amongst the most important food source for saccharides after rice, sugarcane, and maize for over 500 million people in the developing countries within the tropical and sub-tropical belt[1]. Under prolonged drought, cassava reduces both its leaf canopy and transpiration water loss, but its attached leaves remain photosynthetically active, though at reduced rates[1].

PROBLEM

Cassava is inherently drought tolerant, but there is a wide variation within cassava cultivars in their ability to maintain high yield and starch quality under drought stress. Lenis and colleagues[2] reported that cassava clones with leaf retention/staygreen trait can produce more total fresh biomass and a 33% high root dry matter compared to drought susceptible cultivars. The genetic, biochemical and /or molecular basis of staygreen trait needs to be understood.



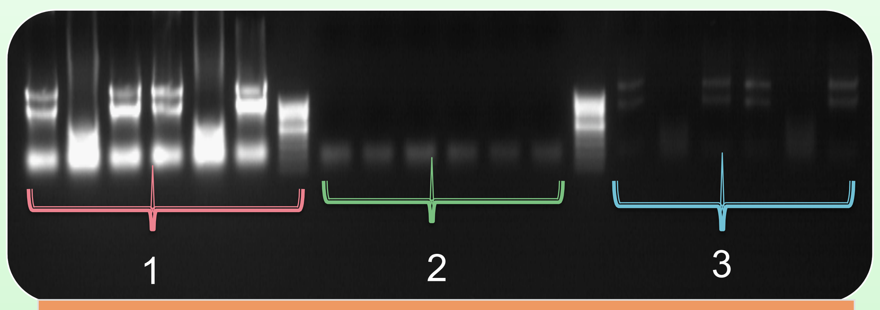
STRATEGIES & TECHNIQUES

Greenhouse & Field Experiments

Several parameters measured on water-stressed plants (internode elongation, leaf loss, stomatal conductance, photosynthetic rate, chlorophyll fluorescence, water soil content)

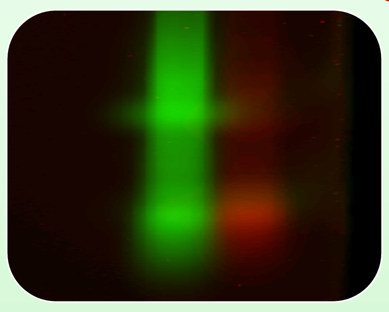
Cassava-Leafy Spurge cDNA Microarray & RT-PCR

RNA extraction & cDNA synthesis

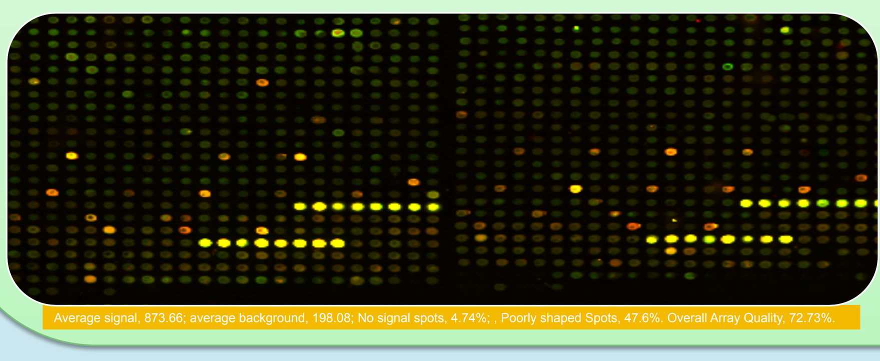


1=Total Nucleic Acid+Dnase treatment ,2=Trizoltreatment, 3=Rneasy kit

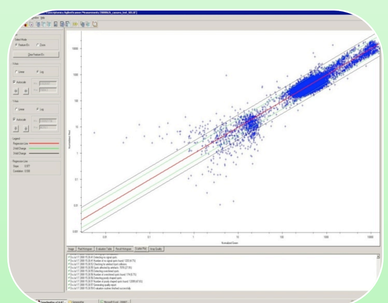
ULS-Based cDNA Labeling



Labeled cDNA Hybridization

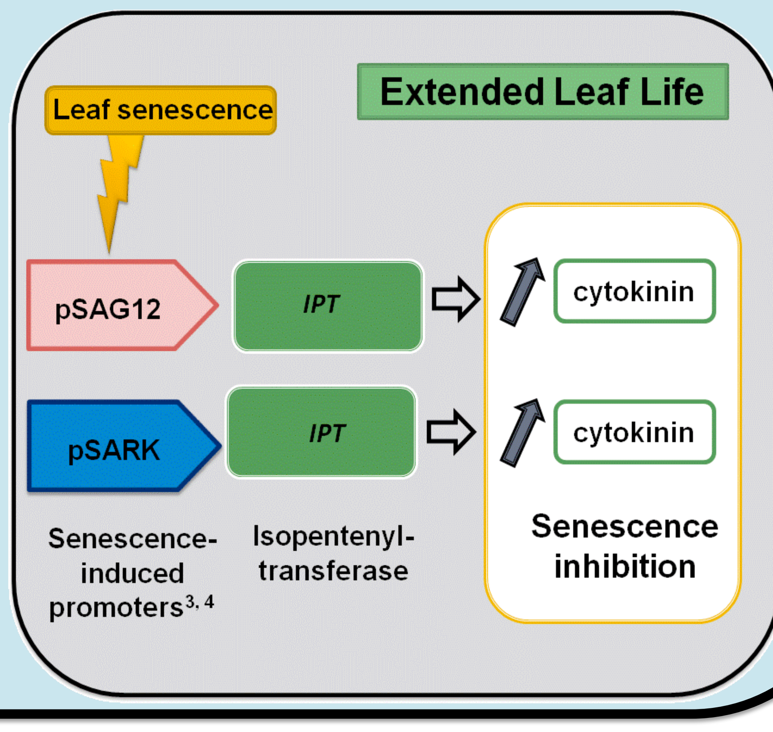


Cy3 & Cy5 signal intensities



Transgenic Approach

Production of transgenic cassava lines with senescence-inducible expression of isopentenyltransferase



RESULTS & PROSPECTS

FIELD EXPERIMENT

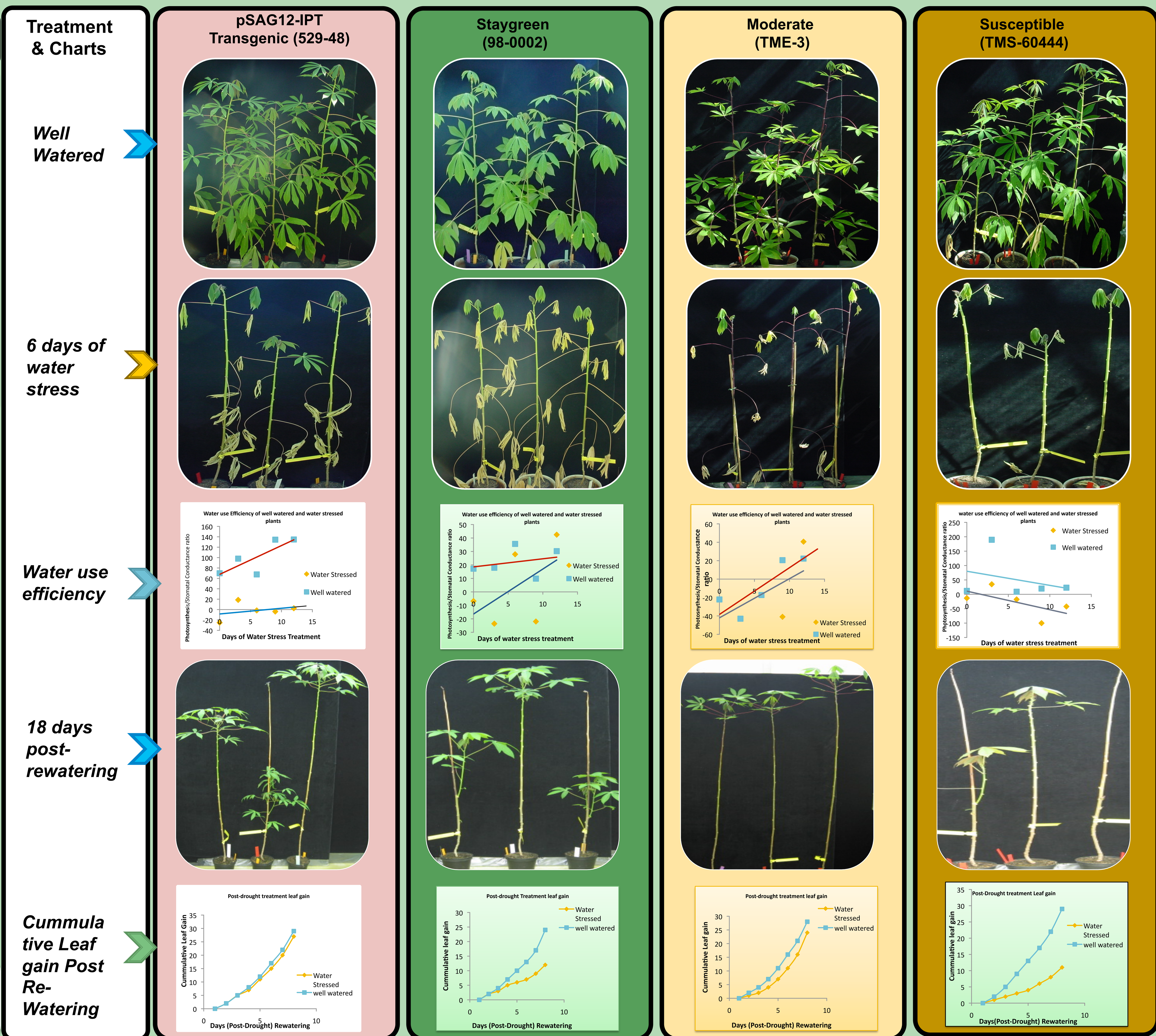
Hombolo ,Tanzania; <600 mm rainfall/year, (28 – 30ºC)

Drought-tolerant cultivars

Drought-susceptible cultivars

GREENHOUSE EXPERIMENT

ETH-Eschikon, Switzerland, (17 – 26ºC)



PROSPECTS

1.Selection of drought-tolerant / leaf-retainingcultivars with high yield and high water use efficiency under stress conditions

2.Identification of up- and down-regulated genes during water stress in cassava genotypes with different levels of staygreen trait or with transgene-activated resistance

3.Identification of biochemical pathways of staygreen encoded by genes in 2.

4.Development of molecular markers to facilitate staygreen trait introgression in cassava cultivars of interest

ACKNOWLEDGEMENT

Appreciation to Aquino Catharine Fournier (Transcriptomics; Functional Genomics Centre; Zurich)and Dr. Jörg Leipner (ETH-Zurich, Institute of Plant Sciences; Prof. Peter Stamp group).

References: El-Sharkawy M.A . (2006). Cassava photosynthesis & response to environmental stresses. Photosynthetica, **44**, 481-512. 2) Lenis, R.M. et al. (2006). Leaf retention and cassava productivity. Field Crops Research, **95**,126-134.3) Gan S. & Amasino R.M. (1995). Inhibition of leaf senescence by autoregulated production of cytokinin. Science, **22**, 1986-1988. 4) Rivero, R.M., et al. (2007). Delayed leaf senescence induces extreme drought tolerance in a flowering plant. PNAS, **104**, 19631-19636.