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Root-Shoot-Communication in Drought-Stressed Maize Is Modified by Atmospheric Conditions

Folkard Asch[1], Andi Bahrun[2], Christian R. Jensen[3]

[1] *University of Bonn, Plant Nutrition in the Tropics and Subtropics, Germany*
[2] *Universitas Haluoleo, Indonesia*
[3] *Royal Veterinary and Agricultural University, Denmark*

Abstract

Maize (*Zea mays* L.) was subjected to drought stress in a lysimeter set-up over two consecutive years. The lysimeter comprised 18 experimental basins filled with loamy sand and with a surface area of 4 m^2. Maize was sown in early June in both years and grown for about three weeks before the treatments started. The objective of this study was to investigate the chain of signals ultimately leading to control of water loss from the plant surfaces. Early morning shoot-water potential, stomatal conductance and photosynthesis were measured at regular intervals during the drying cycle. Xylem sap was sampled from plants cut a few centimeters above the ground by guttation sampling. The sap was analyzed for pH, nitrate and abscisic acid concentration. Physio-chemical responses to drought differed significantly between the two years as a function of both rate of soil-moisture loss and atmospheric vapor pressure deficit (VPD) during the early phases of drought stress. Under conditions of low VPD plants adapted to the environmental changes through alterations in their physio-chemistry, including an increased level of abscisic acid in both xylem and leaves, leading to a stable water status in the plant. Under conditions of high VPD a transient peak of xylem abscisic acid was observed following the time course of VPD. Plants did not adapt to the drought stress and had a negative water status, low stomatal conductance and reduced photosynthesis rates despite the absence of increased levels of leaf or xylem abscisic acid. The chain of events leading to stomatal control and ultimately reduction in transpiration differed between the two climatic environments and may have been a direct effect of the difference in the rate of soil moisture loss. Implications for adaptation strategies to drought in relation to climatic conditions are discussed.

Contact Address: Folkard Asch, University of Bonn, Plant Nutrition in the Tropics and Subtropics, Karlrobert Kreiten Straße 13, 53115 Bonn, Germany, e-mail: fa@uni-bonn.de