

Nutrient Management Planning for Orchards

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Guest Speaker

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Good nutrient management is important for maintaining yields, quality, and environmental sustainability. In this week's session of the Lunchtime Seminar Series for Organic Growers, Dr. Kat Jarvis-Shean shared some fundamental principles for nutrient management in tree crops, with a focus on stone fruits. A good fertility program rest on four core principles:

- **Replace what the crop removes** The harvested fruits or nuts contain nutrients, and nutrients also go into building the tree's woody tissues. In general, fertilization rates can be based on replacing these nutrients so they do not become depleted.
- **Monitor with annual tissue samples** The most direct way to check if your trees are getting what they need is to ask them! Taking a leaf sample (or dormant shoot sample, for zinc) every year will show nutrient trends over time and help you correct problems before they become serious.
- **Check for changes in soil chemistry with an occasional soil sample** Amendments can change soil pH and salinity over time, as well as nutrients. Soil samples taken before an orchard is planted and occasionally afterwards will show potential soil chemistry issues.
- **Remember: by the time you see symptoms, yield is already affected** Stop nutrient problems before they start by careful management and monitoring—by the time symptoms show, yield is already affected.

"4 Rs" of nutrient management

Improve nutrient use efficiency by observing the "4 Rs"

- **Right rate** The application rate depends on how much of the nutrient the tree needs for yearly growth, the amount removed in harvest, how much of the amendment is expected to be available, and the efficiency with which the nutrient is taken up.
- **Right time** Nutrients applied at the wrong time can be lost or reduce quality. Getting the timing right depends on the stage of tree growth, how quickly the nutrient becomes available, and how easily it is lost from the soil.
- **Right placement** Nutrients should be kept where growing tree roots can reach them, usually in the top 1-2 ft of soil.
- **Right source** The type of amendment will interact with the rate, timing, and placement to determine nutrient uptake efficiency.

Four important nutrients to keep track of in Yolo, Solano, and Sacramento county orchard crops are nitrogen (N), potassium (K), zinc (Zn), and boron (B)

Nitrogen is an important component of chlorophyll, proteins, and DNA, and is especially high in seeds and pits. N deficient trees grow slowly and have yellowing leaves throughout the canopy, sometimes with a reddish tinge or spots under severe deficiency. Too much N can cause fruit quality issues. The N rate should be based on estimates of export in the harvested fruit, N stored in woody tissues, and N use efficiency (often about 70% of the N available in the soil is expected to be taken up). Not all N applied in organic amendments is available right away; here's [a guide for estimating how much you can expect, and when](#). N moves quickly in the soil and is easily lost, so N should be most available when and where the tree is most actively taking it up. This period starts about a month after dormancy and lasts through rapid fruit expansion. And remember, nitrogen can move with irrigation water! So when using rapidly available N sources, be careful irrigation doesn't leach it past the active rooting zone.

Potassium is important in water management and fruit growth, and deficiency symptoms are most common in early summer when fruit are expanding. An early symptom is leaves curling up and inward, which under severe deficiencies can turn to yellowing and burned edges. Deficiencies are especially severe in prunes, where whole limbs can dieback. Fruit set can be decreased and the size and color reduced. The K removed in the fruit should be replaced. Unlike N, K is not mobile in soil and will not be leached. However, it can be bound to clay particles and so when applying to correct a deficiency, it is a good idea to apply in concentrated bands within the wetting zone of the irrigation system, at rates about double the expected tree uptake. High concentrations of K will overwhelm the soil's ability to bind it and ensure that the plant roots can take it up. K can also be applied foliarly.

Zinc deficiency is common in fruit orchards grown on soils with pH above 7. Zn is important for hormone synthesis, chlorophyll, and membrane integrity. Mild Zn deficiency appears as yellowing between the veins. Severe Zn deficiency causes leaves to be small, pointy, pale and closely spaced. Deficient trees also have a wider bloom window. Tree Zn uptake depends heavily on how available the Zn in the soils is—deficiencies are most common when soil pH is high, under cold, wet conditions, and when soil organic matter is very high. Some rootstocks are better at taking up Zn than others—Nemagaurd tends to be poor.

Boron is an essential nutrient for plant growth, but too much can be toxic. Soils in the Cache Creek watershed are naturally very high in B, so B toxicity can be a problem. B moves in the tree along with sugars, so over time it can build up in the tree's sugar sinks, the growing tips and fruit. Fruit from affected trees may develop slowly or asynchronously, be small, bitter, or subject to rot that starts from the blossom end. Young shoots may also die back. Since it's the accumulation of B over the season that's toxic, symptoms are worse in fruit that are on the tree a long time than in fruit like apricots which ripen early. Like with Zn, rootstocks can play a role in B accumulation. For stone fruits, rootstocks with almond genetics (e.g. Peach-Almond hybrids, complex hybrids like Viking) are less susceptible to B toxicity.

Monitoring nutrients using tissue samples

Tissue samples are the most direct way to assess tree nutrient status. For the major nutrients in many tree crops, such as peaches, nectarines, plums, and olives, researchers have identified critical values for deficient, adequate, and excess nutrients.

- **When to sample** Since leaf nutrients change throughout the season, samples need to be taken at a standardized time in order to be interpreted. For stone fruits, this is usually June or July. Consult the test lab for their recommended times for your orchard. If you have done a foliar spray for N, wait at least a week to take leaf samples. If you have done a foliar spray for Zn, leaves cannot be sampled. In this case, dormant shoot samples can be taken during winter. Leaf samples should be taken every year. Monitoring trends over time can help you adjust your nutrient management program before deficiencies start.
- **How to sample** Sample 60-100 young, mature, healthy leaves from representative trees. Sample different blocks or areas that perform differently separately. Depending on the tree species, you may need to follow a specific protocol in order to compare your values with established thresholds. Check with your test lab before you sample.
- **What if I have many different types of trees in a mixed orchard?** If you grow a mix of many trees in a small area, it may be too expensive to test every type. Dr. Jarvis-Shean recommends choosing one species as the “canary in the coal mine”—if you see problems there, the other species may also be affected.
- **What if I grow a niche crop for which not much information is available?** Critical values may not be available for every species. However, tracking increases or decreases over time can still help you make sure you are adequately replenishing what the tree takes up in the long term.
- **Can I do a soil test instead?** Soil tests for nutrients in orchard crops are not as reliable as tissue tests.

Resources for nutrient management in orchard crops

- Extensive information on nutrient management for stone fruits can be found at the **UCANR Fruit Report** website
[https://ucanr.edu/sites/fruitreport/Nutrition - Fertilization/Individual Nutrients/](https://ucanr.edu/sites/fruitreport/Nutrition_-_Fertilization/Individual_Nutrients/)
- The **California Fertilization Guidelines** contains information for several orchard crops:
<http://geisseler.ucdavis.edu/Guidelines/Home.html>

Questions? Stories to share? Contact Dr. Margaret Lloyd at mglloyd@ucdavis.edu

A recording of this talk is available at:

[http://ccsmallfarms.ucanr.edu/Events and trainings/Organic Agriculture Seminar Series for Growers/](http://ccsmallfarms.ucanr.edu/Events_and_trainings/Organic_Agriculture_Seminar_Series_for_Growers/)