

ORCHARD REPLANT CONSIDERATIONS

By Janet Caprile, FarmAdvisor, Contra Costa & Alameda Counties
and Mike McKenry, Nematology Specialist, Kearney Ag Center

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The phasing out of Methyl Bromide (MB) has made replanting decisions more complex. Although MB is still technically available it becomes significantly more expensive every year and this has made its use economically difficult for all but the most high value crops.

The Replant Problem: When an orchard is removed and the same kind of orchard is replanted in short order, without fumigation, the replanted orchard frequently grows poorly exhibiting stunting and yellowing in an uneven pattern across the field. This can be due to high populations of nematodes or other soil pests or microbes that overwhelm the small root mass of the young trees. But even without an identifiable pest problem, the orchard can grow very poorly in the first year or two and we don't exactly know why – we call this the “*rejection component*” of the replant problem. It is difficult to predict whether the “rejection” will occur in a certain location except by past history. It is common in portions of the San Joaquin Valley and infrequent in the Sacramento Valley. It is more likely to be a problem on walnuts than on stone fruit.

The replant problem is often more severe on sandy soils prone to nematodes but the fine textured soils can also have problems. Fumigation with MB virtually eliminated orchard replant problem due to either nematodes or the “rejection component”. It killed old roots, soil microbes and pests, weed seeds and whatever was responsible for the rejection component.

UC researchers had been seeking alternatives to MB long before the 1992 phase out began. A combination of methods is going to be needed to approach the effectiveness of a MB fumigation before replanting an orchard. Here are the options that Dr. Mike McKenry, UC Cooperative Extension Nematologist, suggests after years of work on this topic:

1. **Sample for nematodes.** When the soil is moist, take a number of soil cores from across the field and down to 36 inches. Combine them thoroughly and send them to a lab for analysis. For more complete sampling guidelines and a list of labs that do nematode analysis, you're your local Cooperative extension office. Root-lesion (*Pratylenchus vulnus*) and ring (*Mesocriconema xenoplax*) nematodes are the most problematic for walnut and stone fruit (almond, apricot, cherry, peach, plum, nectarine, pluot). Root-knot (*Meloidogyne spp.*) nematodes can also be a problem for Lovell peach rootstocks. Unfortunately, about 85% of the walnut orchards in California have nematode levels that are too high for replanting. Fortunately, only about 35% of stone fruit orchards have nematode levels that are too high for replanting. If your nematode levels are high or you anticipate the rejection component, you'll either need to fumigate OR rotate to a non-host crop for a few years, as described below.
2. **Kill the old tree roots and wait 18 months before replanting.** This procedure reduces the rejection component. It will NOT provide nematode control, although it is a good first step for a nematode control program as it speeds root breakdown so that rippers and fumigation shanks can more easily penetrate. Additionally, it kills the nematodes inside walnut roots but not in the soil and not in stone fruit roots. Dr. McKenry estimates that this procedure plus nutrients at planting time and a rootstock with different parentage can mitigate the “rejection

component” by more than 85%. He highly recommends it for any walnut replant site. For stonefruit, if you haven’t seen the “rejection component” in your area and don’t need to prep the soil for fumigation (ie. you don’t have nematodes) you can skip this procedure. This process takes some advance preparation and planning, as follows:

- Complete the final harvest of the old trees
 - Irrigate deeply
 - Deep rip between the old orchard and any border orchard to avoid the possibility of herbicide damage from grafted roots and/or leave a border of untreated trees.
 - Cut trunks exposing the cambium before the end of October
 - *Immediately* paint the cut surface of the trunk with an herbicide to kill the roots of the old trees:
 - **Walnuts:** 50 ml Garlon3A + 50 ml MorAct
 - **Prunus:** 50 ml Roundup + 50 ml MorAct
 - Wait at least 60 days before removal of the old tree trunks
 - Wait 12 to 18 months before replanting the orchard
 - During the wait, correct any physical (hard pan, plow pan, compaction, etc) or chemical (salt, pH, nutrient, herbicide residue) problems.
 - During the wait, fumigate in the fall if you have high nematode counts.
 - During the wait, plant an annual, non-nematode host crop.
 - Sudan grass or sorghum x sudan hybrids are good choices to begin to reduce nematode populations while improving soil tilth. These non-irrigated crops will also help to dry the soil if a fall Telone fumigation is necessary.
 - If the soil does not need to be dried for fumigation many of our irrigated annual crops (except beans) may be suitable as they don’t host *P. vulnus*; however, they can host ring and root-knot nematodes.
3. **Fumigate** if your soil has high nematode counts. Your choices are Telone or Chloropicrin or a combination of these. All soil preparation (ripping, disking, leveling) needs to be completed when the soil is still moist enough to allow for efficient equipment operation (by June-July) and to avoid the development of large clods in clay loam soils. Very little plant residue should be present on the soil surface.
- **Telone II** is the standard replacement for MB. It is a good root killer and nematicide but compared to MB it doesn’t penetrate well throughout the soil profile and is not as good on the fungal and bacterial components. It performs quite well on coarse- textured soils. To get a performance even close to MB you need to pay attention to:

Soil Moisture: Dry the lower soil to 12% moisture content. Sands and sandy loam soils can achieve this with a summer of fallow. For finer-textured soils a spring/summer crop of sudan grass or safflower may be needed to remove deep moisture. This can also be accomplished with winter wheat sown the previous fall to utilize winter rainfalls followed by July soil ripping and a summer of drying. Even then it can be difficult to dry clay loam soils down to 12%.

Soil Preparation: To improve fumigant delivery, pre-rip the soil on 4 to 5 foot centers and then come back through, even deeper, with the placement of shanks between the previous rip shanks. Re-settle the soil with a disc and ring roller. How deep you need to rip depends on your soil moisture. At 12% moisture ripping to 3 feet is usually adequate. At 12-15% moisture rip to 4 feet. At 15-19% moisture rip to 5 feet.

Rate: This again depends on your soil moisture. The highest legal rate is 330 lbs a.i./A (33.7 gallons/A). With 12% moisture, use 330 pounds a.i. per acre, shanked in at least 20 inches deep across the entire field. At moisture contents of 12-19% you need to roughly double that rate to get the same effect. As this would exceed legal label amounts, the only alternative is to use an increased rate applied as a strip treatment to a portion of the field surface. The shank should be fitted with 2-3 narrow wings along its length (a Buessing shank) and this feature is *critical* for proper fumigation of clay loam soils. The best results can be obtained by delivering half the material at a 20 inch depth and the other half at a 28-inch depth, although this type of delivery system is not widely available. After all that, a strip treatment will only provide 1-2 years of protection before the tree growth starts to slow whereas a properly applied broadcast treatment can provide 6 years of protection.

Surface treatment: To prevent off-gassing, the surface must either be tarped or contain adequate surface moisture at the time of treatment. Tarping allows the full effect of the fumigation to reach the surface soil. Without a tarp, the surface soil needs to be treated separately with a Vapam application to get a completely clean profile. However, there is no need to spend the extra effort with a surface treatment if one has strip applied the Telone.

Timing: Applications are typically done from mid September to November 15 to allow the soil time to dry and cool a bit but also to receive the surface moisture benefits of an early rain. Complete the fumigation before more than 2 inches of rain falls or it will reduce the effectiveness of the fumigation. Trees can be planted the following spring.

Bottom Line: You can achieve MB like results on properly dried and prepared sandy and sandy loam soils with a full field application and a tarp or surface treatment. It is difficult to get as effective a treatment with Telone on finer-textured soils due to higher moisture contents and the need for extensive (and expensive) soil preparation and strip treatments. Combinations with Chloropicrin can increase the efficacy but also the expense.

- **Chloropicrin (CP)** doesn't penetrate roots well but travels further than Telone if the soil profile has been opened with deep ripping. This could be useful on finer-textured soils that are difficult to dry AND on walnuts where the deep roots have already been killed with herbicides as described in 2 above. Chloropicrin also provides a greater "increased growth response" in the first year after fumigation which is unrelated to nematode control. It is more commonly used in combination with Telone II and soil preparation needs to be the same as for a Telone application. A good optimum treatment rate for soils with less than 12% moisture content is 170lb/*treated acre* stripped down the planting row after a broadcast application of Telone II. In clay loam soils you'll need to use 250 to 350lb/*treated acre* in conjunction with a standard Telone II treatment. The most effective (and expensive) approach for soils containing 15 to 19% moisture would be CP at the 28-inch depth and Telone II applied at 20 inch depth. Do not apply CP after Nov 15.
- **Telone C35** is a combination of Telone and Chloropicrin. Soil preparation is basically the same as for Telone II above. The highest label rate of 50 gallons/ac contains 342lb/ac Telone and 194 lb/ac Chloropicrin. Base any strip application rate on the total lbs/acre of Telone in the product. For example, for a soil moisture of 12-15%, use 75gal of C35/*treated acre* (which contains 513 lbs of Telone applied over $\frac{3}{4}$ of the orchard floor).

- **Metam sodium** (Vapam, Sectagon) or **metam potassium** (K-pam) are not true fumigants and must be pushed into the soil with water. This can only be accomplished in coarse textured orchard soils and will NOT work in clay loam soils. Neither of these products should be used in this deep drench fashion prior to planting a stone fruit orchard because those trees will not grow well even a year after treatment.

Metam sodium or potassium can be useful as a surface treatment in conjunction with an untarped Telone application. The best method for application is at a rate of 110lb/ac (25gal/ac) applied in front of a rotavator that incorporates the surface 5 inches of soil. It can also be applied as a drench at 250 ppm in 2 acre-inches of water (25 gallons/acre in 54,000 gallons of water) prior to or following the Telone II or C35 treatment. It is OK to plant either stone fruits or walnuts within a few months of using these lower, surface treatment rates of metam sodium.

4. **Prepare the soil** thoroughly to correct any physical problems (hard pans, plow pans, compacted soil, poor water penetration, etc.) or chemical problems (salt, pH, herbicide residues, phosphorus or potassium additions, etc) and level the soil. Keep in mind that 28-inch deep shanks on a fumigation rig are going to be destroyed if the soil isn't pre-ripped to 4-feet deep or if there is a lot of old wood/roots in the field. The herbicide treatment applied to cut trunks (described in 2 above) results in roots that are more easily sliced through during ripping and fumigation operations.
5. **Rotate** to a different crop or a different rootstock. This, the herbicide treatment and a year of wait should take care of the "rejection" component". If you have nematodes, select a crop that does not host the type you have. Three years of alfalfa can reduce *P. vulnus* (lesion) nematode problems. Tomatoes, sweet corn, cucurbits and many other annual crops (except beans) do not host *P. vulnus*. If ring nematodes are your problem, a year or two of sudan or a sorghum x sudan hybrid can reduce this pest. Where both ring and *P. vulnus* are problematic the alfalfa planting should be followed with a year (minimum) or two (better) of sudan grass. If root-knot nematodes are the problem, a resistant rootstock may be the best choice as a lot of crops host this pest – choose NemaGuard, Nemared, any cherry, any plum or a black walnut rootstock.
6. **Fertilize.** All trees benefit from a small amount of macro & micro nutrients at planting. Dr. McKenry has found that 1/6 pound of Peters 20-20-20 plus 8.3 ml of Super Micro mixed into 2 gallons of water and applied to each tree at planting can double first year tree size. Other starter fertilizers may work just as well. If trees have not been fumigated, you may achieve an additional growth response with foliar micronutrient sprays and frequent, small N applications.

I hope this overview has helped to clarify this complex topic. More detailed and crop specific information can be found on Dr. McKenry's website: <http://www.uckac.edu/nematode>.

