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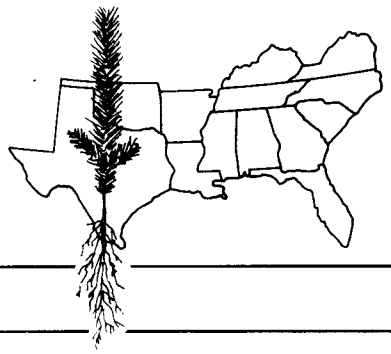

RESEARCH NOTE 96-2

Testing Alternatives to Methyl Bromide Fumigation At the Winona Nursery

by
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INTRODUCTION

Forest tree nurseries have one of the largest benefit per acre fumigated or per pound of methyl bromide (MBr) used of all crops that utilize significant quantities (Anonymous, 1993) and fumigation, with 2% or 33% chloropicrin, has become almost universal in southern forest nurseries (South, 1992, Carey, 1991). The expected loss of this important management tool after the year 2001 understandably concerns nursery managers. Hopefully, new fumigants, combinations of fumigants, or improved application techniques will provide adequate replacement for current fumigation practices.

Across the country, the improved seed efficiency and seedling quality attributable to MBr fumigation has appeared to be independent of region, soil type, or tree species (Carey, 1994). Unfortunately, recent trials indicate that efficiencies of potential replacements for MBr will be more site specific. This makes preliminary screenings advisable at each nursery.

METHODOLOGY

The Winona Tree Nursery is located near Winona, Mississippi on a silt loam soil (57% silt, 14% clay and 29% sand) with a pH of 5.9. The study area was last fumigated (350 lbs/ac MC33) in 1990 and produced two crops of pine seedlings (1990 and 91) and two cover crops (winter wheat and sudex in 1992 and 93).

The study area is eight beds wide and 600 ft long. Treatments were assigned, within eight adjoining beds containing eight plots each in a standard 8 by 8 Latin square. Treatment plots were one-bed-wide (5ft) by 62 feet long and separated within a bed by 15 foot buffers. Six fumigation treatments, 350 lbs/ac 67% methyl bromide plus 33% chloropicrin (MC33), 300 lbs/ac 70% 1,3 dichloropropene plus 30% chloropicrin (Triform®), 250 lbs/ac chloropicrin (96.5% ai HDPic®), 400 lb/ac metham-sodium, 400 lbs/ac metham sodium plus 115 lbs/ac chloropicrin or 250 lbs/ac dazomet (Basamid®) were applied April 27, 1994. The dazomet was

applied to the soil surface and rototilled immediately into the soil. All other fumigants were shank-injected and covered immediately by plastic tarp.

A single mixed seed lot of loblolly pine (*Pinus taeda* L.) was sown in all study plots May 18, 1994 (21 days after fumigation). Seedlings were counted 35 and 202 days after sowing (June 23 and December 6, 1994). Seedlings within a four-square-foot frame were counted at two systematically located points within each treatment plot. When the December counts were made, more than 25 seedlings were removed from each counted subplot for determination of size and mass. Root collar diameters were measured for 25 seedlings randomly selected from each subplot and these (25) were then ovendried to a constant weight.

All weeds were counted 58 days after fumigations within the same four-square-foot areas within which seedbed densities were assessed (June 23, 1994). Weed cover was also estimated on a scale of 1 to 10 for the whole plot.

Soil samples were collected from 12 treatment plots two days before fumigation and from all plots (n=64) 58, 130 and 244 days after treatment. Soil was collected at points roughly 1/3, ½ and 2/3 into each treatment plot, bulked and transported to the laboratory to be plated and assessed for *Fusarium*, *Trichoderma*, and *Rhizoctonia*.

RESULTS

The Nursery Coop has evaluated fumigation trials at five nurseries over the past three years using the techniques described here. Winona's soil is by far the heaviest among these nurseries. Soils were greater than 90% sand at the other four nurseries compared to less than 30% at Winona (57% silt, 13% clay).

Seedling Quality:

No differences were measured for seedbed densities or in seedling quality among treatments (Table 1). Differences in seedbed densities are usually attributable to disease so a lack of difference is not surprising. Past studies have shown the suppression of chronic, soil born, diseases by MBr for more than two years. Past fumigation and cultural practices over several years have reduced the incidence of low soil diseases. However, there have been differences in seedling quality between fumigation treatments in several studies. No significant seedling quality differences among fumigation treatments is unusual.

Weeds:

Numbers of weeds and weed cover per plot differed among treatments (Table 2). These variables also differed within the study area for column but not for bed location. As expected, MC33 reduced weeds more than the other fumigants.

Table 1. Fumigation effects on seedbed density and seedling development.

	Number/ft² (Date)		Seedling Grade[1]			Weight	
Treatment[2]	6/23	12/6	Dia.	plant	one cull	total	root
Control	26	27	4.2	18.1	3.8 8.5	81.3	17.3
MC33	27	28	4.4	17.5	2.1 10.5	91.9	17.3
HD-PIC	28	26	4.2	16.9	2.9 8.8	80.8	15.8
Triform	28	30	4.1	22.2	2.6 8.2	91.9	16.8
SMDC/Chl	28	28	4.3	17.9	2.9 10.3	91.4	17.0
SMDC	27	28	4.2	19.0	3.3 8.6	85.4	17.6
Dazomet	27	26	4.2	20.0	2.3 6.4	80.9	15.6
lsd[3] 2.7	3.8	0.2	4.5	1.9	3.7 16.3	3.4	

[1] Seedling grades of one, cull and plant, respectively, refer to root collar diameters > 4.75mm, < 3.2mm, and > 3.2mm. The numbers reported for grade and for weight are for square foot of bed.
[2] MC33 is 235 lb/ac 67% MBr + 37% chloropicrin, HD-PIC is 250 lb/ac chloropicrin, Triform = 300 lbs/ac 70% 1,3 dichloropropene plus 30% chloropicrin, SMDC is 400 lb/ac metham-sodium, SMDC/Chl is 400 lbs/ac metham sodium plus 115 lbs/ac chloropicrin, and dazomet is 250 lb/ac.
[3] lsd is for SAS ANOVA α 0.05.

Table 2. Weed abundance by treatment 53 days after fumigation.

Treatment[1]	Number in 4 ft²	Percent Coverage
Control	13.7 a	38.7 a
MC33	2.3 c	5.9 c
HDPic	6.1 bc	14.4 bc
Triform	4.5 bc	21.2 bc
SMDC	9.5 ab	25.0 ab
SMDC/Chl	2.6 c	11.2 bc
Dazomet	4.6 bc	21.9 bc
lsd[2]	5.3	14.9

[1] MC33 is 235 lb/ac 67% MBr + 37% chloropicrin, HD-PIC is 250 lb/ac chloropicrin, Triform = 300 lbs/ac 70% 1,3 dichloropropene plus 30% chloropicrin, SMDC is 400 lb/ac metham-sodium, SMDC/Chl is 400 lbs/ac metham sodium plus 115 lbs/ac chloropicrin, and dazomet is 250 lb/ac.
[2] lsd and Duncan's means separation are for SAS ANOVA $\alpha = 0.05$.

Table 3. Colonies of soil fungi on selective media receiving 0.5 ml suspension containing 4.4 mg nursery soil by fumigation treatment and sampling date.

	Fusarium			Trichoderma			Herr's Medium			
	date[1]			date			date			
Treatment[2]	6/2	3 9/5	12/6	6/23	9/5	12/6	6/23	9/5	12/6	
Control	6.8	10.3	8.0	6.4	5.8	5.1	12.9	12.3	9.6	
MC33	2.9 b	3.8 b	2.0 b	10.2 b	10.7 b	10.6 b	10.2	13.7	5.8	
HD-PIC	1.5 b	2.9 b	3.7 b	10.7 b	6.6	12.5 b	19.4 b	9.1	22.3 b	
Triform	3.7	5.7 b	5.3	11.0 b	7.2	9.0 b	17.7 b	10.6	12.8	
SMDC/Chl	1.9 b	1.5 b	3.1 b	6.0	4.5	3.2	6.5 b	9.1	11.3	
SMDC	5.4	10.5	8.1	4.8	4.8	3.2	12.6	10.2	10.1	
Dazomet	5.2	8.4	7.2	5.3	4.3	3.8	11.2	4.7 b	6.4	
lsd[3]	2.9	2.4	3.5	3.8	2.3	2.4	5.5	5.9	12.8	

[1] Dates 6/23, 9/5 and 12/6 are, respectively, 58, 130 and 244 days after fumigation.
[2] MC33 is 235 lb/ac 67% MBr + 37% chloropicrin, HD-PIC is 250 lb/ac chloropicrin. Triform = 300 lbs/ac 70% 1,3 dichloropropene plus 30% chloropicrin, SMDC is 400 lb/ac metham-sodium, SMDC/Chl is 400 lbs/ac metham sodium plus 115 lbs/ac chloropicrin, and dazomet is 250 lb/ac.
[3] lsd is for SAS ANOVA α 0.05.

Soil Fungi:
Numbers of colonies of *Fusarium*, *Rhizoctonia*, and *Trichoderma* in soil samples from two days before or 58 days after treatment did not differ for position (bed or columns) within the nursery (Table 2). Numbers of soil fungi, especially *Trichoderma*, should be considered to represent proportional differences between treatments rather than an exact number of cfu's per gram of soil. With that caveat, populations of soil fungi at Winona responded similarly to those at other nurseries. More colony forming units (cfu's) of *Trichoderma* after fumigation with MC33, chloropicrin or Triform (see Table 2) and no increase or a decrease after dazomet has occurred at the other tested nurseries. No reduction in cfu's isolated on Herr's medium after fumigation has not occurred at other nurseries. Because Winona is the only heavy textured soil tested using these techniques this may be normal for this soil texture. Numbers of *Fusarium* cfu's were fewest among treatments that included chloropicrin (MC33, chloropicrin, sectagon plus chloropicrin and Triform).

IMPLICATIONS FOR MANAGEMENT

In pine nurseries, most weeds are effectively controlled by herbicides and weed abundance did not differ among fumigants after herbicide application at Winona. Nevertheless, savings for reducing herbicide applications (both economic and ecologic) could reduce the cost for fumigation. Whether the reduction from 13.7 to 2.4 weeds per 4 ft^2 (at 35 days after sowing) would reduce herbicide applications would vary between nurseries with such factors as the weed tolerance of the nursery manager and the flexibility of personnel and equipment schedules.