METHYL BROMIDE ALTERNATIVES AND MYCORRHIZAL COLONIZATION IN VINEYARD REPLANT TRIALS.

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The impact of methyl bromide alternatives on mycorrhizal colonization of roots in vineyard replant sites was evaluated in on-going studies at Parlier, CA. We examined the effects of seven pre-plant chemical alternatives, along with untreated controls and methyl bromide, on fine root production and root colonization by arbuscular mycorrhizal fungi (AMF) in self-rooted Thompson Seedless grapevines. We determined the percentage of root length colonized by AMF after the first growing season (Jan. 2002) and in the summer of the second growing season (July 2002). This analysis was conducted by collecting roots from soil core samples taken to a depth of 50 cm. We also examined the levels of macro and micro elements in leaves during the summer of 2002. Treatments that we examined in this study are shown in Table 1.

Table 1. Treatments examined in 2001 grapevine replant trial.

Untreated control
Methyl Bromide, 400 lbs/acre, SHANK
Iodomethane + Chloropicrin, 200 + 200 lbs/acre, SHANK
Propargyl Bromide, 180 lbs/acre, SHANK
Iodomethane + Chloropicrin, 200 + 200 lbs/acre, DRIP, water cap
Azide, 300 lbs/acre, DRIP, water cap
Propargyl Bromide, 180 lbs/acre, DRIP, water cap
Chloropicrin, 400 lbs/acre, DRIP, metam cap
Inline (dichloropropene + chloropicrin), 50 gal/acre, DRIP, metam cap

Results showed that colonization of roots by AMF in January of 2002 (8 months after planting) was significantly reduced in all chemical treatments that were shanked into soil and in the drip-applied chloropicrin and Inline treatments, as compared to the untreated control (Figure 1). By the summer of the second growing season (July 2002) only Methyl Bromide shanked, Propargyl Bromide shanked and Inline treatments continued to have depressed levels of AMF colonization (Figure 1). In July of 2002 all replicate samples from every treatment had at least some AMF colonization in roots. This was not true in January of 2002, where some replicates had no colonization. These findings suggest that AMF were brought into the vineyard along with the planting stock, and that the level of AMF in the planting stock roots was quite variable. Our findings also suggest that drip applications of certain chemicals (Propargyl Bromide and Iodomethane/chloropicrin) were less harmful to AMF than shanked treatments. The efficacy of drip versus shank delivery in controlling nematode pests was, however, not different.

Treatments did not have a significant effect on the density of fine roots produced by Thompson Seedless vines in July of 2002 (Figure 2). However, there was a trend for lower root production in the untreated control, Iodomethane/chloropicrin shank, chloropicrin drip, and Inline treatments compared to other treatments. Less root growth in the untreated control and chloropicrin treatments may have been due to high nematode populations, but nematodes do not appear to be responsible for reduced root growth in the Iodomethane/chloropicrin shank or Inline treatments.

Treatments did not have a large impact on nutrient concentrations of leaves collected in July 2002. Only leaf phosphorus was significantly affected by treatments, but differences were very small. Leaf P concentrations were significantly correlated to the frequency of arbuscules (the site of nutrient transfer between plants and AMF) in roots across all treatments.

We also examined the impacts of long-term fallowing and Methyl Bromide fumigation on root growth and AMF colonization in another replant trial with vines in their third growing season (planted in 2000). We focused our efforts on the longest fallow period of three years as compared to Methyl Bromide, because the length of the fallow period did not significantly affect AMF colonization of roots. We suspect that AMF fungi were introduced into the soil via the planting stock in this experiment as well. We examined root growth and AMF colonization at three soil depths in own-rooted Thompson Seedless vines, and in Thompson Seedless vines on Teleki 5C or Harmony rootstocks.

Results showed that the long fallow of three years was more detrimental to AMF than was the Methyl Bromide treatment (Figure 3). AMF colonization of roots was also affected by depth and by rootstock. Colonization decreased with increasing depth in the soil profile. Both rootstocks had significantly lower levels of AMF colonization as compared to the self-rooted Thompson Seedless vines. These results indicate that long-fallowing is not a good alternative to Methyl Bromide for maintaining populations of AMF. The fact that higher levels of AMF colonization occurred in the Methyl Bromide treated plots indicates that the AMF introduced with the planting stock were better competitors in the post-fumigation soil environment, or that the resident fungi in the soil were not completely killed by the fumigant.

Root growth in the long fallow experiment primarily occurred within the upper 40 cm of the soil profile (Figure 4). The Methyl Bromide treatment had significantly more fine roots than the 3 year fallow treatment. Fine root density was not affected by rootstock, even though rootstock had influenced AMF colonization. The levels of leaf nutrients were not affected by treatment, but were affected by rootstock. Thompson Seedless on it's own roots had higher levels of phosphorus and magnesium in leaves than either rootstock. However, this was largely a dilution effect because self-rooted vines were smaller than vines on Teleki 5C or Harmony roots. Leaf P concentrations were again significantly correlated to the frequency of arbuscules in roots.

In conclusion, the Methyl Bromide alternatives, Propargyl bromide (shank applied) and Inline, had the greatest negative impact on AMF in grapevine replant soil. These two chemicals in our trial were similar to Methyl Bromide in terms of reducing AMF colonization of roots for at least 13 months after planting. Iodomethane/chloropicrin (shanked) and chloropicrin (drip) treatments also reduced AMF colonization within the first 8 months after planting, but levels of colonization had recovered to the control level by the middle of the second growing season. Treatments did not appear to alter fine root growth in this trial. A 3 year fallow treatment prior to planting grapevines in another replant study was more detrimental to AMF than was Methyl Bromide fumigation. AMF were apparently introduced with the planting material in both replant studies examined. Therefore, effects of treatments on the indigenous or resident AMF within the treated vineyard soils were probably underestimated.

FIGURE 1. AMF Colonization in Thompson Seedless Roots, 8 and 13 months after planting

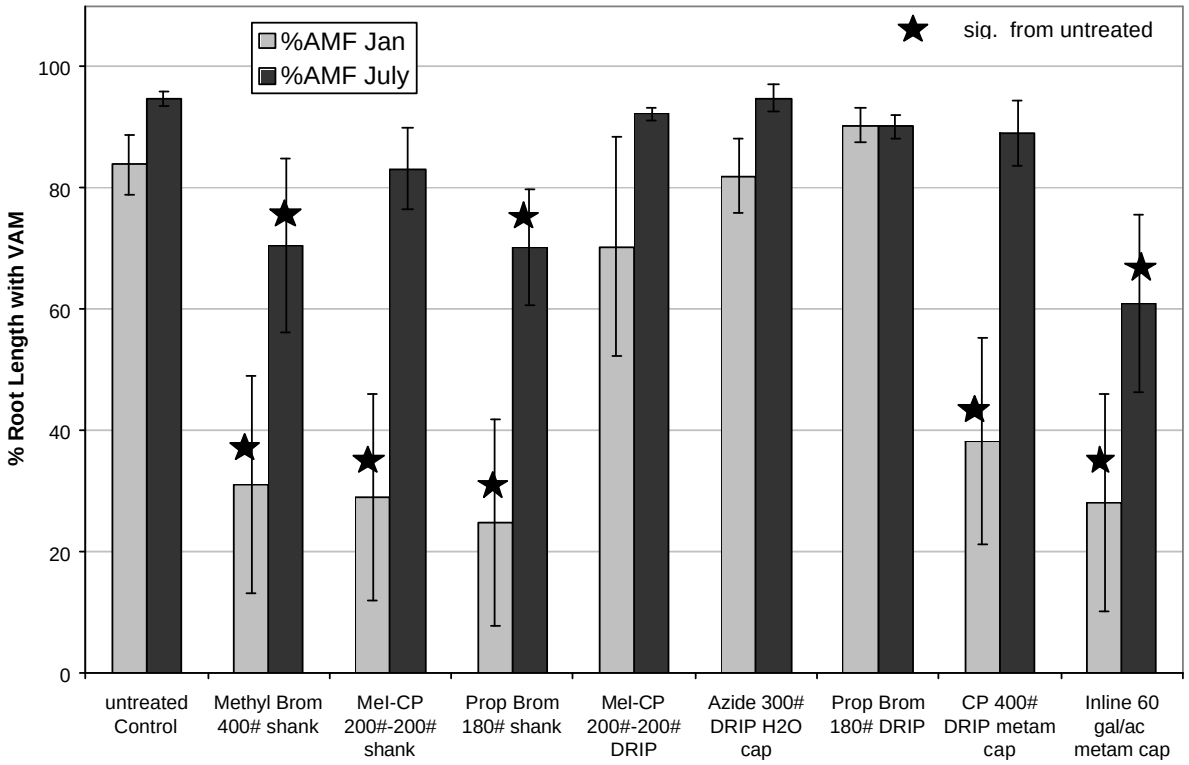

FIGURE 2. Fine Root Mass in Thompson Seedless, 13 months after planting July 2002

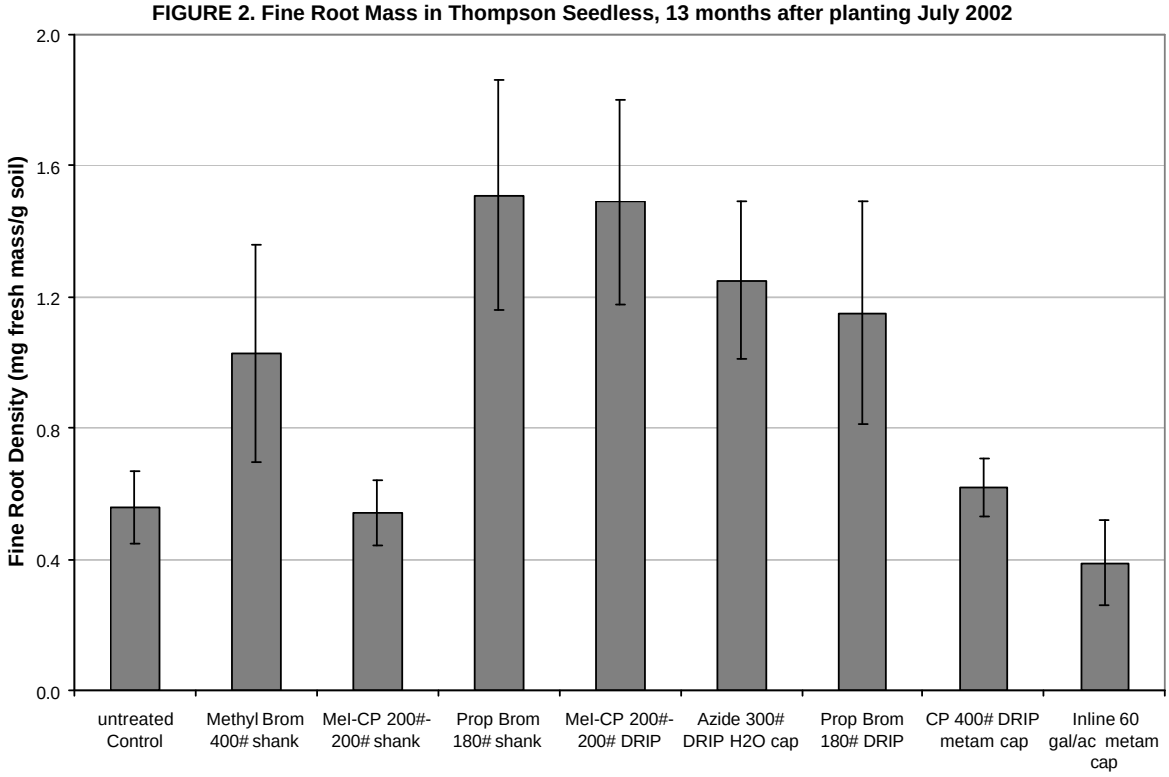

FIGURE 3. AMF Colonization in Thompson Seedless Vines on different Rootstocks 2 Years after planting (3rd Leaf)

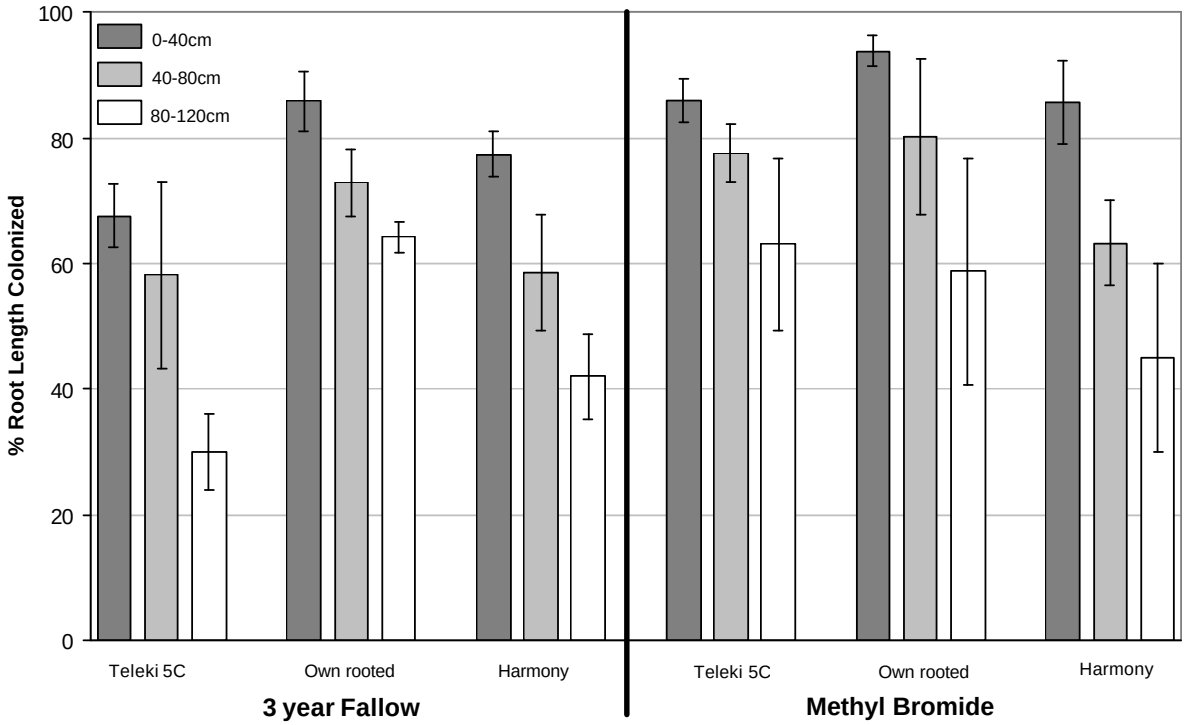

FIGURE 4. Fine Root Mass in Thompson Seedless Vines on different Rootstocks 2 Years after planting (3rd Leaf)