ALTERNATIVE STRATEGIES TO METHYL BROMIDE FOR SOILBORNE PEST AND DISEASE CONTROL IN FLORIDA STRAWBERRY

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Preplant soil fumigation with methyl bromide, used almost exclusively by Florida strawberry growers for broadspectrum soilborne pest and disease control, has almost completely alleviated problems of the sting nematode, ***Belonolaimus longicaudatus***, (as well as other apparent soilborne pest and disease problems) in Florida strawberry production systems. Because of the antiscipated phaseout of methyl bromide production and use by January 1, 2001, there is an urgent need to develop alternative pest control stategies which are as effective, and worker, food, and environmentally compatible and safe. To address these needs, three experiments were conducted at the University of Florida Agricultural Research and Education Center in Dover, FL to evaluate: (1) the importance of and extent to which crop losses are induced by sting nematode on Florida strawberry; (2) to determine the degree to which alternative chemicals may substitute for methyl bromide soil pest control; and (3) to initiate development of an overall IPM program for sting nematode management.

Fumigant treatments for experiments 1 and 2 (Table 1) were applied 28 September 1995. The fumigant treatments for **Experiment 1** included: Methyl bromide (98%) / Chloropicrin (2%); Chloropicrin and Telone C17 (1,3-dichloropropene (77.9%) and chloropicrin (16.5%). All were all soil injected at their maximum broadcast equivalent application rates of 400 lb/a, 350 lb/a, and 35 gal/a respectively. Soil applications were made via a single row bed press through 3 chisels per row (2ft wide bed) to a depth of 8 inches using nitrogen gas as the propellant. Vapam (32.7% sodium methyldithiocarbamate) was applied as a simultaneous rotovator incorporated-soil spray treatment with a 3 nozzle (8004 flat fan, 18 inch spacing) tractor mounted boom, targeted entirely into a 48 inch wide Maleti rotovator advancing at 1.88 ft/sec (1.28 mph). For the chemigation treatment, each of seven plots recieved 956 ml Vapam (32.7% Sodium methyldithiocarbamate; 3.18 lb a.i./gal), diluted in 35 gallons of water (2,750 ppm) and continuously injected (8 psi: 0.39 gal/min) into the drip-irrigation system of individual plots over a 90 minute injection period on October 3, 1995

<u>**Experiment 2**</u> consisted of four treatments. As the commercial standard reference treatment, a black laminated polyethylene plastic film with a permeation constant (PC) to methyl bromide of 12.2 was sealed over the plant bed immediately following MBC soil fumigation at a broadcast equivalent rate of 400 lb/a. Treatment number 3 utilized a white, highly methyl bromide impervious (1 mil, PC=6.6) polyethylene plastic film (Experiment unit #XUR-1551-3619-6, Dow Chemical Film Division, Fresno, CA) with MBC broadcast equivalent application rate of 200 lb/a. The appropriate plastic mulch cover and a single drip irrigation tube per bed center were installed immediately following bed construction and soil fumigation. All beds were constructed 20 cm high and 60 cm (24 in.) wide on 1.5 m (48 in.)centers. All methyl bromide treatments were a formulation of 98% methyl bromide and 2% chloropicrin and were compared with an untreated control and a hotwater treatment.

On September 28, 1995, the hotwater soil treatment was applied using a prototype hotwater generation, delivery, and soil incorporation system developed by AquaHeat Technology, Inc., Minneapolis, Mn. Hotwater (230 F, 87.5 gal/min) was delivered, via 10 soil chisels, to a depth of 8-10 inches and immediately rotovated to mix the soil and hotwater to achieve greater uniformity and heat distribution and temperature elevation throughout the surface 10 inch soil profile. Tractor speed was 0.336 ft/sec (0.23 mph) with a total hotwater volume of 217 gallons per 50 ft plot (the broadcast equivalent of 47,273 gallons water /acre).

Ratings of plant growth, vigor, and weed and disease incidence were assessed periodically during the October to May cropping season. For each plot, sting nematode population densities in soil were assessed before, twice posttreatment, and again after final harvest in May 1996. Soil samples consisted of 12 cores (1 inch diam. X 12 inches deep) from the root zone of strawberry plants within the plant row. Nematodes were extracted from 500 cc subsamples (sugar centrifugation / flotation) and counted under a inverted stereomicroscope. Crop fertilization, irrigation, and pest control actions (other than weeds) were according to normal and recommended practices. Strawberry plants from each plot were harvested according to commercial practices and time schedules, graded, and weighed. All data, including log transformed nematode population counts, were subjected to analysis of variance and appropriate mean separation tests.

Experiment 3 was designed to assess the value of sorghum sudangrass (*Sorghum bicolor x S. sudanense*), velvetbean (*Mucuna deeringiana*), hairy indigo (*Indigofera hirsuta*), and clean fallow as summer off-season IPM practices for management of the sting nematode (*Belonolaimus longicaudatus*). The experiment was designed as a randomized, complete block with four treatments and four replications . Plots of each treatment measured 50 by 24 feet. Experiment 3 was initiated May 15, 1996, after final harvest of experiments 1 & 2. Each field was disked and rotovated, and appropriate portions of the new, composite field plot planted to either velvetbean, hairy indigo, sorghum sudangrass or maintained as a clean, weed-free, fallow condition. Sting nematode populations were assessed monthly from May through planting in October 1996.

RESULTS and DISCUSSION:

EXPERIMENT 1: January yield of strawberries were significantly (P=0.05) increased on average by 187% over that of the untreated control by all soil fumigant treatments (Fig. 1). Although strawberry yields within the chloropicrin treatments were numerically higher, no significant (P=0.05) differences in January yields were observed between any of the fumigant treatments. The increase in strawberry yields among fumigant treatments directly corresponded to significant (P=0.05) increases in fruit numbers over that of the untreated control. By seasons end, cumulative strawberry marketable fruit yields were significantly (P=0.05) increased on average 46% over that of the untreated control by soil fumigant treatment. Among the soil fumigant treatments, use of chloropicrin resulted in significantly (P=0.05) greater marketable fruit yields compared to the Vapam chemigation treatment.

EXPERIMENT 2: January market fruit yields were significantly (P=0.05) greater within the methyl bromide (1x) treatment compared to the untreated control, half dose methyl bromide or hotwater soil treatment. By seasons end, cummulative marketable strawberry fruit numbers and yields were significantly (P=0.05) increased by the commercial standard methyl bromide (1x) treatment compared to either the untreated control, half dose methyl bromide, or hotwater soil treatments.

Due to the low and nonuniform field distribution of sting nematode within the experimental area, differences in nematode control efficacies between treatments in experiment 1 or 2 could not be meaningfully evaluated. Pre and post treatment soil population densities of the sting nematode were low and no differences (P=0.05) in pest control efficacy between treatment were observed in either experiment 1 or 2. Soil populations densities increased late season in an apparent response to strawberry plant growth and soil temperature. Control of winter annual weeds was similar for all fumigants. Given the nonuniform distribution and low abundance of nematodes and to a certain extent weeds, suggests that other undefined soilborne pests, diseases, or environmental factors can be equally important yield determining constraints. The failure of the hotwater and reduced, half-dose methyl bromide application rate to produce equivalent yield response to that of the standard methyl bromide treatment is also suggestive of the importance of other, more difficult to control, soilborne pests in determining strawberry yield.

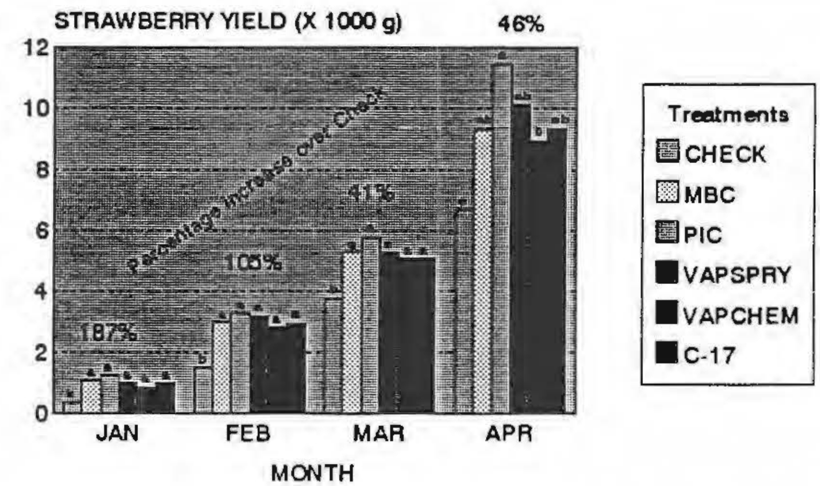
EXPERIMENT 3 : Prior to cover crop destruction on August 26, 1996, soil population densities of the sting nematode had increased 3 fold within the sorghum x sudangrass plots (98/500 cc soil) and declined to low, near undetectable levels (>2/500 cc soil) in plots maintained clean fallow or planted to velvetbean. The poor to nonhost status of hairy indigo could not be assess as a summer off-season management strategy for sting nematode due to poor seed germination and slow stand establishment.

Table 1.

	Broadcast Equivalent Application Rate @ Acre
EXPERIMENT 1.	
1. Untreated Control	- - - -
2. Methyl Bromide/ Chloropicrin	*400 lb*
3. Chloropicrin	*350 lb*
4. Vapam Rotovated Spray	*100 gal*
5. Vapam - Chemigation	*100 gal*
6. Telone C-17	*35 gal*
EXPERIMENT 2.	
1. Untreated Check	- - - -
2. Methyl Bromide/ Chloropicrin	*400 lb*
3. Methyl Bromide/ Chloropicrin (0.5X)	*200 lb*
4. Hotwater	*47,271 gal*

CUMMULATIVE STRAWBERRY YIELD

DOVER ALTERNATIVE CHEMICALS TRIAL 1995-96



CUMMULATIVE STRAWBERRY YIELD

DOVER ALTERNATIVE CHEMICALS TRIAL 1995-96