

METHYL BROMIDE ALTERNATIVES FOR RED RASPBERRY AND FORESTRY NURSERIES

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During the first year of this project, experiments have focused on raspberry nursery production. Production systems and soil pH are different for forest nursery and will require experiments designed specifically for the needs of that industry. However, soilborne plant pathogens important in forest nurseries were found in soil collected from the field site. The effects of the treatments will be evaluated for these pathogens, but separate experiments and funding will be necessary in the future to identify suitable replacements for methyl bromide in forest nursery production.

. The raspberry nursery field experiments focus on root rot caused by *Phytophthora fragariae* var. *rubi* (PFR), and on Crown gall, caused by *Agrobacterium tumefaciens*. PFR causes the most serious root disease of red raspberries in many growing regions. Spread of the disease was associated with infected nursery stock in Scotland, and freedom from PFR remains a high priority for raspberry nurseries. Crown gall is frequently encountered in the coarse-textured soils favorable to raspberry nursery production. While not often a limiting disease in production fields, infected plants are unmarketable. Fumigation with MB:chloropicrin mixtures remains critical to producing raspberry nursery plants free from these diseases. However, MB fumigation can eliminate arbuscular mycorrhizal fungi (AMF), common beneficial symbionts in the roots of most plants including raspberries. AMF contribute to mineral uptake by plants and are a primary determinant of soil aggregate stability in many soils.

Objective: To evaluate dripline application of telone:chloropicrin, solarization, and iodomethane:chloropicrin as alternatives to MB:chloropicrin fumigation for reduction of pathogens and weeds in raspberry and forestry seedling nursery production.

Methods: The experiment was established at WSU-Mount Vernon NWREC, in a field of silt loam soil. (55% silt, 14% clay, 31% sand)

Treatments in 2007; five replicates with plots 100' long and 10' wide.

- 1) Non-fumigated check
- 2) Mid-August hilling and black plastic mulch application immediately followed by dripline fumigation with In-Line[®] (Dow Chemical) Telone 61%, chloropicrin 33%, 35 gallons per acre broadcast rate..
- 3) Late June hilling and solarization followed by early September dripline fumigation with In-Line[®] at the same rate as treatment 2.
- 4) Late June hilling and solarization only.
- 5) Early September shank fumigation with MB 67%, chloropicrin 33%, 350 lb/A and covered with a conventional fumigation tarp. Hilling in Spring 2008.
- 6) Early September shank fumigation with Midas[®] (Arvesta Life Sciences), Iodomethane 50%, chloropicrin 50% , 350 lb/A and covered with a conventional fumigation tarp. Hilling in spring 2008.

Non-replicated demonstration plots.

- 1) Late June hilling and solarization with incorporation of 0.5% (3500 lb/A) mustard meal
- 2) Midas® at 350 lb/A applied during hilling in September and covered with conventional tarp. Fumigants will be applied while hilling in September.
- 3) Midas® at 350 lb/A covered with VIF tarp. Fumigants will be applied while hilling in September.
- 4) Midas® at 175 lb/A covered with VIF tarp. Fumigants will be applied while hilling in September.
- 5) Telone:chloropicrin (65%:35%) at 350 lb /A covered with conventional film. Fumigants will be applied while hilling in September.
- 6) Telone:chloropicrin (65%:35%) at 350 lb/A covered with VIF film. Fumigants will be applied while hilling in September.

Addition of pathogens and weeds to plots. The field was not known to have significant population densities of PFR, pathogenic *Agrobacterium*, or weeds that are difficult to control in nursery production. Therefore, nylon mesh bags containing sterilized soil and laboratory-derived inoculum of PFR or *A. tumefasciens* were placed at 10 cm (4”), 30 cm (12”) and 45 cm (18”) depth in the plots prior to solarization or fumigation. Bags of soil inoculated with *Verticillium dahliae* placed at 30 cm in the plots. Bags containing locally collected nutlets of yellow nutsedge (*Cyperus esculentus*) and rhizomes of quackgrass (*Elymus repens* L. Gould) will also be placed at these depths.

Native *Pythium* and *Fusarium* inoculum were evaluated by an industry cooperator (Weyerhaeuser) prior to treatment, and will be reevaluated after treatment. The pathogenic potential of the soil may be evaluated by planting Douglas fir seed or seedlings in the soil.

Evaluation of treatments. Bags of inoculated soil will be dug from the plots in October, one month after fumigation, and the soil will be assessed for viable pathogens by plating on selective media and by greenhouse bioassay test with a susceptible raspberry cultivar. A second set of bags containing inoculated soil will be dug up and processed in a similar manner in spring 2008. The viability of nutlets of yellow nutsedge and rhizomes of quackgrass will be evaluated by mixing the nutlets or rhizomes with a tenfold-volume of soil, and scattering this mix on the surface of potting mix in containers in the greenhouse.

In spring 2008, each bed will be planted with two rows of cut root registered stock of ‘Coho’, a common variety susceptible to both PFR and *A. tumefasciens*.raspberry plants. Disease symptoms and incidence will be recorded throughout the growing season. Primocane length, primocane numbers and above-ground biomass will be recorded at the end of the growing season. The root systems of representative plants will be examined for root rot symptoms and any suspected samples will be plated onto selective or semi-selective media to confirm presence of pathogens

Results. In June 2007, inocula of PFR, *Agrobacterium tumefasciens* and *Verticillium* were prepared, mixed with sterilized soil and bagged. The experimental area was established in June 2007 with five replicate blocks in a randomized complete block design, with six adjoining unreplicated demonstration plots. Inoculum bags of PRF, *Agrobacterium tumefasciens* and

Verticillium were buried in plots to be solarized and in non-solarized controls Clear plastic (1-mil thickness) was laid over plots to be solarized using a commercial bed shaper/mulch layer (Rain-Flo 2600).

The remaining fumigation treatments will be applied in the first two weeks of September. Soil fumigation in the Pacific Northwest is typically done in the early fall when soil temperatures and moisture content are optimal for fumigation. Inoculum bags will be placed in the plots just prior to fumigation, and will be collected two weeks after the fumigants are applied. We expect that we will have preliminary efficacy data to present at the annual MBAO meeting.