THE EFFECTIVENESS OF SUPERABSORBENT MATERIALS FOR MAINTAINING SOUTHERN PINE SEEDLINGS DURING COLD STORAGE

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Abstract.--First-year survival and growth of loblolly pine (Pinus taeda L.) seedlings packaged with seven different superabsorben polymers, and planted within 48 hours or after 30 days cold storage, were evaluated in Mississippi and Louisiana. Differences in survival were significant at the Mississippi site with several superabsorbent treatments being superior to the clay slurry control. Total height differences among treatments were not significant at either the Mississippi or Louisiana site.

INTRODUCTION

The use of more expensive genetically improved southern pine seedlings and high site preparation costs demand a high plantation survival. It is also essential that the seedlings begin root regeneration and height growth as quickly as possible to overcome weed competition.

The method of seedling packing and storage following lifting influences the survival and growth of pine seedlings. Many southern nurserymen pack seedlings in Kraft-polyethylene bags, just before the bags are sealed, the seedling roots are sprayed with a kaolin clay slurry to help maintain a moist root surface and provide protection from exposure. This packing process is felt by tree planters to be superior to the Forest Service bale system which has been used for many years and is still used in some areas.

In 1973, a research team at the USDA Northern Regional Research Center discovered that a starch-poly-acrylonitrile polymer was capable of absorbing up to 300 times its weight in water. Since this product (commonly called a superabsorbent) has been in the public domain, it has been tested for several uses in agriculture and related disciplines. Among the potential uses are seed coatings, soil amendments, rooting media, and root coatings to retard drying (Doane and Mayberry 1979, Copley 1980).

Superabsorbents are used at some forest tree nurseries as a root coating to prevent drying. However, the effects of superabsorbents on seedling survival and growth have not been reported in detail. In a North Carolina study, seedlings dipped in a superabsorbent immediately prior to outplanting did not survive as well as seedlings dipped in water or clay slurry (Goodwin 1982).

Superabsorbents are produced in several formulations by various manufacturers. Differences among superabsorbents are primarily in the base material and in their texture. Finer textured materials generally have greater water-

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holding capacity.

This study examined the effects of several different superabsorbents in seedling packaging on survival and growth after a period of cold storage.

MATERIALS AND METHODS

In mid-January 1981, seven water absorbing substrates[2/] were mixed at the W. W. Ashe Nursery in Mississippi according to the instructions supplied by their respective manufacturers. The superabsorbents varied in texture from coarse, sawdust-like material to a flour-like powder. Five of the absorbents were starch based, two were synthetic based. Bundles of 50 loblolly pine (Pinus taeda L.) seedlings were collected from a single seed lot that had been processed normally on a grading table. Seedlings were graded to Wakeley's grades 1 and 2. These seedlings were then hand dipped into one of the water-absorbing substrates and packed inside a Kraft-polyethylene bag. As a control, graded seedlings operationally sprayed with clay slurry and then bagged were used. Separate groups of treatments were planted within 48 hours after lifting at sandy loam sites on Erambert Seed Orchard in Brooklyn, Mississippi and the J. K. Johnson Tract of the Palustris Experimental Forest in central Louisiana. In addition, two groups of treatments were packaged and stored at 34°F for 30 days prior to outplanting at the same planting sites. The seedlings were planted in four complete blocks of randomized row plots. Each plot consisted of 50 seedlings spaced two feet within the row. The individual rows were also spaced at two feet. The seedlings were hand planted with dibbles.

RESULTS AND DISCUSSION

Survival

Differences in first year survival among treatments were statistically significant at the Mississippi planting site but not in Louisiana. At the Johnson Tract in Louisiana, the trend was for better survival among seedlings packed with some of the superabsorbents (table 1). With no storage, the best survival was observed for seedlings packed in Terra-Sorb 200 and ES 148 fine. Survival of these two treatments was uniform throughout the four blocks. However, the remaining treatments had highly variable results as indicated by the very high standard errors associated with the treatment means. The same problem was observed for seedlings stored 30 days. Terra-Sorb 200, 201, 250, and Water-Lock B-100 had high survival rates and relatively low standard errors of the means. The remaining treatments had high standard errors associated with their means.

[2/] The use of trade, firm, or corporation names of materials is for the reader's information and convenience. Such use does not constitute offical endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.

Table 1.--Percent survival of loblolly seedlings root dipped with various water absorbents prior to outplanting in central Louisiana in January and February 1981. The seedlings were checked for survival in December 1981. Fifty seedlings were planted in each plot. Differences among the means were not statistically significant at the $P < 0.05$ level.

Treatments	Blocks 1	2	3	4	$\bar{x} \pm$ S.E.
	% survival				
Outplanted within 48 hours					
Terra-Sorb 200	86	84	84	82	84.0 ± 1.6
Terra-Sorb 201	90	88	78	48	76.0 ± 19.3
Terra-Sorb 250	88	78	22	86	68.5 ± 31.3
Terra-Sorb 1000	94	12	10	94	52.5 ± 47.9
ES 148, fine	78	62	88	78	76.5 ± 10.8
ES 148, 20 mesh	64	90	18	82	63.5 ± 32.2
Water-Lock B-100	86	2	54	42	46.0 ± 34.7
Kaolin slurry	72	76	20	28	49.0 ± 29.1
Stored for 30 days					
Terra-Sorb 200	66	78	84	62	72.5 ± 10.2
Terra-Sorb 201	92	92	80	88	88.0 ± 5.7
Terra-Sorb 250	68	84	94	90	84.0 ± 11.4
Terra-Sorb 1000	82	96	86	6	67.5 ± 41.4
ES-148 fine	18	12	86	6	38.5 ± 33.6
ES-148, 20 mesh	14	72	78	64	57.0 ± 29.2
Water-Lock B-100	90	70	60	82	75.5 ± 13.2
Kaolin slurry	18	82	90	92	70.5 ± 35.3

At the Erambert Seed Orchard site in Mississippi, seedlings treated with Terra-Sorb 1000, ES 148 20 mesh, and Water-Lock B-100 had significantly better survival, whether stored or planted within 48 hours (table 2). Clay slurry, Terra-Sorb 200, and Terra-Sorb 201 treatments gave the poorest survival, with significant reductions in survival of seedlings stored 30 days versus those planted within 48 hours. Survival of seedlings treated with Terra-Sorb 250 was better after 30-day storage than without storage.

That statistically significant differences were detected among treatments planted in Mississippi but not in Louisiana can be attributed to different survival variations at the two sites. The standard error of the mean of each treatment was much lower for the Mississippi planting than for the Louisiana planting. High variability of the standard errors reflects a wider range in percent survival among individual plots of each treatment, and consequently a lack of statistical significance among the means of the Louisiana data.

At the Louisiana site, poor survival was often associated with individual row plots. This is illustrated by the plot survival data for Terra-Sorb 1000 stored 30 days; this was the best treatment in Mississippi, averaging 94.5 percent survival, but in Louisiana the 4 plots had 82, 96, 86, and 6 percent survival, respectively. Other treatments showed similar trends which raise

suspicion that some factor other than drought stress was responsible for low survival of individual plots.

Table 2.--Percent survival of loblolly seedlings root dipped with various water absorbents prior to outplanting in Mississippi in January and February 1981. The seedlings were checked for survival in December 1981. Fifty seedlings were planted in each plot. Means and standard errors followed by different letters are statistically significant at the $P < 0.05$ level.

Treatments	Blocks 1	2	3	4	$\bar{x} \pm$ S.E.
	% survival				
Outplanted within 48 hours					
Terra-Sorb 200	82	78	86	80	81.5 ± 3.4 cd
Terra-Sorb 201	80	88	76	78	80.5 ± 5.3 cd
Terra-Sorb 250	68	82	78	76	76.0 ± 5.9 d
Terra-Sorb 1000	92	98	88	90	92.0 ± 4.3 a
ES 148, fine	84	94	94	92	91.0 ± 4.8 ab
ES 148, 20 mesh	88	90	98	94	92.5 ± 4.4 a
Water-Lock B-100	80	94	98	90	90.5 ± 7.7 ab
Kaolin slurry	72	86	88	90	84.0 ± 8.2 bc
Stored for 30 days					
Terra-Sorb 200	64	46	56	44	52.5 ± 9.3 c
Terra-Sorb 201	58	30	70	52	52.5 ± 16.8 c
Terra-Sorb 250	76	84	92	94	86.5 ± 8.2 a
Terra-Sorb 1000	88	92	98	100	94.5 ± 5.5 a
ES 148, fine	88	82	80	96	86.5 ± 7.2 a
ES 148, 20 mesh	94	100	90	94	94.5 ± 4.1 a
Water-Lock B-100	90	94	90	90	91.0 ± 2.0 a
Kaolin slurry	66	58	58	86	67.0 ± 13.2 b

Height growth

There were no statistically significant differences in first-year total height among the treatments planted at each site, whether the seedlings were planted within 48 hours or stored for 30 days. Mean heights of treatments ranged from 19.2 cm to 25.9 cm at the Louisiana planting site (table 3). Seedlings planted without storage averaged only 0.4 cm taller than those planted after 30 days storage. At the Mississippi planting site, treatment means ranged from 25.4 cm to 31.7 cm tall (table 4). The mean of seedlings planted within 48 hours was 1.1 cm greater than the mean height of seedlings planted after 30 days storage. Better height growth was expected from seedlings planted at the Mississippi site as it is more productive than the Louisiana site tested in this study.

Table 3.--Height growth of loblolly pine seedlings which were root dipped with various water absorbents prior to outplanting in central Louisiana in January and February 1981. The data represents the mean height of the surviving seedlings from 50 tree plots in December 1981. Differences among the means were not statistically significant at the $P < 0.05$ level.

Treatments	Blocks 1	2	3	4	$\bar{x} \pm$ S.E.
	Heights in cm				
Outplanted within 48 hours					
Terra-Sorb 200	24.8	26.6	25.8	11.9	22.3 ± 6.9
Terra-Sorb 201	27.0	28.1	24.2	24.5	25.9 ± 1.9
Terra-Sorb 250	27.6	23.1	18.9	23.8	23.4 ± 3.6
Terra-Sorb 1000	27.3	15.5	20.2	26.3	22.3 ± 5.5
ES 148, fine	22.8	22.2	26.4	19.8	22.8 ± 2.7
ES 148, 20 mesh	23.3	27.7	19.0	24.3	23.6 ± 3.6
Water-Lock B-100	18.4	19.0	23.0	20.2	20.2 ± 2.0
Kaolin slurry	22.8	23.5	15.1	15.4	19.2 ± 4.6
Stored for 30 days					
Terra-Sorb 200	28.5	20.4	24.7	18.9	23.1 ± 4.4
Terra-Sorb 201	22.2	24.2	20.9	22.6	22.5 ± 1.4
Terra-Sorb 250	25.8	22.7	22.5	24.5	23.9 ± 1.6
Terra-Sorb 1000	23.1	25.6	23.2	13.0	21.2 ± 5.2
ES 148, fine	24.4	18.0	27.7	16.9	21.8 ± 5.2
ES 148, 20 mesh	18.3	18.0	25.0	20.0	20.3 ± 3.2
Water-Lock B-100	26.0	19.8	24.5	26.8	24.3 ± 3.1
Kaolin slurry	25.6	19.8	22.6	21.1	22.3 ± 2.5

CONCLUSIONS

The survival results of this study indicate that some superabsorbents are effective root packing media for maintaining bare-root seedlings, either for prompt planting or for holding in cold storage up to 30 days storage. Those superabosrbents that were best were the finer textured matierals which apparently have greater water holding capacity.

Based on one year results, superabsorbents do not appear to offer any growth advantages over treatment with clay slurry. However, there do not appear to be any negative effects of superabsorbents on seedling growth either. At least three southern forest tree nurseries have converted their pine seedling packing operations from kaolin clay slurry to a superabsorbent without any reported negative effects.

Of course, seedlings packed in Kraft-polyethylene bags with superabsorbents, as with clay slurry, must be kept in cold storage between 1/2°C and 5°C until they are planted.

The results of this study show that superabsorbents represent a promising packing material for bare-root pine seedlings.

Table 4.--Height growth of loblolly pine seedlings which were root dipped with various water absorbents prior to outplanting in central Mississippi in January and February 1981. The data represents the mean height of the surviving seedlings from 50 tree plots in December 1981. Differences among the means were not statistically significant at the $P < 0.05$ level.

Treatments	Blocks 1	2	3	4	$\bar{x} \pm$ S.E.
	Height in cm				
Outplanted within 48 hours					
Terra-Sorb 200	28.6	32.9	29.0	29.7	30.1 ± 2.0
Terra-Sorb 201	29.8	29.1	29.9	33.9	30.2 ± 2.6
Terra-Sorb 250	24.8	30.2	31.2	32.4	29.7 ± 3.4
Terra-Sorb 1000	30.3	28.8	25.9	41.6	31.7 ± 6.9
ES 148, fine	27.9	29.4	24.9	32.7	28.7 ± 3.2
ES 148, 20 mesh	26.8	28.8	26.5	32.2	28.6 ± 2.6
Water-Lock B-100	30.3	31.1	31.1	31.1	30.9 ± 0.4
Kaolin slurry	25.4	24.9	27.3	25.9	25.9 ± 1.0
Stored for 30 days					
Terra-Sorb 200	25.2	29.1	24.0	31.4	27.4 ± 3.4
Terra-Sorb 201	25.2	26.6	24.7	24.9	25.4 ± 0.9
Terra-Sorb 250	27.6	27.4	28.7	33.1	29.2 ± 2.7
Terra-Sorb 1000	25.8	27.8	30.9	36.6	30.3 ± 4.7
ES 148, fine	24.3	27.1	26.7	37.1	28.8 ± 5.7
ES 148, 20 mesh	24.8	29.4	27.3	29.3	27.7 ± 2.1
Water-Lock B-100	25.2	29.8	28.6	29.2	28.2 ± 2.1
Kaolin slurry	25.7	29.2	30.3	36.4	30.4 ± 4.5

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