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

F. Niederholzer
R. Rosecrance

PROBLEM AND ITS SIGNIFICANCE

Potassium 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 potassium fertilizer use efficiency should benefit prune growers. Unfortunately, a non-radioactive tracer for potassium research (such as ^{15}N used in nitrogen studies) does not exist, and changes in leaf nutrient concentrations don't always match changes in plant nutrient content. Without a tracer to follow current fertilizer uptake, researchers must rely on destructive, whole tree sampling to measure differences in tree nutrient absorption. This approach is expensive and time consuming. Tree crop potassium research would benefit from the development of practices to study potassium uptake and movement in the tree/orchard.

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

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

We propose research to test the feasibility of using rubidium 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 potassium/rubidium ratios in future potassium research.

Objectives:

1) Learn how to use rubidium in experiments in prune orchards.

2) Evaluate the possibility of using a ratio of potassium to rubidium as a way of labeling tree potassium content and thus tracking apparent uptake of potassium fertilizer.

PROCEDURES

An experiment was set up in a commercial prune orchard in Sutter County to test rubidium as a potassium tracer. The experiment will test the hypothesis that adding gypsum to a band of potassium sulfate fertilizer applied to the soil under prune trees in the late fall or winter can increase potassium availability early in the spring following application. Five trees were treated with potassium + rubidium at a rate equivalent to 400 pounds of potassium sulfate per acre. Seven percent of the fertilizer was applied as rubidium sulfate (100 grams/tree). Five other trees were treated with the same amount of potassium/rubidium, and granular gypsum equivalent to 1000 pounds per acre was applied over the top of the potassium. Five other trees received just gypsum and no potassium. Five additional trees were identified as untreated control trees. They received no fertilizer.

Leaves, 30 per sample, were taken from bearing spurs, non-bearing spurs, and shoots were of all 20 trees on September 1, 2010 – the day before harvest. Leaves were kept on ice, transported to the lab, rinsed in tap water, and then oven dried at 55^{o}C. Dried samples were analyzed for K, and Rb.

Total crop fresh weight from each tree, including field screened fruit, was measured at harvest. Three to four pound fresh weight subsamples were dried at the Sunsweet dryer in Gridley. Total crop dry weight was then determined from dry away ratio and total fresh weight. Fruit size distribution was determined from each dried subsample by 1) screening and 2) direct weight of individual fruit.

RESULTS AND DISCUSSION

Potassium treatments did not significantly change total crop/tree dry weight or the percent A+B screen fruit (Table 1). In addition, potassium treatments did not alter leaf K levels (Table 1).

Application of 100 grams of rubidium in December, 2009 doubled leaf rubidium levels compared with treatments not receiving rubidium (Table 1). Addition of gypsum did not affect leaf rubidium levels.

Rubidium levels in different leaf samples followed a similar pattern as potassium levels (Table 1). Spur leaf samples showed potassium and rubidium levels roughly double those of upright, vertical shoots.

Table 1. Affect of potassium alone, potassium + gypsum or gypsum alone applications in December, 2009 on crop yield per try (pounds dry weight), % A+B screen fruit, leaf K, and leaf Rb in 2010. Treatment details appear in the text. Data followed by the same letter are not significantly different (95% certainty) than other values in that same column.

Treatments	Total crop dry wt/tree (lbs)	% A+B screen per tree	% Leaf K*	ppm Leaf Rb*
Control	**68 a**	**81 a**	**1.5 a**	**4 a**
Gypsum only	**49 a**	**84 a**	**1.4 a**	**5 a**
Potassium only*	**57 a**	**91 a**	**1.7 a**	**11 b**
Gpysum + potassium*	**58 a**	**91 a**	**1.5 a**	**12 b**

*Non-bearing spur leaves, sampled September 1, 2010

Table 2. Comparison of the affect of leaf sampling location on potassium and rubidium leaf concentrations – based on dry weight basis in 'French' prune. Samples taken on September 1, 2010.

Treatments	% Leaf K	ppm Leaf Rb
Bearing spur leaves	**1.66 a**	**12 a**
Non-bearing spur leaves	**1.61 a**	**11 a**
Vertical shoot leaves	**0.75 b**	**7 b**