

## STRATEGIES AND TACTICS FOR FUMIGATING CLAY LOAM SOILS

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It is silt and clay loam soils that best exemplify the benefit of higher vapor pressure and longer half-life associated with methyl bromide (MB). Utilizing lower vapor pressure products we have now obtained nematode control adequate to produce a “nematode free” 2-year nursery crop within clay loam soil. This achievement requires increased attention to soil preparation and higher application rates. This report will focus on clay loam soils having no more than 19% soil moisture content within the surface 1.6 m of soil profile.

Attention to soil moisture content is paramount to successful soil fumigation, particularly when fumigants of lower vapor pressure are to be used (McKenry, 1978). The surface 1.6 m of a loamy sand soil dried to less than 5% moisture, or a sandy loam soil dried to less than 12%, can be successfully fumigated with 370 kg / ha (330 lb / acre) 1,3-dichloropropene (1,3-D) delivered at the 50 cm depth. Note that use of a tarp or some additional surface treatment is necessary for this treatment to provide 99.99% nematode control. Treatments with 370 kg / ha 1,3-D can be comparable to those involving 370 kg / ha MB applied at the 30 cm depth followed by deployment of a plastic tarp. Pre-treatment soil ripping to 90 cm depth generally provides adequate preparation for coarser-textured soils.

In finer-textured soils MB at 448 kg / ha delivered at 30 cm depth and covered with a plastic tarp can provide 99.9 to 99.99% nematode control to 1.6 m depth in appropriately prepared soils. Equivalent nematode control with 1,3-D alone, 1,3-D plus chloropicrin (CP), or methyl iodide (MI) plus CP requires increased application rates and attention to soil moisture content. For example, if 1,3-D is to be the sole fumigant it must be applied at 560 to 750 kg / ha where soil moistures are 12-15% or 15-19%, respectively. Just as important, for soils of 12 to 15% moisture content to receive adequate treatment they must be: 1/ pre-ripped on 60 to 75 cm centers in at least one direction to the 1.3 m depth; 2/ re-settled with disc and ring roller; 3/ the fumigant delivery shank must have a Buessing wing mounted at two or three locations located along each shank for shank trace closure; 4/ fumigant delivery must be split with half being emitted at 40-50 cm depth and half at 60-75 cm depth; and 5/ delivery shanks must be followed by a disc and ring roller device. In field settings where 15 to 19% soil moisture prevails the conditions are listed above except pre-ripping must reach down to 1.6 m depth. Successful combination treatments of 1,3-D with CP involve 370 kg / ha 1,3-D applied at 40-50 cm depth plus 280 to 392 kg / ha at the 60-75 cm depth at 12-15% to 15-19% soil moisture, respectively. Successful combination treatments of MI plus CP involve replacement of the shallower 1,3-D delivery with 263 kg / ha MI.

**Implications for Growers:**

Adherence to the specifications listed above provides three new soil fumigation treatments that can replace MB use in clay loam soils. Although these studies were conducted to meet prevailing regulations of California nurserymen the results have implications for orchard replant settings as well as implications relative to reducing fumigant emissions. The CDFA Nursery Certification program accepted in March 2005 the protocols for treatment of higher-moisture soils as presented in Chart 1.

**Regulatory Implications:**

Replacement of MB use in clay loam soils requires higher application rates because replacement products degrade more quickly (CP), move more slowly (1,3-D) via soil air passageways, or cannot be applied at high enough application rates (MI). California Department of Pesticide Registration does not currently suggest applications of 1,3-D in excess of 370 kg / broadcast acre. This application ceiling is based on off-gassing models involving sandy loam soils but models appropriate to finer-textured soils with appropriate soil preparation have not yet been developed.

USEPA is currently grouping soil fumigants into a single risk cup and off-gassing will become a greater issue. Our studies have shown the need for higher application rates but also introduce six application activities and each will reduce fumigant off-gassing. These include: 1/ greater depths of application, 2/ increase in available air passageways deep within the soil, 3/ spreading of fumigant delivery points, 4/ applications to soils of higher water holding capacity, 5/ use of winged devices along each shank to better fill shank traces, and 6/ selection of fumigants with lower half-life. Equipment for conducting these activities is available in the US, particularly California, but the required equipment is not commonly available world-wide. Off-gassing from MB and each of its replacements should be modeled because the soil preparation indicated above could reduce emissions from clay loam soils by 2 to 5-fold.

**Literature Cited:**

McKenry, M.V., D. Buessing, and K. Williams. 2003. New chisel shanks enable improved fumigation of finer-textured soils. International Methyl Bromide Conference, San Diego. 3 pages.

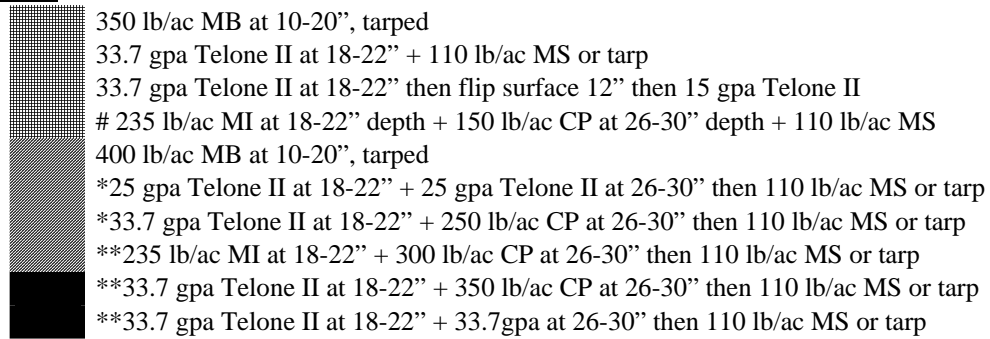
McKenry, M.V. 1978. Selection of pre-plant fumigation. California Agriculture, January 1978. Pp. 15-16.

**Acknowledgements:**

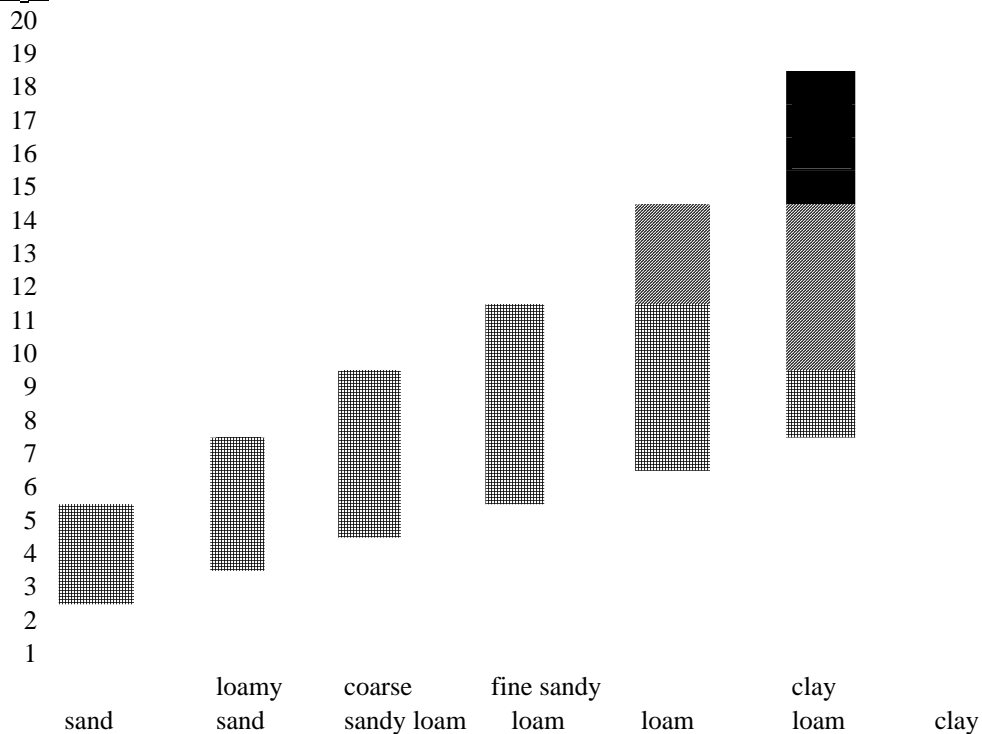
Greatly appreciated was the assistance of TriCal Inc., Hollister, CA; Stuke Nursery, Gridley, CA; Sierra Gold Nursery, Yuba City, CA; and Bob Lemos of UC Davis Pomology Dept.

**Chart 1. Fumigation requirements to obtain 27-mo-old nematode-free nursery stock.**

**Treatments:**



**% H<sub>2</sub>O**



\* must use Buessing winged shank in soil pre-ripped to 4 ft on 2 ft centers

\*\*must use Buessing winged shank in soil pre-ripped to 5 ft on 2 ft centers

# pluot, plum, prune and cherry scions can exhibit iodide toxicity in sandy soils

**Field preparation and assessment**

- steps 1 two years since previous perennial crop
- 2 fall-plant deeper-rooted crops such as winter wheat or oats to utilize winter rainfall
- 3 harvest by early summer to avoid green matter on field surface at fumigation time
- 4 rip soil to depth with shanks on 4 ft centers then second pass between markings  
step 4 may be substituted by a slip plow on 6 ft centers (= 3 ft between passes)
- 5 re-level and smooth as needed leaving no clods larger than 2 inch on field surface
- 6 fumigations may be applied simultaneous or MS applied first with 2-ac inch drench
- 7 MS may be applied as a drench or simultaneous with fumigation using rototiller to 5"
- 8 collect H<sub>2</sub>O %, from soil of finest texture in the block, at 1 ft increments to 5 ft depth  
note: 90 lb/ac metam potassium (at 54% ai) may be substituted for 110 lb/ac MS (42%)