Auburn University Southern Forest Nursery Management Cooperative

RESEARCH REPORT 05-04

SEEDLING PRODUCTION BY SEED TREATMENT AND FUMIGATION TREATMENT AT THE GLENNVILLE REGENERATION CENTER IN 2004

by
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INTRODUCTION

Fumigation:

Dimethyl disulfide (DMDS) is being developed by Cerexagri (subsidiary of ATOFINA) as a possible soil fumigant. It is reported to be one of the products released when soil is amended by cabbage and solarized (MITC is another product) and is being researched as a possible replacement for methyl bromide (MBr). It is a colorless to yellow liquid with a very unpleasant smell (according to the MSDS and anyone who has been exposed to it). We were approached to evaluate the efficacy of DMDS for fumigating forest nursery seedlings and arranged trials at two nurseries. The trial at the Rayonier nursery near Glennville, GA is summarized here and that for the Plum Creek Timber Co. Nursery near Hazlehurst, MS is in a separate Research Report.

Seed Treatments:

Seed treatments can be very cost effective ways of protecting crops from pests. Great examples of this are the two seed treatments used most extensively by Coop members, Bayleton and Thiram. At the standard rate employed, the systemic fungicide Bayleton protects seedlings from fusiform rust for up to four weeks at a rate of only 1.1 oz ai per acre. Thiram, used by most producers of bareroot pine seedlings at about 8 oz per acre (1 qt/100 lbs seed), is probably most important to us as an animal repellent to prevent birds and rodents from eating seed but it also has fungicidal activity. The effects of Thiram, if any, on damping-off fungi have not been evaluated in our bareroot nurseries for a long time and many newer fungicide chemistries and formulations have been developed that should be more effective against pathogenic fungi. Two fungicide seed treatments were evaluated for their effects on seedling production across the 2004 fumigation trial. These were Topsin-M (thiophanate methyl, also now from Cerexagri) and a combination of fungicides formulated by Gustafson (L 1332-A2) as a seed treatment for peanut.

METHODOLOGY

Fumigation:

On March 25, 2004 fumigation treatments were applied at the Glennville Regeneration Center. The study area was a 390-foot-long section of three adjoining beds which were divided into five blocks (four were 80-foot-long blocks and the fifth, and last, 70-foot-long). Each of two fumigation treatments were randomly assigned to a 35-foot-long section of each block and a 10-foot-long section of each 80-foot-long block received no treatment (fumigation control). The DMDS was applied using standard MBr application equipment. That is, shank injected six to eight inches below the soil surface. The application rate for DMDS was determined by net weight loss to cylinder contents to have been 814 lbs/ac. (Note to applicators: application equipment calibrated for MBr indicated an application rate of 400 lbs/ac). The MC2 was applied at 350 lbs/ac using the system calibrated for its application. Both fumigants were tarped after being injected into the soil.

Seed Treatments:

The seed provided for the study area by Rayonier had been treated with Bayleton (0.04 oz / lb seed) and Thiram (0.16 oz / lb), respectively, for protection against rust and bird feeding. Two of the three beds treated with DMDS on March 25 were included in the seed treatment evaluation. These beds were precision sown with eight drills of seed and the two center drills (drills 4 and 5) were sown with only the standard practice control treatment of Bayleton and Thiram. Enough seed to sow three drills per bed were treated with Topsin-M and an equal amount of seed were treated with the Gustafson product (L 1332-A2), each applied over the standard seed treatments. Both fungicides were applied at the rate of 0.076 oz product / lbs of seed. Seed treatments for the study were applied and the seed were sown on April 7, 2004, fourteen days after fumigation. The three drills on one side of the control treatment were sown with Topsin-M treated seed and the other three were sown with the four-way fungicide mix.

Data Collection:

Immediately after sowing, before stabilizer and bark mulch were applied, the seed per linear foot of drill were counted in one plot near the center of each fumigation treatment plot of one bed to determine if numbers differed either by drill or by seed treatment. A month after sowing (on May 5th) the number of seedlings per foot of drill was counted near the center of each fumigation treatment plot of both beds to determine the effects of fumigation and of seed treatments on germination. At this time soil was collected to assess selected soil fungi. Sub-samples of collected soil were plated on media selective for *Trichoderma* and for *Fusarium* to assess the effects of fumigation on these fungi. On October 14 (193 days after sowing) seedlings per foot of drill were again determined in each fumigation plot of one bed and the seedlings in those plots were harvested for determination of RCB and mass. The data for seed sowing on April 4 was considered adequately replicated by counting a single bed. However, the October 14 data, for seedling numbers and biomass, was cancelled for one of two beds due to a problem on one bed (undercutting) not related to our variables of concern.

RESULTS AND DISCUSSION

Numbers of seed sown and of seedlings produced per foot of drill by fumigation and by seed treatment are presented in Table 1. The effects of fumigation on seedling growth are presented in Table 2.

Table 1. Seed and seedlings per foot of drill by seed treatment and by fumigation treatment at Glennville in 2004.

		Seed (Apr 4) or seedlings (May & Oct) per drill foot by date[2]				
Variable	**Level[1]**	**April 4**	**May 5**	**Change Apr to May**	**October**	**Change May to Oct**
Seed Treatment	Control	14.4 a	13.5	- 0.9	13.4 a	- 0.07
	Topsin-M	14.2 b	13.0	- 1.8	11.8 b	-1.14
	4 Way	15.9 b	13.9	- 1.9	12.1 a	0.32
	lsd	1.0	0.9	1.5	0.9	1.44
Fumigation	Control	14.7	13.9	- 0.7	12.7	- 1.04
	MC2	14.8	13.3	- 1.3	13.1	- 0.03
	DMDS	14.8	13.3	- 1.8	13.5	0.03
	lsd	*1.0*	*0.9*	*1.7*	*1.0*	*1.44*

1. The control seed treatment is Bayleton (0.04 oz / lb seed) plus Thiram (0.16 oz / lb) and the Topsin-M and 4-Way treatments are each at 0.07 oz/lb and are in addition to the control treatment. The Control fumigant is nothing. The MC2 is 7 lbs/ac chloropicrin plus 343 lbs/ac MBr and the DMDS is 814 lbs/ac dimethyl disulfide.
2. The Apr, and the Oct. data are for single beds and the May data is a mean for two beds. The numbers for Change compare the indicated single bed month to the same bed measure for May.

Table 2. Seedbed density and seedling mass by fumigation treatment at Glennville in 2004.

Fumigant[1]	**Stems/ft^2 bed**	**Mass / 25 stems**	**Mass/ft^2 bed**
None	31.4	105.6	132.8
MC2	30.3	104.4	126.1
DMDS	32.1	107.4	137.8
lsd	*6.3*	*16.9*	*34.0*

1. The MC2 is 7 lbs/ac chloropicrin plus 343 lbs/ac MBr and the DMDS is 814 lbs/ac dimethyl disulfide.

Seed treatments:

We knew without further study, that any improvement in seed efficiency was likely to be too small to be statistically significant without a great amount of replication. This is based on an extensive history of fumigation trials in which damping-off has rarely been significant, even in control plots at regularly fumigated nurseries. However, with the cost efficiencies of fungicidal seed treatments, even small, non-significant improvements in seed efficiency would probably be well worth further investigation. Unfortunately, neither of the tested alternatives produced even insignificant improvements to the standard treatment, so it unnecessary to debate either statistics or economics based on these data.

Fumigation:

In this study, there were no significant differences among fumigation treatments either for seedbed density (Pr>F 0.80) or seedling mass per/ft2 of seedbed (Pr > F 0.71). Although non-significant "improvements" for MBr fumigated plots is not very unusual, it has been rare (I can't think of a case offhand) to actually have less mean growth (even non-significantly less) for MBr plots compared to not fumigated plots. This occurred in the present study. Although we don't attribute this unusual result to the site, it had a unique history (as far as past studies go) which is worth citing for the record. That is, prior to the study the area had maintained perennial pines as hedges to produce multiple shoots for vegetative propagation. This would modify the populations of soil microorganisms compared to those in seedling production. An unanticipated result of converting the area was that the thick stems and roots of the hedged pines were much more difficult to totally remove than anticipated and kept "turning-up" every time the soil was tilled before, during and after fumigation and sowing. This "turning-up" during normal root pruning resulted in severe modification to one of the two study beds and its exclusion from data collection.

Soil Fungi:

Number of colonies of *Trichoderma* and of *Fusarium* across the fumigation study on May 5th are presented in Table 3. There were no significant differences among fumigants; trends for differences in cfu's (colony forming units) were normal but for the size of the differences, especially that for *Trichoderma* which would usually be larger between MBr and control treatments.

Table 3. Soil fungi by fumigation treatment at Glennville in 2004.

Fumigant[1]	Trichoderma cfu's / 0.01 gm soil	Fusarium cfu's / 0.01 gm soil
None	9.5	2.9
MC2	10.1	1.2
DMDS	11.5	1.5
lsd	*3.6*	*1.9*

1. The MC2 is 7 lbs/ac chloropicrin plus 343 lbs/ac MBr and the DMDS is 814 lbs/ac dimethyl disulfide.

Application Concerns:

The warning in the MSDS of a "very unpleasant smell" for DMDS is an understatement. Although chloropicrin is well known to have a very unpleasant smell, during normal or even experimental applications it seldom concerns the applicators and by the time the tarps can be removed there is little odor remaining. Precautions were taken to minimize exposure to the gas during tarp removal. An approved NIOSH respirator was worn by the individual working on the ground during removal and an approved filter was in the system for the cab tractor utilized. Despite the "airing out" of the site, during bed formation and sowing operators still noticed lingering traces of the gas as the soil was disturbed during these operations. In this study, treating only 0.04 total acres with a total of only 36 lbs of DMDS resulted in all the unpleasant smell anyone could ever stand for a large area. Dividing this application into five individual plots probably increased the amount that escaped to the air compared to a normal fumigation. Nevertheless, the amount of unpleasant smell produced both during fumigation and at tarp removal was sufficient to create concern for what could occur with a treatment of several acres.

MANAGEMENT IMPLICATIONS

The experimental seed treatments did not improve seed efficiency and seedling growth did not differ among the fumigation treatments. For reasons that may be related to the past use of the study area, variables in the control plots were similar to what seems more normal for fumigated plots. The smell of the DMDS at application and tarp removal creates some significant concerns for our ability to use it even if effective.