PROPARGYL BROMIDE, BIORATIONALS, AND OTHER FUMIGANTS FOR NEMATODE CONTROL

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Soil borne pest and disease control in Florida tomato production had been achieved for over 25 years with the broadspectum soil fumigant methyl bromide. The objectives of the studies reported herein were to evaluate the use and efficacy of various alternative fumigants and biorational compounds as preplant and postplant soil treatments for control of the southern root-knot nematode, Meloidogyne incognita, yellow nutsedge (Cyperus esculentus) and to measure resultant impacts on tomato plant growth, development, and yield.

USE of BIORATIONAL COMPOUNDS: Beginning Spring 1998, a series of three small plot field experiments were conducted to evaluate the nematode suppressiveness of eleven biorational compounds (Table 1) and to determine any corresponding enhancement of tomato fruit yield. The term biorational is defined herein as a more environmentally friendly, soft pesticide used for management of nematodes in soil. The active ingredients of these compounds can best be described as either microbial agents or derived toxins, plant extracts or dried plant products, or simple blends of fatty acids, stabilized colloids, or secondary alcohols. In these studies, microplot soil infested with *Meloidogyne incognita* was treated with each formulated product at or above maximum label or recommended rates (Table 1).

In an attempt to evaluate and compare the performance of these compounds to that of methyl bromide and Telone C17 for nematode control on an experimentwide basis over the three cropping seasons, separate analyses for each experiment were first performed to quantify the actual numerical differences in root gall severity and tomato yield between biorational treatments and the untreated control. Average root gall severity values for each treatment were divided by the average value of the untreated control to establish proportional differences between treatments on a relative scale of 0 to 1. Relative root gall severity ratings were then averaged across all experiments for a particular compound to derive an overall, experimentwide, comparison of biorational treatments on nematode control. Similarly, average tomato yield for each biorational treatment was divided by the average value of the methyl bromide treatment to establish proportional differences between treatments on a relative yield scale of 0 to 1. Using the relative scale, seasonal effects in tomato yield and root gall severity could be largely removed and treatments evaluated and compared on their own merits.

In general, the results from these three studies showed that the biorational compounds provide little or only very weak nematicidal activity, and were always considerably less effective than that of the current industry standard, methyl bromide or of Telone C-17 (Fig 1). For example, none of the biorationals produced a significant (P=0.05) reduction in final

harvest root gall severity compared to the untreated control during any season in which they were applied. In some cases, this occurred even though weekly applications of the compound were made rather than a single preplant treatment. On average, relative root gall severity of the biorational compounds on an experimentwide basis was within 10 to 15% of that of the untreated control (Fig. 1). Whereas, an 80 to 95% (P=0.05) reduction in final harvest root gall severity was achieved with either Telone C-17 or methyl bromide compared to the untreated control. Differences in tomato yield were usually directly related to final harvest root gall severity. For example, highest tomato plant fruit yields were always associated with plants expressing little or no symptoms of root system galling. All biorationals significantly (P=0.05) reduced tomato yields compared to methyl bromide in each of the three experiments. On average, tomato yield losses of 30 to 50% were observed with the biorational compounds compared to that of methyl bromide (Figure 2). In general these results would suggest that suitable and or consistent nematode control and tomato yield enhancement cannot be achieved with the biorational compounds evaluated in these studies. Further research characterizing the utility of these compounds under different environmental conditions, and the ways and means in which to increase their effectiveness is necessary.

USE OF ALTERNATIVE FUMIGANTS: During the spring of 1999, a single replicated field experiment was conducted to compare nematode control and tomato yields in response to broadcast equivalent propargyl bromide application rates of 150 and 300 lb/a compared with Basamid (400 lb/a), methyl bromide 98/2 (400 lb/a), Telone C17 (35 gal/a), and an untreated control. Propargyl bromide and Telone C17 soil injections were made using a Hamilton Gas Tight syringe installed with a 25 cm long stainless steel needle. After an appropriate soil aeration period, tomato plants were grown to maturity and harvested twice. At each harvest fruit was sorted and weighed into 3 size categories including medium, large, and extra large tomatoes. Following harvest, these same plants were cut at the soil line and the foliage weighed. Immediately after foliage removal the plants were uprooted and the root systems evaluated for root gall severity based on a visual rating scale of zero to ten. Final soil population density samples were then removed after root gall assessment.

The results of this study showed that all fumigant treatments significantly (P=0.05) reduced final harvest soil population density of *Meloidogyne incognita* and tomato root gall severity (Fig. 3) compared to the untreated control. No differences (P=0.05) or dose response relationship between application rates of propargyl bromide, Telone C17, or methyl bromide were observed in these parameters. Tomato yields were significantly (P=0.05) increased by all fumigant treatments compared to the untreated control (Fig. 4). Both propargyl bromide (150 lb/a) and Telone C17 increased (P=0.05) tomato yields compared to the Basamid treatment. In summary, propargyl bromide proved to be a compound which was easy to handle and apply, demonstrated excellent nematicidal and herbicidal activity (data not shown), and produced tomato yields equal to that of methyl bromide. Field research with propargyl bromide is continuing, however other factors and regulatory concerns must be addressed before being realistically considered a potential alternative to methyl bromide.

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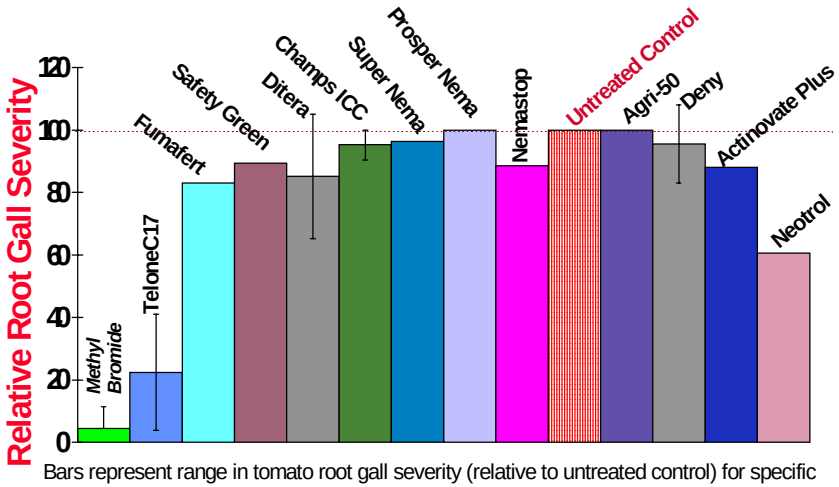
TABLE 1. List of Individual biorational compounds, product composition, and broadcast equivalent application rates evaluated for control of the southern root-knot nematode, *Meloidogyne incognita*, and for tomato yield enhancement in small plot field trials at Lake Alfred, Florida during the Spring 1998, Fall 1998, and Spring 1999 cropping seasons.

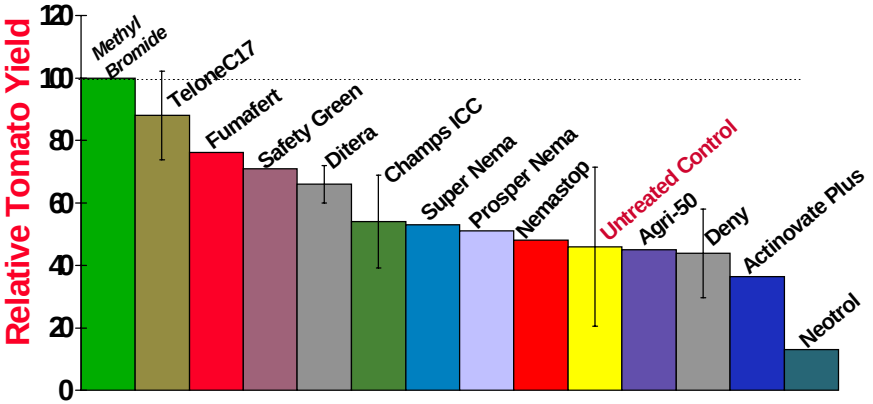
TREATMENT	**COMPOSITION**	**RATE**
1. Untreated Control --		---
2. Actinovate Plus	*Steptomyces lydicus*	16 oz/a @ week
3. Agri-50	Stabilized colloid mixture	143 gal/a
4. Champon Insect Control Concentrate	mixture pepper, mustard, & citrus oils	50-150 gal/a
5. Deny	0.6% *Burkholderia cepacia*	1 pt/a @ week
6. DiTera WDG	toxin derived from *Myrothecium verrucaria*	100 lb/a @ week
7. Fumafert	mixture rapeseed meal & neem oilseed meal	916 lb/a
8. Nemastop	Liquid combination of plant extracts and fatty acids.	20 gal/a
9. Neotrol	100% ground sesame plant	460 lb/a (2x)
10. Prosper Nema	Selected strains of mycorrhizal fungal spores	305 lb/a
11. Safety Green	Proprietary blend secondary alcohols	2 pts/a
12. SuperNeem	Combination of humic acid, seaweed extract and neem concentrate	2gal/a
13. Methyl bromide	combination of methyl bromide and chloropicrin	400 lb/a
14. Telone C-17	liquid formulation of 1,3 dichloropropene and chloropicrin	35 gal/a

Figure. 1. Overall effect of biorational compounds on root gall severity by *Meloidogyne incognita*, relative to the untreated control, in replicated tomato field microplot trials during spring 1998, fall 1998, and spring 1999 at Lake Alfred, Fl.



Bars represent range in tomato root gall severity (relative to untreated control) for specific treatments which were evaluated in multiple field trials

Fig. 2. Effect of biorational compounds on tomato yield, relative to methyl bromide, in replicated tomato field microplot trials during spring 1998, fall 1998, and spring 1999 at Lake Alfred, Fl.



Bars represent range in tomato yield (relative to methyl bromide) for specific treatments which were evaluated in separate trials

Figure 3. Influence of various fumigants on tomato root gall severity caused by *Meloidogyne incognita* during Spring 1999, Lake Alfred, FL.

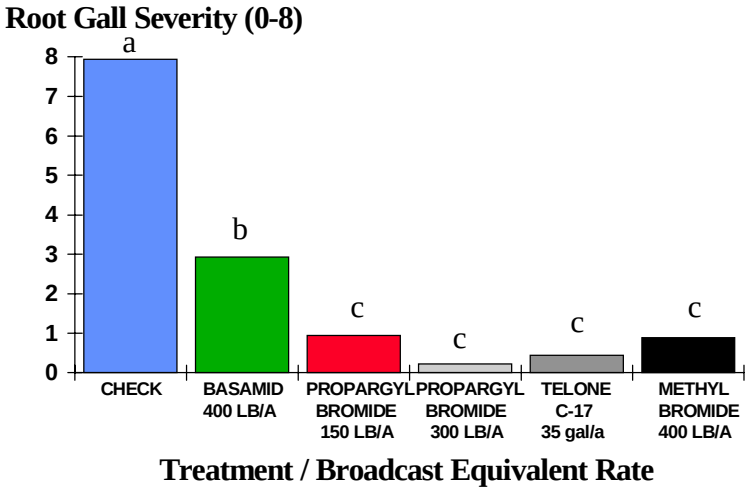


Figure 4. Influence of various fumigants on tomato yield (cv. Agriset 761) during Spring 1999, CREC, Lake Alfred, FL.