WATER STRESS AND STRESS RECOVERY OF PORTUGUESE MAIZE CULTIVARS

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Introduction

Water stress is the most important limitation to plant productivity (Chaves *et al.*, 2003).

Maize is one of the world's most cultivated crops, but its production is limited to warm regions, where water limitation is often common (Bruce *et al.*, 2002).

The development of drought resistant cultivars has become extremely important as we face dramatic climate changes.

Material and Methods

Six Portuguese maize cultivars (*Zea mays; AD3R, PB64, PB260, PB269, PB304, PB369*) were grown under a photosynthetic photon flux density of approximately 500 µmol m^{-2} s^{-1}, a photoperiod of 16h temperatures of 25º / 18ºC (day/night) and a relative humidity of *ca.* 40%.

Drought was imposed to 45 days-old plants, over one week, withholding water supply. Supply of water was restored afterwards and the plants studied for another week.

Gas exchange measurements were made with an Infra-Red Gas Analyser (IRGA; LC*pro*+ and LCA-2, ADC, Hoddesdon, UK) with a light intensity of 870 µmol m^{-2} s^{-1}, CO_2 concentration of 370 ppm, a relative humidity of 40-50% and a leaf temperature of 25º C.

Chlorophyll *a* fluorescence measurements were determined at room temperature (around 25ºC) and atmospheric CO_2 concentrations (around 370 ppm) with a portable pulse amplitude modulation fluorometer (PAM-210, Heinz Walz GmbH), using DA-TEACH software (version 1.01, Heinz Walz GmbH).

Leaves were dark-adapted for 10 minutes, and the maximum potential photochemical efficiency of photosystem II (PSII) (Fv/Fm) was determined. Continuous illumination of leaves with an actinic light of 840 µmol m^{-2} s^{-1} was applied during 30 minutes, and the effective quantum yield of PSII (Φ_{PSII}), the photochemical quenching (qP) and the non-photochemical quenching (qN) values (Maxwell and Johnson, 2000) were determined.

Leaf relative water content (RWC) was assessed as a measure of plant water status, according to Catsky (1960). Data was evaluated statistically, using a ANOVA ($p<0.05$; Tukey comparison) (OriginPro, version 7.5, OriginLab Corporation).

References

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Results

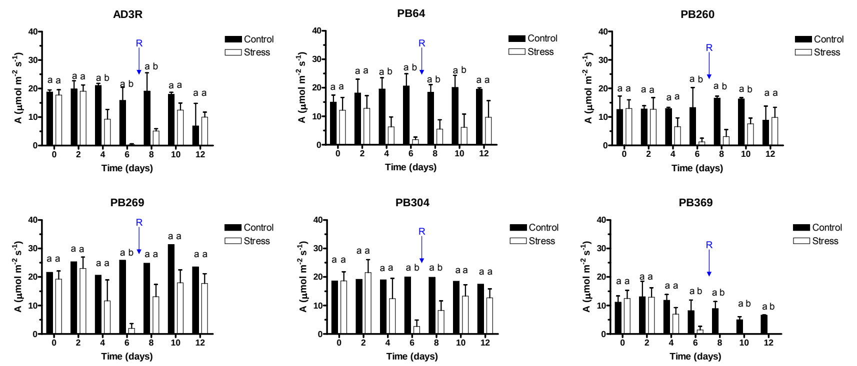

Figure 1. Net photosynthetic rate for control and water stressed *Zea mays* plants. Data are means (±SD) of 1-2 (control) or 4-5 (stressed) independent replicates. Different letters indicate statistically significant differences between control and stress ($p<0.05$); R – start of the recovery period.

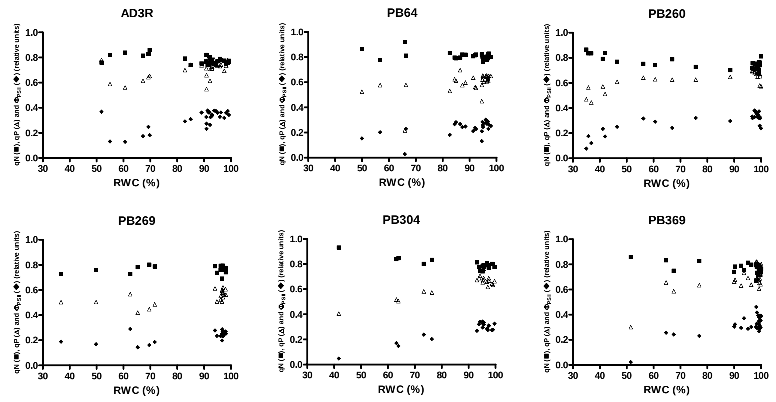

Figure 2. Fluorescence parameters plotted with RWC, during the stress period (■ - non-photochemical quenching [qN]; Δ - photochemical quenching [qP]; ♦ - effective photochemical efficiency of photosystem II [Φ_{PSII}]).

In control plants, RWC was superior to 90% in all cultivars but stressed plants showed a strong decrease, especially PB260.

Net photosynthesis reached values close to zero after a week of stress and all cultivars recovered, with the exception of PB369 (Fig. 1). The same pattern was observed in transpiration and stomatal conductance.

The effective photochemical efficiency of photosystem II (Φ_{PSII}) and the photochemical quenching showed a small decrease in the last day of stress in all cultivars, following the decrease in RWC. The non-photochemical quenching remained constant (Fig. 2).

Conclusions

The results shows that:

- PB269 seems to be the cultivar most tolerant to drought, showing the highest rates of photosynthesis, even during water stress.
- on the contrary, PB369 seems to be the most susceptible cultivar to water stress.

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