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Management and pest management considerations on droughty soils: four year results

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MANAGEMENT AND PEST MANAGEMENT CONSIDERATIONS ON DROUGHTY SOILS: FOUR YEARS RESULTS[1]

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Abstract.--Four year survival of pines on droughty (Typic Quartzipsamments) soils was best for longleaf pine and Terr-Sorb[R]-treated loblolly pine. Pest considerations include town ants and Nantucket pine tip moths on loblolly pine. Untreated loblolly pine had reduced leader and total height growth and increased tip moth infestations, compared to Terra-Sorb[R] and clay-slurry treated loblolly pine. Soil texture averaged less than eight percent silt and clay combined in the treatment areas.

INTRODUCTION

Intensive site preparation and planting with genetically improved seedlings are widely used methods for southern pine regeneration. On droughty sites, clearcutting followed by these methods may lead to less than optimum results. While attempting to regenerate pines on droughty soils (= Tonkawa series), management and pest management options should be considered. Tonkawa soils, a Typic Quartzipsamment, consisting of excessively drained sandy soils on uplands, are characterized by low fertility with slopes ranging from 0-20 percent. In east Texas, these soils cover approximately 23,000 acres in Nacogdoches, Panola, Rusk and San Augustine Counties. Site index is approximately 55 (base 50 years). Original forest cover was probably dominated by shortleaf pine (Pinus echinata) with longleaf pine (P. palustris) intermixed. Dominant hardwood species were sandjack (bluejack) oak (Quercus incana).

In clearcut areas, with or without chopping, burning and/or shearing and windrowing and whole-tree chipping, regeneration is difficult due to the removal of organic matter and exposure of bare mineral soil to the sun and wind. This greatly decreases the moisture holding capacity of the soil as well as increasing surface temperature. Attempts to reforest these areas to pines often result in less than 10 percent survival. In 1983, a study was initiated to investigate management and pest management considerations, on these droughty soils. Kroll et al. (1985) reported the first two year's survival. This paper reports on four year results and additional management considerations.

METHODS AND MATERIALS

Study plots were established on Tonkawa (Typic Quartzipsamment) soils (Dolezel 1980) 6 miles West of Garrison, TX. Seven treatments with eight replicates were established. Within each replicate, 48 seedlings were planted on an 8x8 foot spacing in four rows of 12 seedlings each. A buffer zone equal in size to the replicates was planted between and an the ends of each replicate with bare rooted loblolly pine seedlings. The seven treatments, randomly assigned in each replicate, were:

1. bare-rooted loblolly pine,
2. Terra-Sorb[R][3] treated loblolly pine,
3. clay-slurry treated loblolly pine,
4. bare-rooted slash pine,
5. Terra-Sorb[R] treated slash pine,
6. clay-slurry treated loblolly pine, and
7. containerized longleaf.

Details of plot lay-out are presented in Kroll et al. (1985).

Terra-Sorb[R] is a starch-based synthetic acrylic polymer capable of absorbing water[3]. It forms a hygroscopic substance used as a root dip to increase moisture holding capacity. Clay-slurry is a similiar but inorganic compound also forming a hygroscopic substance when mixed with water. Replicates were hand-planted using standard methods in January 1983. The study was replicated in January 1984 and 1985 but failed due to excessively low winter temperatures, high rabbit predation, and drought and drying winds in 1984 and 1985, respectively.

Survival counts were taken at the end of the four growing seasons and data grouped to compare survival, differences in height growth, 1986 leader length and Nantucket pine tip moth, Rhyacionia frustrana, infestation rates. All data were analysed used one-way analysis of variance and means compared using Duncan's multiple range test at P = 0.05.

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RESULTS AND DISCUSSION

Four-year survival is reported in Table 1. Note the steep decline in survival in the 1983-1984 growing seasons and the absence of significant mortality in the 1985-1986 growing seasons. At the end of the 1986 growing season, longleaf pine had 56 percent survival followed by 40.1 percent survival for Terra-Sorb -treated loblolly pine (P. taeda). Slash pine, P. palustris, had an average survival of 13 percent for all three treatments, combined.

Table 1. Survival of loblolly, slash and longleaf pine, Typic Quartzipsamments soils, four year results.

Treatment	October 1983	1984	1985	1986
Longleaf Pine	85.2	56.5	56.0	56.0
Loblolly (Terra-Sorb^R)	81.3	50.8	46.5	40.1
Loblolly (Clay Slurry)	49.2	31.9	31.3	29.2
Loblolly (Untreated)	50.5	19.6	21.3	21.3
Slash (Terra-Sorb^R)	46.9	20.8	16.2	14.6
Slash (Clay Slurry)	35.4	16.9	12.0	10.4
Slash (Untreated)	41.4	16.9	23.5	14.1

The decline in loblolly pine survival from 1984 to 1986 was due primarily to Texas leaf-cutting ants (town ants), Atta texana. Town ant predation is common on sandy sites (Moser 1984) and damage to pines is most severe in winter when there is little or no other green vegetation for the ants to forage (Thatcher et al. 1986). Currently, the Dowfume MC-2 formulation of methyl bromide, used for town ant control, and produced by Dow Chemical Company, is no longer available. The Texas Forest Service is involved with developing alternatives to methyl bromide for the control of town ants (R. Scott Cameron, Texas Forest Service, Lufkin, TX, pers. commun.).

Additional pests of loblolly pine on the study plots include the redheaded pine sawfly, Neodiprion lecontei, and the Nantucket pine tip moth (NPTM). Sawflies defoliated portions of the crown of loblolly pine. NPTM infestation rates were significantly higher on control loblolly pine than those treated with Terra-Sorb^R (Table 2). These higher infestation rates led to increased multiple leaders and crooked boles in the control plots. Due to economic contraints, control of NPTM may not be practical on these sites.

Long-term effects of tip moth are difficult to assess, but include bole sweep and compression wood (Hedden and Nebeker 1984). Cade (1985) indicated tip moth damage is greater and lasts longer on poorly stocked or open grown stands.

Table 2. Nantucket pine tip moth infestation rates for four-year old loblolly pine, Typic Quartzipsamments soils.

Treatment	Number of trees	Infestation Rate (mean ± SD)[1]
Untreated	32	7.8% ± 7.8a
Clay Slurry	56	5.8% ± 4.5ab
Terra-Sorb^R	77	5.1% ± 5.9b
All Trees Combined	165	5.9%

[1] Means followed by same letter not significantly different at P=.05 using Duncan's Multiple Range Test.

For loblolly pine, fourth-year leader length and total tree height were significantly greater for Terra-Sorb^R and clay-slurry treated trees compared to control trees (Tables 3 and 4). During the 1986 growing season, 43 percent of the total height growth occurred for loblolly pine, compared over all treatments. Average height ranged from 148 cm for untreated loblolly to 181 and 190 cm for Terra-Sorb^R and clay-slurry treated loblolly pine, respectively (Table 4).

Table 3. Fourth year leader length and percent total height, four year old loblolly pine, Typic Quartzipsamments soils.

Treatment	Number of trees	Leader Length (cm)x ± SD[1]	Percent Total Height
Untreated	32	60 ± 28 A	40.5%
Clay Sturry	56	91 ± 24 B	47.9%
Terra-Sorb^R	77	85 ± 33 C	47.0%
	165	82 ± 31	43.1%

[1] Means followed by same letter not significantly different at P=.05 using Duncan's multiple range test.

Table 4. Total tree height for four-year old loblolly pine, Typic Quartzipsamments soils.

Treatment	Number of trees	Height (cm) (mean ± SD)[1]
Untreated	32	148 ± 56a
Clay Slurry	56	190 ± 51b
Terra-Sorb[R]	77	181 ± 57b
All Trees Combined	165	178 ± 56

[1] Means followed by same letter not significantly different at p =.05 using Duncan's Multiple Range Test.

Soil texture (Table 5) reflected the deep sand conditions (Dolezel 1980). Percent silt and clay combined, averaged less than eight percent for the top six centimeters measured over three sites. Longleaf pine, with 56 percent survival, was emerging from the grass stage. No brown spot needle blight, caused by Scirrhia acicola, was detected. Hazard rating for brown spot in this site is low as less than 50 percent of the stand is infected (Anderson et al. 1984).

On these droughty sites, stand disturbance during harvest cutting should be kept to a minimum. Containerized longleaf and Terra-Sorb[R]-treated loblolly pine had better survival (Table 1), but pest considerations (town ants and tip moths) reduce the usefulness of loblolly pine. To regenerate these sites, minimum exposure to drying winds to conserve soil moisture and to reduce decomposition of humus and organic remains (Wilde 1948, 1958) is recommended.

Table 5. Texture analyses of planting sites TN-1 (planted Jan. 83), TN-2 (planted Jan. 85, and an undisturbed natural stand (TN-3), a Typic Quartzipsamment.

Sampling Depth (cm)	TN-1 % sand	TN-1 % silt	TN-1 % clay	TN-2 % sand	TN-2 % silt	TN-2 % clay	TN-3 % sand	TN-3 % silt	TN-3 % clay
0 - 6	92.0	4.5	3.5	91.0	4.7	4.3	92.1	5.1	2.8
30 - 38	94.1	3.6	2.3	91.8	3.9	4.3	92.5	4.4	3.1
61 - 69	95.0	3.2	1.8	92.5	3.8	4.2	92.6	4.4	3.0
91 - 99	96.0	2.6	1.4	92.6	3.6	4.7	92.5	4.6	2.9
122 - 130	96.1	2.6	1.3	92.5	3.8	4.4	92.7	4.4	2.9
152 - 160	96.2	2.7	1.1	92.7	3.8	4.4	93.4	4.3	2.3
Average	94.9	3.2	1.9	91.7	3.9	4.4	92.7	4.5	2.8

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