PRELIMINARY STUDIES ON THE USE OF RUBIDIUM AS A POTASSIUM TRACER IN PRUNES.

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PROBLEM AND ITS SIGNIFICANCE

Potassium (K) is an essential nutrient, vital to the health of a mature, cropping prune orchard. Potassium fertilizer is significant annual expense for prune growers, and research to improve K fertilizer use efficiency should benefit prune growers. Unfortunately, a non-radioactive tracer for K research (such as ^{15}N used in nitrogen studies) does not exist. Changes in leaf nutrient concentrations don't always match changes in plant nutrient content, because fruit and woody tissue also contain significant amounts of essential nutrients. So, using leaf analysis for a particular nutrient doesn't always reflect the activity of that nutrient in the entire plant. Without a tracer to follow current fertilizer uptake, researchers must rely on destructive, whole tree sampling to measure differences in tree K absorption. This approach is expensive and time consuming. Tree crop K research would benefit from the development of new approaches to studying K uptake and movement in the tree and/or orchard.

Rubidium (Rb) is an element in the same chemical family as K, and has similar chemical properties. Rubidium has been used as a K analog in agricultural and natural ecosystems research for many years. It does not function exactly like K in plants and animals, but is non-toxic, relatively inexpensive and behaves similarly.

Rubidium occurs naturally in soils in amounts that are just a fraction of K content. In contrast, fertilizer K contains very little Rb, so changes in plant K to Rb ratios have been used as a means of measuring changes in fertilizer K content of plants – both trees and annuals.

We propose research to test the feasibility of using Rb in prune orchards as a tool to assess root system activity at different times of the year and in different locations in the soil. In addition, we will evaluate the potential for use of K/Rb ratios in future K research.

Objectives:

1) Test Rb as a tracer of prune root activity by using it to evaluate the activity of adjacent tree roots under individual trees treated with Rb.

PROCEDURES

Study trees in this experiment were part of larger experiment set up in a commercial prune orchard in Sutter County in December, 2009 to test Rb as a K tracer. This experiment has been reported previously. In that experiment, one of the treatments was to treat five trees with K + Rb at a rate equivalent to 400 pounds of K sulfate per acre. Seven percent of the fertilizer was applied as Rb sulfate (100 grams/tree). Four of those five trees were used in this experiment. Trees in the study orchard were planted 20' across the rows and 18' down the rows.

On August 18, 2012, non-bearing spur leaves, 30 per sample, were taken from the treated trees and adjacent trees both down the tree row and across the row. Leaves were kept on ice, transported to the lab and then oven dried at 55^oC. Leaf K and Rb concentrations were determined via lab analysis (UC Davis Analytical Lab).

Statistical analysis was conducted to determine if the leaf Rb concentrations differed significantly between the treated trees and those adjacent.

RESULTS AND DISCUSSION

Rubidium applied under treatment trees in December, 2009 was not measured in leaves of adjacent trees in either direction -- down the tree row ($p=0.005$) or across the tree rows ($p=0.006$) -- in significant amounts in August, 2012. (See Figures 1 and 2).

For this orchard, these results suggest that relatively immobile fertilizer such as potassium, applied under a single tree, will not be absorbed in measureable amounts by adjacent trees, either along the tree row or across them. A roughly 3-4 foot gap between canopies exists in this orchard. Further research on this topic might examine tracer presence in trees adjacent to fertilized trees where canopies touch (hedgerow plantings).

There was no correlation between K and Rb in the leaves from the same trees ($r^2 = 0.0136$). However, because leaf nutrient concentrations are net measurements of leaf nutrient pools influenced by nutrient fluxes from soil into leaves and from leaves to fruit, we can draw no conclusions from these data regarding the use of rubidium as an analog of potassium.

Figure 1. Mean leaf Rb concentration (ppm Rb) with 95% confidence intervals (Tukey HSD) for trees (n=4) treated with 100 gm/tree rubidium sulfate and trees in a transect across tree rows running perpendicular from the treatment tree row. Tree rows are 20' apart.

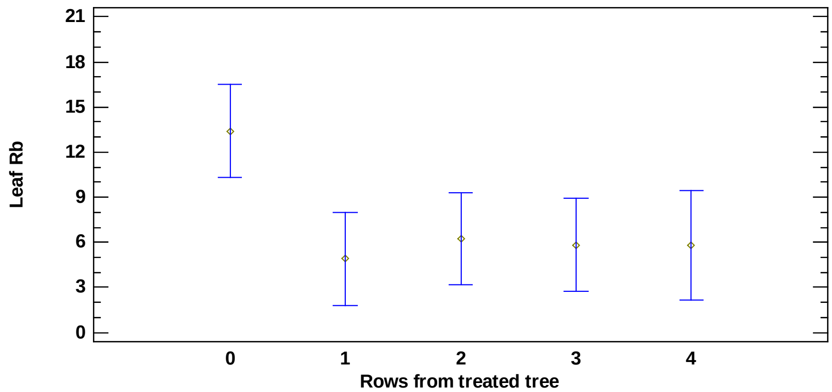

Figure 2. Mean leaf Rb concentration (ppm Rb) with 95% confidence intervals (Tukey HSD) for trees (n=4) treated with 100 gm/tree rubidium sulfate and trees at set distances down the tree row in the same direction. Trees are planted 18' apart down the row.