Root Dip - Does it Work ?

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Root dips are superabsorbent polymers which can absorb hundreds of times their weight in moisture. They are promoted as being very effective in increasing water-holding capacity of a substance by retaining moisture at levels many times their weight and presumably act to make it available for later plant needs. Many forestry agencies coat seedling roots with a water slurry of one of the commercial root dips to help prevent drying of roots while exposed during planting. Some agencies dip the seedling roots in a polymer product at the nursery prior to packaging and others dip just prior to field outplanting.

Erazo (1987) described various types of superabsorbents and their potential benefits in forestry but provided no supporting data that benefits are really attained. The several field trials described in the literature show mixed results. For example, a study with Southern pines using Terra Sorb as a root dip showed no significant improvement in survival over controls on two of three study sites (Echols et al 1990). Tung et al (1986) reported no survival increase when Douglas-fir seedlings were treated with Terra Sorb during any of three growing seasons. Dunsworth (1985) had similar results after treating Douglas-fir with a Symbex root dip. Ingram and Burbage (1985) used Terra-Sore on live oak and

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found 13% less survival than those sprayed with water in a controlled study. In casual conversation some concern has been expressed that use of the superabsorbent polymers may actually increase mortality since they may retain the moisture and not make it available to the plant. However, this premise has not been documented.

1987 DEMONSTRATION PLANTING

Many of the Minnesota Department of Natural Resources (DNR) foresters routinely use Terra-Sorb as a pre-planting root dip just prior to placement of bare root stock in the planting bags. However, the benefits of this practice have not been well documented. In spring, 1987, a small-scale demonstration trial was established in northwestern Minnesota in an attempt to test the effectiveness of the treatment.

Survival of red pine, jack pine and white spruce seedlings that had been dipped in a Terra-Sorb^R/water slurry (.251b/5 gal H20) was compared with undipped seedlings. Seedlings were exposed to air drying periods prior to planting of 0, 5, 10, 30, and 60 minutes. The control, undipped seedlings were exposed for 0, 3, 5, 10 and 60 minutes. Five seedlings of each species were planted for each treatment combination without replication. After the first growing season, the dipped red and jack pine survived better than controls after 0, 5, and 10-minute exposure periods (Table 1). Mortality, ranging from 80% for jack pine to 20% for white spruce, occurred when either control or coated seedlings were exposed for 60 minutes.

1989 PLANTING

The 1987 study indicated that Terra-Sorb® may increase survival of stressed seedlings but the results were questionable because of the small sample size with no replications. Therefore, we decided to further test the use of pre-planting commercial root dips by establishing a replicated trial on several sites.

Two commercial polymer products, Terra-Sorb' and Terra-Verde Growing Polymer®, were compared with a control. Five replications of 25 red pine seedlings each were planted in spring, 1989 on each of five study sites and similarily 25 jack pine on each of four sites. Planting and on-site root dipping with each of the two polymers and the control were done by contract planting crews. The seedlings were not intentially stressed as was done in the 1987 trial with air exposure but were planted immediately after dipping. The nine planting sites were scattered throughout northern Minnesota with planting conditions varying from good to adverse in terms of soil moisture. Onsite precipitation data is not available, but generally, the four-week period following planting was droughty on all of the sites.

The survival data were analyzed with a two-way analysis of variance with arc sine transformation. On two of the jack pine sites, mean survival of the Terra-Verde® dipped seedlings was significantly greater than the Terra-Sorb® treatment after the first growing season (Table 2). The overall mean of the jack pine seedlings coated with Terra-Verde® was nearly 10 percent higher than those coated with Terra-Sorb® or the control seedlings with no difference between the latter two. On five of the red pine sites

there were no significant differences in mean survival between the root dipping treatments and the untreated control. However, on one of the red pine sites, mean survival of the control seedlings was significantly lower (21%) than either of the dipping treatments. Similar to the jack pine, the overall mean survival was similar between the Terra-Sorb[R] and control red pine but the Terra-Verde coated seedlings had about five percent greater survival than the other two treatments.

It was concluded from these plantings that root dips may increase survival but the results were too inconclusive to make any recommendations for either red or jack pine under the constraints of the study (Alm and Stanton 1990).

1990 AND 1991 PLANTINGS

Based on the original limited results of the 1987 study where the seedlings were artificially stressed and the 1989 results when the stress treatments were not used, we decided to explore the use of polymers further by repeating the 1987 study with replicated plantings and a larger sample.

In spring 1990, 20 seedlings each of red pine, jack pine and white spruce were planted on Faunce sandy soil near Warroad in northwestern Minnesota with four replications each of the following treatments for each species: air drying exposure times of 0, 5, 10 and 20 minutes both with and without Terra-Sorb[R] root dipping prior to exposure. Total number of study trees was 1920 or 640 per species.

Terra-Sorb[R] was selected since that was the product being used

by the Minnesota DNR at the time of the study. It was mixed at the rate of .25 lb/5 gal of H_20. The plantings (excluding white spruce) were repeated with the same treatments in 1991 on an adjacent site with the same soil type. Planting was done by Minnesota DNR personnel. Temperatures of planting stock were monitored during seedling storage to assure uniform stock quality at time of planting.

The Warroad area in Minnesota is relatively drought prone. Rain gauges were installed each year on the sites. As shown in Table 3, the 1990 growing season had below normal rainfall every month except June. July and August were below normal in 1991 but large amounts of rainfall in June and September resulted in total seasonal precipitation considerably above normal.

Survival results for both plantings at the end of the 1991 growing season are shown in Table 4. These results, unlike those from the 1989 planting, indicated that the use of a root dip treatment such as Terra-Sorb can substantially increase seedling survival especially when the seedlings are stressed by exposure to air drying. This is especially illustrated by the 1990 red pine planting. The mean survival of the dipped red pine which were exposed for 5- 10- or 20-minutes was significantly greater **than the** undipped red pine. Survival for the dipped seedlings was over 100 percent greater than for the control seedlings for all of those exposure periods. At zero exposure, the survival of the dipped seedlings was substantially greater than the control seedlings but the difference was not statistically significant.

Similarily, the 1990 jack pine dipped seedlings had higher

mean survival than the undipped for all of the equivalent exposure periods but the differences were statistically significant only at the 10 and 20-minute exposures.

However, survival of the white spruce was significantly increased by the use of Terra-Sorb[R] only at the 20-minute exposure period. The mean survival was about 40 percent greater for the dipped seedlings at this exposure time. As noted above, white spruce was not used in the 1991 planting.

The 1991 results were somewhat similar to those from 1990. The substantially different precipitation patterns between the two years should be noted. In 1991, unlike 1990, there was ample rainfall following planting and extending into the growing season.

Mean survival for the 1991 dipped red pine was significantly higher than the control at both the 5- and 10-minute exposure periods (Table 5). There were no differences at the 0- or 20-minute exposures. The 1991 dipped jack pine had significantly greater mean survival than the control at both the 10-minute (27 %) and the 20-minute (22 %) exposure times with no differences at the 0-and 5-minute exposures.

CONCLUSION AND APPLICATION

These study results indicate that use of moisture retention root dip products such as Terra-Sorb[R] and Terra-Verde[R] immediately before planting can increase survival of red pine and jack pine seedlings that have been stressed by exposure to air drying. Results with white spruce, which was tested only one year, are less conclusive.

One of the common causes of plantation failure is drying of seedling roots by exposure to the air by tree planters. This can occur as seedlings are taken from a shipping box or bag, while they are being sorted or counted, or while they are held in the hand prior to placement in the planting hole. The use of a root dip for protection from desiccation should not be considered a replacement for common sense, careful stock handling practices. However, based on these results, products such as Terra-Sorb® and Terra-Verde' can offer some insurance as a preplanting treatment to compensate for human errors in stock handling.

Some nurseries routinely dip their stock in moisture retention materials prior to shipment. This would seemingly also provide protection while in transit and later at the planting site. However, evaluation of preshipment dipping was not a part of this study.

Table 1. Results of 1987 plantings (mean % survival after one growing season).

Exposure Period (min)	Percent Survival Red Pine T-S[1]	Red Pine C	Jack Pine T-S	Jack Pine C	White Spruce T-S	White Spruce C
0	100	80	100	100	80	100
3	-	60	-	40	-	100
5	100	40	100	60	100	100
10	100	60	100	100	100	100
30	80	-	100	-	100	-
60	40	-	20	-	80	-

[1] T-S = Terra Sorb C = Control

Table 2. Results of 1989 plantings (mean % survival after one growing season).

Site # and Species	Percent Survival T-S[1]	T-V	C
1. Jp	64.0 b[2]	82.4 a	52.8 b
2. Jp	62.4 b	83.2 a	76.8 ab
3. Jp	85.3 a	82.0 a	88.0 a
4. Jp	50.0 a	53.3 a	47.3 a
Mean Jp	65.4	75.2	66.2
5. Rp	76.0 a	60.0 a	70.4 a
6. Rp	68.0 a	80.0 a	84.0 a
7. Rp	71.2 a	69.6 a	49.6 b
8. Rp	36.0 a	55.2 a	44.0 a
9. Rp	67.2 a	75.2 a	65.6 a
Mean Rp	63.7	68.0	62.7

[1] T-S = Terra Sorb T-V = Terra Verde C = Control
[2] Means within a row followed by different letters differ significantly at P = 0.05.

Table 3. Precipitation received on study site for May 1 - September 18, 1990 and 1991.

Year	PPT (in) by Month and Departure from Normal[1]											
	May	Dep.	June	Dep.	July	Dep.	Aug.	Dep.	Sep.	Dep.	Tot.	Dep.
1990	.83	-1.30	6.67	3.26	2.79	-0.45	0.47	-2.22	1.50	-0.05	12.26	-0.76
1991	3.91	1.78	6.49	3.41	2.95	-0.29	1.15	-1.54	6.90	5.35	21.40	8.71

[1] Normal PPT data taken from cooperating weather station at Warroad, MN about 12 miles from the study site.

Table 4. Results of 1990 plantings (mean % survival after one growing season).

Species	Jack Pine		Red Pine		White Spruce	
Treatment	T-S[1]	C	T-S	C	T-S	C
0 min.	44.5 b[2]	30.0 b	61.2 a	65.0 a	68.8 a	72.5 a
5 min.	46.2 a	22.5 b	72.5 a	60.0 b	53.8 a	48.8 a
10 min.	51.2 a	17.5 b	75.0 a	25.0 b	46.2 a	41.0 a
20 min.	57.5 a	32.5 b	48.8 a	13.8 b	63.8 a	28.8 b

[1] T-S = Terra Sorb C = Control
[2] Means within a row within a species followed by different letters differ significantly at P = 0.05.

Table 5. Results of 1991 plantings (mean % survival after one growing season).

Species	Jack Pine		Red Pine	
Treatment	T-S[1]	C	T-S	C
0 min.	86.2 a[2]	87.5 a	90.0 a	96.2 a
5 min.	93.8 a	86.2 a	93.8 a	78.8 b
10 min.	96.2 a	68.8 b	85.0 a	72.5 b
20 min.	83.8 a	61.2 b	70.0 a	67.5 a

[1] T-S = Terra Sorb C = Control
[2] Means within a row within a species followed by different letters differ significantly at P = 0.05.

LITERATURE CITED

ALM, A., and J. STANTON. 1990. Field trials of root dipping treatments for red pine, jack pine, and white spruce nursery stock in Minnesota. Tree Planters' Notes. 41(3):18-20.

DUNSWORTH, B.G. 1985. Three-year survival and height growth of 2+0 bareroot Douglas-fir seedlings treated with a Symbex root dip. Tree Planters' Notes. 36(1):24-25.

ECHOLS, R.J., C.E. MEIER, A.W. EZELL, and C.R. MCKINLEY. Dry site survival of bareroot and container seedlings of Southern pines from different genetic sources given root dip and ectomycorrhizal treatments. Tree Planters' Notes. 41(2):13-21.

ERAZO, F. 1987. Superabsorbent hydrogels and their benefits in forestry applications. P.14-17 in Proc. intermountain forest nursery association, Oklahoma City OK, USDA Rcky. Mt. For. and Rng. Expt. Sta.

INGRAM, L. and W. Burbage. 1985. Effects of irrigation regime, antitranspirants and a water absorbing polymer on the survival and establishment of transplanted live oaks. Proc. Florida State Hort. Soc. 98:85-87.

TUNG, C. H., J. BATDORFF, and D.R. DEYOE. 1986. Survival and growth of Douglas-fir seedlings with spot spraying, mulching, and root dipping. West. Jo. Appl. For. 1(4):108-111.