

EVALUATION OF CURRENTLY AVAILABLE ALTERNATIVES TO METHYL BROMIDE FOR ORNAMENTAL CROP PRODUCTION IN FLORIDA

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Funding for this project was provided by the South Atlantic Areawide Pest Management Project for Methyl Bromide Alternatives and was a cooperative effort among USDA, ARS, the University of Florida, ornamental producers, and fumigant industry representatives. Studies were designed to test the efficacy of the chemical alternatives, Midas™ (iodomethane:chloropicrin (pic) 50:50 [MI 50:50] and 98:2 [MI 98:2], Arysta LifeScience Corp., Cary, NC) and dimethyl disulfide:pic (Paladin™ 79:21 [DMDS], United Phosphorous, Inc., King of Prussia, PA) compared with methyl bromide (MeBr) as a standard at the scale appropriate for commercial production of the selected crops. All materials were applied by commercial applicators. Trials were conducted in two locations on commercial ornamental farms, one producing cut flowers and one producing caladium bulbs. The studies were replicated, randomized complete blocks with split plots to accommodate multiple cultivars in each location. The trials were repeated with treatments maintained in the same plots over multiple seasons.

The cut flower trial was performed in Hobe Sound, FL, and treatments were MeBr 400lb/A (98:2), MI 50:50 at 300 lb/A, and DMDS (79:21) at 74 gal/A. Treatments were replicated three times with each main plot measuring 26' x 110'. Plots were split to contain two rows each of delphinium cultivars 'Belladonna' and 'Bellamosum'. All materials were applied under standard 1 mil clear plastic mulch (Cadillac Plastic Ltd., Swindon, UK). There were no significant differences between treatments with regard to total weeding time in either year, but there were significantly more weeds per meter in the DMDS treatment than in the others in the second year. Principal weed problems were clover (*Trifolium repens*), spotted spurge (*Chamaesyce maculata*), goosegrass (*Eleusine indica*), and portulaca (*Portulaca oleracea*). 'Bellamosum' plants in the MI 50:50 treatments were the fastest growing plants, but early in the season there were a greater number of cut stems harvested from the MeBr and DMDS 'Bellamosum' plots than in the MI 50:50 plots. This trend did not continue as the total cuts and average number of cuts per plant did not differ between treatments in either year. There were no significant populations of root-knot (RKN) or other parasitic nematodes at the Hobe Sound location in either year 1 or 2 and no galling occurred on roots in any treatment in either season.

The first year of the caladium trial at Zolfo Springs included two formulations of MI 98:2 (100 lb/A) and MI 50:50 (160 lb/A), DMDS (79:21 at 60 gal/A), and MeBr:pic (98:2 at

180 lb/A), all applied under high barrier, Blockade[®] plastic mulch (Pliant Corp., Chippewa Falls, WI) using raised beds. A shank application of Telone II was applied 12-14" deep to the entire site before application of the test fumigants. Each treatment was replicated four times with each plot approximately 0.5 A, split into sub-plots planted to four cultivars. In the second year, the same treatments were applied using flat fumigation. In all trials, nematode and fungal populations were assessed prior to fumigation, two-to-five days following tarp removal, at mid-season, and at harvest. Plots were harvested by the grower. Dominant weed species were identified and time-to-weed data were collected by the grower. Galling was assessed and nematodes were extracted from roots at harvest. Fungi inhabiting roots were also assessed at harvest.

There were significant cultivar by fumigant interactions with regard to fungal colonization of caladium roots, particularly for *Fusarium* (Figure 1), *Trichoderma*, and *Pythium* (Figure 2). Root-knot nematodes in soil were equally well controlled by all fumigants early in the season. However, root-knot nematodes in soil rebounded in all treatments by harvest, eight months after fumigation. Root-knot nematode numbers in roots and root galling were more dependent upon cultivar than on fumigant (Figure 3). In general, nematode and fungal numbers were lower in the 2009 season when compared to 2008. The total number of weeds per acre was highest in plots treated with DMDS in the first year, but there was a high level of variability and the difference was not statistically significant. The number of weeds was highest early in the second season in plots treated with MI 50:50. Due to heavy weed pressure, weeds were weighed at the end of season rather than counted. Weed weights were highest in MI 98:2. The total number of bulbs produced, which includes both marketable bulbs and non-marketable seed stock, was also dependent upon the interaction between cultivar and fumigant (Figure 4). Value per acre was highly dependent upon cultivar.

Significant improvements in fumigant application resulted in higher yields in the second year of the delphinium trial. This location had insignificant nematode populations, but the weed pressure was high. Although the total number of weeds per plot was higher in DMDS-treated plots, this did not impact the total number of harvested marketable stems. Two full-field demonstration trials using MI 98:2 have been established at this location for the production of multiple cut flower species. In these fields, the use of VIF film was accomplished with standard tarp glue, but applications were made to a relatively small area, under 1 acre each. In the caladium trial, where RKN pressure was high, MI 98:2 application resulted in consistent reductions in populations, although cultivar selection will play a major role in the success of any alternative fumigant applied in this system. The additional time required prior to plastic removal was also an issue in the caladium trials due to the quantity of blowing soil being deposited on the plastic prior to removal in a full field tarping. This caused a significant increase in the cost of removal and disposal of plastic. The reduction in all pathogen and nematode populations in the second year supports the anecdotal information that the grower has gathered concerning the more effective control of soilborne pathogens using the full field broadcast application versus bedded applications. A grower field day was conducted at the site prior to harvest of the crop.

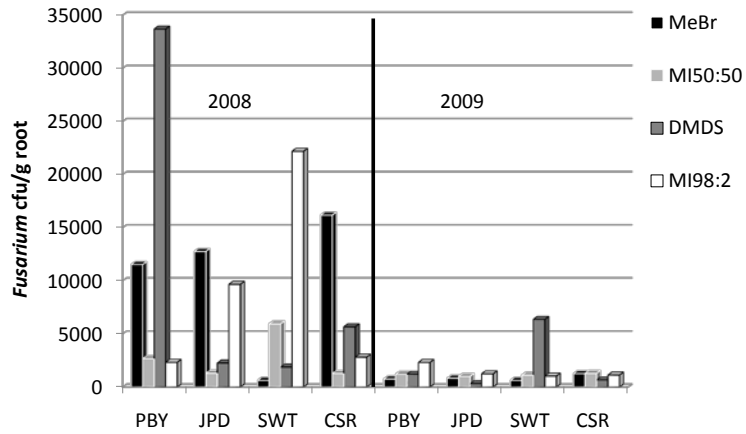


Figure 1. Interaction between soil fumigant (MI methyl iodide:chloropicrin 98:2 (100 lb/A) and MI 50:50 (160 lb/A), DMDs dimethyl disulfide: pic 79:21 (60 gal/A), and MeBr methyl bromide:pic (98:2 at 180 lb/A) and caladium cultivar (PBY 'Pink Beauty', JPD 'John Peed', SWT 'Sweatheart', and CSR 'Candidum Senior') on the recovery of *Fusarium* colony forming unit (cfu) per gram of root tissue at harvest in 2008 and 2009.

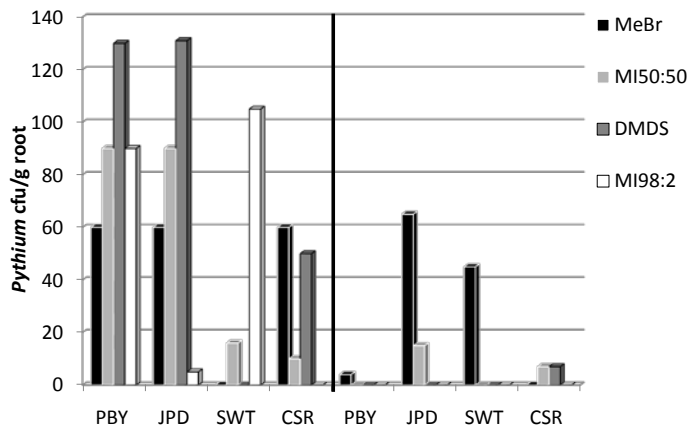


Figure 2. Interaction between soil fumigant (MI methyl iodide:chloropicrin 98:2 (100 lb/A) and MI 50:50 (160 lb/A), DMDs dimethyl disulfide: pic 79:21 (60 gal/A), and MeBr methyl bromide:pic (98:2 at 180 lb/A) and caladium cultivar (PBY 'Pink Beauty', JPD 'John Peed', SWT 'Sweatheart', and CSR 'Candidum Senior') on the recovery of *Pythium* colony forming unit (cfu) per gram of root tissue at harvest in 2008 and 2009.

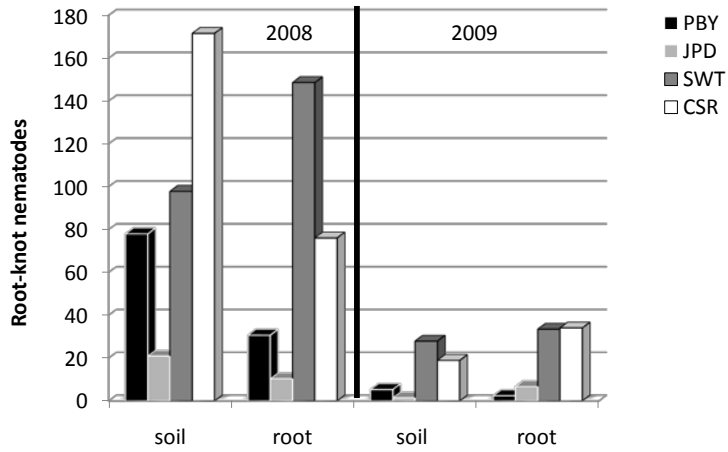


Figure 3. Impact of caladium cultivar (PBY 'Pink Beauty', JPD 'John Peed', SWT 'Sweatheart', and CSR 'Candidum Senior') on the numbers of root-knot nematodes per gram of root or per 100 cm³ of soil at harvest in 2008 and 2009.

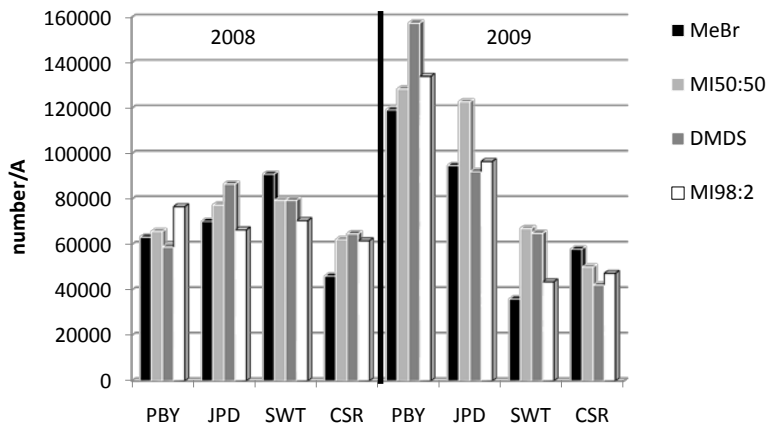


Figure 4. Interaction between soil fumigant (MI methyl iodide:chloropicrin 98:2 (100 lb/A) and MI 50:50 (160 lb/A), DMDS dimethyl disulfide: pic 79:21 (60 gal/A), and MeBr methyl bromide:pic (98:2 at 180 lb/A) and caladium cultivar (PBY 'Pink Beauty', JPD 'John Peed', SWT 'Sweatheart', and CSR 'Candidum Senior') on the total number of marketable and seed caladium bulbs produced adjusted to the acre for the 2008 and 2009 harvests.