EVALUATIONS OF CHEMICAL ALTERNATIVES TO METHYL BROMIDE FOR NEMATODE CONTROL AND TOMATO YIELD IN FIELD MICROPLOTS

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During Fall 2003 and Spring of 2004, single experiments were conducted in field microplots (95 l) at the University of Florida Citrus Research and Education Center in Lake Alfred, FL. The objectives of these experiments were to evaluate single preplant applications of various alternative chemicals, many of which were non EPA registered, for control of the southern root-knot nematode, *Meloidogyne incognita*, and resultant impacts on tomato yield. The microplots were blow molded, polypropylene containers (0.48 m long x 0.6 m i.d.) buried 43 cm deep and filled with 0.13 m^3 of Chandler fine sand (96% sand, <2% clay, silt, and organic matter content). Treatments included an untreated control, methyl bromide chloropicrin (98/2; 392 kg ha^{-1}), Telone C35 (243 L ha^{-1}); Midas 98/2 (methyl iodide: 196, 263, and 336 kg ha^{-1}); Sep 100 (sodium azide: 84, 140, 148, 222, 263, and 370 kg ha^{-1}); Dimethyl disulfide (DMDS: 672, 896, and 1120 kg ha^{-1}); Fosthiosate 900 EC (5.0 kg a.i. ha^{-1};); Multiguard Protect (1973 L ha^{-1}); Multiguard FFA (1973 L ha^{-1}); TerraKleen (Hydrogen Peroxide: 9.4, 47, and 94 L ha^{-1}); and *Quillaja sopanaria* extract (374 L ha^{-1}).

For each treatment, the soil was hand rotovated to a depth of 25 cm and lightly tamped to insure a smooth, flat surface. A 50 cm diameter template with 100- 15 cm long nail spikes, (the spikes are driven through the template), was pushed into the soil of each microplot to create 100 channels for penetration of treatment solution into soil. The appropriate dose of SEP 100, DMDS, Multiguard Protect, Multiguard FFA, Terra Kleen, and *Q. sopanaria* was then suspended in 3.9 L of water and drenched via a sprinkler can into each microplot. As for all treatments evaluated in this test, a black/white 1.25 mil polypropylene plastic mulch cover was then cut to appropriate size and installed over the microplot following treatment and remained in place until planting at which time it was permanently removed. Rates of application for all treatments were calculated based on a proportional reduction from a broadcast application rate. Each microplot was calculated to be 0.3 m^2. This figure was used to calculate the actual rate of each chemical product per microplot. The technique which was employed for soil injection of the liquid fumigants (ie., Methyl bromide, Telone C35, and Midas 98/2) was as follows 3 weeks prior to planting. The cap from a half liter container filled with either Telone C-35 or Midas 98/2. was replaced with septum cap, and the appropriate dose removed from the glass bottle using a Hamilton Gas Tight syringe installed with a 5 cm long stainless steel needle. Then for each microplot, three separate soil injections will be made in a triangular pattern with each injection point separated from its neighbor by a distance of 25 cm. One-third of each microplot dose was dispensed to a depth of 25 cm to each of the 3 centrally located soil injection sites per microplot. This technique not only insures a more uniform distribution of the fumigant within each microplot but almost completely eliminates any direct dermal or respiratory exposure to the individual products. Methyl bromide chloropicrin (98/2) was injected via use of a specially designed micro-dispenser system.

All treatments were arranged within the experimental area as a completely randomized design with 9 replications per treatment. Five week old tomato transplants were obtained from Speedling Corporation and planted within the microplots following treatment. Water and nutrients were supplied to each microplot via pressure regulated (15PSI) E-2 drip emitters (7.5 l/hr) on a daily/ twice daily basis (unless sufficient rainfall occurs) for a period of 1-2 hours each irrigation. Fertigation rates were seasonally defined based on crop growth stage. Fertilization rates were based on a field equivalent of 102 kg NPK per acre per season. Other pest and disease control measures were maintained primarily on both a prophylactic and as needed basis. Tomato fruit were harvested once during Fall 2003 and twice during Spring 2004 according to commercial USDA size grade standard, with a portable field grader which sorted fruit according to size into extra large (5x6), large (6x6), and medium(6x7) sized fruit. Only extra-large and large fruit were picked during the first harvest on . At the second harvest, all remaining fruit were stripped from the plant and sorted again to size grade, fruit numbers determined, and weight recorded from a mettler balance for each size category including cull. Following harvest, plants were cut at ground level and foliage weight recorded with a digital mettler balance in the field. Plant root systems within the microplots were then excavated, carefully shaken of soil, and the root systems evaluated for root gall severity based on a visual rating scale of zero to ten. An analysis of variance and a Least Significant Difference (LSD) mean separation test was performed on yield and root gall data.

Results

During Fall 2003, no significant ($P \leq 0.05$) or meaningful differences were measured in tomato fruit yield among the methyl bromide chloropicrin, Telone C-35, Midas 98/2, and higher rate Sep 100 treatments (Table1). In general these treatments produced tomato yields which were 2 to 3 times greater than that of the untreated control. Only the TerraKleen (hydrogen peroxide) treatments produced yields which could not be discriminated from the untreated control. No treatment evaluated during Fall 2003 completely eliminated final harvest root galling caused by *M. incognita* (Table1). Although a significant ($P \leq 0.05$) dose response relationship was not observed, lowest levels of root galling was observed with any of the SEP 100 treatments. Compared to the untreated control, little or no reductions in root galling were observed with Multiguard Protect, Multiguard FFA, or any TerraKleen or *Q. sopanaria* treatment. Fosthiosate and most Midas 98/2 treatments only reduced root gall severity to intermediate levels (Table 1).

Compared to the untreated control, Tomato fruit yield was significantly ($P \leq 0.05$) increased with methyl bromide chloropicrin 98/2, Telone C-35, all rates Midas 98/2, and by SEP 100 (140 kg ha^{-1}) during Spring 2004. All of the methyl disulfide (DMDS), Fosthiosate, and the SEP 100 (84 kg ha^{-1}) treatment produced tomato yields which did not differ ($P \leq 0.05$) from that of the untreated control (Table 1). Once again, none of the treatements evaluated during Spring 2004 completely eliminated root galling caused by *M. incognita*. Compared to the untreated control, the lowest ($P \leq 0.05$) level of root galling was observed with Telone C-35, followed by methyl bromide chloropicrin and the higher rate of SEP 100 (140 kg ha^{-1}). Surprisingly, none of the Midas 98/2 treatments reduced ($P \leq 0.05$) the levels of root gall severity compared to that of the untreated control during Spring 2004. A significant ($P \leq 0.05$) but generally intermediate reduction in root gall severity was obtained with the methyl disulfide (DMDS) treatments compared to the untreated control. A significant ($P \leq 0.05$) dose response between soil application rate and root gall severity was not observed with either Midas 98/2 or that of methyl disulfide (DMDS) during Spring 2004.

TABLE 1. Alternative chemicals evaluated for nematode control and tomato yield response in field microplots during Fall 2003 and Spring 2004, Lake Alfred, FL.

TREATMENTS		Rate per Hectare	FALL 2003		SPRING 2004	
			Tomato Yield (g/plant)	Root Gall Severity (0-10)	Tomato Yield (g/plant)	Root Gall Severity (0-10)
1	Untreated Control	---	1177 f [1]	7.8 a	3115 e	7.3 a
2	Methyl Bromide Chloropicrin 98/2	448 kg	2787 a	2.5 de	4491 abc	3.1 ef
3	Telone C-35	243 L	2576 abc	2.3 de	4812 ab	1.9 f
4	Midas 98/2	196 kg	2542 abc	6.6 abc	5237 a	6.3ab
5	Midas 98/2	263 kg	2871 a	6.1 bc	4307 abcd	7.0 a
6	Midas 98/2	336 kg	2936 a	5.4 c	4635 ab	6.9 a
7	Sep 100	84 kg	--	--	4027 bcde	5.6 abcd
8	Sep 100	140 kg	--	--	4189 bcd	3.3 def
9	Sep 100	148 kg	2565 abc	1.5 ef	--	--
10	Sep 100	222 kg	1998 bcde	0.9 ef	--	--
11	Sep 100	263 kg	2631 ab	0.7 f	--	--
12	Sep 100	370 kg	2282 abcd	1.1 ef	--	--
13	Methyl Disulfide	672 kg	--	--	3087 e	3.6 cdef
14	Methyl Disulfide	896 kg	--	--	3418 de	3.9 bcdef
15	Methyl Disulfide	1120 kg	--	--	3175 e	4.3 bcde
16	Fosthiosate 900 EC	5 kg a.i.	2344 abcd	5.5 c	3612 cde	5.9 abc
17	Multiguard Protect	1973 L	2206 abcde	6.9 abc	--	--
18	Multiguard FFA	1973 L	2680 ab	6.3 abc	--	--
19	TerraKleen	9.4 L	1844 cdef	7.9 a	--	--
20	TerraKleen	47 L	1163 f	7.6 ab	--	--
21	TerraKleen	94 L	1604 edf	7.4 ab	--	--
22	Quillaja sopanaria	374 L	1603 edf	7.4 ab	--	--

[1] Data are means of 9 replicates. Means within columns followed by the same letter do not differ as P≤0.05 Student Newman Keul (SNK) Mean Separation Test.