# Continued Investigation Into The Interactions of Saline Drainage Water on Crop Tolerance to Boron

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## EXECUTIVE SUMMARY:

Reuse of saline drainage water is a management option on the west side of the San Joaquin Valley (SJV) that is necessary for reducing the volume of drainage water (San Joaquin Valley Drainage Implementation Program, 2000). A potential limitation is determining the extent by which boron, a naturally occurring element in the drainage water, affects the selection, growth and yield of crops in the reuse system.

Boron is a concern for several reasons. First, boron is a microelement that is essential for crops but has a small concentration window between deficiency and toxicity. Second, it has a higher affinity to the soil than most common salts requiring much more water to reduce soil B than it does to reduce the salinity. Furthermore, the B concentration in San Joaquin Valley drainage water varies widely but in nearly all cases, far exceeds levels that would result in toxic conditions based on B-tolerance guidelines.

Unlike guidelines for salt tolerance, the guidelines for boron tolerance are limited. With the exception of a few sand tank studies that actually provide B coefficients (i.e. threshold and slope) for a few crops (see Maas and Grattan, 1999), most of the B classification has come from work conducted over a half a century ago by Eaton et al.(1944). More importantly, these older studies defined the B-tolerance limit based on the development of incipient injury on the crop (i.e. foliar burn), not yield response under a range of B concentrations.

The question is often raised, are the effects of salinity and boron on crops additive, synergistic or antagonistic? Despite the common occurrence of high boron and high salinity in many parts of the world, very little research has been done to study the interaction of the two. For those that have been done, contradictory results have been obtained. A series of controlled greenhouse studies are underway to evaluate B tolerance particularly in relation to salinity. Our goal is answer this question. Should the answer be that the effects of the two are antagonistic, B may not be as much a limiting factor in reuse systems as previously thought.

To date, one greenhouse experiment at the US Salinity Laboratory in Riverside and one field experiment at Red Rock Ranch near Five Points have been conducted to evaluate the interactions between B and saline drainage water and to determine how limiting B really is to plants grown in drainage reuse systems. Broccoli was the crop selected in the greenhouse and processing tomato was selected for the field.

In the greenhouse study particular interest was directed towards the composition of the salinizing solution to determine what role various salts have on the salinity-boron interaction. Results from this first study indicate that both Cl based salts and those characteristic of shallow saline drainage water (i.e. a mixture of salts dominated by sodium sulfate) showed a significant salinity-boron interaction. That is at high salinity, increased B concentration was less detrimental, both visually and quantitatively (i.e. biomass), than it was at low salinity. However there was no significant difference between salt types. Spectral analyses showed striking differences among treatments in NDVI with a strong decline in non-saline-treated plants at high B. Over 450 plant samples were generated from this experiment although not all have been completed as of this date.

In the field, there were obvious trends that both salinity and B reduced tomato yields yet there was no significant interaction between salinity and B. This lack of significance is related to field variability and insufficient treatment responses.

We propose to continue this line of research by conducting a series of controlled experiments on other crops, particularly those where it has been reported that salinity increased B toxicity, to determine if the composition of SJV drainage water is unique in that it reduces B detrimental effect. This is a critical issue facing the feasibility of drainage water reuse in the SJV.