Rootstock Selections for Improved Salinity Tolerance of Avocado

Project Leaders: David Crowley (909) 787-3785)
e-mail: crowley@mail.ucr.edu
Dept. of Environmental Sciences
University of California, Riverside, CA 92521

Mary Lu Arpaia (559- 646-6561)
mary.arpaia@.ucr.edu
Dept. of Botany and Plant Sciences UC Riverside
Kearney Agricultural Center, S. Riverbend Ave. 9240 Parlier, CA 93648

Cooperating Personnel: Woody Smith, Pete Clark, and Gary Bender

Benefit to the Industry

Avocado trees are highly susceptible to salt damage, but are frequently grown in areas where irrigation water contains high levels of sodium chloride. Resulting problems associated with high soil salinity and chloride toxicity include reductions in fruit yield and tree size, lowered leaf chlorophyll content, decreased photosynthesis, poor root growth, and leaf scorching. In California, this problem has becoming increasingly common as the cost for high quality irrigation water has increased and growers leach their soil less frequently, or are forced to rely on saline groundwater for their irrigation water supply. This research is being conducted to identify and rank salinity tolerant rootstocks that may be used to improve avocado production under saline soil conditions.

Objectives

1) To compare the salinity tolerance of currently used and newly developed *Phytophthora* root rot resistant rootstocks in field experiments which will allow us to ascertain the physiological basis of salinity tolerance, and make recommendations for specific rootstocks which can be used by avocado growers in California.

2) Identify new rootstocks which will be incorporated into the ongoing breeding program at UCR for selection of *Phytophthora* resistant, salinity tolerant plant material.

Summary

Experimental Design. In the spring of 2000, a large field trial was initiated to compare all available rootstocks under high salinity conditions at a site located on the Stehley ranch near Pauma Valley, CA. Using a complete block design, 20 replicate trees of 15 rootstocks with Hass scions were planted in a commercial orchard. Irrigation well water at this ranch is highly saline, with an EC of 2.5. A chemical analysis of the water is provided in Table 1. Additional samples have been analyzed at monthly intervals. We are also maintaining records of the soil salinity based on analyses of soil extraction tubes that are installed on each of the 5 replicate blocks in the field trial.

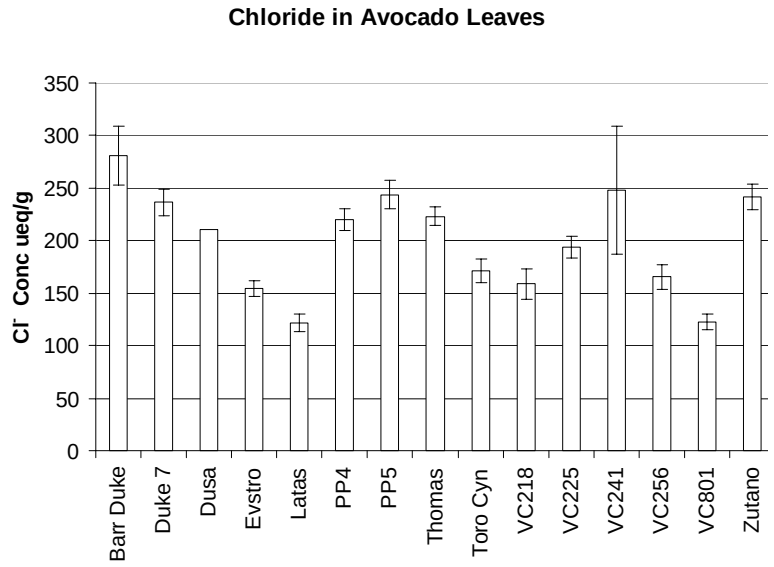
Table 1. Water analysis for Stehley ranch.

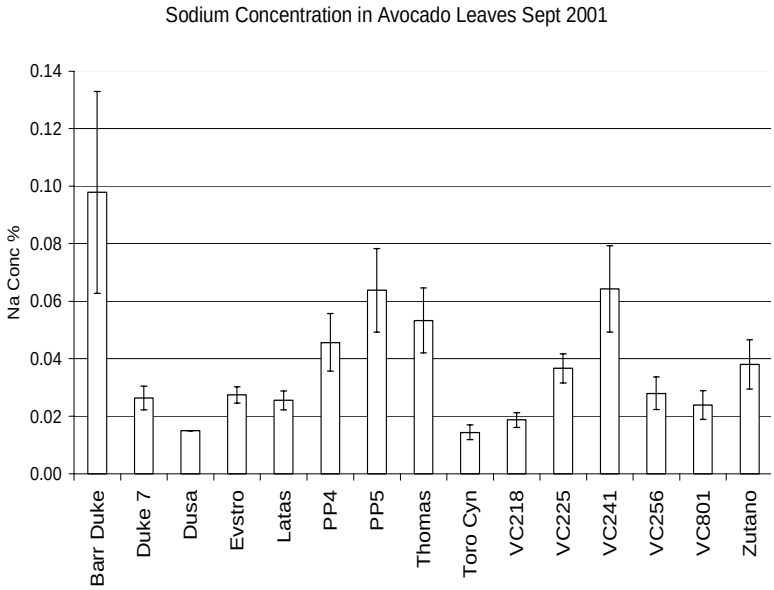
Source	EC	pH	Cl	Na	Ca	Mg	K
	dS/m		mg/L	mg/L	mg/L	mg/L	mg/L
Well	2.24	7.5	276	173	196	97	6.3
Pond	1.84	7.8	239	143	171	78	7.1

Evaluation of rootstocks for salinity tolerance based on leaf tissue analyses. Results of the leaf tissue analyses for chloride and sodium for trees sampled in September 2001 are provided in Figure 1. The two best rootstocks for preventing chloride accumulation in the scion are Latas and VC801. Low levels of chloride were also observed for scions grafted on to VC 218, VC 256, and Toro Canyon. The worst performing rootstocks with respect to chloride

accumulation were Barr Duke, Duke 7, Zutano, Thomas, PP4 and PP5, and VC 241. There were approximately 2 fold differences in chloride accumulation between the best and worst rootstocks. Nearly identical patterns were observed with respect to sodium accumulation, although the relative differences in sodium accumulation were much greater for sodium than for chloride. Toro Canyon and Dusa had the lowest sodium contents. The next group included Latas, VC 801, VC 218, VC 256, and Duke 7. In contrast, the highest sodium contents were measured in leaves of Hass scions on Barr Duke, PP4, PP5, and Thomas.

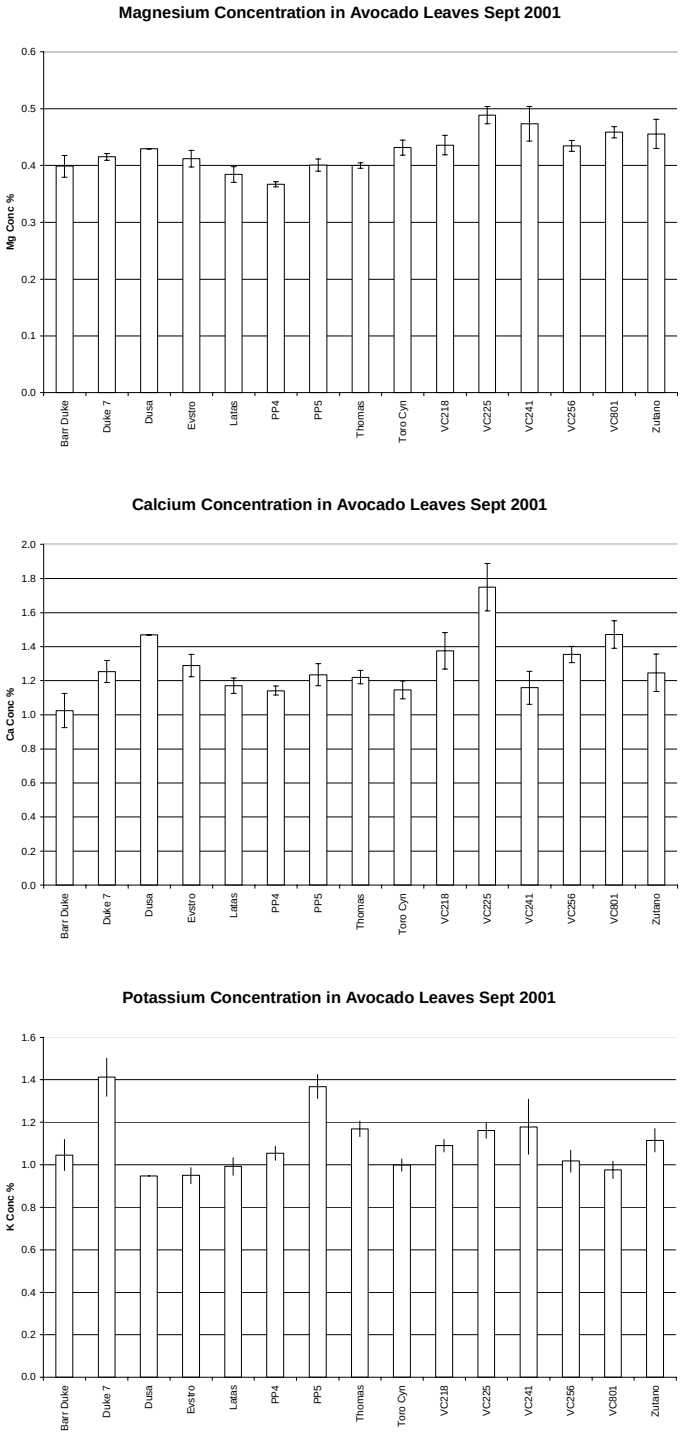
Figure 1. Leaf analysis of chloride and sodium concentrations in Stehley Ranch Salinity Trial for Hass avocado scions grafted on to rootstocks varying in salinity tolerance.





Leaf tissue analyses were also conducted for potassium, magnesium, and calcium (Figure 2). There were a number of significant differences in the leaf tissue concentrations of these nutrient elements, some of which may interact in helping to offset impaired plant water relations due to high sodium and chloride. For example, Duke 7 and PP5 had approximately 40% higher potassium levels than most of the other rootstocks. However, additional experiments would be required to determine whether and to what extent these nutrient interactions may influence plant performance under high salinity conditions.

Figure 2. Leaf tissue concentrations of magnesium, calcium, and potassium for Hass scions grafted on to rootstocks varying in salinity tolerance.



Current Status of the Field Experiment. During the winter of 2001-2002, the field site experienced a hard freeze which severely damaged or killed many of the trees. The trees were replicated in 5 blocks across the field site, and most of the damage that occurred was for the blocks of trees at the lower elevation on the bottom of the hill on which the trees were located. However, there were also considerable differences in the cold tolerance of the different rootstocks, some of which were damaged at all locations on the site, and others that experienced minimal loss or damage. The surviving trees have been sampled during September 2002, and the leaf tissue analyses are currently in progress. This winter, the dead trees will be replaced with Hass trees grafted on to several other rootstocks for preliminary evaluation. In the following year, the majority of the remaining salinity tolerant rootstocks imported from Israel will be out of quarantine and will be propagated for outplanting in a new field trial at this site, and at another site to be selected. Lastly, a large number of trees with different Phytophthora resistant rootstocks, along with approximately 120 seedlings from the salinity tolerance selections have been planted in different locations by Dr. John Menge. Several of these locations have highly saline irrigation water. We will follow these trees with analyses of the leaf tissue contents of chloride, sodium, and other nutrients, and will monitor the irrigation water quality on these experimental sites. This will provide field performance data on a number of rootstocks that may eventually be used or that are already being used for commercial production of avocado tree seedlings.