EFFICACY AND 1,3-D EMISSIONS WITH APPROVED NURSERY STOCK CERTIFICATION TREATMENTS APPLIED WITH TWO SHANK DESIGNS

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Introduction:

Nursery producers of perennial crops including fruit and nut trees, grapevines, and ornamentals in California rely on preplant soil fumigation to meet CDFA requirements for nematode free planting stock. Certified clean stock is essential for successful establishment and future productivity of new orchards and vineyards and is a requirement for intra- and interstate as well as international commerce of planting materials. Historically, most field grown perennial nursery operations have used methyl bromide (MB) for preplant pest control because the chemical can effectively diffuse through the soil profile, penetrate existing roots, and has dependably provided effective pest control across a range of soil type and moisture conditions. Currently the primary non-MB fumigant that meets the requirements of the CDFA's Nursery Stock Nematode Certification program (CDFA 2007) is 1,3-dichloropropene (1,3-D). Several factors limit the adoption of 1,3-D in perennial crop nurseries:

- Not an approved nematode treatment in fine textured soils.
- Requires greater attention to soil preparation and moisture management.
- Township caps and buffer zone requirements.
- Weed control concerns.
- Air quality concerns related to volatile organic compounds (VOC).

The specific objectives of this research are to:

1. Determine the effects of a modified Buessing shank on 1,3-D emissions compared to standard application shanks.
2. Demonstrate effective nematode control with currently approved 1,3-D fumigation treatments in field nursery situations and determine if VOC mitigation procedures affect efficacy.
3. Determine the effects of approved nursery treatments applied with Buessing or straight shanks and several surface treatments on weed, pathogen, and nematode control efficacy and crop growth parameters.

Materials and Methods:
This research was initiated in fall 2007 and four field trials will be conducted over the next three years. In each of the first two years of this project, two experiments will be established. First, an experiment will be established in either nursery or orchard fields containing sandy or sandy loam soil and having testable plant parasitic nematode populations. Emissions of 1,3-D will be monitored in this trial using active flux chambers and nematode samples will be collected before and after treatment to address objectives 1 and 2; however, no nursery crop will be planted. A second experiment with identical treatments will be conducted in a commercial nursery planted to a 15 month nursery crop in order to address objectives 2 and 3 under standard nursery production practices. This two-site strategy is necessary due to the fact that many nursery operations have very low resident nematode populations after many years of effective MB fumigation.

Each experiment will be designed as a randomized complete block with four replicates. Individual plot size will be approximately 0.02 ha (7 by 30 m) and will be treated with commercial application equipment. Specific fumigant treatments are listed in Table 1 and include four NIPM approved treatments designed to provide nematode free status for a 26 month crop. Treatments will be applied with conventional equipment including a Noble plow rig (methyl bromide) and conventional Telone rig (Telone II treatments). NIPM guidelines for Telone II allow several surface treatments designed to reduce emissions and increase pest control efficacy near the soil surface including tarping with high density polyethylene (HDPE), “flipping” 14 to 30 DAT and retreating with additional Telone II, and a subsequent treatment 7 to 21 DAT with either metam sodium or metam potassium. Water seal techniques for emission reductions (Gao and Trout, 2007) currently under discussion for inclusion in future NIPM regulations and a high barrier film (virtually impenetrable film, VIF) have also been included. In addition to the conventional shank system, each of the Telone II treatments will also be applied with modified shanks based on the Buessing shank (McKenry et al. 2003). This shank is designed to split inject fumigants at 45 and 70 cm and has “wings” welded at several points on the shank. The wings are intended to scrape soil into the shank trace and, combined with the split injection, could lead to better efficacy at deeper depths in the soil profile and potentially reduce 1,3-D emissions. Data will be collected on 1,3-D emissions, nematode and weed control efficacy, and economic considerations for the various treatments.

Results and Conclusions:
These trials have only recently been established and will be ongoing for the next several years. The results of this work will be disseminated to growers and pest control advisors (PCA) during field days, extension meetings, pest management conferences, and in journal articles. Peer-to-peer among conversations cooperating nurserymen and will also be an important part of technology transfer and outreach effort. Additionally, emission reduction data will be presented to regulatory agencies in an effort to encourage science-based decisions on fumigant and other VOC emissions.

Table 1. Treatments for Nursery Fumigation Efficacy and Emission Research Project

		Rate	Surface treatment	Shank system
1	Untreated	--	--	--
2	Methyl bromide	337 kg/ha	HDPE tarp	Noble plow
3	Telone II	373 kg/ha	HDPE tarp	Standard
4	Telone II	373 kg/ha	HDPE tarp	Buessing
5	Telone II fb Telone II	320 kg/ha fb 213 kg/ha	Flipped and retreated	Standard
6	Telone II fb Telone II	320 kg/ha fb 213 kg/ha	Flipped and retreated	Buessing
7	Telone II fb Vapam	373 kg/ha fb 187 L/ha	Vapam cap	Standard
8	Telone II fb Vapam	373 kg/ha fb 187 L/ha	Vapam cap	Buessing
9	Telone II	373 kg/ha	Water seal	Standard
10	Telone II	373 kg/ha	Water seal	Buessing
11	Telone II	373 kg/ha	VIF	Standard
12	Telone II	373 kg/ha	VIF	Buessing

Literature Cited:

CDFA. Nematode Inspection Procedures Manual (NIPM) guidelines. Available online at: http://www.cdfa.ca.gov/phpps/pe/NIPM.htm. Last accessed August 2007.

Gao, S., and T. Trout. 2007. Surface seals reduce 1,3-dichloropropene and chloropicrin emissions in field tests. J. Environ. Qual. 36:110-119.

McKenry et al. 2003. New chisel shanks enable improved fumigation of finer-textured soils. Proc. Annual Int. Research Conf. on Methyl Bromide Alternatives and Emission Reductions p. 36.