Field Trials of Root Dipping Treatments for Red Pine, Jack Pine, and White Spruce Nursery Stock in Minnesota

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*Root dipping treatments for moisture retention were tested for red pine (*Pinus resinosa *Ait.), jack pine (*P. banksiana *Lamb.), and white spruce (*Picea glauca *(Moench) Voss) in two separate field trials. Results were mixed, but they suggest that survival is not necessarily increased by using the root dipping products tried.* Tree Planters' Notes 41(3):18-20; 1990.

Bareroot seedlings are susceptible to loss and growth stunting resulting from summer drought after planting. Dipping the seedling roots in polymer root dip products before planting has the potential of reducing water loss through transpiration. A number of new super-absorbent products have been introduced recently that have improved capabilities in protecting seedling roots from moisture loss.

However, published results of survival and growth enhancement using treated seedlings are somewhat mixed. For example, Tung *et al. (7)* reported no increase in survival or growth of seedlings of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) during any of three growing seasons included in the test when treated with Terra-Sorb®. Similar results were reported earlier with 2+0 Douglas-fir treated with a Symbex root dip *(2)*. Ingram and Burbage *(3)* found that Terra-Sorb-treated seedlings of live oak (*Quercus virginiana* Mill.) had 13% less survival than those sprayed with water in their controlled study.

The commercial root dips do increase water-holding capacity of soils *(1)* and compare favorably with the clay slurry dips often used for seedling root protection *(6)*. They have been recommended as a precautionary measure against drought-induced mortality *(4)*, but their effectiveness will vary with weather conditions such as relative humidity during lifting *(5)*.

1987 Field Trial

In spring 1987, a field trial was conducted in northwestern Minnesota to test the effectiveness of Terra-Sorb in protecting seedling roots from drying out before and after planting. This area is subject to extensive drought during the growing-season, which can be critical to newly planted seedlings. Terra-Sorb is reported to be a "super-concentrated absorbent capable of absorbing hundreds of times its weight in plant available moisture." Its primary use is to maintain optimum soil moisture levels and provide a balance of water available to plant roots.

In this first study, seedlings root dipped into Terra-Sorb (.25 pound per 5 gallons water) and untreated trees were then exposed to various air drying periods before planting and then compared. For treated trees, these periods were: immediate planting after dipping; 5, 10, 30, and 60 minutes; control trees were planted with no air drying and after being exposed to the air for 3, 5, and 10 minutes. Three species were used—red pine, jack pine, and white spruce. Five trees were planted for each species-treatment combination. The conditions of planting were relatively dry soil (Faunce sand), air temperature of 59 °F, relative humidity of 21%, and NW wind at 5 to 10 mph. Precipitation received during 1987 was 16.5 inches or 5.0 inches below the 10-year normal.

Survival and growth of the study trees were monitored for three growing seasons (table 1). Seedling height and leader growth measurements are not included because browsing prevented valid comparisons. It should be noted that the sample size used in this trial was extremely small and treatments were not replicated. Results demonstrate interesting trends but not definitive conclusions.

The results showed increased survival of treated trees for red pine and jack pine but not white spruce after the first growing season. This is contradictory to Magnussen's results *(4)* using the polymer

Table 1—*Summarized results of 1987 plantings of red pine, jack pine, and white spruce treated with Terra-Sorb® and air dried for varying periods*

	Mean percent survival*	
Air drying (min.)	Oct. 1987	Aug. 1989
3+0 Red pine		
Control		
0	80	0
3	60	0
5	40	20
10	60	0
Terra-Sorb		
0	100	100
5	100	80
10	100	60
30	80	0
60	40	10
2+0 Jack pine		
Control		
0	100	80
3	40	40
5	60	40
10	100	100
Terra-Sorb		
0	100	80
5	100	100
10	100	100
30	100	100
60	20	20
3+0 White spruce		
Control		
0	100	0
3	100	0
5	100	20
10	100	20
Terra-Sorb		
0	80	20
5	100	0
10	100	40
30	100	0
60	80	0

*Five seedlings per species-treatment combination, unreplicated design.

Water-lock® to coat the roots of red pine and white spruce. He reported a 24% increase with treated white spruce compared to control but no significant effect on red pine. The 1987 trial also showed a substantial decrease in survival after an air drying period of 60 minutes, especially with red and jack pine. This is similar to Mullin's results *(5)* after exposing seedling roots of white pine, red pine, and white spruce for periods ranging from 0 to 3 hours. After 60 minutes of exposure, his data showed an average mortality 42% higher than that of the controls.

The third-year survival inventory indicates similar survival results for treated red pine and jack pine seedlings compared to the control. White spruce survival decreased substantially for both treated and untreated seedlings.

1989 Field Trials

Results from the 1987 field trials stimulated interest in further exploration of the use of commercial root dips in Minnesota before outplanting. A study was installed on nine areas in spring 1989 using seedlings treated with Terra-Sorb or Terra Verde Growing Polymer®, and untreated seedlings. Growing Polymer is a polyacrylamide-based product designed to protect bare tree roots from desiccation and provide available water for the root after planting. Wolcyn reported a 17% increase in survival of Scotch pine transplants when treated with this product compared to a control *(8)*.

Five replications of 25 trees each were planted using each treatment on each of the nine sites. Planting and on-site root dipping were done by regular contract planters for the Department of Natural Resources, Division of Forestry. Weather conditions at time of planting were not monitored for each site but covered the broad range from ideal to adverse. The 4-week period following planting was droughty. The study sites are described and soil types are listed in table 2 along with first-year survival results.

Statistical analysis of the data indicates that there is a significant mean survival difference ($p = 0.05$) between root dip treatments on only two of the sites. On the other seven sites, at the end of the first growing season, mean seedling survival was not increased by root dip treatment when compared to control.

The seedlings receiving root dip treatments both had significantly higher survival than controls on both the Baudette #1 and Hill City sites. There was no statistical variation between using the two root dip treatments on either site even though on the Terra Verde-treated seedlings planted on the Baudette site had an average of 18.4% higher survival than the Terra-Sorb treatment. On Baudette #2 site, there was no significant difference

Table 2—*Conditions of 1989 root dip study and mean percent survival after one growing season*

Study site and species*	Description of site	Soil type	Percent survival†		
			Terra Sorb®	Terra Verde	Control
1. Baudette (JP)	Leno scalping, clean planting site	Hiwood loamy fine sand	64.0b	82.4a	52.8b
2. Baudette (JP)	Replant, undisturbed duff layer	Hiwood loamy fine sand	62.4b	83.2a	76.8ab
3. Deer River (RP)	Slash raked, clean planting site level	Redby loamy fine sand	76.0a	60.0a	70.4a
4. Deer River (RP)	Slash raked, clean planting site hilly	Marquette loamy sand	68.0a	80.0a	84.0a
5. Hill City (RP)	Replant, grass competition	Cushing sandy loam	71.2a	69.6a	49.6b
6. Orr (RP)	Slash raking, slash and debris, rock	Toivola loamy sand	36.0a	55.2a	44.0a
7. Orr (RP)	Slash raking, slash and debris	Loamy sand	67.2a	75.2a	65.6a
8. Warroad (JP)	Leno scalping, jack pine cut over	Faunce sand	85.3a	82.0a	88.0a
9. Warroad (JP)	Leno scalping, glyphosate application	Hiwood loamy fine sand	50.0a	53.3a	47.3a
Mean			64.4	71.2	64.3

* 5 replications per study site (6 at Warroad), 25 trees per replication. JP = jack pine, RP = red pine.
† Means within a row followed by different letters differ significantly (P = 0.05).

in mean survival between the control and either one of the root dip treatments, but Terra Verde-treated seedlings showed significantly greater survival rates than those treated with Terra-Sorb; the difference was 19.8%.

These results seem to indicate that use of commercial root dips does not necessarily increase survival of red pine and jack pine. It may well be that, as Magnussen (1986) suggests, these treatments offer a precautionary protection measure against drought. Seedlings used in this study may not have been drought-stressed to the point of the root dip treatments having any effect. Monitoring will be continued for several more growing seasons.

Our study results should not be interpreted as a final judgment of root dip treatment. The results and the cited literature show a need for a carefully designed study including replications of simulated drought-stressed seedlings. This might include lifting, handling, and shipping under conditions ranging from normal to adverse. Or, it might be designed similar to the 1987 study to include varying periods of air drying.

Literature Cited

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