Impact of Drought on Salinity Tolerance of Landscape Woody Plants Irrigated with Reclaimed Water

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Objectives

With the population expected to be double by 2050 in Texas, the decreasing water supplies will be more difficult to meet the needs in the future. Reuse of water is being encouraged by the State of Texas as availability is becoming more crucial to many communities and municipalities. Reclaimed water is expected to become increasingly vital to sustain the quality of life for Texas. Although reclaimed water has been used for irrigating golf courses for more than a decade in some regions of Texas, its use for irrigating landscape with multiple plant species has just begun. However, foliage damage and whole plant death due to reclaimed water irrigation have been reported. Up to date, only a very limited number of landscape plants have been documented on their salinity tolerance (Cabrera, 2001 and 2003; Miyamoto et al., 2004). In order to increase the use of reclaimed water to irrigate landscape plants other than turfgrass and minimize damage and loss, salinity tolerance of commonly planted landscape plants needs to be identified and characterized.

Salinity tolerance studies are usually conducted under well watered conditions. The response of plants to saline soil or irrigation solution may change due to drought stress. Little information is available on the impact of drought on salinity tolerance of landscape plants.

The specific objectives of this study are to evaluate the relative salinity tolerance and water use of the selected shrubs and trees under well-irrigated and drought-stressed conditions and analyze sodium and chloride ions uptake and their translocation in plant tissue.

Methodology

The following shrubs and trees will be used for this study: Aromatic Sumac (*Rhus aromatica*), Black Cherry (*Prunus serotina*), Green Ash (*Fraxinus pennsylvanica*), Hackberry (*Celtis occidentalis*), Lacebark Elm (*Ulmus parvifolia*), Russian Olive (*Elaeagnus angustifolia*), Sand Cherry (*Prunus besseyi*), Sand Plum (*Prunus angustifolia*), Sawtooth Oak (*Quercus acutissima*), Shumard Oak (*Quercus shumardii*), and Smooth Sumac (*Rhus glabra*). These shrubs and trees are recommended by Texas Forest Service recently for planting in West Texas. However, the salinity tolerance of these species has not been characterized.

Seedlings of the above shrubs and trees will be purchased in the early spring from Texas Forest Service through local Texas Cooperative Extension office. Upon arrival, seedlings will be potted to 3- or 5-gallon containers, depending on seedlings sizes, filled with a commonly used nursery growing medium. The containers will be placed in a fenced, outdoor field plot in completely randomized blocks with 6 replications per treatment. Environmental conditions (temperature, humidity, light) will be monitored automatically by a datalogging system. Plants will be irrigated with tap water for six-week establishment before the treatments start.

There will be four saline solution treatments: electrical conductivity (EC) of approximately 1.0 (tap water), 3.0, 6.0, or 12 dS/m, made up from tap water and chemicals of NaCl (85%), $CaCl_2$, and $MgSO_4$ in appropriate ratios to simulate reclaimed water ion compositions of El Paso region. In each salt treatment, drought stress will be given to half of the plants by withholding

irrigation for certain period of time until stress symptoms exhibit. Therefore, there will be a total of eight experimental treatments. A 20-20-20 water soluble fertilizer will be mixed into each saline solution at 0.25 g/L, which will be prepared in 100 L tanks and pumped to individual plant through drip irrigation system by submersible pumps.

To quantify the growth response to salinity, plant height, stem diameter and canopy volume (if applicable) will be measured at the beginning and during the experiment at appropriate intervals. Salt stress symptoms such as leaf chlorosis and aesthetic quality will be periodically recorded and evaluated. Soil leaching samples will be collected and analyzed for pH and EC. Plant tissues (roots and leaves) will be collected and analyzed for major ion concentrations. To examine the impact of drought and salt stress, plant physiological responses (photosynthetic rate, transpiration and stomatal conductance) will be characterized using a portable photosynthesis measurement system (recently purchased).

Anticipated Results

This study will enhance our understanding on physiological responses of the selected shrubs and trees to salt and drought stresses. The impact of drought on salinity tolerance, the threshold of salinity levels, which cause plant injury, under well-watered and drought-stressed conditions will provide guidance to irrigation management with reclaimed water in urban landscapes and nursery industry. The water use of these plants irrigated with tap water and reclaimed water, respectively, will be determined. The knowledge of water use will allow nursery and landscape professionals to schedule irrigation more accurately and efficiently.

The results will be disseminated to the landscape, nursery and forest industries through TWRI, TWDB and TAMU technical reports, newsletters, meetings/workshops, and educational websites. Presentations will be given at regional and national meetings and technical articles and peer review papers will be published.

Budget

We are requesting a research support fund of $ 9,425 to cover the expenses of hiring student workers, purchasing plant materials and supplies including irrigation tubing and pumps, nutrient tanks, containers, growing medium, fertilizer, and sensors. Plant tissue samples will be sent out to a commercial lab for ion analysis (other expenses). A fund of $9,700 will be matched to cover 35% of technician’s salary. The budget breakdown is shown on a separate page.

Literature Cited

Cabrera, R.I. 2003. Growth, quality and nutrient responses of azalea hybrids to salinity. Acta Hort. 609: 241-245.

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