

HOW COPPER DEFICIENCY IN NUT CROPS IS SHRINKING YIELDS ACROSS CALIFORNIA

Solumetrix Study - Ag Source Harris Labs

RESEARCH SUMMARY

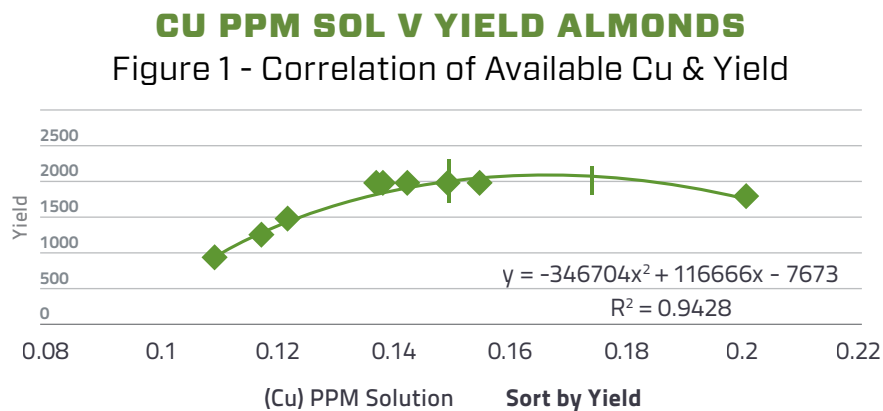
A study was conducted on 900 bearing orchards to determine the nutrient deficiencies that were directly correlated to yield. After the study was complete and the data was analyzed, it was determined that Copper, an often overlooked nutrient, was the most strongly correlated to yields. It was also discovered that 90% of the orchards studied were copper deficient!

Even with good growing conditions, excellent pollination success, and a high nut set percentage, Copper deficiencies can negatively affect nut development. The main reason is copper deficiency causes shriveled kernels which reduces yields.

AVAILABLE COPPER CORRELATES STRONGLY TO YIELDS



FBSciences recently analyzed more than 900 bearing almond fields in California that had been soil sampled. The raw data was compiled by Ag Source Harris Labs using the Solumetrix™ expert system. Copper can be analyzed using either a DTPA extract or by using the simple water extraction method. Both methods of extraction correlate strongly to almond yields. The DTPA extract pulls more Copper into solution, but it tends to over-predict how much Copper the almonds can take up from the soil. Still the DTPA Copper value was correlated to yields at the 85% level (R² value 0.85). The simple water extract method is a better predictor of how much Copper is available to the trees. It correlates with yield at an impressive 94% (R² value 0.94). See Figure 1. From this analysis it was determined that 0.15 ppm should be the target for bearing almonds. Unfortunately, the majority of fields in California fall short of this level.



WHY COPPER COUNTS



Figure 2 - Shriveled kernels could be a symptom of Copper deficiency.



Figure 3 - Copper deficiency symptoms on leaves.

Even though Copper is a micronutrient that is used by trees in small quantities, it is extremely important. Copper is especially important in the formation of lignins, which are the woody fibers that make up almond hulls and the bark of the trees. Symptoms of Copper deficiency include irregular, wavy leaf margins, shriveled kernels and splitting and gumming of the bark. See Figures 2 and 3. These symptoms often go unnoticed. **Due to the use of higher pH irrigation water, the levels of available Copper have plummeted due to tie-ups.** Not one of the hundreds of samples run through Solumetrix™ from the San Joaquin Valley had adequate available Copper levels.

There are two peak periods for Copper use during the season on bearing trees. The first is during the shell enlargement and hardening period. Because this precedes nut fill, there may be little Copper left for the formation of the kernels themselves. A Copper deficiency at this stage has the greatest negative effect on yields and quality. Correction of Copper deficiency should involve an application of **Copron® Soil** through the irrigation system before nut enlargement begins (usually in late March or early April). This application helps meet the demands for Copper during the formation of the almond shells. A second application should follow about 4-6 weeks later when the nuts reach full size in order to replenish available Copper for nut fill.

The second period of high use is after harvest in the early fall. This period sees the greatest rate of trunk and root growth, which is a big sink for Copper use. If the trees are deficient in available Copper, the bark can split and the tree will tend to produce copious amounts of gum to heal the wounds. This can make the trees more vulnerable to diseases. An application of **Copron Soil** via the irrigation system on the first irrigation after harvest is important to address the deficiency. In addition, an application of **MicroBlend Foliar™ Zn-Mn-Cu** supports increased carbohydrate demand as the trees go into dormancy and loads the tissues and buds for successful pollination and nut set as the trees break dormancy in the spring

In addition to these two peak periods of copper demand, a foliar application of **MicroBlend Foliar Zn-Mn-Cu** at the petal fall/leaf-out stage is important to 'fill the bank' with copper instead of waiting until peak demand in April when the lignin production is high during shell formation and shriveled kernels might already be starting. This application timing is perfect for maximum leaf expansion with the Zn & Mn in the **MicroBlend Foliar Zn-Mn-Cu**, as well as front loading the copper before shell formation.

PROGRAM RECOMMENDATIONS

We recommend both **MicroBlend Foliar Zn-Mn-Cu** and **Copron Soil** for copper applications to support lignin synthesis for nut fill and bark health.

- **Petal fall, leaf out (Early to Mid-March) MicroBlend Foliar Zn-Mn-Cu** at 3-4 pints/acre supports maximum leaf expansion with the Zn & Mn, as well as front loading the copper before shell formation.
- **Early nut fill (Late March to Early April) Copron Soil** at 1 quart/acre with N or K fertilizer to support hull formation.
- **Late nut fill (Mid to Late May) Copron Soil** at 1 quart/acre with N or K fertilizer for the kernels.
- **Post-harvest MicroBlend Foliar Zn-Mn-Cu** at 4-6 pints/acre and **Copron Soil** at 1 quart/acre with irrigation to support the grand trunk and root growth period. The foliar spray supports the fall root flush and increases the storage of nutrients and energy for later use next season.

