DETERMINING METHAM SODIUM LETHAL DOSAGE FOR NEMATODES IN GROWER FIELD MICROPLOTS

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In Florida, drip fumigation has not been extensively used because of rapid conductivities of our fine sandy soils, and because seep, rather than drip irrigation is still extensively used in many vegetable production regions of the state. In Florida strawberry where the drip system is used for fumigant delivery, drip fumigation is used as a pest management tool for rapid crop destruction or as a preplant pest control treatment for production of a double crop. Previous research has demonstrated that even under optimal conditions, use of a single drip tube per bed is typically capable of wetting only a maximum of about 50% of the bed. Interest as a preplant fumigant treatment for the primary crop has been renewed by the EPA fumigant reassessment / reregistration process. In these published reviews, drip fumigation has been identified as one of the most effective means in which to reduce buffer zone distances and to increase treated acreage per day limits with the alternative fumigants. In general, EPAs reassessment analyses of the alternative fumigants indicates that tarped drip-irrigation applications generally result in significantly lower fumigant emissions than tarped or untarped shank injection applications. As such, these preliminary analyses seem to indicate that chemigational approaches to soil fumigant treatment, rather than shank injections, are the most efficient means in which to reduce future buffer zone requirements and for total numbers of workers requiring personal protective equipment. Fumigant concentration in water (ppm) as a function of application rate and water volume can be calculated as follows:

Previous research have repeatedly demonstrated that if toxic concentrations of the nematicide do not come in contact with the nematode for sufficient time, acceptable levels of control will not occur. The lethal effect of a drip applied fumigant nematicide is determined by two components. The first is concentration (C) of the drip applied fumigant in soil solution, usually expressed as parts per million (PPM). The second is the length of time (T) the nematode is exposed, expressed in minutes, hours or days. The level of nematode control is then related to dosage, the amount of fumigant placed in the environment of the nematode for a known length of exposure time (concentration X time). The primary objective of the studies reported herein was to evaluate lethal dosage between different metham sodium concentration applied to soil to control the sting nematode, *Belonolaimus longicaudatus*.

To maximize lateral spread, growers should plan on a fumigant injection period to deliver 125 to 150 gal/ 100 linear feet of row. This equates to at least 13,500 gallons or about 50% (0.50) of a broadcast acre inch of water (1 acre inch is 27,154 gallons water). For most medium to high flow commercial drip tapes (0.4 to 0.6 gal/min/100 ft of row), a three to five hour injection period is the minimum required to maximize lateral spread of the fumigant in our soils. Chemical Injection is always followed by a complete flush of the lines. So when we talk about rates, the actual rates of application used for drip fumigation are thus a function of the fumigant concentration in irrigation water (ie., at least 500 ppm Telone EC; 1500 ppm KPam or Vapam) that you decide on and the overall length of the injection period. From this information it is possible to calculate overall chemical needs.

Methods: Four field microplot experiments were conducted in commercial grower fields in Dover, FL at the end of the strawberry production season during spring 2008. Each field was selected based on its high incidence and severity of plant stunting due to the sting nematode, *Belonolaimus longicaudatus.* Within each field, a large and relatively uniform area of stunted plants was selected before proceeding with microplot installation. For purposes of these trials, grower field microplots were 4 inch I.D. thin wall PVC tubing cut to overall length of 18 inches. Stunted plants were standardized among experimental locations as intermediately sized plants with measured canopy diameters approximating 10 inches. Once selected, the plant foliage was cut at the soil interface, and the PVC tube centered over the plant and driven to the traffic pan, a level just below the base of the mulch covered bed. A pointed rod (0.5 inch O.D.) was driven through the tube center and to the bottom of the microplot to provide a backfilling drainage hole to insure uniform distribution of metham sodium solution thoughout the overall length and width of the microplot. Once installed and drain channel created, a one liter solution of one of five metham sodium concentrations was dispensed into each microplot. Each treatment concentration was replicated 5 or 6 times at each field location. The objectives of each experiment were to evaluate single preplant applications of five soil fumigation application rates of metham sodium (Vapam HL 42% for control of the sting nematode, *Belonolaimus longicaudatus*. In these trials, metham sodium (Vapm HL: 4.26 lb ai / gallon) application rates of 10.9, 21.7, 32.6, 43.5, and 54.3 gallons per acre. Soil fumigation rates of 23, 46, 70, 93, and 116% of the maximum broadcast labeled rates were evaluated for each field location. The highest concentration (2552 ppm) was calculated to exceed the maximum per acre use rate for metham sodium for strip fumigation (62.5% of land area) by 15% when applied in 0.4 acre inches of irrigation water. Separate untreated controls were included for dosage comparison at each field location. Ten days post application, the PVC tubes, with soil intact, were carefully lifted from the plant bed, and the soil removed, bagged, tagged and returned to the laboratory where sting nematode was extracted using a Baerman funnel technique. Nematodes were then counted under a stereo microscope and expressed per 100 cc soil. Percent control was calculated as a percentage reduction from sting nematode population density of the untreated control at each experimental field location.

Results: End of season sting nematode populations were considerably different among the four experimental sites, rangeing from 9 to nearly sixty sting nematodes per 100 cc soil. At all experimental locations, effective nematode control was achieved at the lowest metham sodium concentration of 500 ppm (10.9 gal/a) (Fig. 1). However, sting nematode survivorship was not observed at concentrations greater than 1500 ppm (32.6 gal/a). Toxicologically, fumigant concentrations of the active ingredient of Vapam HL in irrigation water must exceed 1500 ppm to effectively and consistently kill nematodes. Because of inconsistencies observed, current recommendations for concentrations of the active ingredients of Vapam HL in irrigation water is 1500 ppm or higher.

Sting nematode is notoriously difficult to culture to generate pest populations to test plant damage or pest control relationships in greenhouse or small plot field studies. The use of this grower field microplot technique allowed us to take advantage of numerous field locations in which high endemic population of sting nematode existed. Undeniably, the system is not perfect since it does not duplicate the actual field environment, and thus dosage CT products in which metham sodium drip fumigation typically occurs. It does however reflect pest control capability under conditions in which the product is dispensed uniformly thoughout soil. With drip fumigation, the wetting front of known concentration moves through the soil, and after irrigation delivery ends, water continues to move gravitationally until water holding capacity is met. As air spaces develop, MITC gases are capable of moving relatively short distances. As a barrier, the PVC tube thus interferes with gas phase movement. Given the limited gas phase movement of metham sodium, the barrier properties of the PVC tube is not envisioned to have overwhelming effects to CT products over time.

Key Points:

1) Superior control of yellow or purple nutsedge at reduced application rates of methyl bromide or methyl iodide and chloropicrin was achieved only with the low permeability, high barrier VIF or metalized mulches.
2) Based on these results, Chloropicrin was observed to contribute little, either directly or synergistically with other fumigants for control

of nematodes or yellow or purple nutsedge. These data would suggest that potential importance of fumigant synergy only with disease control.

Table 1. Metham sodium concentrations evaluated in field microplots.			
	ml Vapm HL / liter Water	**PPM MITC Irrigation Water**	**Overall Use Rate (gal/a)**
1	1	510.5	10.9
2	2	1021.0	21.7
3	3	1531.5	32.6
4	4	2042.0	43.5
5	5	2552.5	54.3
Above use rates assume metham sodium (ml a.i. product / liter water) applied overall in 0.4 acre inches water per acre (1 acre inch = 27,154 gallons)			

Figure 1. Summary VAPAM Lethal Concentration Studies in True Field Microplots -Spring 2008