Auburn University Southern Forest Nursery Management Cooperative

RESEARCH REPORT 99 - 1

ROOT WASHING LOBLOLLY SEEDLINGS REDUCES THEIR VIGOR

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INTRODUCTION

Depending on soil type and weather conditions, soil sticking to the roots of lifted seedlings can increase bundle weight enough to cause problems for packers and planters. This can increase costs of packing, storage, and shipment operations. Bowater developed a system to wash roots using low pressure water. The system worked well and one year reduced bundle weights from an average 62 pounds, for not washed seedlings to 35 pounds and returned 100 tons of soil to the nursery (Bryan 1993). Later, as the Bowater system was copied at other nurseries some planters were concerned that washing might affect seedling performance. In 1997, Coop personnel began an investigation to determine the effects of washing on the growth and survival of loblolly seedlings after outplanting. We assumed that effects would probably be negligible. However, differences in the timing of the first flush were evident almost immediately and these difference persisted through the first year.

METHODOLOGY

Loblolly pine seedlings were lifted from two Georgia nurseries and washed using equipment built for that purpose by the nurseries. There were two lengths of storage and seedlings were outplanted at sites not far from the nursery of origin. Seedlings from one nursery were also planted in coarse sand at Auburn University.

In the first trial (February 5, 1997), seedlings were obtained as they arrived at the packing house during operational harvest and separated into three groups of approximately 500 each. These then interred the packing house on a conveyor belt through the seedling

washer. Five hundred seedlings were not washed, 500 were washed once at 5 psi, and 500 were washed four times at 10 psi (gathered after washing and returned to the conveyor starting point). Seedlings were lifted and treated on two occasions (February 5 and 17) placed in cold storage after treatment and then removed from storage together and planted February 20th (after 15 or 3 days cold storage) on a Troop Series soil in Marion, Co. Georgia. Initial height and bud growth of outplanted seedlings were measured March 17, 1997 and seedling height and survival were recorded on June 2, 1997, and March 10, 1998.

The second trial also tested three levels of root-wash and two levels of storage but there were two storage lengths for each lifting date and uniform initial size was insured by lifting all seedlings from a pre-reserved bed. Seedlings were lifted February 12 and 26th separated into three groups of approximately 1,000 each at the packing house and again transported down a conveyor under low-pressure nozzles and either not washed, washed once, or washed three times. Seedlings from each wash treatment were then separated into 10 replicates of approximately 100 seedlings, bagged separately and placed in the cooler. Seedlings were outplanted in a freshly disced area at the edge of the nursery on a Sullivan Loam. Some seedlings from the first lift date were taken to Auburn and planted there on February 27 in a stress pit of coarse sand.

Initial heights and first flush of seedlings outplanted in the loam were measured 4/20/98 and first years growth and survival was measured 2/22/99. Seedlings planted at Auburn were evaluated 31 days after planting for survival, and bud development. Bud development was recorded on a three point scale. New root growth and bud development were evaluated in detail between April 2 and 9, 1998 for a subset of these seedlings. The sum of the lengths of the new roots was measured macroscopically and microscopically.

RESULTS AND DISCUSSION:

Immediately after washing, root weights and the length of fine roots, determined by electronic scanner, did not differ between washed and not washed seedlings from either nursery.

After 30 days in the Auburn stress pit, bud development differed between wash treatments. Buds of 0-washed or 1-washed seedlings did not differ but these were larger than those of 3-washed seedlings. By 60 days after planting in the stress pit, more 0-washed seedlings survived than did 3-washed seedlings (88% and 76% respectively (lsd α 0.05 = 10% survival). Once-washed seedlings (84% survival) did not differ from other treatments. Among seedlings lifted from sand after 30 days, there were more roots (length of microscopically measured roots) on not washed seedlings than on either 1- or 3-washed seedlings. These root lengths correlated with bud length (at 30 days) and with survival at 60 days.

The results for the seedlings outplanted near their nursery of origin are presented in Table 1. A month after planting on a Troup Sand, (March 17, 1997) the number of seedlings

with new terminal growth (flush) differed by storage and by wash treatments. This new growth later correlated with fourth month (June) survival which also differed between wash treatments.

Table 1. Growth and survival of loblolly seedlings by wash and by storage treatment and by Soil type for seedlings outplanting on a Troup Sand (1997) and a Sullivan Loam (1998).

Soil	Treatment	Height (cm) Level	Survival[1]	1st Flush	1st Season
Sand	Washes	0	98 a	30 a	36 a
		1	88 b	27 b	35 a
		4	75 c	25 c	34 a
		lsd	*6.5*	*1.5*	*3.4*
	Storage	Short	92 a	29 a	36 a
		Long	82 b	26 b	34 a
		lsd	*5.3*	*1.0*	*2.8*
Loam	Washes	0	97 a	20.8 a	43 a
		1	96 a	20.5 a	42 a
		3	96 a	19.0 b	38 b
		lsd	*3.3*	*1.5*	*2.6*
	Storage	Short	96 a	20.2 a	41 a
		Long	96 a	20.0 a	42 a
		lsd	*2.7*	*1.0*	*2.1*

1) Survival is for the 5th month at the Troup Sand and for the 12th month at the Sullivan Loam.

The Troop Series used for outplanting in this study is a poor site for loblolly pine. Pricklypear (*Opuntia sp*) is abundant and the site is planted mostly in sand pine (*P. clausa* (Englem. Sarg.) by the managing foresters. Mortality associated with the site continued throughout the season and tended to "overshadow" treatments. Differences between experimental blocks were large and heights and survival no longer differed between wash treatments after 15 months in the field. The Troup sand and the sand in the Auburn Trophotron both have extremely poor moisture holding capacities and although harsh conditions help separate treatment effects they probably exaggerate what would occur under more normal site conditions for loblolly pine. Both the final survival (69%) and the mortality after the first survey at the Troop soil site is unexpected for loblolly on normal sites.

By April 20, 1998 height growth on the Sullivan Loam differed by wash but not by storage treatments (Table 1). Survival was not affected by washing on this more favorable site. However, growth differences persisted through the first growing season.

The correlation between the initiation of bud growth and new root growth among seedlings in the Auburn stress pit should be noted by those who evaluate the vigor of outplanted seedlings. It implies a useful correlation between aboveground growth and what is occurring in the root systems where growth is critical to seedling establishment. This is further indicated by the correlation of survival at 60 days with bud growth at 30 days. Seedlings which quickly produce new root growth have a better chance of establishing themselves after outplanting. This is also indicated by the results at Troup Sand where bud length measured in March (a month after planting) differed between washed and not washed seedlings and correlated with June survival.

MANAGEMENT IMPLICATIONS

Much to the surprise of the Coop researchers, washing loblolly seedlings somehow reduced vigor after ouplanting.
Difference for the timing of initial flush were sufficient to be apparent on casual observation where treatments were planted side-by-side in the field. On a good site, (Sullivan Loam) no mortality resulted from wash treatments but growth differences persisted. On a drought prone site, mortality differed between wash treatments but growth differences were not maintained into the second season.

The advantages from washing excess soil from seedlings may be worth the risk of reduced vigor where the nursery soil is heavy and wet weather makes bundle weights excessive. However, special care should be taken with washed seedlings to insure that further stress factors such as long storage and planting on harsh sites are minimized.

LITERATURE CITED

Bryan, Harry. 1993. Innovative forest tree nursery seedling washer. American Pulpwood Association Inc. Technical Release 93-R-30. 2 pp.