Printed in: Southwest Horticulture (2005) 22(2):11, 20.

Salinity – What's Tolerant, What's Not?

Ursula Schuch, Plant Sciences Department, University of Arizona, Tucson

Most landscapes in Arizona are currently irrigated with potable water. How long this practice will continue is questionable as new urban developments are flourishing throughout the state and water reservoirs and rivers are still low from the drought. The increasing demand for more irrigation water is likely to result in the use of more reclaimed water to irrigate urban landscapes in the future. Reclaimed water is available in some areas and is already successfully used for irrigation on some golf courses, in parks and schools. One of the concerns of using reclaimed water is that the amount of salts in this water is often higher than in potable water. Over time, salts will build up in the soil and if not leached below the root zone of landscape plants, can injure roots, stunt growth, and lead to the death of salt sensitive species.

Increasing salinity of soils and water supplies is a constant challenge in arid areas and poor quality of ground water is already a concern. According to the Central Arizona Salinity Study, of the 1.5 million tons of salts brought by different water supplies into the Phoenix area each year, 1.1 million tons remain in the area. Quality of water is variable across the state. Groundwater supply in the southwest area of Phoenix has already reached salt levels of 2,500 mg/L total dissolved solids (TDS) and is considered saline while Tucson water supply generally does not exceed salinity of 650 mg/L and is considered good quality. With water quality likely to deteriorate, landscape managers and growers in the Southwest should be knowledgeable about their water quality and the salinity tolerance of the plants they are managing.

Table 1. Irrigation water quality

EC dS/m	TDS mg/L	Salinity level	Irrigation value *
<0.25	<163	Low	Excellent
0.25-0.75	163-487	Moderate	Satisfactory
0.75-2.25	487-1,462	High	Avoid on soil with poor drainage, leaching necessary
>2.25	>1,462	Very high	Not recommended, only for salt tolerant crops

* These recommendations were developed for agricultural crops.

We have finished two years of testing salt tolerance of common Southwest landscape species at the University of Arizona in Tucson. Plants were grown in containers in sand culture outdoors. For the control treatment, plants were irrigated with solutions containing only fertilizer. This solution had an electrical conductivity (EC) of 0.6 dS/m which equals 390 ppm TDS. For the other treatments, the fertilizer solution was supplemented with sodium chloride and calcium chloride up to 2.5, 5, or 10 dS/m (1625, 3250, or 6500 ppm TDS). Transplanted liners were established with the fertilizer solution for approximately 4 weeks and were then slowly acclimated to their respective treatments. Plants were irrigated with drip emitters for 12 or 14 weeks (June or July to October) with the different treatment solutions during the two years of study. Irrigation was supplied several times each day to ensure that the treatments were maintained at the assigned level of salinity without allowing drought conditions and the associated rise in salinity in the root zone. Plant growth and potential problems such as leaf burn or branch dieback were monitored during the study. At the conclusion of the experiments root and shoot dry weights were determined.

Salinity tolerance varied among the fourteen species tested based on canopy growth, biomass production and mortality. Based on growth measurements, final biomass and visual observations *Acacia stenophylla*, *Parkinsonia florida*, *Eremophila maculata* 'Valentine™', *Leucophyllum frutescens and Leucophyllum frutescens '*Heavenly Cloud' had a high tolerance to salinity as they were not affected by any of the salinity treatments. These species that are tolerant to high salinity cover the range of fast growing to slow growing plants based on relative canopy growth rate.

Calliandra californica, Tecoma stans, Muhlenbergia rigens, Lantana montevidensis, Verbena pulchella gracilior and *Verbena rigida* can be considered intermediate in salinity tolerance as canopy growth was reduced when plants were exposed to EC 5 dS/m or greater or survival of plants under the two higher salinity treatments was less than 100%.   *Tecoma stans*, *Salvia greggii* 'Sierra Linda™', *Lantana* 'New Gold™', and *Chilopsis linearis* 'Warren Jones™' and 'Rio Salado™' were most susceptible to salinity treatments based on mortality and reduction of canopy growth at higher salinity levels. None of the plants treated with 10.0 dS/m irrigation solution survived longer than five weeks. For some species even a few plants treated with EC 5.0 dS/m succumbed to salinity stress before the end of the experiment.

Symptoms of damage from high salinity varied between species. *Chilopsis* started to develop the classical signs of leaf margin burn, starting on the youngest leaves. In *Tecoma stans* leaf yellowing and drying was observed on oldest leaves first and then moved towards the younger leaves. In both species more leaves turned brown, abscised, and branch dieback followed. *Lantana* 'New Gold™' leaves remained green, but plants quickly defoliated in response to increasing salinity, with those under the highest treatment having less than 10% foliage compared to control plants. First symptoms on *Verbena* and *Lantana montevidensis* were yellow leaves. *Calliandra californica* never showed symptoms on leaves, but after stunted growth was noticed, plants perished quickly. *Muhlenbergia rigens* responded with drying of leaf tips in response to higher salinity. Although *M. rigens* produced less biomass under the higher salinity treatments, plants were still aesthetically acceptable.

Our studies show that *Acacia stenophylla, Parkinsonia florida*, *Leucophyllum frutescens*, and *Eremophyla maculata* ‘Valentine™’, can be produced without problems with irrigation water that has an EC of up to 5.0 dS/m as long as the irrigation is applied directly to the soil and not to the foliage. Previous research has shown that several species can tolerate higher salinity in the root zone, but will quickly display damage to the foliage and begin to decline when sprayed overhead with water of higher salinity. Results of our studies are based on the application of irrigation water through drip emitters to the growing media. The experiments show that there is an opportunity to use recycled or reclaimed water and conserve potable water in nursery production. However, care needs to be taken to assure that salinity in the root zone media will not accumulate beyond the tolerance level of plants which can occur when the root zone dries out and salts accumulate. Monitoring EC levels in the root zone is imperative to avoid salt accumulation and potential damage to plants. Leaching of the media with good quality water as necessary can prevent this problem.

Table 2. List of species and cultivars tested for salinity tolerance at the University of Arizona in Tucson. Irrigation water with EC of 0.6, 2.5, 5.0, or 10.0 dS/m was applied through drip emitters to the growing substrate.

Plants with high tolerance (to EC of 10 dS/m)
Acacia stenophylla, *Parkinsonia florida*, *Leucophyllum frutescens*, *Leucophyllum frutescens* ‘Heavenly Cloud’, *Eremophylla maculata* ‘Valentine™’

Plants with medium tolerance (to EC of 5.0 dS/m)
Calliandra californica, *Muhlenbergia rigens*, *Verbena rigida, Lantana montevidensis*

Plants with low tolerance (to EC of 2.5 dS/m)
Chilopsis linearis ‘Rio Salado™’ and ‘Warren Jones™’, *Salvia greggii* ‘Sierra Linda™’, *Tecoma stans, Lantana* ‘New Gold™’, *Verbena pulchella gracilior*,