Effects of Non-Uniform Salinity on Growth and Physiology of Citrus Seedlings

Mongi Zekri[1] and Lawrence R. Parsons[2]

[1]University of Florida, IFAS, Hendry County Extension Office, P.O. Box 68, LaBelle, FL 33975, USA

[2]University of Florida, IFAS, Citrus Research and Education Center, 700 Experiment Station Road, Lake Alfred, FL 33850, USA

Introduction

Most work on salinity has been done by exposing plant roots to nearly uniform concentrations, but exposure of all roots to a uniform salinity may differ from its situation in the field. Under field conditions, the roots of a plant grow in soil which varies in water content, salt concentration, and water potential both in space and with time. With saline water, micro-irrigation systems form a zone of low salt concentration immediately below the emitter outlet and zones of higher salt concentration near the periphery of the wetted soil zone. Plants growing in such conditions may, therefore, have roots from different parts of the root zone exposed to very different salt concentrations.

Objective

To evaluate growth and physiological parameters when half or whole root systems were stressed with salinity and to determine if the non-stressed portion of the root system would compensate for the decrease in water uptake by the salt-stressed portion.

Materials & Methods

The tap root of each sour orange (*Citrus aurantium*) seedling at the 3-leaf stage was cut to a 1.0 cm length and all other roots were removed. The remaining portion of the tap root was dipped into a 50% ethanol solution containing 5.0 g dm^{-3} of indolebutyric acid. Seedlings were then placed in a mix of peat, perlite, and vermiculite (PROMIX BX), watered daily and fertilized weekly for 2 months. Seedlings with two uniform adventitious roots were selected and transplanted when 5-months-old into 2·2 dm^3 square plastic containers stapled together along one side and filled with soil. These seedlings were allowed to adjust in their double pots in a greenhouse for 1 month before salinity treatment were imposed. Seedlings were irrigated with a modified half-strength Hoagland's solution. Sodium chloride (NaCl) was added to the half-strength Hoagland's solution to achieve final osmotic potentials of -0.10, -0.20, and -0.35 MPa. The basic nutrient solution NS (no salt or half-strength Hoagland's solution) had an osmotic potential (OP) of -0.05 MPa. Plants were irrigated with the treatment solutions every 2 days. The treatments were replicated four times in a randomized complete block design. Leaf water potential, osmotic potential of the leaf sap, and turgor potential were determined. Morning and midday stomatal conductance was measured. Water use or evapotranspiration from each of the two sides was estimated. After 4 months of NaCl treatment, the seedlings were harvested, and shoot and root dry weights were determined after oven-drying for 3 days at 60 °C.

Conclusions

Plant growth, leaf water potential, osmotic potential, stomatal conductance, and evapotranspiration decreased with increasing NaCl concentrations and were more disturbed under uniform salinity than under non-uniform salinity conditions. Shoot growth did not correlate with the average osmotic potential of the two root halves. Seedlings with one stressed half-root system had shoot dry weight and leaf water potential values closer to those of the non-stressed control than to those with the completely stressed root system. The non-stressed portion of the root system compensated for the decrease in growth, water uptake, and physiological processes by the salt-stressed portion.

A split-root system

NS NS | NS -0.35 MPa | -0.35 MPa

References

Zekri, M. and L.R. Parsons. 1989. Growth and root hydraulic conductivity of several citrus rootstocks under salt and polyethylene glycol stresses. Physiol. Plant. 77:99-106.

Zekri, M. and L.R. Parsons. 1990. Response of split-root sour orange seedlings to NaCl and polyethylene glycol stresses. J. Exp. Bot. 41(222):35-40.

Zekri, M. and L.R. Parsons. 1990. Calcium influences growth and leaf mineral concentration of citrus under saline conditions. HortScience 25(7):784-786.

Zekri, M. and L.R. Parsons. 1990. Comparative effects of NaCl and polyethylene glycol on root distribution, growth, and stomatal conductance of sour orange seedlings. Plant and Soil 129:137-143.

Zekri, M. 1991. Effects of NaCl on growth and physiology of sour orange and Cleopatra mandarin seedlings. Scientia Horticulturae 47:305-315.

Zekri, M. and L.R. Parsons. 1992. Salinity tolerance of citrus rootstocks: Effects of salt on root and leaf mineral concentrations. Plant and Soil 147:171-181.