Growing Young Fruit Trees in Old Orchard Sites

Mike Willett, Robert Stevens and Tim Smith
Introduction

The orchard replant problem is any situation in which the replanted trees do not grow to the grower's expectations. If you have lowered your expectations due to a previous lack of success, the replant problem may result in an unprofitable orchard. In Pacific Northwest orchards, the problem has been most obvious when apples were planted after apples.

The apple replant problem has been identified in virtually every fruit growing region in the world and similar problems have been documented for many fruit crops. Moreover, throughout agricultural history there are cases where growth of a particular crop has been reduced or prevented by continuously cropping it in the same field. The reasons for these yield reductions or failures are the changes that the crop and its production practices cause in the soil. These include chemical, physical and biological changes. Some examples are toxic spray residues such as lead arsenate, low soil pH caused by nitrogen fertilizer application, soil compaction caused by heavy equipment, poor water management, buildup of soil organisms that damage tree roots or a combination of these.

Older orchards have extensive root systems and are apparently more resistant to these soil changes. They show fewer ill effects than new trees. However, decline in the vigor and performance of older orchards has been attributed to some of these factors. When young trees are planted into this hostile environment, their roots don't grow well and this affects the growth of the entire tree.

In order to have a healthy orchard, you must manage all the factors listed below before you plant new trees. Some of these are more limiting than others. The most limiting factors are listed first.
Biological Factors and Toxic Chemical Residues

Soilborne pathogens. The most common cause of poor tree growth and low yields in replanted orchards is called Specific Replant Disease. This disease is caused by soil fungi and bacteria that build up on orchard tree roots. Both apples and pears seem to be affected by similar groups of organisms. Stone fruits appear to be affected by a separate group of pathogens. Mature trees can tolerate these root damaging organisms, but young trees are unable to develop adequate root systems when pathogen numbers are high. Young trees seldom die from this disease. Growth is slightly to severely slowed, and the trees appear to be nutrient and moisture deficient. Yields are reduced, even after the trees fill their spaces. Careful management of soils, nutrients, weeds and irrigation will reduce, but not eliminate the effects of this disease. There is no completely effective treatment once the young trees are affected. Broad spectrum soil fumigants are the most common and effective control. Soil fumigation often leads to normal tree growth and production, while untreated areas of the same block grow and yield 20 to 50 percent less. Fumigation is currently the only control for Specific Replant Disease. Fumigation is not required when planting stone fruits after pome fruits or vice versa.

Microscopic soilborne roundworms called nematodes are not a significant cause of poor tree growth in replanted orchards and reduce tree growth only in a few replant situations. A specific nematode, *Xiphinema americanum*, may carry a virus that causes flat apple disease. A relatively small number of *Xiphinema* may spread this virus throughout an orchard. Broad spectrum fumigation for Specific Replant Disease will also control nematodes but the species of nematodes present will determine whether spot, strip, or overall soil fumigation is needed. Overall soil fumigation is recommended if the symptoms of flat apple disease have been found in the orchard. If you are replanting an old cherry orchard into apples, carefully examine the old cherry trees for the presence of cherry rasp leaf symptoms. Overall soil fumigation may be needed if cherry rasp leaf is present.

Arsenic. Lead arsenate was used for codling moth control in Washington orchards for almost 50 years and in 1943, the peak use year, 17,000,000 pounds of lead arsenate were used in central Washington. Elevated levels of arsenic can be toxic to fruit trees and particularly damaging to young trees. Arsenic is relatively immobile and moves through the soil profile slowly by leaching. Arsenic is usually more toxic to plants at lower soil pH, in sandier soils and in soils with low organic matter. Any condition that limits root vigor and growth, such as Specific Replant Disease, compaction or poor irrigation management, will increase the toxic effects of soil arsenic levels. Many lead arsenate sprays were applied with handguns, therefore the residues are usually concentrated in the tree canopy drip lines of previous orchards. While virtually no lead arsenate has been applied since 1948, variable amounts are still present in orchards where it was used. Take detailed soil samples at depths of 1, 2, and 3 feet. While no systematic tests have been done in recent years, field
experience suggests that soil arsenic levels in excess of 100 ppm are now rare. Sites with soil arsenic levels of 100 to 200 ppm can be successfully replanted if the site is fumigated and all other potential limiting factors are corrected.

**Soil pH, Water, and Compaction**

**Soil pH.** Many orchards in the Pacific Northwest were planted on neutral to slightly alkaline soils. Years of nitrogen fertilizer application and irrigation have resulted in a gradual decline in soil pH. In many orchards the pH has dropped below the best range (pH 6.2-7.2) for tree growth. Because the fertilizer is usually banded near the trees rather than broadcast, the pattern of pH change is not uniform across the entire orchard. Areas near the row or around the drip line may have a significantly lower pH than the row middles.

Low soil pH does not directly cause problems in replant situations. At soil pH below 5.5, aluminum and manganese may increase in the soil solution to levels that are toxic to trees. Spur-type Red Delicious appears to be particularly sensitive to high levels of available manganese and aluminum. As manganese accumulates in the tree, shoot growth and leaf size are reduced and, in Red Delicious, bark measles may develop. Low levels of calcium and magnesium may occur under acid conditions and low soil pH may alter the productivity of beneficial soil organisms. Low soil pH and its related effects on soil chemistry and biology can reduce root growth.

Test the soil to determine the pH level in an orchard. Take separate samples for the areas between the rows and in the rows themselves. If an initial surface soil test indicates a pH problem, also take samples at depths of 1, 2, and 3 feet in the area where fertilizer has been applied. If the pH is too low at the lower depths, the best cure is to incorporate lime to those depths. This is difficult to accomplish when young trees are interplanted in existing orchards.

**Water.** Because of their relatively small root systems, it is critical that young trees receive adequate soil moisture. Mid-season moisture stress can prematurely stop annual growth. You can prevent tree moisture problems by designing an irrigation system that delivers water uniformly to the root zone. Take soil samples of the area to be planted to determine if differences in soil depth or texture will affect the irrigation system design.

Irrigation scheduling is critical because young trees have relatively shallow root systems. They require shorter but more frequent irrigations than mature trees to avoid periodic drought or waterlogging of the soil and to minimize nutrient leaching.
Soil moisture problems in replanted orchards occur most often when growers try to salvage irrigation systems designed for a mature planting. These systems were usually installed long after the old orchard was planted and often do not deliver water uniformly across the orchard floor, vital to trees with small root volumes. Small trees are very susceptible to salt damage, so take soil and water samples to determine if salinity is a problem.

Soil compaction. Soil is composed of mineral particles, living organisms, organic matter, water and air. The water and air are held in the pore spaces between the soil particles. As much as 50% of the soil volume can be composed of pore space. Compaction occurs when a weight or force is placed on the soil causing the solid particles to slip closer together and thus reduce the amount of soil volume available to hold water or air. Compaction can occur in any soil type, even sands. Driving heavy farm equipment on wet soils greatly increases soil compaction. Roots must expend more energy to move through compacted soil, and this reduces their growth. Reduced root growth decreases the amount of water and nutrients the plant can obtain. Roots growing in frequently wet soil above a compacted layer may be more susceptible to pathogens.

Use a probe or shovel to find out if your soil is compacted. You can reduce or eliminate compaction by thoroughly ripping the compacted layer, ideally to a depth of 2 feet. Do this in the fall because compacted layers will shatter more completely when the soil is dry. The effects of ripping often last only a few growing seasons, but the effects of improved tree growth continue over time.

Sites to be fumigated with subsurface injection of methyl bromide must be ripped prior to application. Compacted soil slows the application process and increases the cost. Distribution of the fumigant may be poorer under compacted soil conditions.

Soil Fertility and Pest Management

Soil fertility. Trees need proper nutrition for optimum growth. Soil tests can determine whether or not you must add nutrients before planting. In the Pacific Northwest, soil tests should include nutrient analysis for nitrogen, phosphorus, potassium, zinc and boron. With the exception of nitrogen, shortages of these nutrients are best remedied by pre-plant incorporation. Fertilizer applications should consider cover crop requirements as well as tree requirements.

Recent studies using monoammonium phosphate (MAP) fertilizer, such as 11-55-0, have produced additional tree growth when incorporated in the planting
hole. We do not know how this happens, but we do know it is not primarily a nitrogen response. Sometimes young trees are killed by improper MAP applications. Mix MAP thoroughly with soil to avoid damaging fertilizer concentrations. Use lower rates and extreme caution when applying MAP on sandy soils. The use of MAP on high density plantings may cost more than can be justified considering the small increment of growth it induces on most Pacific Northwest soils, which are relatively high in phosphorus. Orchards planted in phosphorus deficient soils must receive additional phosphorus.

Pest management. You must control pests in the young planting. These include tentiform leafminer, aphids, white apple leafhopper, leafrollers, powdery mildew, apple scab, deer and other grazing mammals and rodents. Weed control is extremely important in young orchards but must be done carefully to avoid damaging the young trees. Develop a routine scouting and management plan to prevent economic loss from other pests. Remember, relatively low populations of pests can quickly damage small trees.

Orchard Systems

Rootstock and variety selection. Variety selection is primarily determined by marketing considerations rather than by the variety's productivity. However, you should select rootstocks based on potential productivity and suitability for the variety. Many growers of Red Delicious in the Pacific Northwest previously used rootstocks that promoted vegetative growth at the expense of early fruit production. By paying greater attention to soil preparation prior to replanting, you can use more productive rootstocks and plant the trees closer together. This will increase your income from the orchard in a shorter period of time. It costs more to renovate old orchard sites correctly, but bringing these orchards into production more quickly will justify that cost.

Summary

Successfully establishing new orchards on old apple orchard sites requires attention to several factors. Potential problems can be reduced by carefully evaluating each orchard site based on these factors. Correcting the specific limitations of each site will result in optimum tree growth and early fruit production.
## General Replant Planning Guide

<table>
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<tr>
<th>When</th>
<th>Action Needed</th>
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<tr>
<td>Three years before planting</td>
<td>Plan variety, spacing and irrigation system.</td>
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<td>Map soil for depth, water-holding capacity and soil compaction problems.</td>
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<td>Order trees.</td>
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<td>Two years before planting</td>
<td>Reduce soil residual herbicide applications.</td>
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<td></td>
<td>Identify and control perennial weed problems.</td>
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<td>Collect soil samples for pH, fertility, arsenic and nematode analysis.</td>
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<td>The year before planting</td>
<td>Remove old trees in spring or fall.</td>
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<td>Backfill holes and lime, if needed, while tree rows are still visible.</td>
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<td>Rip soil when it dries sufficiently.</td>
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<td>Clean up, fertilize and disk.</td>
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<td>Year of planting</td>
<td>Plant green manure crop if old orchard was removed in spring. Irrigate green manure crop. Disk it in late summer. Fumigate in late summer or early fall. Stake tree sites. If using monoammonium phosphate, mix thoroughly into soil while augering tree holes. Plant and water trees. Control pests.</td>
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Tim Smith, WSU Area Cooperative Extension agent, Chelan-Douglas-Okanogan counties.

Use pesticides with care. Apply them only to plants, animals, or sites listed on the label. When mixing and applying pesticides, follow all label precautions to protect yourself and others around you. It is a violation of law to disregard label directions. If pesticides are spilled on skin or clothing, remove clothing and wash skin thoroughly. Store pesticides in their original containers and keep them out of the reach of children, pets, and livestock.

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