Sodium, Chloride and Boron Accumulation in Almonds – Westside Survey
Can Salt Levels in Woody Tissue Forecast Future Toxicity?

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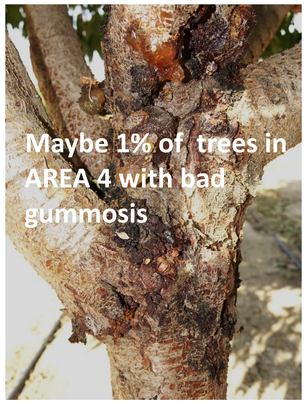
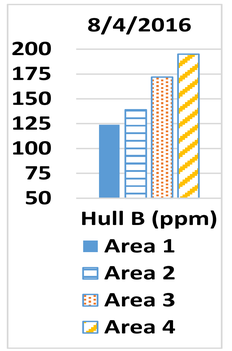
Problem and its Significance:

Almond growers have been pushing the limits on almond salt tolerance for the last 10 years as land price and availability have skyrocketed while available surface water supplies have decreased and groundwater salinity is increasing. Many of these plantings look good for several years and then hit the wall as one or more specific toxic ions (especially boron) finally reaches the critical level in the tree that can limit water/nutrient uptake, cause severe gumming, leaf burn, reduced growth and eventually death. There is no data documenting woody tissue deposition / concentration of these ions as a function of soil salinity to determine if a woody tissue analysis strategy would give a grower an early warning sign of significant pending toxicity problems not always evident in leaf tissues.

Objectives/procedures:

1. Starting 2015 using a 3rd leaf orchard (Hansen rootstock, Nonpareil and Monterey scions) select 4 areas that range from 0.5 to 5 dS/m EC and 0.6 to 2.5 ppm soluble boron. Collect soil, trunk and root tissue data.
2. Document differences in yield and tree stature corresponding to these areas.
3. Correlate soil salinity and specific ion concentration with rootstock, scion and traditional leaf tissue samples to see if wood sampling provides an early indication of pending toxicity problems.





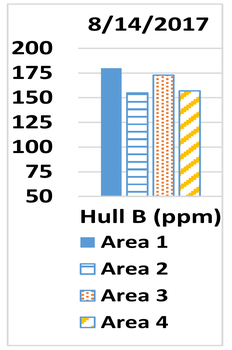


Fig. 10. Hull boron concentration @ harvest.

Results and Discussion:

A quarter section almond block in NW Kern Count, 50/50 Nonpareil and Monterey, was planted on Hansen rootstock in 2013 with double-line drip on Twisselman sandy clay loam. A significant gradient in increasing native salt load in this soil is obvious as you move from East to West despite having leached this ground with two foot of water using sprinklers prior to planting. The total soil salt load (EC), sodium (Na), chloride (Cl) and boron (B) increases 2 to 3-fold from Area 1 to 4. But after three years of sampling there is no real difference in Na and B in woody trunk (xylem) corings or leaf tissues in July or end of season sampling. However, the scion xylem tissue Cl in the elevated saline west side of the field was two times higher than the eastside of the field.

The trunk circumference of Area 4 was 19% less than Area 1 the end of 2015, but was only 15% less the end of 2017. The 3rd leaf yield was very low even for the low salinity Area 1 @ 312 lb/ac and 137 lb/ac for Area 4, a 56% decrease. The 4th leaf yield was 2350 lb/ac for Area 1 and 514 lb/ac for Area 4, a 78% decrease. Area 1, 5th leaf yield was 3528 lb/ac while Area 4 was 1616, a 54% decrease. At this time there is no consistent increase in rootstock or scion wood or leaf tissue Na, Cl or B correlated with higher soil concentrations from Areas 1 to 4. The hull B concentration at the 2016 harvest was 124 ppm for Area 1 and significantly higher for Area 4 @ 195 ppm, but there was no real difference in hull B for the 2017 harvest, which was slightly higher for Area 1 at 180 ppm compared to Area 4 at 155 ppm (Fig. 10). There does appear to be a higher amount of gummosis on the occasional tree in Areas 3 and 4 compared to Area1. The elevated salt load and associated osmotic resistance to water uptake has definitely decreased tree size in Area 4, but the usual marginal salt burn associated with this is basically absent. Surfactant amendments made no difference in tree water stress (CONDUCTANCE) or growth/vigor (NDVI) in the small plot companion test in the elevated salinity zone of Area 4.

OVERALL CONCLUSION

Higher total root zone salinity will reduce tree growth as it limits water uptake. But extra leaching in this area as a result of this stress can help the tree "catch up". Aerial imagery can identify these areas. The Hanson rootstock was able to exclude excessive Na, Cl and B concentrations measured in the wood and leaf tissues (so these are no help in predicting future problems), but still allowed excess B accumulation in the hull and random gummosis. Additional surfactant, polymer and nutrient amendments did not reduce soil salinity or improve tree growth or yield.

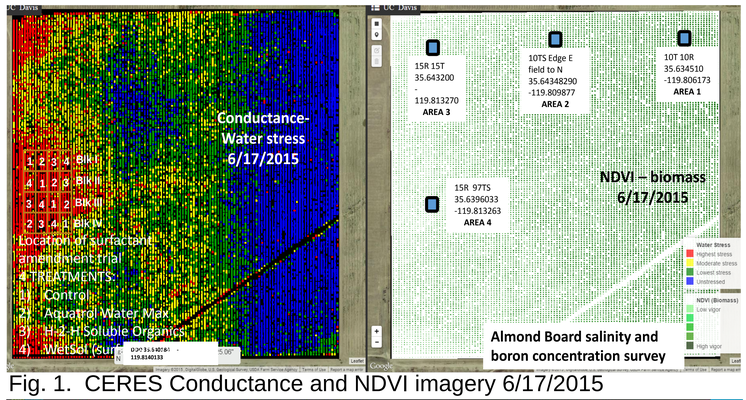


Fig. 1. CERES Conductance and NDVI imagery 6/17/2015

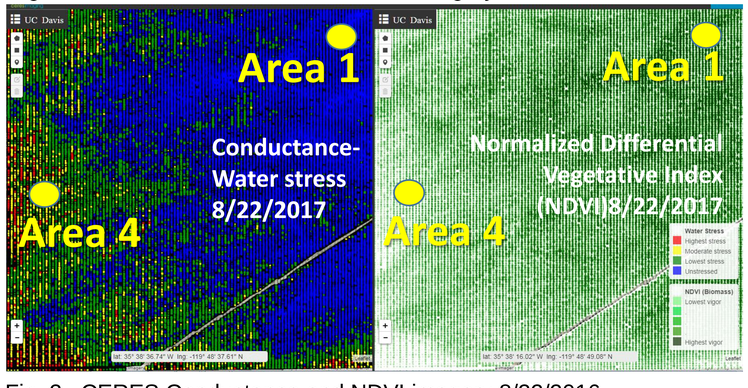
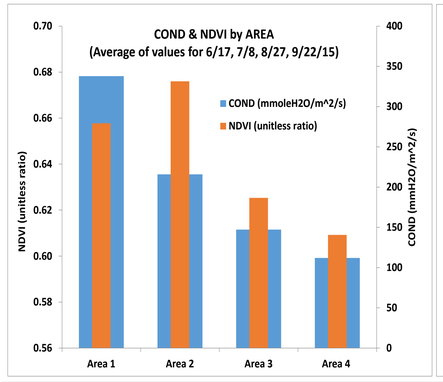
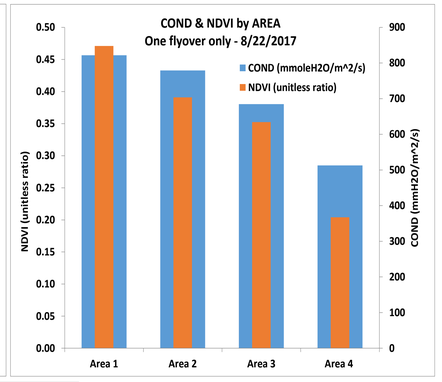
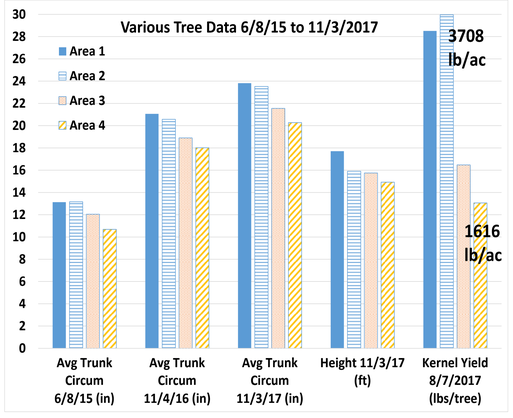
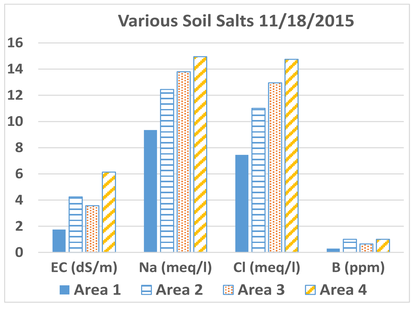


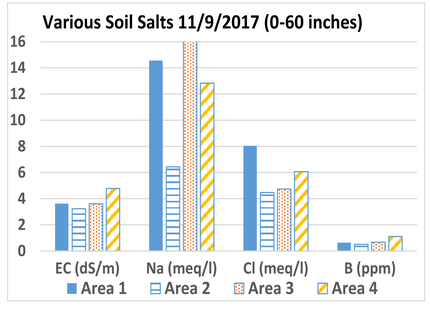
Fig. 2. CERES Conductance and NDVI imagery 8/22/2016

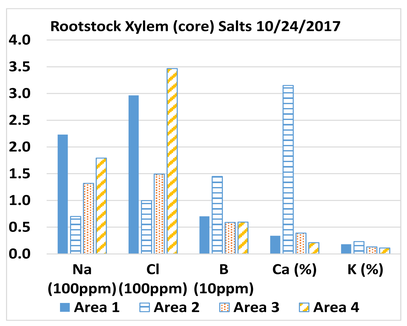


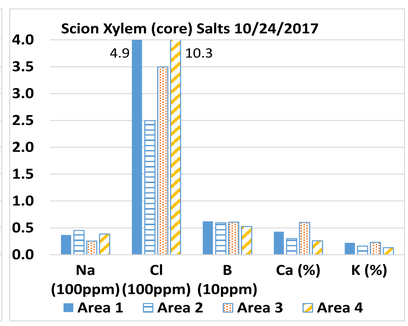


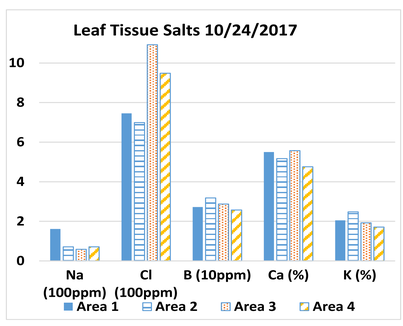












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