ESPCA | Advanced School on the Present and Future of Bioenergy
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School of Chemical Engineering (FEQ) | University of Campinas (Unicamp)
Campinas, SP Brazil

ADVANCES IN SUGARCANE PHYSIOLOGY

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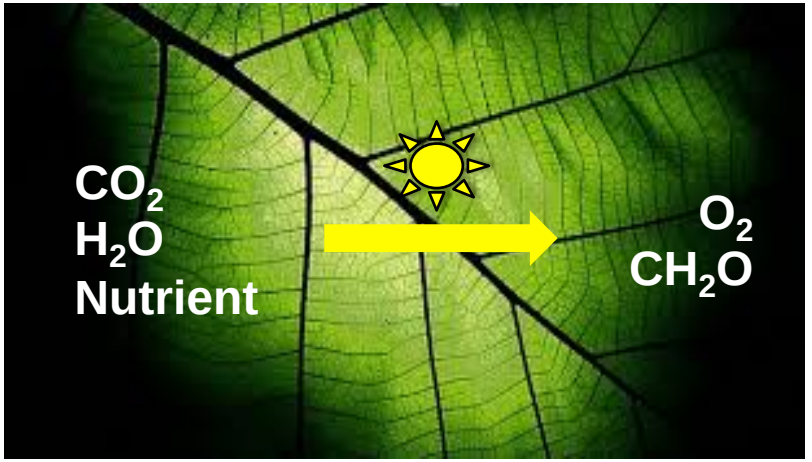
PLANTS ARE MAGIC
BEINGS!

WHY MAGIC!


Your clothes!

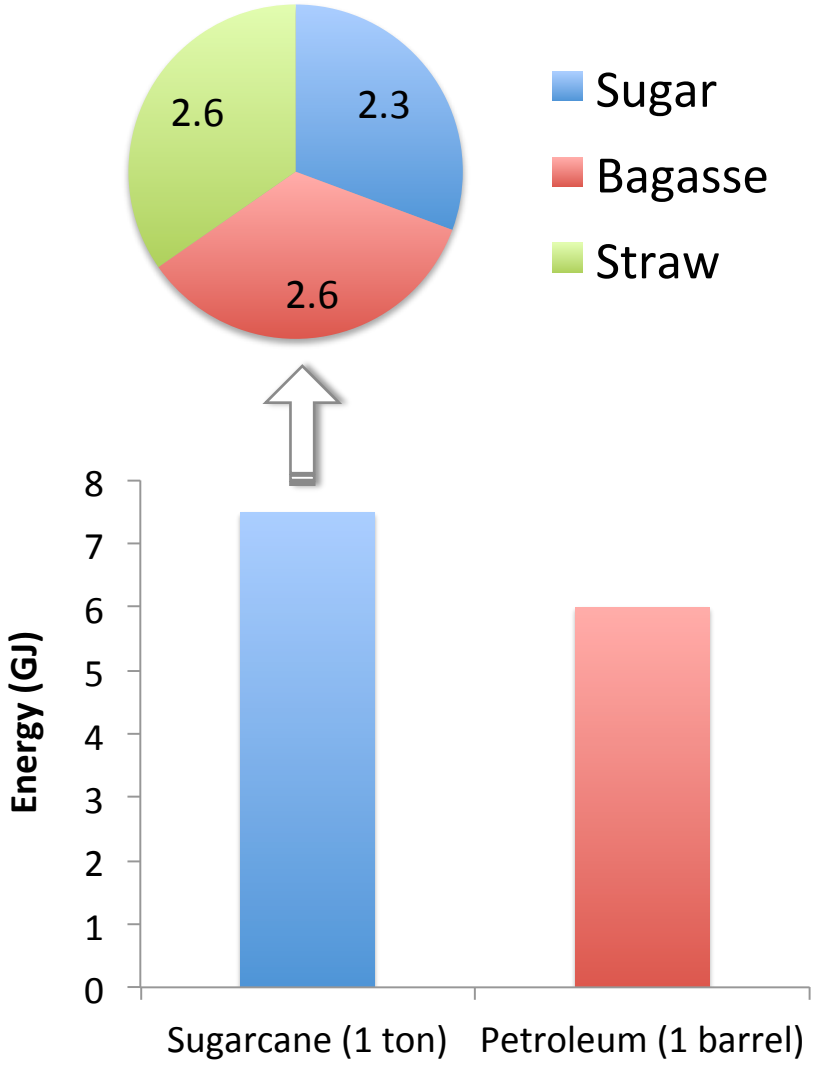

Your forniture!


Your food!


CO_2
H_2O
Nutrient
O_2
CH_2O

WHY MAGIC!

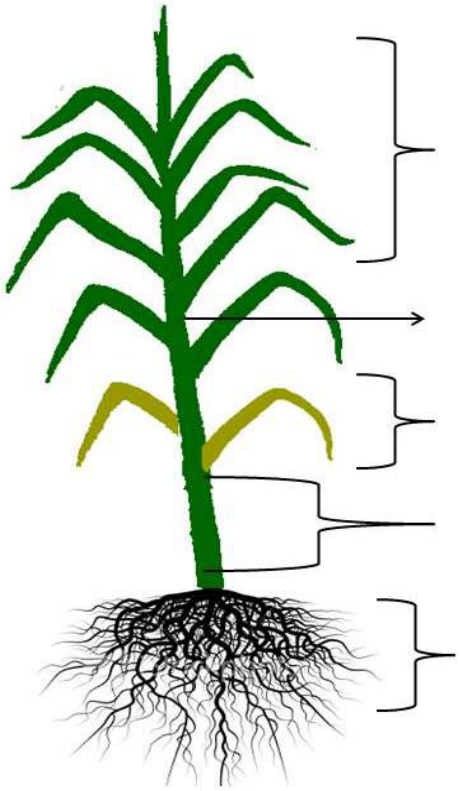
Bioenergy!



Silva (2010)

WHY MAGIC!

Superior calorific power
determined in each plant part…
…plants were 5-months-old.



Energy partitioning

10.9% green leaves

14.9% leaf sheathes

13.0% dry leaves

38.8%

30.2% stalks

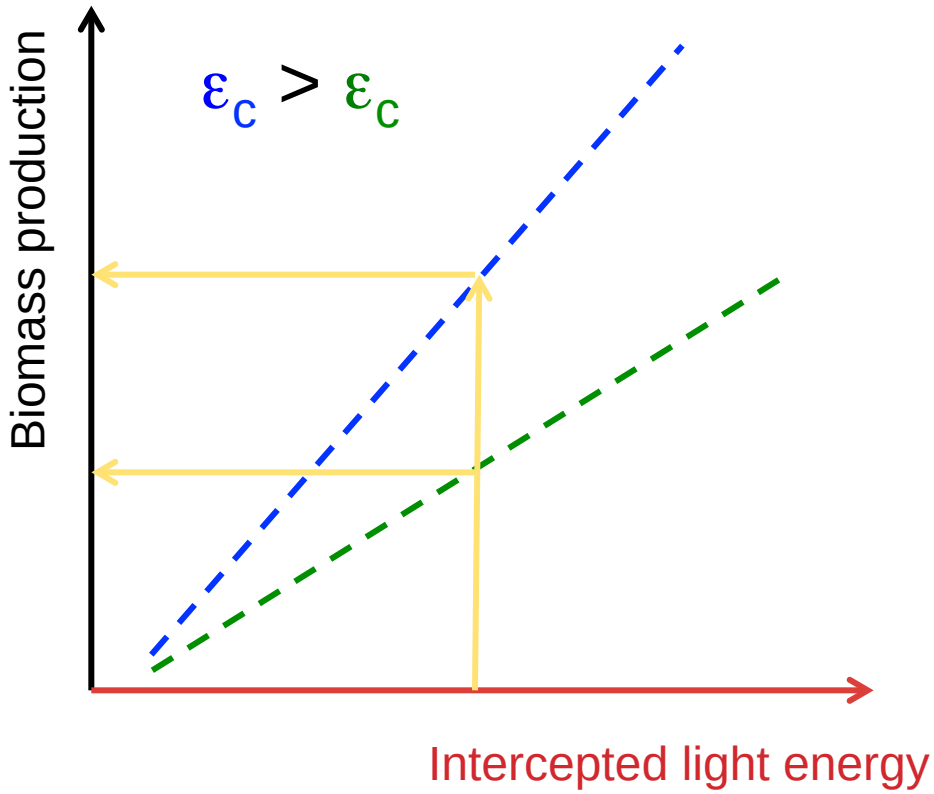
31.0% roots

Barbosa et al. (2014)

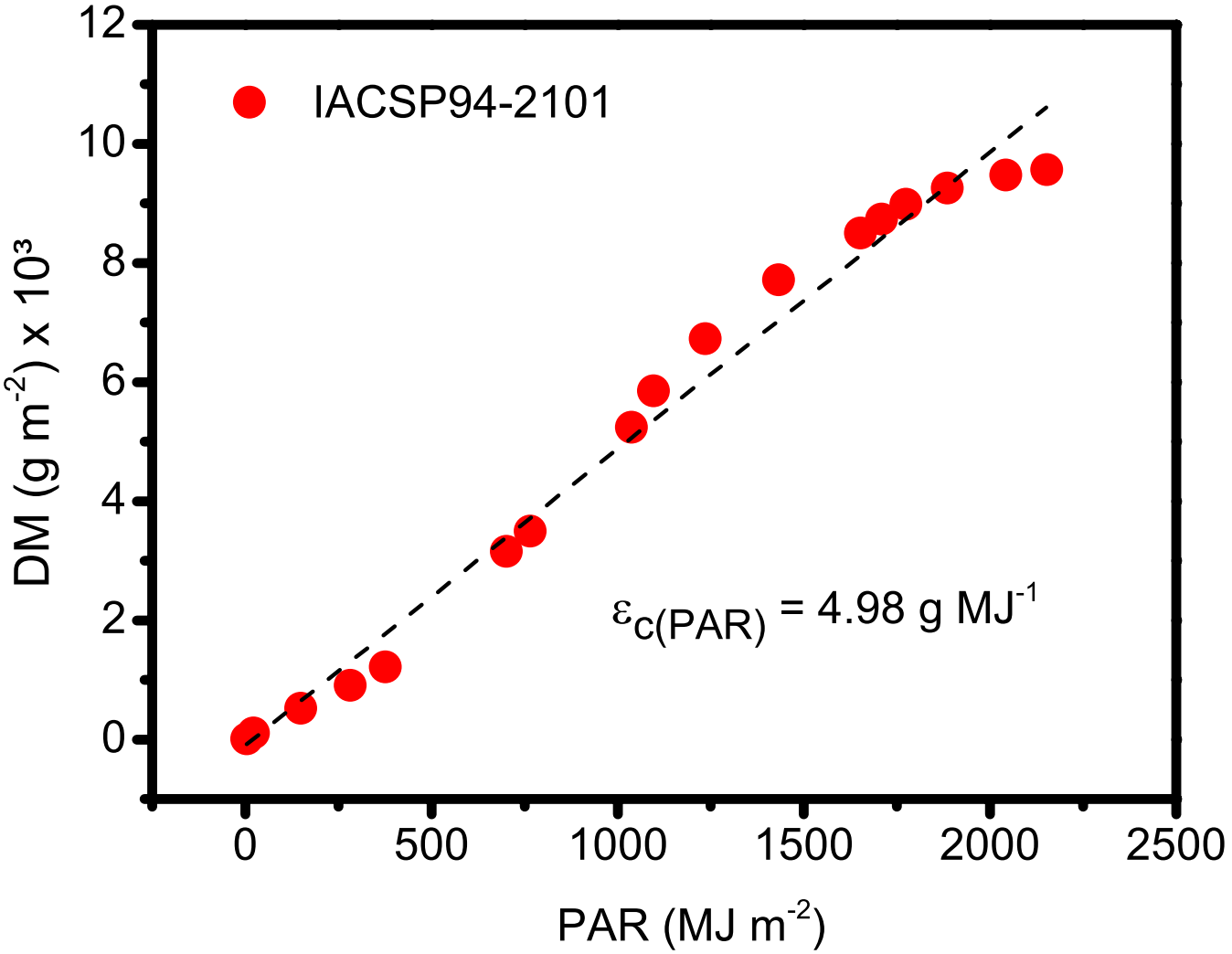
LIGHT CONVERSION EFFICIENCY BY PLANTS

How:

- **Take simultaneous measurements of light energy above and below crop canopy and then estimate intercepted light;**
- **Harvest plants in a given area and estimate biomass production;**
- **Repeat above actions during the entire crop cycle.**



LIGHT CONVERSION EFFICIENCY BY **SUGARCANE**



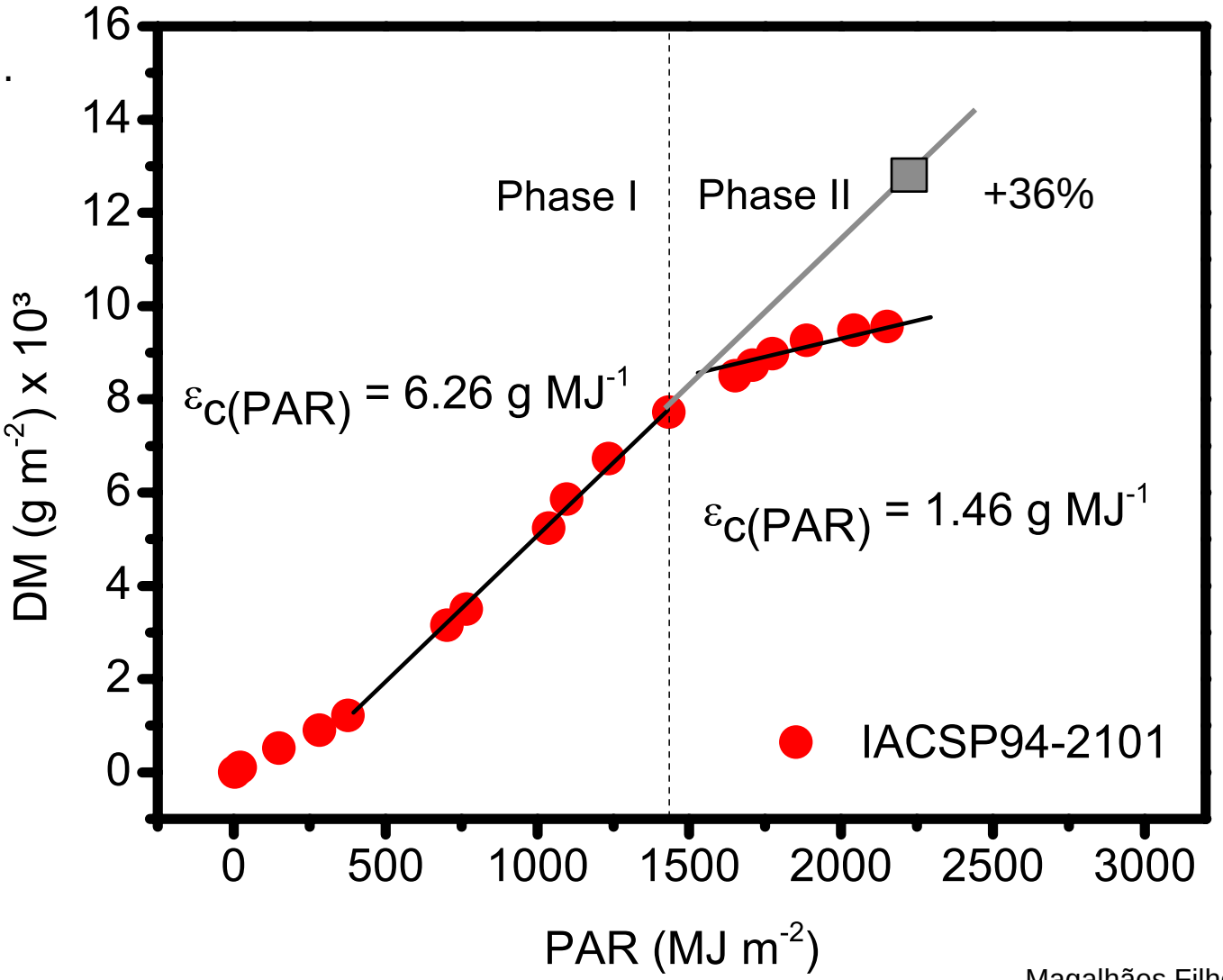
Superior calorific power: 17.5 MJ kg^{-1}

ε_c = 0.087 or 8.7%

Magalhães Filho et al. (2014)

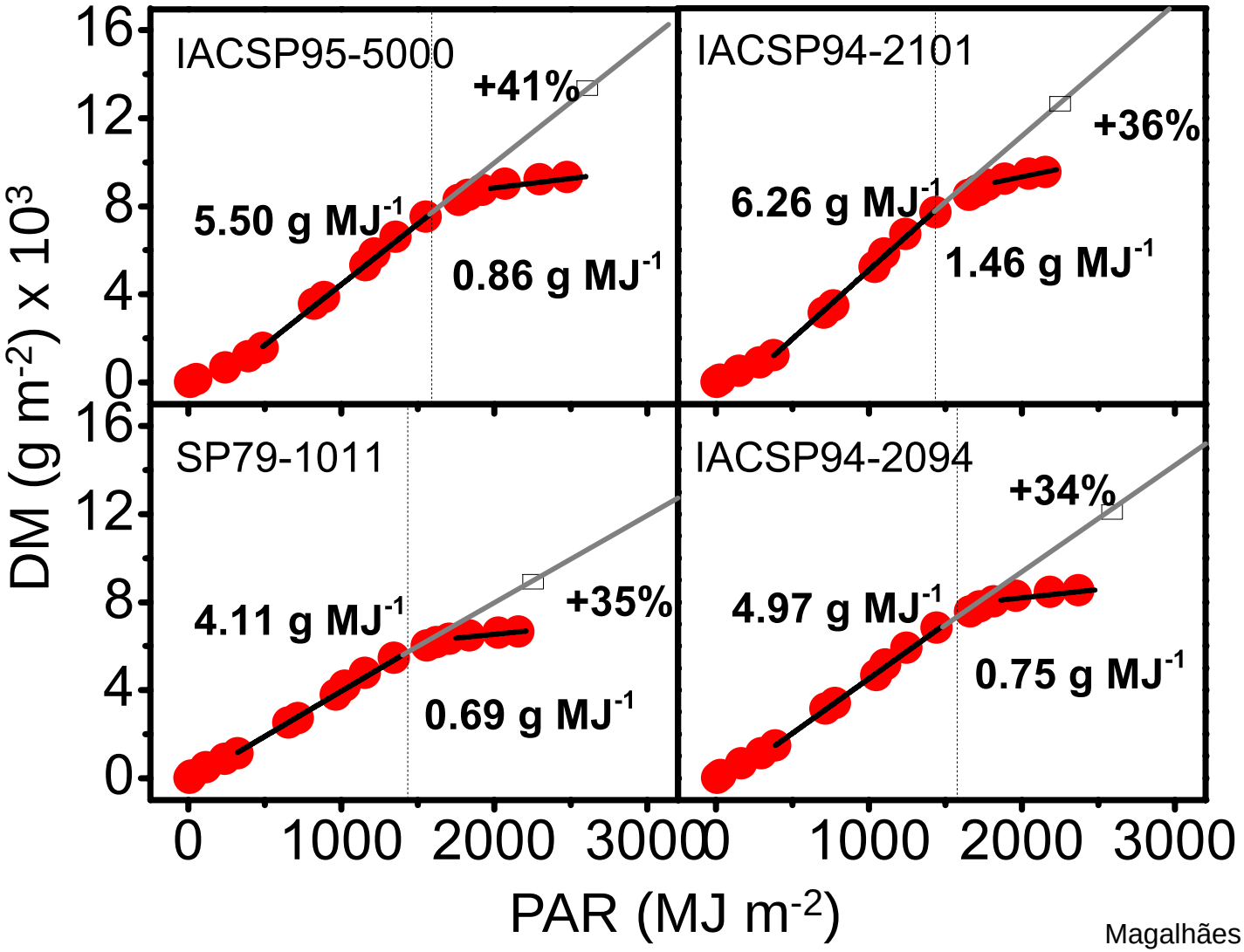
LIGHT CONVERSION EFFICIENCY BY **SUGARCANE**

In detail…



Magalhães Filho et al. (2014)

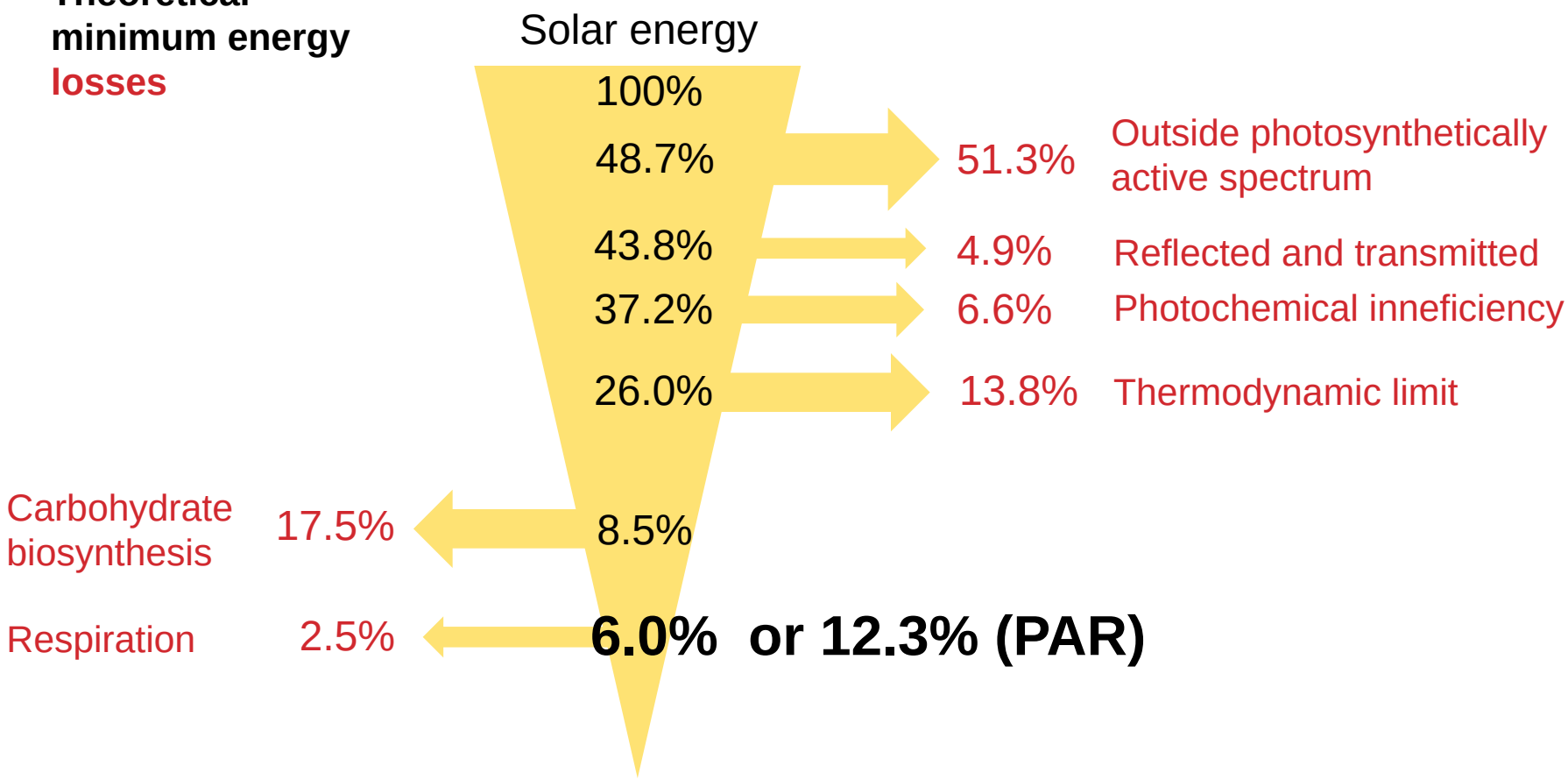
LIGHT CONVERSION EFFICIENCY BY **SUGARCANE**



Magalhães Filho et al. (2014)

LIGHT CONVERSION EFFICIENCY BY PLANTS: energy losses in C_4 plants

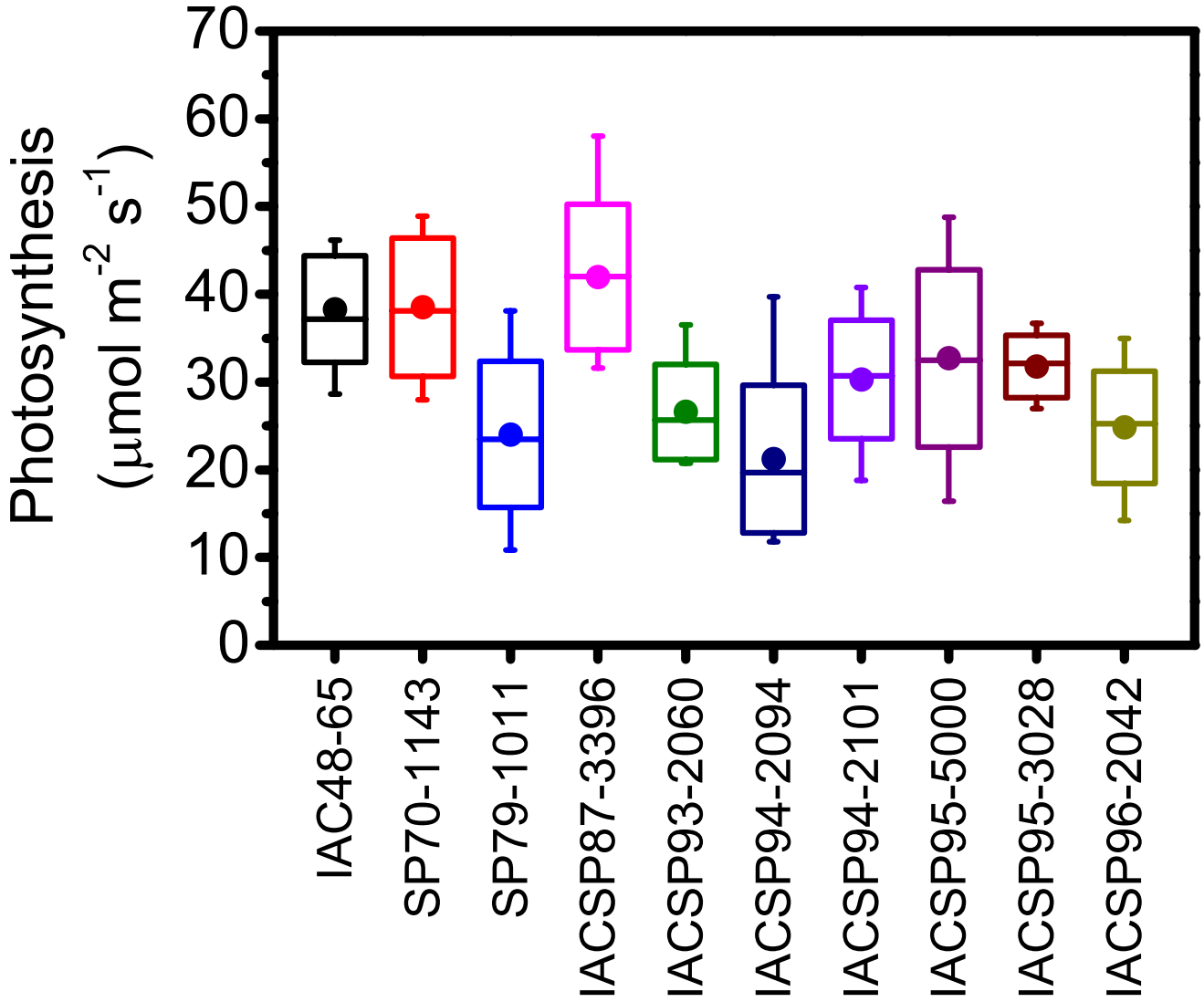
Theoretical minimum energy losses



IACSP94-2101:
6.26 g MJ^{-1} x 17.5 MJ kg^{-1} = 0.1096 ~ 11%

Adapted from Zhu et al. (2010)

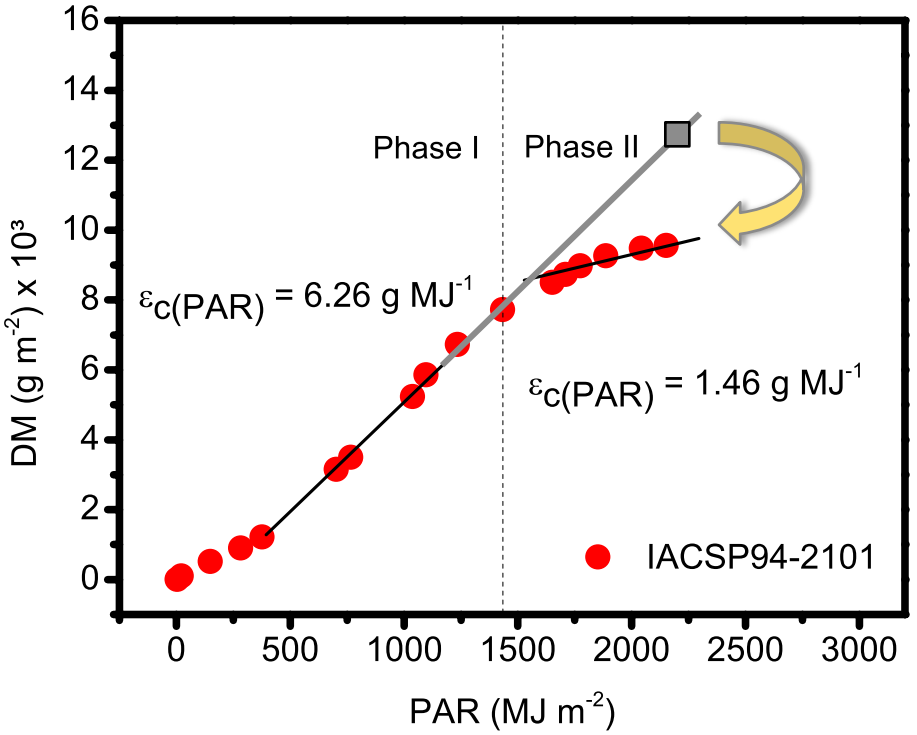
SUGARCANE PHOTOSYNTHESIS:
genotypic variation



LIGHT CONVERSION EFFICIENCY BY SUGARCANE

Why?

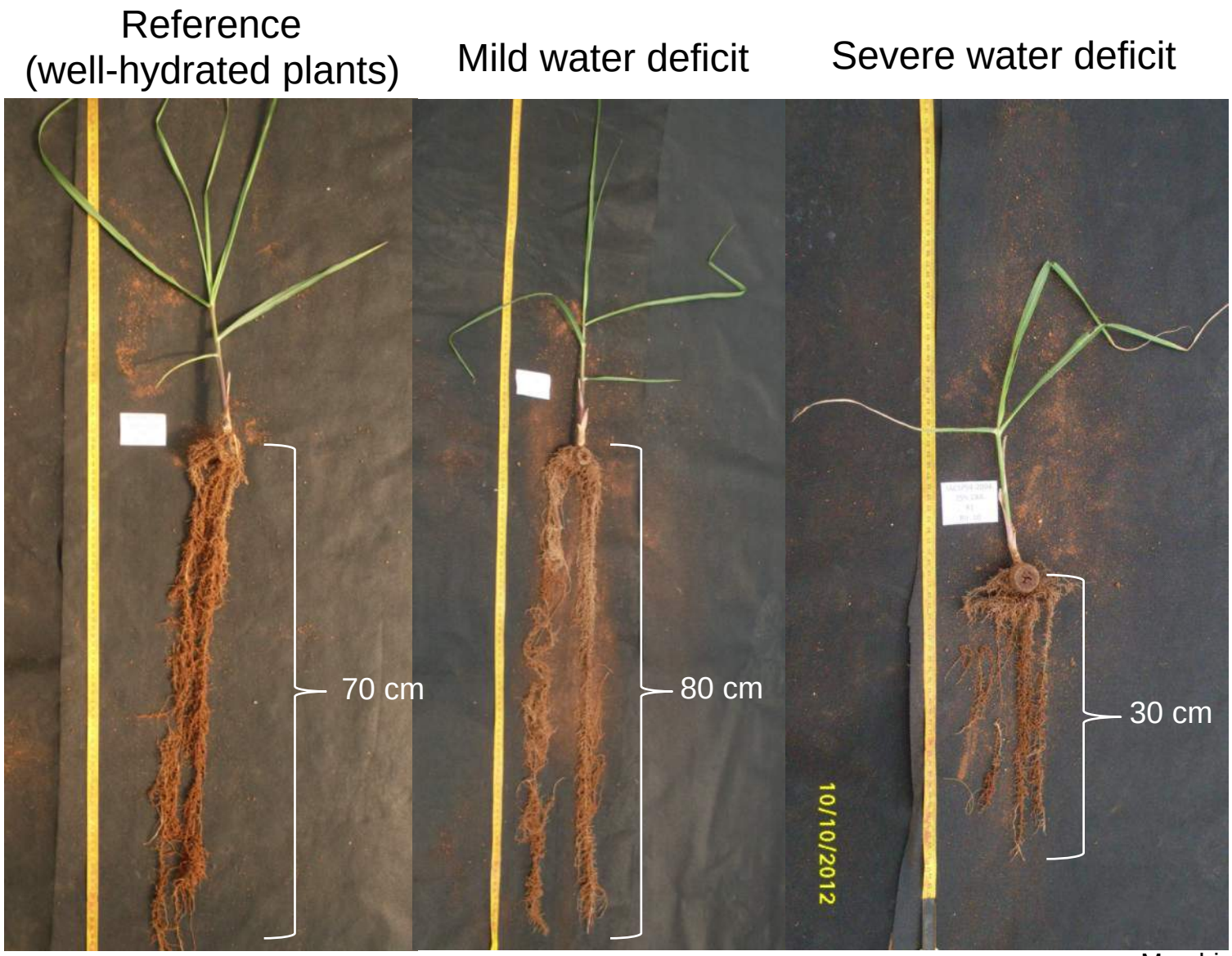
- **Source-sink unbalance (down-regulation of photosynthesis due to sugar)**
- **Environmental constrains (water deficit and low temperature)**
- **Nutritional limitation (nitrogen)**



Why does ε_C sensitivity vary among sugarcane varieties?

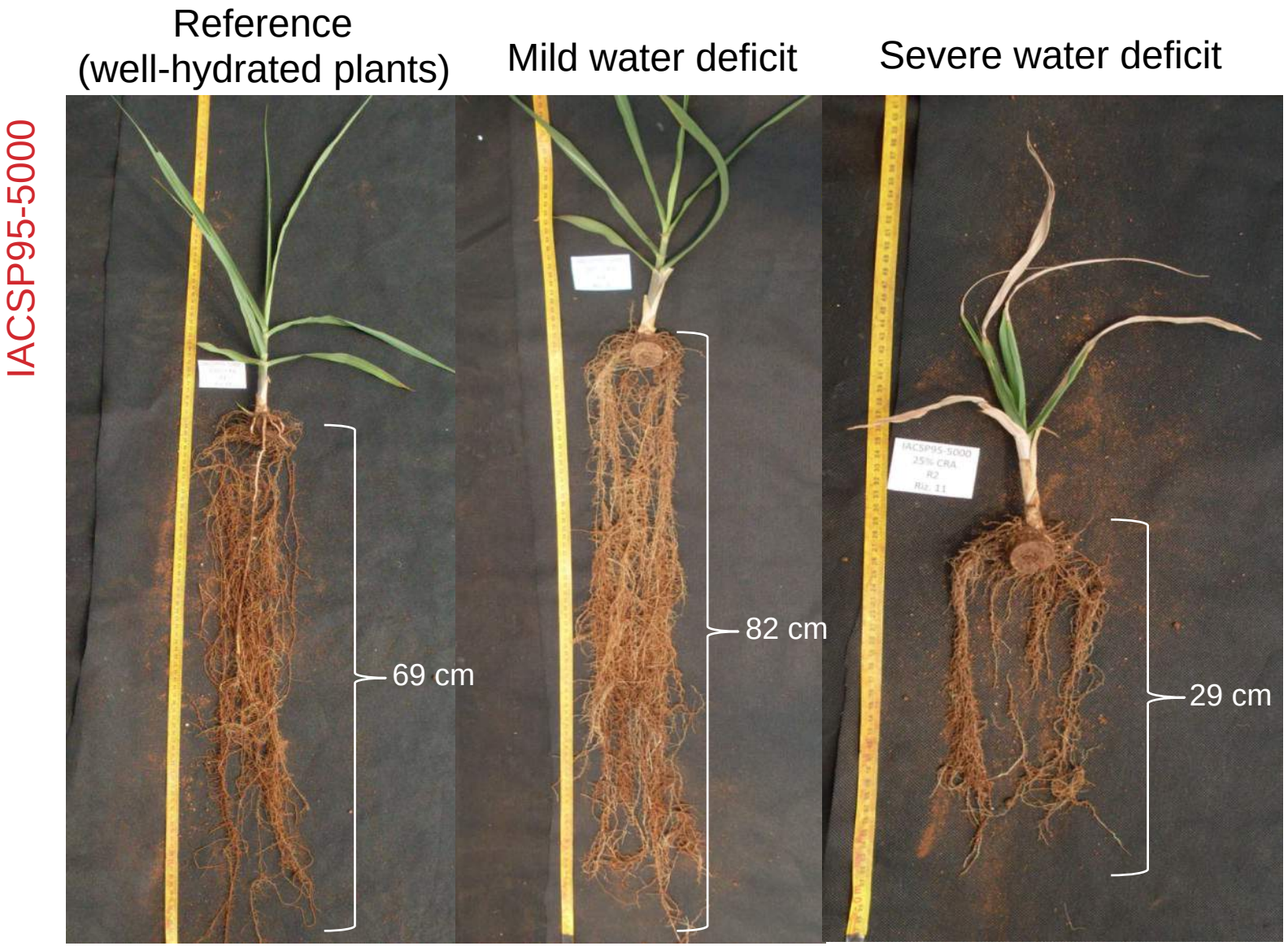
SUGARCANE ROOT GROWTH UNDER WATER DEFICIT

IACSP94-2094



Marchiori et al. (2014)

SUGARCANE ROOT GROWTH UNDER WATER DEFICIT

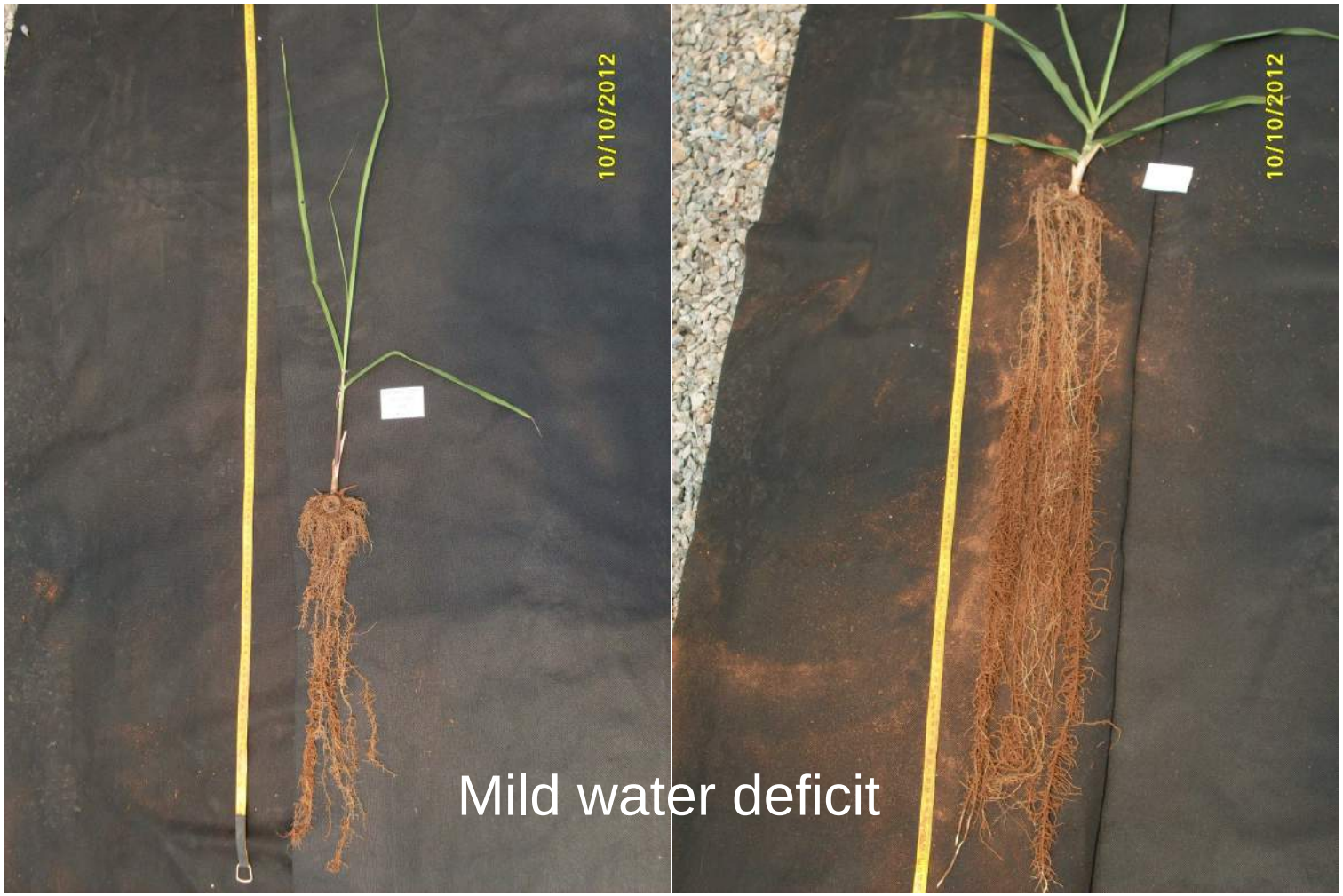


Marchiori et al. (2014)

SUGARCANE ROOT GROWTH UNDER WATER DEFICIT

IACSP94-2094

IACSP95-5000



SUGARCANE ROOT GROWTH UNDER WATER DEFICIT

Root hydraulic conductance

- represents how easy is water flow through root tissues (inverse of hydraulic resistance)
- depends on xylem structure and also on aquaporin activity