SOLARIZATION AND STEAM HEAT FOR SOIL DISINFESTATION IN FLOWER AND STRAWBERRY

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Summary. The objective of this research will be to develop an economically feasible combined solarization and steam heat, soil disinfestation system for field-grown flowers and strawberry. Soil solarization performance in cool coastal areas of California is often inconsistent due to fog and cool summer temperatures that do not allow soil to reach high temperatures required to reliably kill soil pests. Coastal California is also the principal strawberry fruit and cut flower production region, and solarization has displaced virtually no methyl bromide (MB) use in these crops. Soil disinfestation with steam has a long and proven track record for control of soil pests including weeds and pathogens in greenhouse and nursery settings. However, use of steam at the field level has been limited due to difficulty in treating large areas with existing steam applicators and high energy costs for steam disinfestation. Injection of steam into finished planting beds with a mobile steam generator under clear polyethylene mulch, as used for solarization, would allow the use of steam to supplement solarization as needed.

Introduction. Fall 2007 solarization and steam trials began in Salinas and Prunedale, CA prior to planting strawberry and calla bulb fields, respectively. The goal of this research is to test the efficacy of steam alone, solarization alone, and steam in combination with solarization for control of soil pests relative to standard fumigation treatments.

Materials and methods. Field studies began in fall of 2007 in both strawberry beds and calla lily beds to test solarization and steam separately and together for efficacy on weed seed and pathogens in the soil. California locations and crops were: a calla lily field at Prunedale, and a strawberry field on the Spence USDA Farm at Salinas. Plot sizes are one 52 to 68 inch wide beds of 20 ft length. The treatments are arranged in a randomized complete block replicated six times. Hand weeding times will be monitored periodically. Data will be subjected to analysis of variance to determine treatment differences.

Treatments. The five treatments evaluated are; methyl bromide and chloropicrin, a non-treated control, solarization, steam, and solarization plus steam. In solarization treatments, clear tarp will be left in place for 4 weeks total, so the effect of heat accumulation due to solarization may be realized. In the steam treated beds, steam-tolerant 8 mil drip tape (Toro, El Cajon, CA) was installed at a depth of 4 inches prior to laying the tarp. Steam was be applied at low pressure with the objective of heating the top 6 inches of soil. Pathogen and weed seed samples bags were installed in the planting beds prior to tarp installation, at different depths. The steam was injected for a sufficient amount of time to raise the temperature of the bed to 70°C for a period of 30 minutes. The amount of fuel used in each treatment was recorded so that this information can be used in the economic analysis.

Temperature. Temperature recording probes (Hobo, Oneset, Pocasset, MA) were installed in the beds at depths of 2, 6, 12 and 18 inches, to correspond with pathogen sample depths, and temperatures monitored continuously during the solarization and steam disinfestations process.

Soil pest control. Weed seeds/propagules were enclosed in permeable nylon mesh bags and buried in the soil at the depths of 2, 6, 12 and 18 inches prior to treatment. After the bed was prepared, clear plastic mulch was installed and then the beds were irrigated and allowed to solarize for 4 weeks. After treatment weed seeds/propagules were removed and tested for viability. Weed species included in the bioassay were: common chickweed, common knotweed, common purslane, little mallow and yellow nutsedge. All seeds/propagules used in this study were freshly gathered to ensure that they are both viable and dormant.

Economic analysis. The yield, weeding time, steam application time, and fuel consumption data will be combined with data on prices for strawberries, field labor, fuel, steam tubing, and different types of mulch, as well as information regarding other production costs. These data will be collected from industry members, suppliers, and published sources. Because the project involves testing new machinery not currently used in strawberry production in California, the economic analysis will have three steps. First, it will compare the profitability of each alternative treatment to the profitability of MB, as a function of the per-acre cost of using the steam generator. Second, it will evaluate whether it would be economically feasible for growers to purchase steam generators individually by computing the number of acres that must be treated over the life of the steam generator to make it a profitable purchase. Finally, the per-acre analysis in the two previous components will be used to estimate the industry-level effects of alternative treatments

Advantages in using steam + solarization

- Provides a non-chemical alternative to controlling soil pests
- Allows growers to utilize buffer zones and fields in sensitive sites near neighborhoods and schools.
- This method is not dependent on moving equipment
- Use of solar energy to warm soil will hold down energy costs

Disadvantages in the use of steam

- Requires fossil fuel to produce steam

- The slow speed of application will limit the area that can be treated.

Table 1. Treatments, mulch color, temperature threshold and time interval maintained at that temperature.

Treatment	Mulch	Temperature	Time interval
1. MB/Pic 67/33 @ 350 lb/acre	Clear	NA	NA
2. No solarization control	White	Ambient	NA
3. Solarization standard	Clear	NA	4 weeks
4. Steam alone, no solarization	White	70°C	30 minutes
5. Solarization plus steam	Clear	70°C	30 minutes