WATER AND OSMOTIC POTENTIAL IN ROOTS AND LEAVES OF COTTON

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Abstract

Osmotic adjustment is a process that some plants use to maintain both turgor and cell volume as the water deficit intensifies. Few studies have compared differences in water and osmotic potential between leaves and roots in the same plant. Thermocouple psychrometers were used in this work with the objective of identifying differences in water and osmotic potential between roots and leaves of cotton plants (Gossypium hirsutum L., cv. Siokra L-23) during a period of water deficit induced by PEG 6000. Leaves showed a decrease of 0.33MPa (32%) in the osmotic potential. In the roots the same behavior was not observed for this cultivar. The decrease in the osmotic potential of the roots was only 0.03MPa (5.6%).

Introduction

When turgor and cell volume are maintained, processes influenced directly by turgor, such as stomatal conductance, assimilation rate and expansive growth are fully or partially maintained (Ludlow, 1987). Few studies have compared differences in water and osmotic potential between leaves and roots in the same plant. Our preliminary studies have shown the existence of a wide range of Osmotic Adjustment (OSAD) ability mainly in the cotton wild types. Furthermore, there was considerable variation between roots and leaves related to the environment from which these wild types came. Roots seems to have a higher capacity for osmotic adjustment than leaves as observed in peas (Greacen and Oh, 1972), Lupinus spp. (Turner et al., 1987), maize (Frensch and Hsiao, 1994), and woody plants (Osonubi and Davies, 1978). However, according to Oosterhuis and Wullschleger (1987), differences between cultivars and species exist and more studies are needed.

Material and Methods

Seeds of cotton (cv. Siokra L-23) were germinated and the seedlings were inserted in holes in circular polystyrene discs fixed in pots containing aerated nutrient solution. At 23 days after germination plants were placed in pots with dilute nutrient solution containing the non-penetrating PEG 6000 at -0.25 MPa water potential (Chazen and Neuman, 1994). The plants stayed in this stress treatment for 8 hours, during the dark period, for three consecutive days. Leaf discs or the growing tips of the roots were collected (12 hours after the last stress period) and sealed in the psychrometers chamber. The µV readings were recorded after an equilibration time of four hours (Oosterhuis and Wullschleger, 1989). After water potential readings, the osmotic potential was measured by placing the thermocouple psychrometers in liquid nitrogen for three minutes to disrupt membranes and remove turgor. Relative Water Content (RWC) and Leaf/Root dry matter were also analyzed.

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Results and Discussion

Leaves showed a decrease of 0.33MPa (32%) in the osmotic potential. On the other hand, no significant change was observed in the water potential in the same leaves. This results supports that leaves osmotic adjusted to maintain the water potential and consequently, the turgidity of the leaf. Siokra-L23, an Australian cultivar, is known to have a high tolerance for water deficits. This data shown that, probably, this cultivar tolerates periods of drought by decreasing the osmotic potential of its leaves. In the roots the same behavior was not observed for this cultivar. The decrease in the osmotic potential was only 0.03MPa (5.6%). No significant differences were observed in the Relative Water Content of the leaves and roots. This confirms the role of the osmotic adjustment in helping maintain both turgor and volume as the water deficit intensifies. Therefore, the dry matter reduction was less than 10% in the leaves and less than 5% in the roots. The use of hydroponics and PEG 6,000 in this experiment showed to be a useful system to study osmotic adjustment in roots and leaves of cotton. Besides give clean roots this system permits a fast sampling and a more precise control of the water stress period.

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