POTASSIUM NUTRITION OF DECIDUOUS FRUIT CROPS AS DETERMINED BY PROPERTIES OF SOIL AND ROOT SYSTEMS

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Field Studies - Survey Sampling

Leaf and soil samples were again collected from prune orchards throughout the Sacramento Valley during the 1980 season. Chemical analysis of these samples were combined with those of previous years samples to examine overall relationships. We can draw some useful conclusion from the accumulated data. First, the easily exchangeable (readily available) soil K gives no indication of a soil ability to supply prunes with K. Figure 1 shows prune leaf K in mid-season samples plotted against easily exchangeable K. The critical level of this soil test is about 100 ppm for most annual crops. Examination of Figure 1 shows that for soils below 100 ppm by this test, we find prune trees that range from very low to rather high leaf K levels. Even when the soil test is 150 - ppm K, several sampled orchards are deficient in K.

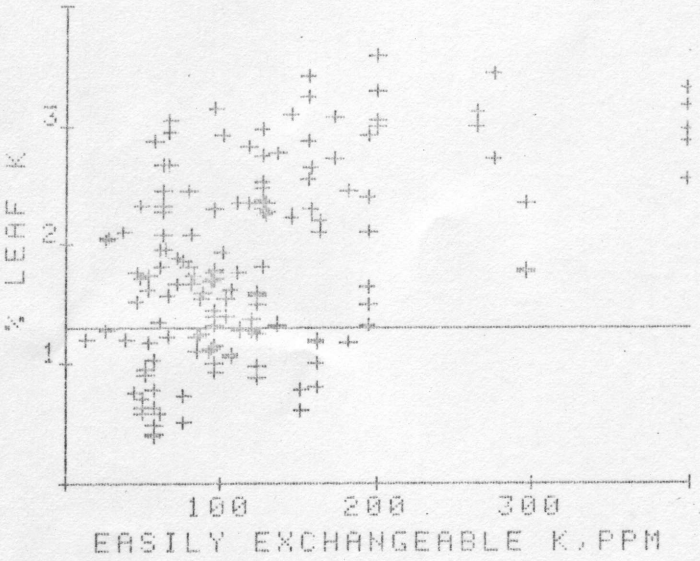

Figure 1. Mid-season prune leaf K concentrations vs. easily exchangeable (readily available) soil K test values. Line drawn across figure at 1.3% leaf K divides deficient and adequate leaf K values.

The second conclusion is that the acid extractable soil K test can be used to identify those orchards where the tree K deficiency is most likely due to a deficiency of K in the soil. Figure 2 shows a cluster of leaf K values below the critical level when the soil test value is 200 to 300 ppm (points enclosed in circle). There are only a couple of leaf K values above the critical level for this range of soil K test values. Thus, when this soil test value is less than ∽ 300 ppm, the soil is very likely deficient in K and application of K fertilizer is indicated. The critical value of this soil test for annual crops is about 250 ppm. It is also clear from this figure that we encountered many orchards with K deficient trees (points below the 1.3% leaf K line) growing in soil that has an ample supply of K.

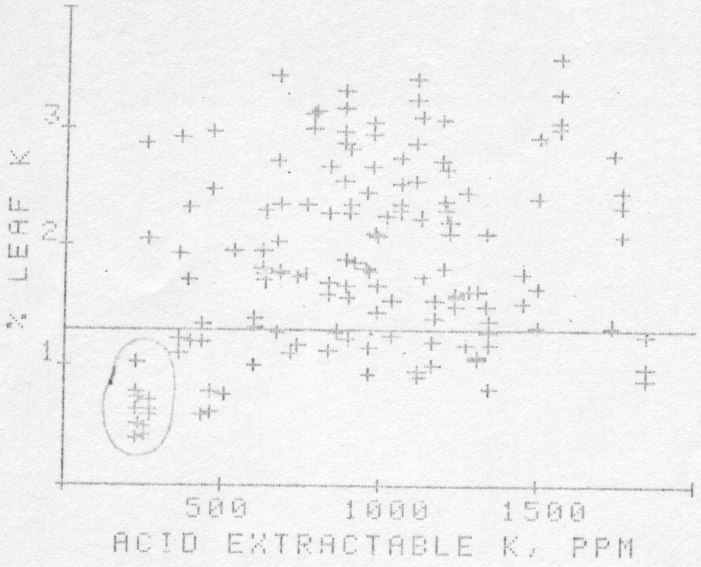

Figure 2. Mid-season prune leaf K concentrations vs. nitric acid extractable soil K. Line drawn across figure at 1.3% leaf K divides deficient and adequate leaf K values.

The third conclusion is that there is a better overall correlation between leaf K and water soluble calcium-magnesium ratio in the subsoil than between leaf K and soil test K values (Figure 3). The relationship clearly indicates that the abundance of magnesium in many Northern California Valley soils is a main factor in the potassium deficiency problem. The data in Figure 3 is from orchards in the Sacramento Valley. Soil samples taken from the Santa Clara Valley are also generally high in magnesium ($Ca/Mg \leq 1$). The amounts of magnesium in these high magnesium soils is so large that it appears to be impractical to replace it with calcium by application of gypsum or similar treatments.

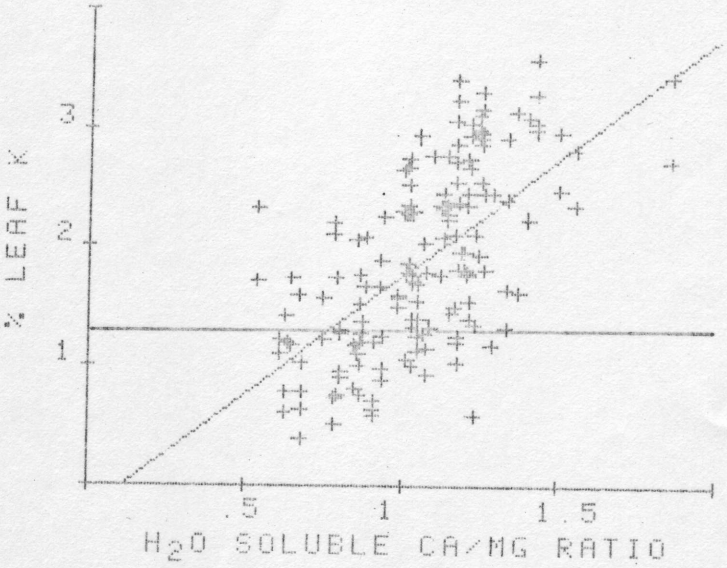

Figure 3. Mid-season prune leaf K vs. water soluble calcium-magnesium ratio in subsoil. Line draw across figure at 1.3% leaf K divides deficient and adequate leaf K values.

Field Studies - Rootstocks

Nine of the Marianna plum seedlings that Dr. Claron Hesse evaluated at the Kearney Field Station have been selected for further evaluation in the Sacramento Valley. The selection criteria were yield of French prunes on these rootstocks, tree vigor and structure and strength of the root system. The rootstock material is being transferred to Davis to provide a permanent source of propagation wood. These rootstocks will be tested in the high magnesium soils typical of the Sacramento Valley.

Six of the new rootstocks propagated to French prune along with French on Marianna 2624, Myrobalan 29C and Nemaguard were planted in the U.C. farm last winter. Leaf samples taken last summer showed that none of the leaf K levels surpassed that of French on Marianna 2624. However, even these are worth further study because of outstanding yields in the Kearney trials and the very adequate levels of K in all of the leaf samples taken from these first season trees. The leaf K in the French on peach (Nemaguard) was the lowest of all samples in this block. This is consistent with earlier sampling in rootstock trials in the Sacramento Valley.

During the coming season, evaluation of these potential rootstocks will continue. Leaf sampling will also begin on the block of French prunes on Peach-Almond hybrid rootstocks that Dr. Dale Kester established in the Johnson Orchard in Butte County.

Plant Studies

Nutrient solution experiments to characterize K uptake abilities and study the ways in which magnesium effects plant K status were carried out. The results indicate that the effect of magnesium on K uptake is not a simple competition. The effect is a long range one (continuous culture in high magnesium media rather than short term exposure) and may be related to the roots ability to withstand and recover from stress (i.e. moisture stress, etc.). Other experiments show that ammonium uptake by roots is very similar to K uptake and that ammonium will compete with K uptake.

French prune on Nemaguard, Marianna 2624 and Myrobalan 29C rootstock were grown on nutrient solution with controlled K levels. Leaf analysis of these trees show the peach to be the least able to supply K to the prune ions. This is in agreement with the field observations and shows that this technique can be used as a rapid screening test for new rootstocks. This experiment also showed a declining leaf K with increasing nutrient solution magnesium, although the conclusions are not unequivocal and adjustment to the system will be made to confirm these results.

These root physiology studies will continue with aim of understanding the mechanism by which magnesium hinders K uptake and screening new rootstocks for their abilities to tolerate high magnesium soils.