Auburn University Southern Forest Nursery Management Cooperative

RESEARCH REPORT 98-3

LOBLOLLY SEEDLING PRODUCTION, SOIL FUNGI AND NEMATODES IN THE FIRST TWO CROPS AFTER FUMIGATION AT THE TEXAS SUPERTREE NURSERY

by
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INTRODUCTION

Methyl bromide (MBr) fumigation has satisfactorily controlled most soil disease problems and enhanced forest tree seedling production throughout the South since the late 1950's. That fumigant is indited as contributing to stratospheric ozone depletion and its use will probably be withdrawn or limited after the year 2,000. All the alternative fumigants have less activity against at least some of the pests (weeds, nematodes and pathogens) controlled by MBr and should vary in suitability between nursery locations depending on what problems are endemic there. This report summarizes seedling production and changes in numbers of selected soil fungi (*Trichoderma* and *Fusarium*) and nematodes during two 1-0 loblolly nursery crops after a single fumigation.

METHODOLOGY

Three treatments, MC2 (300 lbs/ac 98% MBr 2% chloropicrin), Triform (290 lbs/ac 70% 1-3 dichloropropene and 30 % chloropicrin) and chloropicrin (300 lbs/ac) were each randomly assigned to one third of each of three blocks. Irrigation lines between blocks helped maintain treatment integrity. Blocks were 68 feet wide and 680 foot long and nine beds were sown each year. One bed in each MBr replicate was left not fumigated as a control and half of each chloropicrin replicate was tarped. Fumigation treatments were applied February 22, 1996. The biologically derived nematocide, DiTera®, was applied to the fifth bed of each block during the second crop after fumigation. DiTera was applied at a rate of 2.5 gal/ac (in 40 gal/water) on July 1, 8 and 18 and at a rate 5 gal/ac on September 16 and 26, 1997. The soil at this nursery, near Tyler, Texas is 87% sand.

Loblolly (*Pinus Taeda*) seed were sown on April 16, 1996 and April 22, 1997. Seedling development was assessed November 12, 1996 and October 31, 1997. Seedbed densities were assessed within two 1-foot-wide frames across beds (4 ft^2) per fumigation treatment plot. The center six drills of each seedbed density plot were harvested and 25 seedlings were randomly selected from each. Root collar diameters (rcd) were measured before tops were separated from roots, oven dried, and weighed. In 1997, plots in DiTera treated rows were included.

Soil fungi in the genera *Trichoderma* and *Fusarium* were assessed as colony forming units (cfu's)/ gm soil at one week prior to and five and nine months after fumigation. Samples were bulked by treatment plot (n=15) and 0.005 gm subsamples, in 2% water agar, transfered to 6.5 cm diameter Petri plates with selective media. Samples for nematode analysis were collected at the end of each growing season. In 1996, soil samples were collected through treatment plots (n=15) and in 1997, soil was collected at each seedbed density plot and bulked by fumigation and DiTera treatments.

RESULTS AND DISCUSSION

Differences between tarped and not-tarped chloropicrin treatments were not significant so those data were combined. In the first crop after fumigation, there were fewer total and fewer plantable (RCD > 3.2 mm) seedlings in MBr than in control plots. Although MBr fumigation seldom reduces germination or survival a similar, unexplained, reduction in seedling numbers but not growth occurred in Alabama in 1995 where MBr plots contained fewer seedlings than Triform or chloropicrin/Vapam treated plots (Research Report 97-7). Reductions in mycorrhizae can reduce growth, and rarely nursery survival, but this is not indicated here. Seedbed densities did not differ between control, Triform, and chloropicrin treatments and this indicates that there was little disease pressure to affect germination or survival.

Numbers of plantable seedlings were similar among treatments. However, seedling mass per unit area of bed, RCD mean and grade one seedlings (RCD > 4.7 mm) indicate that all fumigants enhanced growth in the first crop after fumigation. The effect did not persist, in the second crop differences between fumigated and not fumigated beds were small. Normally, as seedbed density increases average seedling size becomes smaller and biomass per unit area increases. In the present study, seedbed densities were higher in the second crop 24.5 vs 18.3 /ft^2 lsd=2.7) but biomass was lower (50.3 vs 80.8 gm/ft^2 lsd=14.6). Although the growth enhancement of fumigation normally declines in the second year, the absence of any effect (as indicated in Table 1) is unusual.

Data for soil fungi are presented in Table 2. Cfu's of *Trichoderma* were similar among fumigated plots at all sample dates but increased compared to controls by November among fumigated plots. Increases in this fungus after MBr or chloropicrin fumigation have been observed at other nurseries and for other crops and abundant *Trichoderma* is associated with the biological control of several plant diseases and is considered beneficial for nursery seedlings (South and others 1997).

Cfu's of *Fusarium* decreased after fumigation and stayed low through November 1996 among fumigated plots, however, at no date did treatments differ significantly and mean cfu's were not reduced by Triform. This common plant pathogen is often associated with damping-off in pine nurseries and the failure of Triform to reduce its numbers is troubling even though disease problems did not occur during the study.

Nematodes from the first crop were analyzed as routine agricultural samples and only plant parasites were reported. The stunt nematode *(Tylenchorhynchus claytoni)* was the only species reported from most samples (mean 19, range 0 - 44 / 100 cc soil). Second crop nematodes were analyzed as research samples and parasitic and saprophytic groups are reported in Table 3. Stunt nematodes remained the most abundant parasites but numbers were still less than has been associated with growth loss of pine seedlings. The nematode extraction technique used in 1997 less efficiently extracts stunt nematodes than that used in 1996 (Rodriguez-Kabana and Pope, 1981). MBr was the only tested fumigant that reduced numbers of stunt nematodes (α 0.05) in the second crop. Saprophytic nematodes averaged 150 / 100 cc and these and the few stubby root nematodes (mean 2.7) did not differ among fumigation treatments. DiTera treatment did not affect the number of nematodes extracted. Numbers of nematodes did not correlate either with seedbed densities, seedling sizes, or weights.

Hopper (1958) reported that "low infestations" of stunt nematodes seemed not to affect pine seedlings but that 75 and 125 per 100 cc soil caused severe injury at nurseries, respectively, in MS and LA. Although within our study area control plots averaged only 30 stunt nematodes /100 cc, outside this area they were very abundant (> 1,000 / 100 cc) among patches of stunted seedlings. These stunted seedlings had symptoms of nematode damage and root inspection for the more virulent lesion nematode (*Pratylenchus* sp) was negative. Since stunt nematodes can buildup in this soil it is unfortunate the alternative fumigants seemed ineffective.

MANAGEMENT IMPLICATIONS

Chloropicrin and Triform enhanced seedling development as well as MBr during the first crop after fumigation but did not suppress numbers of stunt nematodes as well. DiTera did not affect numbers of stunt nematodes.

ACKNOWLEDGMENTS

Abbott Laboratories supplied the DiTera®; Hendrix and Dail, Inc. applied the fumigants to the experimental design; Dr. R. Rodriguez-Kabana consulted and provided nematode extraction and analysis.

LITERATURE CITED

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Rodriguez-Kabana, R., and M. H. Pope. 1981. A simple incubation method for the extraction of nematodes from soil. Nematropica 11:175-185.

Table 1. Effects of fumigation in 1996 on two years of loblolly production at a Texas nursery.

Year	Fumigant†	Seedlings Parameters		Stems/ft² by RCD class		
		RCD(mm)	weight(gm)†	all	>3.2mm	4.7mm
96	None	4.6a	61a	19.7a	19.1a	6.8a
	MBr	5.5 b	82ab	16.4 b	16.2 b	12.2 b
	Chloropicrin	5.4 b	91 b	18.5ab	18.4ab	12.7 b
	Triform	5.4 b	89 b	18.6ab	18.4ab	13.4 b
97	None	3.8a	54a	23.3a	19.4a	2.8a
	MBr	3.7a	54a	25.5a	19.1a	1.6a
	Chloropicrin	3.7a	46a	23.4a	16.7a	2.4a
	Triform	3.6a	47a	25.3a	17.9a	2.4a

† This is dry weight of seedling stems /ft² of nursery bed.

Table 2. Fungal populations before and after a February fumigation at a Texas nursery.

Fungal Genus	Treatment	cfu's† / 0.1 gm soil by sample date		
		10 before	117 after	230 after
Trichoderma	None	240	260	80a
"	MBr	240	260	340 b
"	Chloropicrin	240	260	280 b
"	Triform	240	260	320 b
Fusarium	None	240	100	100
"	MBr	240	20	60
"	Chloropicrin	240	20	60
"	Triform	240	140	140

†From 1:200 dilutions.

Table 3. Numbers of nematodes by fumigation and DiTera 22 months after fumigation.

Fumigant	Stunt	Stubby Root	Saprophytic	Dorylaimoid
None	31a	2	157	30
MBr	0 b	1	195	5
Chloropicrin	15ab	6	110	10
Triform	19ab	1	142	2
Ditera				
None	12	2	118	10
Yes†	16	4	193	7

†Ditera at 3 application of 2.5 gal/ac and 2 application of 5 gal/ac.