NEW CHISEL SHANKS ENABLE IMPROVED FUMIGATION OF FINER-TEXTURED SOILS

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Production of an adequate supply of fast-growing, budded, nematode-free nursery stock for orchard and vineyard land requires that nematodes in the surface five-feet be controlled prior to seeding. There are difficulties in delivering soil fumigants throughout a five-foot field surface, but successful production of 14 to 26 month nursery crops depends on this level of nematode control. Methyl bromide (MB) properly applied at 300 to 450 lb/ac can achieve this goal. Telone II (1,3-D) properly applied at 330 lb/ac with a tarp or 480 lb/ac as a dual application can also provide success, but only in coarser-textured soils dried to a level of -45 cb moisture tension. This is because the 1,3-D molecule degrades quicker than MB but also has a higher affinity for water. For 1,3-D applications made to sandy loam soils this level of drying translates to less than 12% soil moisture content throughout the surface five-feet. A finer-textured soil deeply dried to -45 cb can commonly hold 12-20% moisture content throughout the surface 5-feet. Fumigation of these soils can be successful but treatment rates of 500 to 670 lb/ac 1,3-D are essential.

Beginning in 2001, various 1,3-D treatments were applied to clay loam nursery soils of the Sacramento Valley. Compared to MB, the use of 1,3-D in regions north of San Francisco was never popular. Fields near Yuba City and Davis, CA that had not been in permanent crops for two years were selected. Fields were dried with a cropping of winter wheat and then ripped 30-inches deep. To meet California labeling requirements the fields were required to receive ~1.5-ac-in water applied at the field surface. This water delivery is required to impede 1,3-D off-gassing but it actually impedes 1,3-D performance so these field surfaces were not moistened prior to fumigation. Sixty-days after treatment we followed our standard procedure of soil sampling each replicate at one-foot increments to five feet deep. Results depicted for 2001 in Table I revealed that even when soils had been dried to 14-20% soil moisture the addition of higher treatment rates plus a tarp gave inadequate performance. Poorest control occurred deeper in the soil as depicted in Table II. It was also apparent when the tarps were removed from the field that closure of the chisel shank traces was inadequate.

In consultation with the junior authors, new delivery shanks were built. Shanks were designed to deliver fumigant 8-inches deeper than the prevailing depth requirement of 22-inches. Approximately 6 inches above the 30-inch depth a narrow delta wing attachment was welded to each shank. It was positioned so that it scraped soil from the side-walls into the shank trace beneath. A second delta wing was positioned 16 inches above the delivery depth and a third one above that. In order to pull a series of five shanks through the soil at 24-inch

spacings the field had been ripped to 48-inch depth in three directions. Immediately following passage of the shanks a second tractor pulling a disk and ring roller assured complete filling of the shank traces. Compaction and filling of these shank traces was verified by random insertion of a penetrometer across the field surface. Finally, the placement of glued HDPE tarps or application of 20 gpa K-pam in front of a rotavator and press wheel completed the treatments.

Soil samples collected 60 days after treatment are reported in Tables I and II. The 2002 treatment was planted to peach seeds in November 2002. Trees will be grown for two years to evaluate performance of 1,3-D at several rates in addition to various combinations of iodomethane and chloropicrin.

Shortcomings to the realization of this new equipment:

- Larger equipment to pull these designated shanks.
- Deeper soil preparation required.
- CaDPR approval needed for higher 1,3-D treatment rates.
- Verification of these findings in additional field sites.

Attributes and spin-offs of the findings:

- A method of emission reduction that growers might prefer in lieu of current surface moisture requirements (if permitted by CaDPR).
- In 2005 the methodology reported here appears as the only MB alternative for finer-textured vineyard and orchard lands of California.

Table I. Nematode control in clay loam soil expressed as a % of nontreated.

UC Davis Trial, 2001-02	% Parasitic		% Free-living
Telone II at 332 lb, tarped	87%		39%
Telone II at 530 lb, tarped	96%		65%
Telone II at 670 lb, tarped	95%		82%
Non-treated, (actual numbers)	(213 nemas)		(114 nemas)
Yuba City Trial, 2001-02			
Telone II at 332 lb, tarped	97.90%		90%
Telone II at 500 lb, tarped	99.00%		99.50%
Telone II at 670 lb, tarped	99.00%		99.60%
Non-treated, (actual numbers)	(107 nemas)		(356 nemas)
	tarped	K-pam*	
Yuba City Trial, 2002-04			
Telone II at 332 lb, new shank	98%	98.40%	
Telone II at 500 lb, new shank	95.00%	98.80%	
Telone II at 670 lb, new shank	98.50%	100.00%	
Midas + Pic 200 ea., new shank	98.30%	99.80%	
Telone II + Pic 332 lb ea**	99.60%	99.60%	
Methyl Bromide 400 lb,12 inch	96.40%	0	
Non-treated (actual numbers)	(37 nemas)	(17 nemas)	

* K-pam applied at 20 gpa before rotavator to surface 5 inches
** Pic applied at 30 inches (new shank) and Telone at 20 inch depth
Note: A ring roller and disc followed fumigation shanks except with MB
Each % value above emanates from 20 individual soil samples

Table II. Location of surviving nematodes in the soil profile.

		Mean nematode survival /250 cc soil at five depths*				
		0-1 ft	1-2 ft	2-3 ft	3-4 ft	4-5 ft
Telone II at 332 lb						
old shank	Davis, 2001-Tarp	1.75	0.75	43.5	26.25	7.25
old shank	Yuba City, 2001-Tarp	0	0	0	8	13
new shank	Yuba City, 2002-Trp	2.5	0	0	0	0.25
new shank	Yuba City, 2002-MP	0	0	0.25	0	2
Telone II at 500 lb						
old shank	Davis, 2001-Tarp	0.5	0.25	0.75	15	8
old shank	Yuba City, 2001-Tarp	0	0	0	5	17
new shank	Yuba City, 2002-Trp	0.5	0	0	0.25	6
new shank	Yuba City, 2002-MP	0	0	0	0	1.75
Telone II at 670 lb						
old shank	Davis, 2001-Tarp	0.5	0	1.5	16.75	12.25
old shank	Yuba City, 2001-Tarp	1.5	0.5	0	9	12
new shank	Yuba City, 2002-Trp	0.25	0	0	0	1.25
new shank	Yuba City, 2002-MP	0	0	0	0	0

* each value above is the mean of four soil samples
Note: Soil moisture levels ranged from 14 to 20% across surface five feet of soil