In: Proceedings: 1997 Annual International Research Conference on Methyl Bromide Alternatives and Emissions Reductions. Methyl Bromide Alternatives Outreach, US Environ. Prot. Ag., USDA. pp. 25-1 - 25-2.

ALTERNATIVES TO CHEMICAL SOIL FUMIGATION IN WESTERN FEDERAL BAREROOT CONIFER NURSERIES

R.L. James*, J.K. Stone, D.M. Hildebrand, S.M. Frankel and D.S. Gemandt
First, third, and fourth authors: USDA Forest Service, Forest Health Protection, Coeur d'Alene, ID, Portland, OR, and San Franciso, CA, respectively; second and fifth authors: Dept. of Botany and Plant Pathology, Oregon State University, Corvallis, OR.

The objective of this project was to evaluate alternatives to pre-plant soil fumigation with methyl bromide and other commonly-used soil fumigants in seven USDA Forest Service nurseries in the western United States (two in California, Oregon, and Idaho and one in Washington). Alternatives evaluated included bare fallowing (with and without periodic cultivation), several organic amendments (sawdust and composts), use of modified sowing methods and timing, and mulching for erosion and weed control. Different treatments were tested at different nurseries; treatments were selected that would most easily conform to current nursery practices and were based on availability of amended materials. The first cycle of the study was completed in 1995; a second cycle at selected nurseries will be complete at lifting in the fall of 1997.

The major disease-causing pathogen at most nurseries is *Fusarium oxysporum*. *Macrophomina phaseolina* is an important pathogen at one California nursery. Most disease losses occur during the first growing season; effects by the end of the second growing season are often reduced height and diameter growth and sometimes chlorotic foliage. At most nurseries, bare fallowing with or without periodic cultivation was similar to methyl bromide or other chemical fumigation treatments with respect to *Fusarium* and *Pythium* soil populations, seedling density, mortality, and growth (height, stem diameter, and root biomass). Specific results at test nurseries are summarized below.

Oregon Nursery 1

Bare fallow, without cultivation and bare fallow with cultivation was comparable to the nursery standard practice of pea cover crop followed by methyl bromide fumigation. High levels of seedling mortality occurred in the cover crop, non-fumigated treatment, resulting in much lower seedling density in that treatment. Seedling density and mortality in these treatments was inversely related to presow *Fusarium* and *Pythium* populations. *Fusarium* levels increased over 4 times initial levels in the peas, no fumigation treatment but decreased in all other treatments. Surviving seedlings in the control (pea cover crop, non fumigated) treatment were somewhat shorter, but had comparable root volumes to seedlings in other treatments, probably as a result of reduced crowding and competition.

Oregon Nursery 2

Significant differences were detected among treatments in Douglas-fir but not in ponderosa pine at this nursery. However, these differences were attributable to a serious infestation of weeds in the center of the study block, apparently independent of treatment effects. These effects were similarly reflected in the high presow *Fusarium* levels in the sawdust + nitrogen, cultivation treatment, and demonstrated a possible relationship between weed infestation and *Fusarium* levels. Lower weed infestation occurred in

the sawdust + nitrogen, dazomet fumigated and sawdust no nitrogen, cultivation treatments, which also had higher seedling densities and lower *Fusarium* infestation than the other treatments.

Idaho Nursery 1

No significant differences among treatments with respect to Douglas-fir seedling density or mortality were found at this nursery. All treatments were statistically equivalent, including chemical fumigation with dazomet. The highest level of presow *Fusarium* levels was found in the composted sewage sludge treatment, although this did not represent an exceptionally high level and apparently did not contribute to high levels of disease. Differences were found among treatments with respect to shoot length and root volume; seedlings grown in the dazomet, pine mulch, and sludge treated plots had significantly larger root volumes; seedlings grown with pine needle mulch and composted sewage sludge amendment had the longest shoots, and those grown in sawdust-amended soils had the shortest shoot length.

Idaho Nursery 2

Significant differences among treatments were found at this nursery for lodgepole pine seedling densities, but not for ponderosa pine. For lodgepole pine seedling densities, methyl bromide fumigation and bare fallow without cultivation were statistically equivalent. Lowest seedling density and highest mortality occurred in the mushroom compost treatment. Responses of ponderosa pine and lodgepole pine were not consistent in all treatments; the highest seedling density for lodgepole pine occurred in the fallow without cultivation, but for ponderosa pine the highest density occurred in the fallow with cultivation and the lowest density in the fallow without cultivation. Significantly greater mortality of ponderosa pine seedlings occurred in the bare fallow without cultivation, and the least mortality occurred in the methyl bromide fumigation treatment for both species. Results from this nursery for both lodgepole and ponderosa pine support the conclusion that equivalent seedling crops can be obtained in the absence of methyl bromide fumigation. Ponderosa pine shoots were shorter and root volumes smaller for methyl bromide treated plots than either fallow treatment. For lodegpole pine, shoots were longer in the methyl bromide treatment, but root volumes were equivalent among the two fallow treatments and the methyl bromide fumigation.

California Nursery 1

Early sowing treatments at this nursery appeared to result in lower mortality in red fir seedlings. The late-sown seed, however, was soil-covered and the early sown seed was shallow sown, making it difficult to interpret whether the time or depth of sowing was primarily responsible for the effect. Field studies to be completed in the fall of 1997 were designed to further investigate this effect. Other variables did not differ significantly.

California Nursery 2

Methyl bromide fumigation, dazomet fumigation, and fallow treatments were all equivalent at this nursery with respect to 1-0 seedling density and mortality, seedling quality variables, and presow *Fusarium* populations. Methyl bromide and dazoment fumigation appear to provide no added benefit over bare fallow treatments.