Considerations for September/October, 2014
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Orchard removal and replanting is critical to almond operations. Although the lifespan varies, at some point the decision is made to remove the entire orchard and start anew. The removal process should not be rushed, as care must be taken to prevent cultural mistakes that will haunt the new orchard for its 20+ years of existence.

Once the decision is made to replant an orchard, old trees need to be removed. Trees are removed through the use of tub grinders, by burning, or by wood cutting crews. Tub grinding is the fastest method, but there can be a considerable waitlist in some years. Small orchards or blocks (less than15 acres) may be granted a burn permit, pending approval of the local air resource board. Wood cutting crews take more time, and stumps will still need to be removed and disposed.

After the trees in the orchard are removed, the field needs to be shallow ripped and spring-toothed to remove as many of the old roots as possible. These roots harbor soilborne diseases and pests, such as nematodes. Three or more ripper passes are commonly made. In some instances, more severe soil modification will be needed to overcome dense subsurface soil layers. A backhoe can be used to dig pits to determine the extent of limiting layers. If plowpans, hardpans, or fragipans are observed, ripping can help "shatter" these layers. In cases of clay lenses and soil stratification, slip-plowing may be of benefit. The shank needs to be 1.5 times deeper than the deepest limiting layer. For example, if a hard pan is observed at 3 feet deep, a ripper shank of 4.5' will be needed to shatter the hardpan. Backhoeing is also an option and should be considered in sandier soils. The complete mixing of the soil profile by backhoeing promotes tree growth and increases the efficacy of soil fumigant treatments in both new and replanted orchards.

Research indicates that in some circumstances, however, soil modification may not be as necessary as once thought. In a comparative trial at the Nickels Soil Laboratory near Arbuckle, CA, a microspinkler-irrigated almond orchard that was pre-plant slip-plowed has not out yielded an un-modified, microsprinkler-irrigated control orchard. This lack of difference is thought to be due to the use of a low volume irrigation system (microsprinkler or drip), which provides the ability to control water applications and the wetting profile depth within the soil, minimizing the impact of soil saturation occurring at the interface of soil layers. Orchards planned to be flooded or irrigated with solid-set sprinklers (higher volume irrigation systems) should still be modified if a backhoe pit analysis indicates the need. Modification on very shallow soils (<2.5' to first soil layer) is recommended.

Nematode Sampling and Pre-Plant Management:

Nematode sampling is another important task before replanting, but it can be tricky to get consistent results when collecting samples. . Samples should be taken once the soil begins to cool in October. For best results, multiple soil samples should be taken, with a minimum of one sample per soil type present in the orchard. If soils are relatively uniform, two to three samples should be made for fields smaller than 60 acres. Five or six samples are needed for for larger uniform fields. A composite of 5-7 different spots within the soil type or field quadrant should be pooled (mixed and combined) as one "sample." Soil samples should be taken at a depth of 15"-20" within the rootzone of the tree. Once enough samples have been collected, they should be placed in a properly labeled bag, kept cool and out of the sun, and

submitted to a lab to conduct the nematode analysis. The University of California Cooperative Extension has material online describing sampling methods in more detail.

Ring, Lesion, and Rootknot nematodes are the major group of species of concern in almond orchards. Historically, Rootknot nematode was a significant problem until resistant rootstocks were developed. As the name suggests, rootknot nematode causes galls or knots to form on the roots, leading to reduced productivity and low vigor. Many –but not all- modern rootstocks are resistant to rootknot nematode Rootstocks 'Lovell,' 'Krymsk-86,' and 'Paramount,' or 'GF677' are known to be susceptible to this devastating pest. Ring nematodes, which are more common in sandy soils, can cause severe stunting in almond trees as well as predispose the tree to bacterial canker. There is no true resistance to ring nematodes in current rootstocks, but 'Viking' and 'Lovell' appear to be the most tolerant. Lesion nematodes are a particularly tiny type of nematode found in all soil types. It causes stunting of trees that impacts vigor and yield. Typically, trees with high inherent vigor are able to "outgrow" the stunting caused by this nematode. Therefore, more vigorous rootstocks (e.g. peach ***x*** almond hybrids) tend to be more tolerant of lesion nematode.

If sampling reveals high counts of nematodes, soil disturbance, cover-cropping, or soil fumigation with Telone-II containing fumigants should be considered. Although exact thresholds for nematodes have not been determined, I recommend pre-plant fumigation if the average of counts from the field samples for Ring, Lesion, and Rootknot are over 25, 50, and 50 nematodes per 500 g of soil, respectively.. These approximate thresholds are lower if planting to susceptible rootstocks (e.g. 'Lovell'). Cover cropping with non-host plants can help reduce nematode populations as well as improve soil structure. Examples of non-host cover crops include: true Sudangrass (not hybrid Sudangrass), barley, Merced Rye, Blando Brome, and Salina Strawberry Clover. Soil disturbance through back-hoeing of tree sites appears to reduce populations in some trials. Broadcast fumigation with Telone-II containing fumigants should be considered if populations are especially high. Planting with resistant rootstocks is also recommended for the fields with high soil nematode counts.

Prunus Replant Disease and Management

Prunus Replant Disease (PRD) has been found in nearly every orchard location that has had successive plantings of any *Prunus* species (peach, cherry, plum, almond, etc). This disease is thought to be a complex of soil fungi that reduce fine feeder root development, leading to stunted growth, and in severe cases, tree death. Pre-plant soil fumigation, cover cropping, and soil modification appear to reduce the severity of this disease. In multiple trials across the state, fumigants containing chloropicrin have outperformed the non-fumigated control. The results have been the most favorable on sandy loam or coarser soils. Research has not found any comparable alternatives to fumigation, and thus soil fumigation with chloropicrin containing fumigants should be considered when back-to-back plantings of any *Prunus* species is planned.

"The One-Two Punch"

In certain parts of California, orchards replanted into ground with the presence of nematodes (usually Ring) and PRD are severely stunted and fail to be highly productive. These soils should be fumigated with either a broadcast Telone-II treatment or a rowstripped Telone-II C35. These treatments are expensive, but multiple trials have found that fumigated trees have produced nearly double the non-

fumigated control within the first 3 years of harvest (3rd-5th leaf), which more than compensates for the upfront fumigant expenses.

Considerations for Established Orchards.

Within established orchards, the options for managing nematode and PRD are more limited. Dr. Michael McKenry, UC Nematologist emeritus, has found that Spirotetramat (Movento®) can reduce populations of nematodes in almonds and walnuts. Observations from within the field have been favorable. Bayer CropScience, the manufacturer, suggests applying this product as a foliar spray in the spring and fall on blocks severely impacted by nematodes. Because the product is applied to the leaves but operates against pests in the roots, it is critical to mix Movento® with a penetrating adjuvant so that it is absorbed by the leaves, where it will be translocated via the phloem down to the roots. Similarly, spring and fall sprays should be applied when there is adequate canopy cover. Other products are also available or in development, and field tests are underway. Hopefully, we will have more products in the near future.

For PRD, there aren't any chemical options for control. Proper irrigation management and spoon-feeding of nutrients may be of benefit. Work by Dr. Bruce Lampinen and colleagues found that trees within PRD-affected fields are often over-irrigated, which stunts growth. Trees need to be irrigated to match the water demand, which means smaller trees will require less water than larger trees. Since the root system is affected, very small amounts of fertilizer applied frequently may help increase growth. Studies have shown that small trees require less nitrogen than what is usually applied (~25-30 lbs/acre) for the growing season, if applied to the root system of the tree.

PRD and nematodes are best managed with pre-plant actions. Schedule and take the proper amount of time to remove and prepare the orchard prior to fumigation. If the timing of harvest or other factors prevents the ability to properly prepare the orchard as I’ve described, it may be best to delay planting considering that a new orchard is a 25 year investment and commitment.