

EFFECTS OF TOP AND LATERAL ROOT PRUNING ON SURVIVAL AND EARLY GROWTH—THREE BOTTOMLAND HARDWOOD TREE SPECIES

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Root pruning and top pruning are accepted as effective cultural treatment for most hardwood tree seedlings. Many nurseries top-prune hardwood seedlings to obtain uniformity in height (3) and root-prune to limit top growth, modify root patterns, and restrict root system development (1). The underlying objectives of top and root pruning by these nurseries are for the most part to reduce packing and shipping costs (2) and to facilitate planting. While reduced costs are desirable, the fact that pruning treatments could improve or be detrimental to survival and early growth of planted hardwood seedlings should be considered.

Root-pruning seedlings in the nursery during the growing season prior to lifting should increase the number of root tips and allow the development of a more compact fibrous root system. These root systems should be less prone to damage during lifting; thus the seedlings may not undergo as much shock when transplanted and survival should be better.

Top-pruning can provide a better root-shoot ratio by reducing the total leaf area and consequently reduce the rate of transpiration. Thus survival should be increased due to less desiccation of the seedling. There is also some evidence to indicate that lateral bud growth often exceeds apical bud growth in some tree species. Top pruning may increase height

growth of young seedlings and help them compete with weeds.

In recent years numerous hardwood plantations have been initiated but much difficulty has been encountered with establishment and early growth. Weed competition has been a major problem during the early years of establishment (4). The effects of competition on hardwood plantings have been further compounded by the slow rate of initial growth displayed by many hardwoods, especially the oaks (2). Therefore, stimulation of any additional early growth should greatly enhance survival and success in establishing a hardwood plantation. For these reasons this study was initiated to investigate the effects various lateral root- and/or top-pruning practices have on survival and early growth of three hardwood species.

Methods

Seeds of water oak (*Quercus nigra* L.), willow oak (*Quercus phellos* L.), and pecan (*Carya illinoensis* (Wangenh.) K. Koch) were collected from trees growing in south Louisiana just after seedfall in autumn 1969. All seeds were stored over winter and outplanted into prepared nursery beds April 14, 1970. Pruning treatments were applied as noted in table 1.

Root pruning was done in the nursery on August 17, 1970 by cutting all lateral roots to approxi-

mately 15 cm on either side of the seedlings with a flat spade. Top pruning of seedlings in the nursery was done on January 4, 1971 while all buds were dormant. These seedlings were top pruned to 15 cm in height. The top 0.6 cm of the stem was removed from those seedlings less than 15 cm in height.

All seedlings were lifted and outplanted in late March 1971. At the time of lifting, the taproot of all seedlings was pruned to 15 cm. Seedlings to be top-pruned in the field were pruned April 14, 1971, at which time nearly all terminal buds had begun to break dormancy. These seedlings were clipped just above the last lateral bud which had formed during the previous growing season.

The field design was a split plot consisting of six replications. Each replication included all combinations of species and treatments. Each species treatment plot contained 12 seedlings planted on a 3-by 3-foot spacing.

Seedling height was measured and survival tabulated in the fall of 1971 and 1975 after growth ceased. The data were analyzed by ANOV and Duncan's Multiple Range tests.

Results

One-Year Outplanted—Survival was excellent for water oak, willow oak and pecan after 1 year in the field (table 2). No differences were noted in survival among the

Table 1.—Pruning treatments applied to seedlings of three bottomland hardwood species

Abbreviation	Treatment description
RPN	Root-pruned in the nursery bed.
RPN-TPN	Root-pruned in the nursery bed and top-pruned prior to outplanting.
RPN-TPF	Root-pruned in the nursery bed' and top-pruned in the field after break of dormancy.
TPN	Top-pruned prior to outplanting.
TPF	Top-pruned in the field after break of dormancy.
C	Control, no pruning of roots or tops.

three species. Lateral root pruning and/or top pruning had little effect on survival of willow oak or pecan. This was also true for water oak with the exception that survival of RPN-TPF treated seedlings was significantly less than TPN and RPN-TPN treated seedlings (table 2). However this difference (7 percent) would be of little consequence from a practical standpoint.

Total height after 1 year outplanted varied significantly among species, with pecan considerably shorter than either of the oaks (table 2). No differences were detected in total height among treatments for willow oak. However, RPN water oak seedlings

Table 2—Mean survival and height of three bottomland hardwood species 1 and 5 years after outplanting

Species	Treatments ¹	Survival ²		Total height ²	
		One year	Five years	One year	Five years
		Percent	Percent	Cm	Cm
Water oak	RPN	97.2ab	83.3a	44.0 b	312.6a
	RPN-TPN	100.0a	83.3a	49.5ab	318.2a
	RPN-TPF	93.1 b	80.6a	55.1a	355.3a
	TPN	100.0a	87.5a	49.1ab	321.4a
	TPF	93.3ab	76.7a	50.6ab	356.3a
	C	94.4ab	81.9a	57.9a	336.3a
	Overall mean	96.4	82.4	51.0	332.2
Willow oak	RPN	97.2a	93.1a	46.6a	352.2a
	RPN-TPN	98.6a	93.1a	52.6a	387.9a
	RPN-TPF	95.8a	88.9a	45.3a	390.3a
	TPN	97.2a	93.1a	55.9a	384.6a
	TPF	94.4a	90.5a	46.6a	349.8a
	C	97.2a	90.3a	44.3a	370.9a
	Overall mean	97.1	91.4	49.0	372.0
Pecan	RPN	100.0a	90.3a	28.1ab	135.4a
	RPN-TPN	91.7a	91.7a	22.5 c	129.6a
	RPN-TPF	97.2a	94.4a	28.6a	137.4a
	TPN	93.1a	83.3a	24.7 bc	147.1a
	TPF	97.2a	86.1a	25.4abc	122.1a
	C	98.6a	94.4a	28.8a	120.8a
	Overall mean	96.3	90.0	26.4	131.0

¹RPN=Root-pruned in the nursery bed (in Aug., prior to lifting); TPN=top-pruned in the nursery bed (in Jan., prior to lifting); TPF=top-pruned in the field (in April, after planting and just after bud break); C=control (no pruning).

²Treatment means followed by the same letter are not significantly different at the .05 level of probability (Duncan's Multiple Range Test).

were significantly shorter than the control or RPN-TPF seedlings after one season outplanted. Water oak and willow oak completely recovered from top pruning within the first season outplanted. Total height of pecan seedlings also varied considerably among the various pruning treatments after one

year in the field. Pecan seedlings subjected to treatments C, RPN-TPF, and RPN were significantly taller than those seedlings subjected to treatment RPN-TPN and those under treatments C and RPN-TPF grew taller than seedlings subjected to treatment TPN. In general, top pruning in the

nursery did not stimulate sufficient height growth the first year to offset that growth lost to top pruning pecan seedlings.

Five years outplanted—After 5 years in the field significant variation existed in survival among the three species with water oak incurring the greatest mortality (table 2).

Of the six pruning treatments tested, TPN produced the greatest survival rate in water oak while RPN, RPN-TPN; and TPN yielded the best survival of willow oak seedlings. Survival of the unpruned seedlings of water and willow oak ranked fourth and fifth, respectively, among the six treatments tested. On the other hand, unpruned pecan seedlings along with RPN-TPF seedlings had the highest survival after 5 years in the field. It should be noted, however, that statistically no differences could be detected in survival among pruning treatments after 5 years outplanted for any of the three bottomland hardwood species.

Significant variation still existed in total height among the three

species after five growing seasons in the field. Mean total height of willow oak, water oak, and pecan were 372, 322, and 132 cm, respectively. Within each species no differences could be detected in total height among the pruning treatments even though total height varied by 43.7 cm, 40.5 cm and 26.3 cm between the best and poorest pruning treatments for water oak, willow oak, and pecan, respectively. A point of interest is that those pecan seedlings submitted to TPN were the shortest after one year outplanted but the tallest after five years in the field.

Conclusions

For any species tested, after five seasons outplanted, total height and survival were not significantly affected by lateral root and/or top pruning. Therefore, current nursery practices such as root and top pruning did not significantly affect the survival or growth of the three species studied in this experiment. It should be noted that RPN-TPF produced at or near the best height for all three species.

Unfortunately, RPN-TPF also resulted in the poorest survival rate for both water oak and willow oak. However, survival rates were high enough that RPN-TPF should be given strong consideration in field plantings of water and willow oak. Finally, RPN-TPF promoted good height growth and survival in pecan and should be employed where feasible when establishing a pecan plantation.

Literature Cited

1. Briscoe, C. B.
1969. Establishment and early care of sycamore plantation. South. Forest Exp. Stn., USDA Forest Serv. Res. Pap. SO-50. 18 p.
2. Russell, T. E.
1971. Seeding and planting upland oaks. Pages 49-54 *In* D. E. White and B. A. Roach, ed. Oak Symp. Proc. USDA Forest Serv., Northeast. Forest Exp. Stn., Upper Darby, Pa.
3. Williams, R. D. and S. H. Hanks.
1976. Hardwood nurseryman's guide. USDA Agric. Handb. No. 473. 78 p.
4. Hammond, J. W.
1970. Effects of pruning tops and lateral roots on the first-year survival and growth of four species of bottomland hardwoods. M. S. thesis. La. State Univ., Baton Rouge. 67 p.