ALTERNATIVE TREATMENTS TO METHYL BROMIDE

ABSTRACT

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Several fumigants have been used in past years that are no longer available or have been abandoned for reasons of registration, cost, and energy use.

Basamid[R] has been used in several nurseries with varying success. The MacMillan Bloedel Nursery has used Basamid operationally for fumigating pine seedbeds in springs of 1990, 1991, and 1992. The surface of the seedbeds was treated only allowing shoulders and drains to escape. Herbicides (pre-emerge and post-emerge) controlled these areas acceptably.

Solar heat needs further investigation as tried in Montana and Idaho by researchers.

Sanitation has curtailed the need to fumigate in the MBI nursery.

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I. FUMIGANTS USED/TRIED IN PAST YEARS

1) Ethylene Dibromide
- No longer registered
- Seemed fairly effective toward controlling soil insects and fungi when injected with good moisture conditions.

2) Shell DD
- No longer registered
- Same general results as EDB above

3) Vapam
- Never registered for nursery
- Under right conditions of soil and moisture, fair to good results have been reported toward soil-borne insects and fungi.

4) Sodium Azide
- Never registered
- Excellent fumigant but dangerous
  RE: Personal communication w/Walt Kelly

5) Steam Treatment
- Used to limited extent early in nursery development. High energy was required.

II. ALTERNATIVE TREATMENTS TO METHYL BROMIDE INJECTION

1. **Operational Use of Basamid[R] as Soil Fumigant in Nursery Seedbeds**

Introduction: Basamid (Tetrohydro-3,5-dimethyl-ZH-1,3,5-thiadiazine-2-thione) manufactured by Hopkins Agricultural Division, Greely, Colorado 80632-1289 has been used operationally in the MBI nursery in the springs of 1990, 1991, and 1992. The first field rial was conducted during 1989 on approximately two acres of seedbed surface area. Reference APA Technical Release 90-R-53.

Operation: Generally, the same technique used in the field trial in 1989 has been used in subsequent years. The following order of events was employed:

A. Land preparation and fertilization was performed
B. Irrigation system was installed
C. Seedbeds were formed and roto-tilled.
D. Basamid was applied with Whitfield seeder in 1989, 1990, 1992. The Gandy spreaders were used in 1991 with slightly poorer results from observation. The Whitfield seeder feet were lowered so the Basamid was placed about two inches deep and concentrated beneath area where seedling row was installed.
E. The beds were compacted with a heavy roller following Basamid application.
F. At least one inch of water was applied following rolling of beds to form a crust to enhance sealing of fumigant.
G. After at least two weeks, the beds were roto-tilled again allowing residual fumes to escape.
H. To check for harmful residue, a germination test with mustard seed in a flat of treated soil was performed before seeding pine.

Results:

A. Several favorable influences have been noted from the use of Basamid.

1) Germination has not been inhibited
2) Seedlings have appeared more vigorous then seedlings grown on untreated areas.
3) Seedlings have held their green color to a greater extent during the winter months.
4) At least one less top-dressing with nitrogen during the growing season has been necessary.
5) Populations of mycorrhizae (primarily Pisolithus tinctorius have been as numerous (if not greater) from observation.
6) Due to treating only two-thirds of the total area, cost of Basamid treatment at 300-350 lbs/acre of granular fumigant is somewhat less than Methyl Bromide application.

7) The polyethylene cover is not present thus eliminating the disposal problem.

B. A few unfavorable results have been noted from using Basamid as applied by MBI.

1) As only two-thirds of the area is actually treated, pests such as nutgrass will remain in the alleys and bed shoulders. If enough nutgrass is present then control can become a problem without constant control measures.
2) Even on the beds, Basamid does not appear to be as good as Methyl Bromide toward controlling nutgrass, prostrate spurge, and pigweed.
3) The second year control does not appear to be as good as with Methyl Bromide, probably due to the skipped area i.e. alley and shoulder areas.

Comments:
Basamid has been used exclusively in the MBI nursery during 1990, 1991, and 1992 as a soil fumigant.

The added convenience of Basamid is of importance to the nursery operation. Basamid application can be worked into the nursery operation more conveniently especially when Methyl Bromide application awaits a contractor. Existing nursery equipment can be used thus eliminating the need to purchase special equipment.

2. Possible Use of Solar Heat as a Biological Alternative to Methyl Bromide

Ecological Alternatives

Solar Solarization is an alternative to traditional chemical fumigation (see notice about the potential loss of methyl bromide fumigants in the National Nursery Issues section). The process involves covering moist soil with a transparent plastic film and exposing it to the sun. The trapped heat raises the soil temperature to levels that weaken or even kill most potential soil pests, including fungi, bacteria, and weed seeds. Fortunately, most pest organisms are intolerant of moderately warm temperatures whereas other beneficial microbes are more temperature tolerant. This differential means that raising temperatures to around 40°C (104°F) can eliminate most soil-borne pests in soil or growing media.

The effectiveness of soil solarization is a function of soil temperature and exposure time, which are inversely related. With increasing temperature, less time is needed to reach a lethal combination of time and temperature. For example, 2 to 4 weeks may be needed at 37°C (98°F) compared to only 1 to 6 hours at 47°C (116°F).

The potential for using soil solarization depends on several climatic and cultural factors:

<u>Solar intensity and daylength</u> - Soil temperature and exposure time are primarily a function of solar energy input and daylength, and are therefore fixed for any particular season at a nursery location. For bareroot nurseries in the temperate zones, soil solarization is only possible during the summer months whereas year-round treatment is a possibility in container nurseries.

<u>Soil moisture</u> - The moisture content of the soil or growing media is a critical variable. Soil solarization is a hydrothermal process and water vapor is necessary to effectively transfer the heat throughout the treated area by convection. Saturated soils are slow to warm because heat conduction through liquid water is much slower and macropores which are clogged with water inhibit convection. And, as is true for traditional fumigation, soil pests are more susceptible in moist soils because moisture stimulates physiological activity.

<u>Soil color, structure, and depth</u> - Dark colors absorb more solar radiation, and loose, friable soil permits better convective heat transmission than those that are dense or compacted. In field soils, control is much better in the upper horizons and decreases with depth. Unfortunately, soil pathogens and weed seeds from lower soil layers can reinvade sanitized surface soil but, hopefully, beneficial microbes will rapidly colonize the treated area. The depth of the

treated soil is a controllable factor in container nurseries, however, because growing media can be spread in thin layers to maximize heat build-up.

Characteristics of plastic film - Tarps made of polyethylene plastic are ideal for soil solarization because they are relatively inexpensive and widely available. Thinner films (1 to 1.5 mil) are the best compromise between cost and durability. Polyethylene is more transparent to short-wave solar radiation than longer-wave terrestrial radiation which results in heat build-up under the tarp. Double layers of film are even more effective, raising soil temperature from 3 to 10°C (5 to 18°F) compared to a single layer, because they retard both heat and moisture loss.

Be Creative - Fight the urge to say "we tried that once, but it didn't work." Obviously, soil solarization has the most potential at lower latitudes but recent improvements in material and technology make the process more feasible in any climate. Treating growing media in greenhouses is particularly promising: in one test with a vegetable crop, soil solarization was as effective as methyl bromide fumigation. Generating the necessary soil temperatures took only a few weeks during the summer in a greenhouse in Colorado. Treatment time can be reduced to a few days when the media is treated in black plastic pipes in a frame which is covered with clear plastic. Inoculation with beneficial microogranisms immediately after solarization is another innovation that hold considerable promise. This would reduce one of common problem with soil solarization - rapid reinvation by pathogens. As with all biocontrol treatments, soil solarization should not be used as the ultimate pest control method but must be evaluated in the larger context of an integrated pest management program. When compared to the economic and social costs of pesticide use, soil solarization deserves another look.

References:

Baker, R. 1991. Heat-treating soil can prevent Rhizoctonia's boomerang effect. Greenhouse Manager 10(7): 91.

*Corse, Tom. USDI-BIA, Box A, Pablo, MT 59855

DeVay, J.E.; Stapleton, J. J.; Elmore, C. L., eds. 1991. Soil solarization. FAO Plant Production and Protection Paper No. 109. Rome: Food and Agriculture Organization of the United Nations. 396 p.