Root Dipping of Seedlings With Water-Absorbent Gel Improves Survival on Surface Mine Sites in West Virginia

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*Eight tree species were planted at two surface mine sites in north-central West Virginia. In 1990, seedlings were planted on a reclaimed bench at Maidsville and in 1991 on an unreclaimed spoil near Masontown. At both sites, half the seedlings of each species were treated by root dipping with a water-absorbent gel (Supersorb-F). For 11 of 18 comparisons, seedlings with the root dip treatment had higher survival than untreated seedlings. The benefit was small except for black locust (*Robinia pseudoacacia *L.) on the Maidsville site. Root dipping is an inexpensive option for bareroot planting on surface mines and will probably produce the most consistent benefit on harsher sites.* Tree Planters' Notes 43(4):159-162; 1992.

There are several obstacles to successful tree planting on surface mine sites. Minesoils frequently possess chemical or physical limitations, including particle size distribution, which adversely affect water relations (Vogel 1981). Coarse fragments often constitute a high proportion of minesoil volume, particularly in the case of unreclaimed sites. On such sites, moisture retention is low and root desiccation can be a major problem for newly planted seedlings.

In this study I tested the effectiveness of Supersorb-F®, a copolymer acrylamide acrylate gel, as a root dip pre-planting treatment on bareroot seedlings. Such root dip treatments are sometimes recommended for bareroot planting to draw and retain water in close proximity to the roots due to the gel material's hydrophylic properties. The material was tested during two separate growing seasons (one wet, the other dry) on a reclaimed site and an unreclaimed site. Reclamation consisted of leveling, topsoil replacement, and seeding to a grass and legume cover.

Methods

The first planting site, planted in April 1990, was on a reclaimed surface mine near Maidsville, WV. The site was a level bench that was densely vegetated with grass/legume cover (figure 1). The second site, planted in April 1991 near Masontown, WV, was on an unreclaimed area of a surface mine (figure 2). The elevation at Maidsville was 850 feet (259 m) and that at Masontown, about 2,000 feet (609 m). For both plantings a 5-strand barbed wire deer exclosure 180 X 120 feet (55 X 36.5 m) was constructed.

Figure 1—*The Maidsville, West Virginia, planting site.*

Figure 2—*The Masontown, West Virginia, planting site.*

Eight different species were planted: black locust *(Robina pseudoacacia* L.), northern red oak *(Quercus ruba* L), sweetgum *(Liquidambar styraciflua* L)., silver maple *(Aver saccharinum* L.), Virginia pine *(Pinus virginiana* Mill.), pitch X loblolly pine hybrid *(Pinus rigida* X *taeda).* Scotch pine *(Pinus sylvestris* L.) and eastern white pine *(Pinus strobus* L.). Black locust, northern red oak, Virginia pine, and eastern white pine were planted at both sites, but the hybrid pine and silver maple were planted only at Maidsville and sweetgum and Scotch pine only at Masontown. Thus a total of 6 species were represented at each site, 4 of which were common to both sites.

Seedlings were planted in 25-tree row plots with a treated and untreated pair for a given species being randomly replicated 3 times. A 4 X 4 foot (1.2 X 1.2 m) spacing was used and all planting stock were 1+0 nursery-grown seedlings. Thus 150 seedlings of each species were planted on each site with half treated with Supersorb-F® as directed on the label and half being controls. A standard tree planting bar was used for planting. At the Maidsville site, a 2-foot-wide (.6-m) strip corresponding to the planting row was treated with glyphosate herbicide just before planting. A 2-foot (.6-m) circle around each seedling was spot sprayed with glyphosate in June 1990 because the initial treatment did not kill all the competing vegetation. The vegetation at the Masontown site was very sparse and did not need herbicide treatment (figure 2). Because of the paucity of vegetation at the Masontown site, the possibility of soil problems was suspected. A bulk soil sample was taken from the upper 10 inches at 6 locations and tested in the West Virginia University soil testing laboratory.

In October 1990, the survival and total and seasonal height growths were tabulated for each seedling at the Maidsville planting. Similar data were collected for the Masontown site in August 1991. At the same time, second-year growth and survival data were collected for trees growing at the Maidsville site. Data were summarized by species and treatment to allow for comparisons.

Results

Survival of treated seedlings was higher than that of controls in 11 of the 18 comparisons, lower in 4, and equal in 3 (table 1). Treated seedlings showed (on the average) 83.3% survival and control seedlings 79.6% (table 1). The second-year survival of treated black locust at Maidsville was twice that of untreated seedlings (21.3% and 42.7%).

Incremental height growth of seedlings treated with acrylate gel was slightly greater than untreated seedlings in 13 of 16 comparisons (table 1).

There were obvious species effects in all cases studied. At the Maidsville site, the best survival (98% in 1990 and 60% in 1991) was achieved by pitch X loblolly pine hybrids (table 1). The poorest survival at Maidsville occurred for Virginia pine (2% in 1990 and 0% in 1991). Black locust produced the greatest incremental height growth at Maidsville in 1990 (table 1). Its growth of 34.76 cm was 3 times greater than the next highest species (northern red oak). Interestingly, eastern white pine had the greatest incremental height growth at Masontown in 1991 (9.00 cm) which was almost twice that of black locust at that site.

Discussion

The results of our study indicate that root dipping before bareroot planting appeared to slightly improve survival of several species. The benefits were greater for some species. This is consistent with the results of Alm and Stanton (1990), who found that a polymer root dip aided in survival of red and jack pines but not white spruce. They also found that survival was not improved on 7 of 9 planting sites but was improved on the remaining 2 sites. In our study, our 2 sites were considerably different and to add to the difference, the sites were planted in 2 different years, with different rainfalls (table 2).

Although both sites are coal surface mines, the reclaimed site at Maidsville was much less harsh: Topsoil had been replaced and the area had been limed, fertilized, and planted to a grass/legume cover. It was a nearly level bench site upon which water would frequently stand after rain. Any treatment designed to prevent desiccation, such as the root dipping, would probably not be as beneficial as on a drier site. The Masontown site was a hilltop and the soil consisted of gravel to stone spoil material. It has not been reclaimed and was essentially devoid of vegetation. The West Virginia University Soils Laboratory analyzed a bulked sample representing the upper layer of material at the site. They found that the minesoil was low in nutrient element content and, probably more significantly, that the pH averaged 3.6.

Add to the site differences the fact that 1990, the year the Maidsville site was planted, had a normal

Table 1—*Summary statistics for the acrylate gel-treated and control seedlings at the two planting sites*

Species & treatment	% Survival			Avg. height (cm)			Avg. height growth (cm)		
	MDV 90	MDV 91	MST 91	MDV 90	MDV 91	MST 91	MDV 90	MDV 91	MST 91
Pitch × loblolly pine									
Root dip	97.3	60.00	—	25.14	28.43	—	1.11	3.28	—
Control	96.0	52.00	—	24.30	27.49	—	1.35	2.99	—
Virginia pine									
Root dip	1.3	0.00	93.3	31.00	—	21.86	0.00	—	0.73
Control	2.5	0.00	88.0	29.50	—	19.12	0.00	—	0.53
Black locust									
Root dip	93.3	42.67	80.0	44.66	53.47	45.27	36.76	4.00	5.68
Control	88.0	21.33	76.0	37.67	44.00	44.19	32.76	6.00	5.17
Northern red oak									
Root dip	78.7	1.33	66.7	29.55	15.00	56.72	12.42	–8.33	3.82
Control	80.0	4.00	60.0	26.20	19.33	47.91	7.85	–7.00	2.49
Eastern white pine									
Root dip	12.0	0.00	89.3	16.83	—	21.10	1.50	—	9.15
Control	9.3	0.00	85.3	15.79	—	21.56	0.14	—	8.86
Silver maple									
Root dip	88.0	29.33	—	24.63	28.27	—	4.99	1.32	—
Control	81.3	29.33	—	25.05	27.14	—	5.20	–0.53	—
Scotch pine									
Root dip	—	—	73.3	—	—	31.00	—	—	6.95
Control	—	—	69.3	—	—	28.42	—	—	6.27
Sweetgum									
Root dip	—	—	97.3	—	—	21.89	—	—	5.44
Control	—	—	98.7	—	—	20.77	—	—	6.51

MDV = Maidsville, MTS = Masontown.

Table 2—*Precipitation for 1990 and 1991 growing seasons in the vicinity of Morgantown, West Virginia*

Month	Normal precip. (in.)*	Measured monthly precipitation (in.)†	
		1990	1991
April	3.33	2.52	2.95
May	3.63	5.73	2.05
June	4.22	4.53	1.46
July	4.05	3.68	3.40
August	4.11	3.70	—
September	2.83	5.05	—

*Data taken from Weedfall and Dickerson (1965).
†Data measured at Coopers Rock State Forest, West Virginia.

to wet growing season whereas 1991, when the Masontown site was planted, was drier than normal. The high rate of mortality in 1991 at the Maidsville site was unrelated to treatment and probably relates to the fact that a wet year was followed by a dry one. The saturated soil that occurred at the Maidsville site in 1990 may have resulted in root dieback, and trees that survived the saturated conditions would be ill equipped to cope with the extremely dry conditions that occurred in June and July of 1991.

Conclusion and Practical Recommendations

It appears that root dipping with acrylate gels may benefit survival of some tree species on some sites, and although this study does not allow for statistical validation, it also seems likely that the benefits may be greater in certain years than in others. The benefit in survival was small (averaging approximately 4%). However the cost of applying a root dip is very small when compared to the other costs of site preparation, seedlings and planting. Thus a small improvement in survival and growth could easily justify the use of a root dip. Based on these findings, the following recommendations are made:

1. Root dipping seems justified for use in bareroot planting of forest tree seedlings.
2. Root dips should provide the most consistent benefit when seedlings are planted on very harsh and dry sites.
3. During very dry years, root dips will probably provide the maximum benefits.
4. Most species seem to benefit from root dipping, however in this study, sweetgum did not show increased survival.

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