Auburn University Southern Forest Nursery Management Cooperative

RESEARCH REPORT 02-10

A COMPARISON OF FUMIGANTS AND THE EFFECTS OF MYCORRHIZAL INOCULUM ON LOBLOLLY PINE AT ASHBURN GEORGIA

by
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INTRODUCTION

This study compared the efficacies of some relatively new fumigants, combinations, and or application techniques for increasing the growth of bareroot pine seedlings. In addition, a commercial mycorrhizal inoculum (BioGROW™) was applied within each study plot utilizing the replication for fumigants to help evaluate differences.

METHODOLOGY

Six fumigants were evaluated at Ashburn in 2001 (see Table 1 for rates). Methyl Iodide (MI) with chloropicrin is believed to have similar activity to Methyl Bromide with chloropicrin as a fumigant and was applied using the procedures familiar for MBr and tarped. Metham-sodium with chloropicrin (CMS) has been effective at several nurseries through the last decade and metham-potassium with chloropicrin (CMK)is expected to have similar efficacy with the advantage of substituting the fertilizer element potassium (K) for sodium. Improvements in the apparent regulatory status of 1,3 dichloropropene (Telone®) made further evaluation of this compound with chloropicrin (C35) necessary. Although Dazomet (Basamid®)has been evaluated at many nurseries over the last decade, this application utilized a new protocol in which 200 lbs/ac was incorporated to a depth of 6 inches and then 150 lbs/ac was applied to the soil surface and irrigated daily for a week to "release" the active ingredient. Finally, we included a proprietary fumigant, identified here only as MBA 401 (for MBr Alternative 401), in cooperation with Hendrix and Dail Inc.

Table 1 Fumigants applied at the Ashburn Nursery April 12, 2001.

Fumigation Treatment	Rate(lbs/ac)	Application Methods
Methyl Iodide / Chloropicrin	177/118	Shank injected and tarped
Metham-sodium / Chloropicrin	600/150	Rotovated to 6" and tarped
Metham-potassium / Chloropicrin	480/150	Rotovated to 6" and tarped
Dazomet	350	Rotovated then watered
1,3-d / Chloropicrin	273/147	Rotovated to 6" and tarped
MBA 401 (unidentified here)	182 (ai)	Shank injected and tarped

The study design was a randomized complete block similar to those used for most of our fumigation studies since 1997. Each treatment was replicated once in each of three, three-bed-wide blocks across the nine beds between adjacent risers. Each block was divided into six 100-foot-long main plots for fumigants and one 40-foot-long not fumigated (or control) plot was randomly assigned to one end of a treatment plot in each block so that each block contained seven treatment plots with respect to fumigants.

Loblolly seed were sown in the study area May 8, 2001 and temperature and rainfall records for the 20 days after sowing were adequate for good germination and establishment. Germination was evaluated on June 7 by counting live seedlings within a linear foot of bed (4 ft^2) near the center of each treatment plot. At this time, the middle bed in each block was inoculated by the nursery manager using a commercial mycorrhizal preparation BioGROW™ and techniques that were standard practice at the nursery. An amount of inoculum listed as adequate for 200,000 seedlings was mixed with 30 gallons of water and sprayed over three 640 foot-long beds. After mycorrhizae were applied the entire study area was irrigated. Mycorrhizal treatment created a split plot with respect to mycorrhizae and, if this effected seedling growth, doubled replication for fumigants.

Survival was evaluated again on October 30th and approximately 25 seedlings per treatment plot were carefully lifted by hand from the center six drills. Harvested seedlings were taken to Auburn and measured to determine mean size (RCD) and mass (root and shoot weights) which were converted to values per square foot of bed using the seedbed density counts.

RESULTS AND DISCUSSION

There were no interactions ($p = 0.05$) between mycorrhizal inoculation and fumigation treatments so differences between fumigation treatments were analyzed over mycorrhizae treatments for the main effects of fumigation or inoculation. The fumigation means are presented in Table 2 and mycorrhizae means in Table 3. Fumigation significantly effected mean shoot mass and shoot mass and root mass per unit area. Only root mass per unit area differed between mycorrhizae inoculated and not inoculated plots. Compared to past fumigation studies in bareroot nurseries, variability within treatments, as comparisons of lsd's to means, was normal.

Table 2 Survival and growth by fumigation treatment averaged over beds treated and not treated with mycorrhizae sampled October 30, 2001.

Treatment	RCD	Seedling/ft²				Mass (gm/ft²)	
		Total	Cull†	Twos	Ones	Root	Shoot
Control	4.1*	21.8 ab	2.3	15.6	4.0	11.0 b	49.5 a
Telone C35	4.5	22.5 ab	0.9	13.9	7.7	12.9 ab	64.2 b
MI 4.4	22.3 ab	1.3	14.6	6.4		13.6 ab	61.0 b
CMS 4.4	25.0 a	0.8	16.4	7.7		14.2 ab	65.8 b
CMK 4.4	23.5 ab	1.5	15.5	6.5		13.0 ab	63.2 b
Dazomet	4.4	24.0 ab	1.7	15.1	7.1	14.7 a	60.9 b
MBA 401	4.4	20.8 b	2.2	12.6	6.0	11.9 ab	56.4 ab
lsd 0.05	*0.4*	*3.5*	*1.5*	*5.1*	*4.0*	*2.7*	*9.7†*

†Culls, Twos and Ones have RCD's, respectively, < 3.2cmn, 3.2 - 4.8 cm, and > 4.8 cm.
* Within columns, means not followed by letters or followed by the same letter do not differ (p= 0.05)

Averaged over mycorrhizal treatments, there were few differences between fumigants at the Ashburn Nursery in 2001. With the exception of MBA 401 (the unknown fumigant) which did not perform well, the other five treatments were better than the control but not different from each other. This would make their cost (economic and environmental) deciding factors in selection. However, a little more can be inferred from the data in Table 2 based on comparing means across the measured variables. Across all treatments, and as usual, the number of seedlings per foot negatively correlated with mean RCD ($r = -0.51$ $p < 0.01$) and the number of grade-one seedlings per foot ($r = -0.31$ $p = 0.04$). Since CMS averaged both the most seedlings per foot and, against the trend, had (with Telone C35) the most grade-one seedlings, I would select its performance as best, though not statistically different, among tested treatments. Using similar arguments, Dazomet and Telone C35 treatments also performed fairly well.

Table 3. Growth by mycorrhizal treatment averaged over fumigation treatments for October 30, 2001

Mycorrhizae	RCD	Seedling/ft²				Mass (gm/ft²)	
		Total	Cull	Twos	Ones	Root	Shoot
Control	4.4†	22.4	1.4	14.0	6.9	12.3 a	59.2
Inoculated	4.4	23.4	1.6	15.6	6.0	13.7 b	61.1
lsd 0.05	*0.2*	*2.0*	*0.8*	*2.9*	*2.0*	*1.4*	*5.2*

† Within columns, means not followed by different letters do not differ (p= 0.05).

The only significant difference for mycorrhizal inoculation was an increase in root mass per unit area. However, there were 0.7 more plantable seedlings /ft² in inoculated plots, worth about $800 per acre if the difference is real. Considering all the comparisons between mycorrhizae inoculated and not inoculated plots in Table 3, it appears likely there were more seedlings in inoculated beds. Difference of less than 5% are frequently not statistically significant in tests of this size but the mean difference could be economically "significant". Therefore, although we cannot conclude from this

analysis that a real difference existed there is some indication that inoculation increased production. Unfortunately, a similar study planned for 2001 could not be completed and a more confident resolution of this question will require additional data.

MANAGEMENT IMPLICATIONS

With the exception of MBA - 401, the tested fumigants performed similarly. The CMS treatment has performed well in recent tests and was expected to do well. The performances of rates combinations and application techniques for CMK, C35, MI and dazomet indicate we have some reasonable alternatives if necessary. Although it was gratifying to finally get good results with dazomet, the irrigation requirement for the application protocol will be difficult to incorporate into practice at most nurseries.

These data do not provide statistical confidence that the improvements among mycorrhizae inoculated beds did not occur due to chance. However, the differences between means warrant further research.