PREPLANT APPLICATION OF FUMIGANTS TO ORCHARDS BY MICRO-IRRIGATION SYSTEMS

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Methyl Bromide fumigation is often used prior to replanting fruit and nut orchards to control plant parasitic nematodes and pathogens and minimize the "replant problem". Fumigation is used in all nurseries that produce certified planting stock. Telone® (1,3-Dichloropropene) is an effective nematicide and the most likely alternative fumigant to MeBr. Chloropicrin, an effective fungicide, has been shown to provide a positive growth response under replant conditions. Both of these alternative fumigants, like MeBr, have traditionally been applied by deep (250 - 450 mm) shank injection, with and without plastic tarps.

Emulsified formulations of Telone and Chloropicrin can be applied in irrigation water. If properly applied, this method can reduce air emissions, a potentially serious problem with both chemicals. The USDA-ARS Water Management Research Lab has shown that their application through shallow drip irrigation systems under plastic mulch can be effective for strawberry production (see Trout and Ajwa in this Proceedings). We have extended this work to perennial crop replant conditions. The objectives are to determine practical and economical application techniques that maximize efficacy of the fumigants and minimize emissions and worker risk.

Application Method

Polyethylene tarps are an ineffective barrier to 1,3-D movement, but high soil water content dramatically reduces its diffusion rate. Consequently, shank injection of 1,3-D in California presently requires pre-wetted soil, which effectively reduces emissions, but also reduces its diffusion through the soil profile. With application in irrigation water, the material is distributed through the soil with the water. Some movement of the volatile chemicals beyond the wetting front is expected, but the extent is not yet known.

In perennial replant, deleterious organisms are generally found in association with the roots of the previous trees and vines, which are most abundant in the top 0.6 m of soil, but often extend to 1.5 m depth or more. With irrigation water application of fumigants, the objective is to wet the soil from the surface to 1.5 m. Application to this depth requires a soil with reasonably high infiltration - i.e. one that can absorb the required irrigation water in less than 24 hours. It also requires uniform water application and a water table deep enough to insure the chemicals completely break down above the groundwater.

Our approach to maximizing efficacy and minimizing emissions is to apply the 1,3-D and/or chloropicrin through subsurface drip tubes placed about 300 mm below the soil surface (see figure). The soil should be dry and well-tilled so that it can absorb the 75 -

100 mm of irrigation water needed to carry the materials to the 1.5 m depth in relatively dry soil. Movement of the materials to the soil surface and subsequent emissions is minimized by sprinkling the surface before application with 5 - 10 mm of water which will create a 40 - 80 mm thick wet soil seal. At the end of the application, the surface is sprinkled again, this time with 5 - 10 mm of water containing Vapam® (metham sodium) to treat the surface layer for pathogens and also provide weed control.

This application method is economically viable for fields set up for microirrigation systems. Many California growers convert to microspray irrigation when they replant an orchard, or to drip irrigation for vineyards. The irrigation pumping, filtration, and water delivery system are used, but may require the addition of proper backflow prevention devices and chemical injection points. The microspray system used to wet the soil surface and apply the Vapam can later be used to irrigate the crop. It may need to be removed from the field for planting and then replaced. The primary application system cost is for the drip tubing and its installation. We estimate the cost of thin-walled drip tubing (drip tape) and installation at about $300 - $400 per acre, similar to the cost of plastic tarps used for shank fumigation. We expect that the tubing will be left in the ground, but not be used for irrigation.

Preliminary Results

We have tested this application technique in fall 1996 for peaches, in 1997 and 1998 for peaches and grapes, and in 1999 for plums and nectarines. This fall, this fumigant application method was used on a grower's field. At present, only first year plant growth and nematode counts are available. Results of the 1996 application were presented at this conference last year (McKenry et al.). Results of the grape applications are being presented this year (Schneider, et al). First year results on the 1997 and 1998 application to peaches show a significant increase in peach tree growth compared to non-fumigated (even though no plant parasitic nematodes were found in the field). Initial growth was less than the MeBr treatment, (likely due to early phytotoxicity), but second year growth appears to be comparable. The treatment also resulted in the reduction of the pin nematodes below detectable levels to a depth of 1.5 m. No other nematodes were detected in the fields. We will be measuring growth and 3rd and 4th year yields on these crops. We are also measuring water and fumigant distributions in the soil during and following application so that application rates and configurations can be optimized.

Results of Fall 1997 Fumigation with Spring 1998 Replant to Peaches (Nemagard rootstock)

Treatment *(Nov 97)*	**Pin Nematodes** *(per 100cc)* *(May 99)*	**Trunk Diameter** *(mm)* *(Nov 98)*
Non-fumigated	160	21.7 a*
Telone EC (35 gpa) + Vapam (26 gpa)	0	29.3 b
MeBr Shank (350 #/ac)	0	37.4 c

Results of Fall 1998 Fumigation with Spring 1999 Replant to Peaches (Nemagard rootstock)

Treatment *(Nov 98)*	**Pin Nematodes** *(per 100cc)* *(May 99)*	**Trunk Diameter** *(mm)* *(Aug 99)*
Non-fumigated	480	15.4 a*
Telone C35 EC (38 gpa)[1] + Vapam (13 gpa)	0	18.5 b
MeBr Shank (350 #/ac)	0	19.9 b

*Means with the same letter are not significantly different at .05.

[1] Equivalent to 24 gal/ac Telone II (250 lb/ac 1,3-D)