EVALUATION OF STEAM FOR NEMATODE AND WEED CONTROL IN CUT FLOWER PRODUCTION IN FLORIDA

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The goal of this project is to develop a non-fumigant based system, using steam heat, or a combination of steam with solarization to kill soil-borne pests in cut flower production in Florida. Specific objectives were: 1.) evaluate the efficacy of steam plus solarization for the control of soilborne pests; 2.) evaluate crop yield and quality resulting from soil disinfestation with steam and solarization compared to methyl bromide (MB) fumigation; and 3.) demonstrate the methods of steam application to flower producers in Florida.

A field trial was established on a commercial flower production farm in Palm City, FL. Treatments were arranged in a randomized complete block design with four replications and included MB check under Canslit® metalized film, solarization alone, steam treatment after solarization using 3 inch perforated tile, and steam treatment following solarization using custom-drilled drain tile with 1/16 in. holes spaced every 1.5 in. Drain tile was buried at 14 in. depth from the soil surface in order to adequately heat soil for optimal nematode control in a long-term flower crop. Each plot was 100 ft. long and 6 ft. wide. Four tiles were laid in each plot. Prior to treatment application and plastic installation, soil samples were collected from each plot and analyzed for baseline nematode numbers. Nematodes from the subsample were identified as either root-knot nematodes or free-living nematodes using an inverted microscope. Steam application followed the four week solarization period in mid-October. All steam was generated using the Sioux propane boiler system. Plots were steamed for sufficient time to reach the target temperature of 70°C for 20 min. Solarization plastic was retained on the plots during steaming and these were also covered with a layer of carpet padding to provide additional insulation. Soil temperatures were monitored using soil temperature probes. At the completion of the steam application, soil sampling was repeated. Samples were analyzed as previously described. Due to the market and production requirements of the grower, the field was divided into three sub-sections and planted to three different crops. The middle section was planted to snapdragon, east section to larkspur, and the west section to delphinium. In each planting area, two sub-plots were established for data collection. Midseason and late season soil sampling was performed for snapdragon and larkspur, and midseason on delphinium. Weed emergence was quantified in the data collection areas during the same periods and weeds were removed. In addition, yield of marketable stems was recorded by the grower for snapdragon and larkspur.

Root-knot nematode populations prior to steam treatments were low and did not differ among plots (data not shown). Steam and solarization treatments resulted in root-knot nematode numbers in soil that were lower than MB in snapdragon plots (Table 1). Root-knot nematode juveniles in snapdragon roots were highest in the solarization treatment (Table 1). Galling of snapdragon roots was significantly lower in both steam treatments compared with MB and solarization (Table 1). At the end of the season root-knot nematodes in larkspur roots in the steam 2 treatment were reduced to the same level as with MB (data not shown). Galling on larkspur was lower in both steam treatments than in the MB treatment (data not shown). Delphinium does not support high levels of root-knot nematodes in soil and roots, and therefore no differences in root-knot nematode populations in soil or galling were observed.

Steam treatments killed all nutsedge that had emerged under the plastic, but differences between treatments were not statistically significant due to high variability in nutsedge distribution. Soon after treatment application, solarization plots had significantly more goosegrass (Figure 1) and spurge remaining alive than either steam or methyl bromide treatments. In the snapdragon crop, Carolina geranium was a dominant weed and was most effectively controlled by the MB treatment and steam method 2. In the delphinium plots, white clover was most effectively controlled by steam method 2, the total of which was significantly lower than in solarization plots. Total weight of weeds collected from the delphinium subplots was lower in the MB and steam plots than in those treated with solarization alone.

There were no differences between the numbers of marketable stems taken from larkspur plots with the order of treatments being methyl bromide (102 stems), steam method 2 (90), solarization (87), and steam method 1 (85). Snapdragons, the most nematode susceptible crop, had yields that were statistically similar, but in the order of steam 1 (175), steam 2 (174), MB (135), and solarization (131). Height of snapdragon plants followed the same trend, with the tallest and heaviest plants occurring in the steam treatments, which were significantly higher than the other two treatments. Snapdragon and delphinium stem diameter differences were not significant, but larkspur stems were significantly larger in MB and both steam treatments than in solarization alone.

Table 1. Soil and root nematodes and root disease on 2-12-2010 for snapdragons.

	Root-knot nematodes No./100cc soil)	Root-knot nematodes No./g root	Free-living nematodes No./100cc soil	Free-living nematodes No./g root	Gall Rate[1]	Root Weight (g)	Root Condition[2]
Methyl Bromide	72.3 a[3]	12.5 b	2277.9 ab	26.6 a	2.1 b	4.7b	0.68 c
Solarization	15.6 b	49.8 a	1020.6 c	33.8 a	3.1 a	6.6 a	0.70 c
Steam 1	2.8 b	1.9 b	1927.8 bc	18.2 a	0.3 c	4.9 b	1.13 b
Steam 2	0.0 b	0.3 b	3044.8 a	16.1 a	0.1 c	4.9 b	1.77 a

[1] Gall rate is as follows: 0= no galling, 10 = total galling
[2]Root Condition is a s follows: 0= clean, white roots, 4 = totally rotted, discolored roots
[3]Means with the same letter are not significantly different

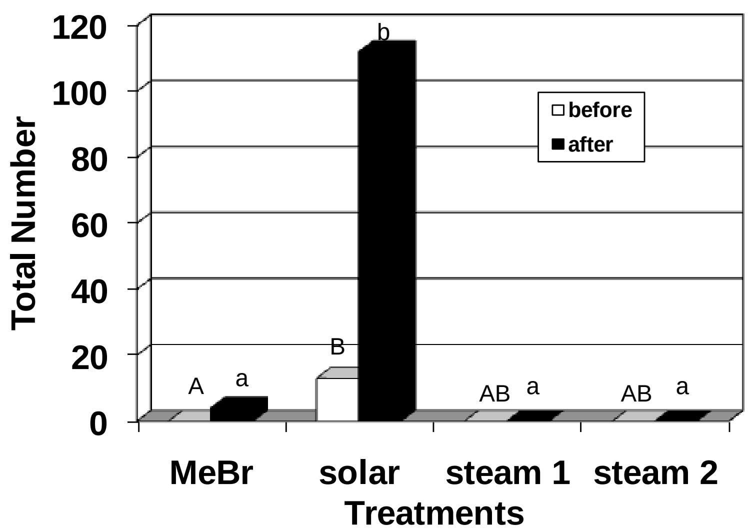

Figure 1. Total goosegrass plants present before and after steam treatments. Bars with same letter of the same case are statistically similar based on Fisher's LSD at the 0.05 level of significance.