Maintaining adequate almond potassium nutrition

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We know that Fall is an excellent time to address potassium (K^+) deficiency through soil applications of potassium sulfate. Maintaining adequate K^+ nutrition is especially critical for almond trees since deficient levels result in dieback of fruiting spurs.

Symptoms. Potassium deficiency in almonds is a problem in some areas of the Sacramento and San Joaquin Valleys more than others. K^+ deficient almond trees show leaf symptoms in spring if the deficiency is severe but by early summer even milder deficiencies can produce symptoms on heavily cropped trees. If soils are very wet and cold, when first leafing out, potassium deficient trees appear pale in color and have small leaves with little new growth. Once new shoots are growing in April and May, pale, potassium deficient leaves roll into a boat shape and develop tip and marginal scorching. This symptom is classic when it occurs in the tree tops on leaves in the middle of new shoot growth. The Butte variety is a good indicator of K^+ deficiency because it is often the first to exhibit leaf scorching. As potassium deficiency progresses, spurs that bear nuts often die by the end of the season. This spur death is what reduces the future cropping potential in potassium deficient trees.

Leaf analysis. Potassium leaf tissue levels start the season high, decrease to a plateau in mid-summer, and then fall off at the end of the season. Leaf samples collected in July are useful for evaluating K^+ levels since leaf tissue levels are relatively stable at that time of year. K^+ is deficient in almond if leaf levels fall below 1% while levels above 1.4% are considered adequate. The latest potassium research supported by the Almond Board was unable to show any benefit of pushing leaf potassium much above this adequate level.

Soil applications. As you know, fertilizer prices went through the roof in 2008 and any form of potassium was expensive. Potassium ions (K^+) have a one plus charge and are readily adsorbed to the negatively charged clay particles in the soil thus becoming unavailable to the tree. Massive doses of 2000 lbs potassium sulfate per acre applied in bands overcome the soils ability to fix all of the K^+ in the enriched zone and can correct a deficiency for about 4 years. Rather than waiting to apply an expensive mass dose, UC research later demonstrated that annual Fall "maintenance" applications of potassium sulfate at 500 lbs/acre banded annually in the same location 4-5 feet out from the tree trunk on both sides of the tree row would maintain K^+ levels before a deficiency became apparent. Potassium chloride has also been used for soil applications but the chloride ion is an undesirable salt that must be leached out of the soil profile before uptake can occur (at least 6 inches of water on top of it during dormancy) if this material is to be used.

Injecting K^+ through in-season drip irrigation is also very effective because the amount of K^+ per wetted area is very high and potassium penetrates well enough to be picked up by the tree. Drip irrigation is a very efficient potassium delivery system. Injecting through micro-irrigation can also be effective as long as the wetted area is focused and tightly confined.

Avoid any type of application that spreads potassium out over a large soil area. UC research showed that four years of broadcast applications only moved K^+ six inches down into the soil while banded treatments penetrated two feet. Banded treatments have worked well under non-tillage but if you cultivate, the band

should be shanked in to get the material closer to the root zone. Soil applications of potassium sulfate can be safely applied in November once leaf drop begins.

If you have been diligent about maintaining your K^+ levels with banded applications, and since K^+ fertilizers are currently so expensive, this might be a year to free up more of the potassium that's already in the enriched banded zone by applying a gypsum (Calcium sulfate) band overtop of the previous potassium bands. The calcium ions (Ca^{++}) in the gypsum have a plus two charge and will displace the potassium ions on the clay particles freeing up more potassium to remain in the soil solution while moving it deeper into the root zone. Gypsum banded at a rate of 1000 to 4000 pounds per acre in the same location as previous potassium bands will improve K^+ availability.

Spring foliar applications. Potassium deficiency can also be corrected by foliar sprays of potassium nitrate in April and May when sufficient material is applied. When the research that developed the recommendation for almond was done, dilute sprays were common. The recommended approach was to apply 10 pounds of potassium nitrate per 100 gallons in 400 gallons of water per acre. This dilute spray was applied at least three times with an interval of a week to 10 days between each application to achieve deficiency correction for the season. This meant that about 40 pounds of potassium nitrate was applied per acre with each of the three 400 gallon dilute applications. These dilute sprays would have applied a total of about 120 pounds of potassium nitrate per acre. This approach effectively corrected potassium deficiency.

If you apply 10 pounds per 100 gallons in three 100 gallon concentrate sprays, you apply only a total of 30 pounds of potassium nitrate per acre. Don't expect to see fantastic results. If you're spraying every other row to cover the orchard more quickly, the job you're doing is even less effective. Three half sprays (every other row) at this rate would only apply a total of 15 pounds of potassium nitrate per acre! A 15 pound total application is a long way from the 120 pound total that U.C. researchers found to effectively correct a deficiency back in the 1960's. Today, potassium nitrate can be safely applied in a 100 gallon per acre concentrate spray application at a rate of 20-30 pounds potassium nitrate per 100 gallons of water.

Figure 1. Dormant season band applications of potassium sulfate to every other middle in a non-tilled orchard.