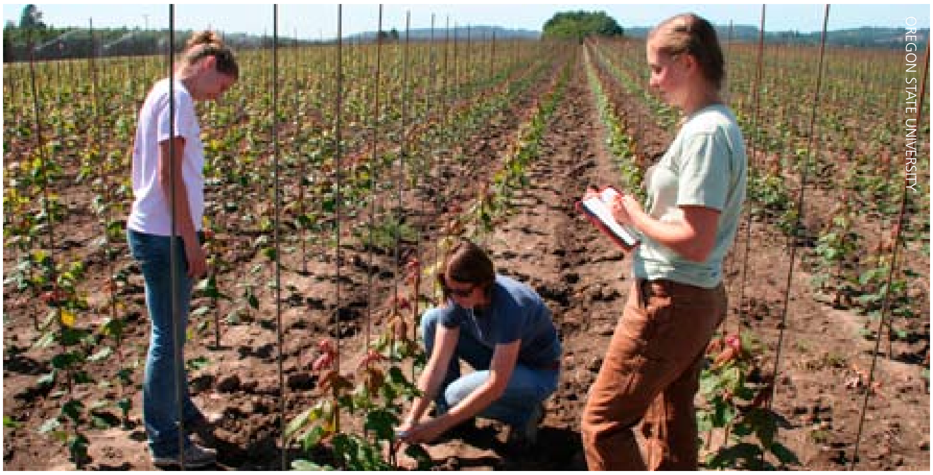
Feeding bare-root trees

Researchers, extension agents and growers provide fertilizer recommendations for growing bare-root shade, flowering and fruit trees in the northern Willamette Valley



Heather Stoven (center) measures the caliper on shade trees that have received no nitrogen, half the rate, or the full annual rate of nitrogen. Assisting her are interns with the North Willamette Research and Extension Center, and Bailey Nurseries (where this photograph was taken).

By Jim Owen and Heather Stoven

Oregon's Willamette Valley, with fertile loamy soils and mild Mediterranean climate, is ideal for growing bare-root shade, flowering and fruit trees.

Growers in the Willamette Valley currently produce more than 1,500 species and cultivars of ornamental and fruit trees. Trees are sold as 4 to 8 foot, 3/4 to 2 inch caliper, barefoot whips or branched trees that can be found in nurseries, landscapes and arboreta throughout the United States, Europe, and Asia.

Nursery producers face many biotic and abiotic challenges during the production of bare-root trees. One challenge is to ensure bare-root trees are adequately supplied the nutrients to reach desired grade and aesthetic quality within the 1–4 year production period, preferably without wasting fertilizer or money.

To accomplish this, growers must consider the soil's physical and chemical factors, such as texture, water-holding capacity, drainage, pH and the soil's ability to store and supply nutrients. These factors are the result of inherent soil characteristics and management practices such as equipment traffic, tillage, and crop rotation.

Soil maps, available from the Natural Resources Conservation Service

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or private consultants, provide information about the inherent soil characteristics, while current and historical soil records from your fields can provide this site-specific soil information.

It is best that soil information and records are obtained from a preplant soil test (0–12 inch depth) from a composite soil sample consisting of 20 or more cores for each management unit or field. It is also best to use the same lab and/or know the specific soil testing procedures used to ensure that you can accurately apply desired nutrient guidelines for making management decisions.

The goal of nutrient management is to match crop need or uptake with the supply of readily available nutrients without waste. Decisions about timing of nutrient applications are based on the mobility of plant-available nutrient forms in the soil, with mobility referring to the ability of a specific nutrient to move within the soil (for example, from soil surface to root zone). Therefore, the mobility of a nutrient dictates if it is applied before planting, once per production cycle, or applied annually.

Plant-available forms of nitrogen (N) and sulfur (S) are negatively charged anions, (nitrate-N (NO_3) and sulfate-S (SO_4), that move readily through the soil profile with water and are therefore mobile, needing to be applied each year to meet crop needs. Recommendations for N and S are based on annual plant uptake needs, not on soil test data.

Nitrogen (N) is supplied to trees from the soil, irrigation water, conventional fertilizers, manure, compost, and/or crop residues. Conventional fertilizers such as urea provide readily available forms of N.

Based on grower experience and ongoing research, an annual application of 120 pounds N/a is adequate to produce high-quality bare-root trees within the Willamette Valley.

Nitrogen is conventionally applied via broadcast application with 60 pounds N/a per application. These are commonly divided into split or multiple applications that occur late winter (February to April) and spring (May to June) to ensure adequate amount of available N throughout the growing season.

You can evaluate the effectiveness of your N fertilizer program and refine rates through targeted testing in your own fields. Nitrate-N samples taken within rows measure N currently available to tree roots.

From April–June, soil nitrate tests can be used to determine the need for an additional midseason N fertilizer application, while in August and September, testing is used to determine whether the total N supply (from irrigation water, soil, and fertilizer) was excessive. An estimate of N contributed from non-fertilizer N sources can be determined by taking soil nitrate-N samples from unfertilized and unplanted areas between rows.

Sulfur (S) is supplied by irrigation water, fertilizers, and decomposition of organic matter. Soil tests provide little information on soil S status or availability. To ensure adequate S, apply 20 or more pounds S/a annually as gypsum ($CaSO_4$) or as fertilizers containing sulfate (ammonium sulfate ($(NH_4)_2SO_4$), K-Mag). Sulfur can be supplied during the cropping cycle as part of a liquid fertilizer or top-dress application.

Elemental S is used specifically to lower soil pH or acidify the soil. The quantity of elemental S needed to reduce soil pH increases with soil buffering capacity (resistance to pH change). It will require one to two years for elemental S to fully react with soil, although most of the reaction takes place during the first year.

In-row fertilizer applications via banding, side-dressing, or fertigating of N and S can be used to produce high-quality trees with lower fertilizer application rates than broadcast methods. With these methods, the goal is to fertilize only the root zone of the trees, leaving the area between rows unfertilized.

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With in-row fertilization, the N fertilizer application rate is reduced proportionally based on the fraction of the field represented by the root zone.

For example, if you want to apply 100 pounds N/a, but the root area (as determined by root pruning, harvesting equipment, and inter-row cultivation) is equal to half of the total field acreage, you can reduce the application rate from 100 pounds/a to 50 pounds/a and still get the expected tree growth response.

Regardless of method, N and S fertilizer applied in a dry form should be accompanied with water to move the fertilizer into the root zone and prevent N loss to the atmosphere.

Most nutrients (phosphorus, potassium, calcium, magnesium, and most micronutrients) are immobile and do not move readily in the soil. Available supply of these nutrients is assessed by preplant soil testing. Fertilizers supplying these nutrients are most effective when applied and incorporated by tillage before planting.

Phosphorus (P) is immobile in the soil profile. Fertilizers such as superphosphates, ammonium phosphates, or other blended fertilizers are commonly top-dressed and incorporated between cropping cycles. Apply P if the Bray P1 soil test is less than 35 ppm.

Potassium (K) is usually top-dressed and incorporated between cropping cycles. Soil K is not used in great quantities by trees and does not decrease rapidly during a cropping cycle. Apply K if soil test K is less than 200 ppm.

If symptoms of P or K deficiency are noted, these nutrients can be applied during the cropping cycle with variable success depending on soil factors. Phosphorus can be applied as a liquid fertilizer such as 10-34-0 via subsurface fertigation. Potassium is equally effective when broadcast, top-dressed, or fertigated.

Calcium (Ca) and Magnesium (Mg) are typically sufficient to grow quality bare-root trees if pH is within desired range of 5.5 to 6.5. Apply Ca if pH is not within desired range, has not been supplied via calcitic lime or if soil test Ca is below 1,000 ppm (5 meq/100 g soil). Similarly, apply Mg if soil test Mg is below 100 ppm (0.8 meq/100 g soil). It should be noted that lime is slow-acting, so apply 6 to 12 months ahead of planting when feasible.

Shade trees require few micronutrients. However, when deficiency symptoms are observed, they are likely due to a soil pH that is too high for the species being grown.

More details of fertilizing bare-root nursery trees such as fertilizer rate recommendations, lime requirement estimates, and acidification requirements for Willamette Valley soils can be found in the newly published Oregon State Extension Fertilizer Guide EM 9013-E titled *Bareroot Shade, Flowering, and Fruit Trees*. This publication is available at extension.oregonstate.edu/catalog/.

The fertilizer guide was written by Oregon State University Extension faculty Jim Owen, Dan Sullivan, Don Horneck and John Hart. Teresa Welsh, Wild Iris Communications, provided technical assistance for editing and layout.

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Additional information can be found under resources at the Climate Friendly Nurseries Project (CFNP) website: www.climatefriendlynurseries.org/.

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