

EFFECT OF SOIL FUMIGATION IN THE NURSERY ON GROWTH OF LOBLOLLY PINE SEEDLINGS AND CONTROL OF WEEDS

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Methyl bromide and Vapam as general soil fumigants for the control of fungi, nematodes, and weeds have been widely tested in forest nurseries (Briscoe and Strickland, 1956; Clifford, 1951; Foster, 1956; Henry, 1951; Hill, 1955; Stoeckeler, 1951; Wycoff, 1952). The excellent and consistent results obtained with methyl bromide to control weeds and increase total plantable seedlings make it probable that this fumigant would be in wider use were it not for the large amount of hand labor involved. The limited area that can be fumigated daily is also a serious drawback, since the soil is not warm enough for fumigation until planting time has almost arrived, and bad weather may prevent treatment.

Water-sealed Vapam has also been widely tested in forest nursery soils, but it has not been uniformly effective in controlling weeds and soil-borne diseases. For this reason, it has not been used more widely in forest tree nurseries.

In 1959, a study was undertaken at the Little River Nursery near Goldsboro, N. C., to compare the effectiveness of various formulations and techniques of applying methyl bromide and Vapam in controlling weeds and increasing seedling growth. In addition, several combinations of Eptam, a herbicide, and Nemagon, a nematocide, were also tested. These materials were included since they would be much cheaper to use than the general-purpose fumigants for certain specific objectives. For the most part, the materials tested had been used before and are commercially available. The major purpose of the study was to compare known effective treatments for the problems existing at the Little River Nursery. The results of the study, however, may be applicable to other southern forest nurseries or may serve as guides for future tests in other areas.

Only one material, Brozone, had not been used previously on forest nurseries. In California, this material has been effectively used for the control of weeds, nematodes, and soil-borne fungi at rates as low as 150 pounds actual methyl bromide per acre (Sher et al., 1958; Thomason, 1959; Wilhelm et al., 1958; Wilhelm et al., 1959). This material contains, by volume, 50 percent methyl bromide and 50 percent of a petroleum carrier. Brozone is injected into the soil with chisel applicators and then the soil is covered with polyethylene covers.

Procedure

The tests were laid out in a randomized block design with three replications of each treatment. Each plot was 60 by 4 feet. Weed ratings were made 6 and 12 weeks after planting, on a rating system of 0 to 10, with 0 indicating complete control and 10 no control. All the plots were weeded by hand following the first rating, since the weeds in some plots were interfering with normal seedling growth. After the second rating, the plots were weeded by applications of mineral spirits or by hand.

At digging time, all the seedlings in a 4- by 4-foot area in the center of each plot were lifted and graded according to Wakeley's morphological grades (Wakeley, 1954). The average weight per seedling was taken by averaging the weights of every 25th plantable seedling selected during the grading operation.

The following treatments were included in the study:

1. Methyl bromide

- A. as the standard treatment, of 1 pound per 150 square feet (300 pounds per acre) released under a 4-mil polyethylene cover.

¹ The chemicals used in this study were contributed by the following companies: Vapam and Eptam, Stauffer Chemical Co.; Brozone, Hendrix-Barnhill Co., Greenville, N. C.; vaporized methyl bromide, Dow Chemical Co. Mention of any chemical company or product does not imply endorsement by the U. S. Department of Agriculture.

- B. vaporized and released at the rate of 300 pounds per acre under a 2-mil polyethylene cover put down with an automatic covering device made by Dow Chemical Company.
- C. as Brozone at the rate of 175 pounds per acre actual methyl bromide, injected into the soil and covered with a 2-mil polyethylene cover or left uncovered.

2. Vapam

- A. at 50 and 100 gallons per acre drenched into the soil with 1300 gallons water.
- B. at 50 gallons per acre drenched into the soil and covered for 2. days with a 2-mil polyethylene cover.

3. Eptam

- A. in liquid form at the rate of 6 pounds active ingredient (1 gallon) in 75 gallons water per acre applied to the soil surface and disked in.
- B. as in A with an additional 6 pounds in 75 gallons water sprayed on seedlings 6 weeks later.
- C. as in A plus 50 gallons per acre Vapam.
- D. as in A plus 1 gallon per acre (active ingredient) Nemagon.
- E. in the granular format the rate of 6 pounds per acre active ingredient applied on the surface and disked in.

4. Nemagon

- A. in the granular form at the rate of 1 gallon per acre active ingredient applied to soil surface and disked in.

5. Check--no treatment.

All treatments were applied at least 2 weeks before planting. The area of the Little River Nursery, where the tests were conducted, is classified as a Wickham fine sandy loam soil.

Results

Considering all criteria measured in the study, the covered Vapam, covered Brozone, standard methyl bromide, and vaporized methyl bromide treatments were significantly superior to no treatment (table 1). The treatment with noncovered Brozone resulted in a significant increase in the number of plantable seedlings. However, seedlings were much smaller than those in the above treatments and weed control was inadequate.

The water-sealed Vapam treatments neither increased seedling size nor lowered weed rating. The fact that this material gave excellent results in all respects when sealed with a polyethylene cover is good evidence that the poor results obtained in the past with this material are due to failure to get an adequate seal with water.

Weed control with both the liquid and granular formulations of Eptam was excellent through 12 weeks but this material did not significantly increase seedling growth.

Nemagon only slightly increased seedling size, indicating that nematodes are not a major factor at this nursery. Weed ratings were significantly increased with this material at the 6-week rating period and were higher than the check at the 12-week rating.

TABLE 1.--Effect of various soil fumigants on growth of loblolly pine seedlings and weed control

Chemical	Rate per acre	Seedlings per square foot		Average seedling weight	Weed rating	
		No. 1	Plantable		6 wks.	12 wks.
Methyl Bromide (standard).....	300 lbs.	<i>Number</i> 1.7**	<i>Number</i> 42.1**	<i>Grams</i> 10.2**	1.3**	1.7*
Methyl Bromide (vaporized).....	300 lbs.	0.9**	31.3*	10.1**	2.7*	2.0*
Brozone (covered).....	175 lbs.	2.8**	32.6*	12.8**	1.3*	1.7*
Brozone (not covered)..	175 lbs.	0.1	30.3*	5.9	3.3	4.0
Brozone (not covered)..	350 lbs.	0.0	32.0*	6.5	3.0	3.7
Brozone (not covered)..	525 lbs.	0.2	31.3*	7.7*	3.0	3.3
Vapam (water sealed)...	50 gal.	0.0	25.1	6.9	5.0	4.3
Vapam (water sealed)...	100 gal.	0.0	16.3	5.7	5.3	6.0
Vapam (covered).....	50 gal.	1.5**	37.8**	9.9**	1.0**	1.0**
Granular Eptam.....	6 lbs.	0.1	32.1	7.3	1.3*	2.0*
Liquid Eptam.....	6 lbs.	0.0	28.5	7.1	1.7**	5.3
Liquid Eptam)..... + Liquid Eptam).....	6 lbs. 6 lbs.	0.0	26.2	6.2	2.7*	2.0*
Liquid Eptam)..... + Vapam).....	6 lbs. 50 gal.	0.0	20.5	6.9	1.0**	2.3
Liquid Eptam)..... + Nemagon).....	6 lbs. 1 gal.	0.0	21.7	5.5	2.3*	3.7
Nemagon.....	1 gal.	0.1	24.3	7.3	9.0**	7.0
Check.....	--	0.0	17.0	6.2	5.3	5.0
LSD, 5 percent.....		0.5	11.8	1.5	2.6	3.1
LSD, 1 percent.....		0.7	15.9	2.1	3.5	4.1

*Denotes significance at the 5 percent level.

**Denotes significance at the 1 percent level.

Discussion

From the standpoint of a general soil fumigant, covered Brozone appears to be very promising. At present this material is available only by contract application by a Dow Chemical Company distributor. Based on contract prices for over 100 acres of nursery soil to be fumigated in North Carolina and South Carolina, the cost of fumigation with Brozone is about equal to or even less than the cost for the standard application of methyl bromide with 1-pound cans and 100 by 20-foot covers. On the basis of the present studies and on inspection of tobacco plant beds treated with Brozone, an application rate of about 200 pounds per acre actual methyl bromide will probably be adequate for most nurseries located on light soils. Further studies of application rates on different soil types are needed.

Since the application of Brozone is highly mechanized, up to 6 acres per day can be fumigated, as compared with approximately 1 acre by the standard method. This is very important when the time available for fumigation is limited.

Vapam, at the rate of 50 gallons per acre and covered with polyethylene, also looks promising. At this rate, the treatment is comparable in cost to methyl bromide and it may cost less if application techniques can be improved by using covers several hundred feet long and sealing the edges of the covers with tractor equipment.

The vaporized methyl bromide was as effective as the other methyl bromide treatments but unless the cover-laying device is modified to use 18- to 20-foot covers instead of the present 6- to 9-foot covers, this method appears uneconomical for broadcast fumigation because of the high percentage of overlap between covers. For single-bed treatment, however, the method would be excellent.

From the standpoint of weed control alone, Eptam gave excellent results up to 12 weeks after planting. Some weed control was obtained up to digging time, but the treatment could not be considered effective over the entire growing season. Inasmuch as the first 8 to 12 weeks is the most critical period from the standpoint of mechanical damage from hand weeding, and the cost of the material and application at the 6-pound rate is only about 35 dollars per acre, Eptam could be a very economical treatment.

No adverse effects on the seedlings were noted in any of the treatments. It should be noted here, however, that Eptam at 5- and 10-pound rates has caused some stunting of seedlings in a Georgia nursery. This may have been due to the heavier soil on which that study was conducted, and is a factor to consider when determining the length of time between application and planting.

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