

SEEDING AND PLANTING SOUTHERN HARDWOODS

by

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I would like to start by giving a complete prescription for planting any hardwood species by a cheap and simple method that will insure excellent survival and good growth. Unfortunately, this is impossible, for we at the Southern Hardwoods Laboratory are still several years away from such prescriptions with nearly all of our important hardwoods. With most species, however, we have had enough experience to gain some knowledge of what we can do and a lot of information about what we can't do. We can, for instance, give you a satisfactory method for stratifying sweetgum seed, and we can also tell you not to use sycamore cuttings for planting old-field clay sites.

I have summarized general information in Table 1, but there are several points that I would like to add.

First, we need to develop seedling grades for all species. The statements about root and shoot sizes are based on very slim research results.

Second, where I have Yes for machine planting, I mean that we know of instances where it did work. The caution here is about site condition. On newly cleared land, preparation must be very thorough to permit use of machines for planting and cultivating. Other obstacles may be weather, drainage, and soil condition, as, for example, on a water tupelo or a cypress site.

Third, I have included a column on fertilization just to indicate the state of our knowledge. Most of the species have not been used in planting-fertilization tests. We would be happy to have some of you try a little fertilization and let us know what you find. But don't put seedlings or cuttings in direct contact with fertilizer, even the slowly soluble pelletized type. Place the fertilizer 6 to 8 inches below the surface in several holes around the seedlings.

Fourth, with the exception of the cottonwood insects, tent caterpillars, and cicadas, insects are not a major problem. Only the cottonwood insects are a constant threat, and systemic insecticides will do a good job on them (27).

Now, I will review some principles of hardwood seeding and planting that cannot be easily put into tabular form.

^{1/} Stationed at the Southern Hardwoods Laboratory, which is maintained at Stoneville, Mississippi, by the Southern Forest Experiment Station in cooperation with the Mississippi Agricultural Experiment Station and the Southern Hardwood Forest Research Group.

Table 1.--Hardwood and cypress planting information ^{1/}

Species and form of stock	Prune roots to:	Good top Length ^{2/}	Best root-collar diameter	Adaptable to machine planting	Response to fertilizer	Usual first-year growth	Suited to wet sites	Animal damage	Insect damage
	<u>Inches</u>	<u>Inches</u>	<u>Inches</u>						
Cottonwood cuttings	-	^{3/} 20	3/8-3/4	No	Some Populus success (<u>1</u>)	Good	No	Deer	Borers, leaf beetles
Cottonwood seedlings	8	15	?	Yes	?	Good	No	Deer, rodents	Borers, leaf beetles
Sweetgum seedlings	8	15	?	Yes	?	Poor	Poor	Rabbits, deer, rodents	Forest tent caterpillar
Green ash seedlings	8	15	?	Yes	?	Good	Yes	Rabbits, rodents	Ash borer, fall webworm (<u>24</u>)
Sycamore seedlings	8	15	3/10 and up (<u>17</u>)	Yes	Some (<u>20, 26</u>)	Poor to good	Poor	None?	Sycamore lacebug, bagworm (<u>24</u>)
Sycamore cuttings	-	^{4/} 20	1/4-3/4	No	?	Poor to good	No	None?	Sycamore lacebug, bagworm (<u>24</u>)
Yellow-poplar seedlings	8	15	1/4 (<u>33</u>) or 1/5 (<u>25</u>) and up	Probably	Some (<u>16</u>)	Good	No ^{5/}	Deer, rodents	Tuliptree scale (<u>24</u>)
Oak seedlings	8	15	?	Probably	?	Poor to fair	Nuttall, willow, water, overcup (others, no)	Rabbits, rodents	Twig girdlers (<u>2</u>), cicadas
Black walnut seedlings	8 (<u>5</u>)	15	?	Probably	?	Poor	No ^{5/}	Rodents	Walnut caterpillar (<u>24</u>)
Water tupelo seedlings	8	15	?	Site may prohibit	?		Yes	None?	Forest tent caterpillar
Baldcypress seedlings	8	15	1/4 and up (<u>19</u>)	Site may prohibit	?	Fair to good	Yes	Rabbits	Spider mites, bagworm

^{1/} Most information is from research and observations of L. C. Maisenhelder and R. C. Morris, Southern Hardwoods Laboratory. Other sources are indicated by numbers in parentheses, which refer to the literature cited.

^{2/} Determined mainly on basis of handling ease. All species can be top-pruned except ash, which forks because of its opposite-bud morphology.

^{3/} May be shorter on sites where drought never occurs.

^{4/} Only basal cuttings seem to root well.

^{5/} Very exacting in site requirements. Plant only on moist, well-drained soils.

Site Considerations

An aspect deserving special attention is the species-site relationship. Our hardwoods in general have much more specific site requirements than do the southern pines. If we have learned anything from hardwood planting experience, it has been this fact.

How do we stand in recognition of site requirements? Broadfoot's site index determinations from soil characteristics have given us our best information. While his soil-species guidelines (3) were designed for management of existing stands, they can certainly be helpful in choosing species and sites for planting.

In connection with site-species relationships, I would like to point out that planting success on old fields has been anything but good. Heavy weed infestation, soil compaction and its several facets, low nutrient status, micro-climatic extremes, and often heavy rodent populations all contribute to failure. Successful planting on these sites will perhaps be our most difficult problem.

Good site preparation is important to plantation success and may be the best way to combat the difficulties of old fields. Removal of existing vegetation may be expensive, but the increase in survival and growth is considerable. With cottonwood, thorough site preparation is essential. The extent of site preparation for other species will depend on management objectives.

Clearing underneath existing stands and underplanting may have a place in management plans. Good survival is possible with yellow-poplar, green or white ash, black walnut, and sweetgum, but removal of the overstory in subsequent years is necessary for satisfactory growth and development of the seedlings (8, 14, 37, 38). Preliminary results at the Southern Hardwoods Laboratory suggest that sycamore and Nuttall oak are also suitable for underplanting.

Protection

Both seeds and seedlings may require protection from animals. Rabbits and rodents of all sizes and shapes are exceptionally fond of sweetgum (4, 29), oaks (28, 32, 36), green ash (32), and yellow-poplar (11, 32). Damage is usually worst in old-field plantings.

Deer continue to be a big problem where herd populations are high. Along the Mississippi River, for example, cottonwood plantations have been heavily browsed.

The obvious remedy would be a repellent that can be applied to seedlings or cuttings prior to planting. We don't have this repellent yet, but are cooperating in research with Dr. Dale Arner of Mississippi State University. Some encouraging results have been published on deer repellents for ponderosa pine in the West (12).

Livestock and fire are deadly menaces to hardwood plantations. If you can keep them out, then do it; if you can't, then expect poor results.

Cultivation and Weed Control

Carl Maisenhelder has clearly demonstrated the necessity of cultivating young cottonwood plantations (27). The terrific competition on hardwood sites makes weed control very beneficial if not essential for other hardwoods also. Favorable responses to early cultivation have been reported for black walnut (9) and sycamore (15) plantations.

Cross-disking is the best method of cultivation in cottonwood plantations. In addition to checking competing vegetation, it also seems to speed growth through an increase in soil aeration and decrease of evaporation. Supplemental weed control by hand-hoeing, although costly, also benefits the trees, especially where rank weeds grow adjacent to the tree. If the rows are straight, you can get close to the trees with a disk, but you may damage the root system.

Research on chemical weed control is in the early stages. Some favorable results have been reported (1, 9), but work by Southern Hardwoods Laboratory scientists at Fidler, Mississippi, in cooperation with Crown Zellerbach Corporation, has been inconclusive (22). Through cooperative research with Auburn University (under Dr. Mason Carter), we are now trying to determine the tolerance of cottonwood to various herbicides. The astonishing number of new herbicide formulations that are constantly being produced make it likely that chemical weeding procedures will soon be developed for cottonwood and other hardwoods.

Mulching of planted seedlings has received some attention from researchers in the East and South (32, 35) and considerable investigation in the West, where outstanding results have been obtained with paper mulches around conifers (13). In preliminary trials at the Southern Hardwoods Laboratory, cottonwood cuttings mulched with black plastic developed more roots near the surface and made much better height growth early in the season than did nonmulched cuttings. Weeds were controlled well also, but only underneath the plastic. Perhaps a closer look at mulches for hardwood plantings is needed.

Direct Seeding

For hardwoods, direct seeding is still in its infancy. With some notable exceptions, we don't even know what the major problems will be. Past work was concentrated on heavy-seeded species, but the best success may come with the light-seeded hardwoods, such as sweet-gum, ash, or sycamore.

Trials with various oaks have been carried out in the Central States (10, 21, 30, 31), the Southeast (18, 20, 29, 34), southern

Arkansas (7), and the Cumberland Plateau in Tennessee (28). Results have been very erratic, and a common factor appears to have influenced most of them: rodents! If the rodent population is low, or if other food is plentiful, the operation may succeed. There is no completely effective repellent. Essentially the same results have been reported from trials with black walnut (10, 29, 31).

A small test with white ash and yellow-poplar in Ohio (31) was not encouraging, but trials with yellow-poplar in Indiana showed promise (6). Several industrial and State experimental projects are under way with sweetgum. At the Southern Hardwoods Laboratory we have had mild success in small-scale seeding of sweetgum, but rodents have always defeated our efforts with oak. Raccoons and grackles are also big problems in our area.

Sometimes direct-seeding results seem poorer after 1 year than they really are. Acorns of Nuttall oak, and probably other red oaks, often lie dormant until the year following seeding and then germinate. This delayed germination would be fine if it weren't for the rodents. Seeds of other hardwoods have shown delayed germination also (31)--white ash in particular has exhibited dormancy into the third year after maturity (23).

Conclusions

In closing, it would seem that we are a long way from complete planting prescriptions for southern hardwoods. But we are making progress. At the Southern Hardwoods Laboratory three men are working on the problem. Another physiologist will join the staff in August to aid in direct seeding research, which, for the immediate future, will be concentrated on sweetgum. We are presently investigating the optimum conditions necessary for sweetgum germination.

In cottonwood planting, the essential steps are known, but new wrinkles in old procedures need investigation, as do the basic biological factors. We are determining the nutrient requirements of cottonwood and the effects of soil compaction on root growth of cuttings. We are comparing different forms of planting stock in both Mississippi Delta and Coastal Plain soils.

We are also doing basic work on the moisture relations of cottonwood, sycamore, sweetgum, and Nuttall oak--specifically on the water use of seedlings and the internal moisture stresses that limit seedling growth.

Planting research with species other than cottonwood concerns the effect of soil saturation during planting and the suitability of various species for underplanting.

To help keep informed of the various trials of hardwood planting, we have established a file on hardwood plantations in the South, no matter how small. Knowledge of the plantations that have been established or attempted can help our research program tremendously. We welcome any information that you may be able to pass on. Nothing is more basic to a research program than a clear understanding of what problems are encountered in actual practice.

Literature Cited

- (1) Aird, P. L. 1962. Fertilization, weed control and the growth of poplar. *Forest Sci.* 8: 413-428, illus.
- (2) Applequist, M. B. 1959. Growth of planted cherrybark oak in southeastern Louisiana. *La. State Univ. Forestry Note* 26, 2 pp.
- (3) Broadfoot, W. M. 1954. Soil suitability for hardwoods in the Midsouth. U.S. Forest Serv. Res. Note SO-10, 10 pp., illus. South. Forest Expt. Sta., New Orleans, La.
- (4) Burns, R. M. 1957. Rabbits prefer sweetgum to pine. U.S. Forest Serv. South. Forest Expt. Sta. South. Forestry Notes 111.
- (5) Chapman, A. G. 1961. Planting black walnut for timber. U.S. Dept. Agr. Leaflet 487, 6 pp., illus.
- (6) Clark, F. B. 1958. Direct seeding yellow-poplar. *Jour. Forestry* 56: 351.
- (7) Clark, R. H. 1958. Direct seeding of cherrybark red oak. Pp. 5-9, in *Management of bottom-land forests*. Seventh Ann. La. State Univ. Forestry Symposium Proc.
- (8) Deitschman, G. H. 1956. Growth of underplanted hardwoods in black locust and shortleaf pine plantations. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 94, 2 pp.
- (9) _____ and Pruett, E. W. 1960. First-year control of weeds in forest plantings. Seventeenth North Cent. Weed Control Conf. Proc., p. 13.
- (10) Engle, L. G., and Clark, F. B. 1959. New rodent repellents fail to work on acorns and walnuts. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 138, 2 pp.
- (11) Hansen, N. J., and McComb, A. L. 1955. Growth, form and survival of plantation-grown broadleaf and coniferous trees in southeastern Iowa. *Iowa Acad. Sci. Proc.* 62: 109-124, illus.
- (12) Heidmann, L. J. 1963. Deer repellents are effective on ponderosa pine in the Southwest. *Jour. Forestry* 61: 53-54, illus.
- (13) Hermann, R. K. 1964. Paper mulch for reforestation in southwestern Oregon. *Jour. Forestry* 62: 98-101, illus.
- (14) Huckenpahler, B. J. 1951. Planted hardwoods survive and grow rapidly. U.S. Forest Serv. South. Forest Expt. Sta. South. Forestry Notes 71.

- (15) Huppuch, C. D. 1960. The effect of site preparation on survival and growth of sycamore cuttings. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 140, 2 pp.
- (16) Ike, A. F., Jr. 1962. Fertilized yellow-poplar seedlings maintain growth advantage after four years. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 175, 2 pp.
- (17) _____ 1962. Root collar diameter is a good measure of height growth potential of sycamore seedlings. U.S. Forest Serv. Tree Planters' Notes 54, pp. 9-11, illus.
- (18) Klawitter, R. A. 1959. Direct seeding hardwoods. Pp. 154-158, in Direct seeding in the South--1959. A symposium. F. W. Woods [ed.], School of Forestry, Duke Univ.
- (19) _____ 1961. Seedling size affects early survival and height growth of planted cypress. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 155, 2 pp., illus.
- (20) _____, Stubbs, J., and Johnson, F. M. 1963. Tests of Arasan 75-Endrin 50W rodent repellent on Shumard and swamp chestnut oak acorns, U.S. Forest Serv. Res. Note SE-4, 2 pp. Southeast. Forest Expt. Sta., Asheville, N.C.
- (21) Krajicek, J. E. 1955. Rodents influence red oak regeneration. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 91, 2 pp.
- (22) Krinard, R. M. 1964. Weed control trials in cottonwood plantations. Miss. Farm Res. 27 (5): 8, illus. Also as Miss. Agr. Expt. Sta. Inform. Sheet 854, 2 pp., illus.
- (23) Leak, W. B. 1963. Delayed germination of white ash seeds under forest conditions. Jour. Forestry 61: 768, 770, 772, illus.
- (24) Limstrom, G. A. 1963. Forest planting practice in the Central States. U.S. Dept. Agr., Agr. Handb. 247, 69 pp., illus.
- (25) _____, Finn, R. F., and Deitschman, G. H. 1953. How to grade yellow-poplar planting stock. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 81, 2 pp.
- (26) McAlpine, R. G. 1963. A comparison of growth and survival between sycamore seedlings and cuttings. U.S. Forest Serv. Res. Note SE-9, 1 p. Southeast. Forest Expt. Sta., Asheville, N.C.
- (27) Maisenhelder, L. C. 1960. Cottonwood plantations for southern bottom lands. U.S. Forest Serv. South. Forest Expt. Sta. Occas. Paper 179, 24 pp. illus.
- (28) Mignery, A. L. 1962. Oak direct seeding/ⁱⁿTennessee. U.S. Forest Serv. South. Forest Expt. Sta. South. Forestry Notes 137.

- (29) Minckler, L. S. 1946. Old field reforestation in the Great Appalachian Valley as related to some ecological factors. Ecol. Monog. 16: 88-108, illus.
- (30) Nichols, J. M. 1954. Direct seeding of oak in Missouri. Mo. Agr. Expt. Sta. Bul. 609, 4 pp.
- (31) Plass, W. T. 1952. Direct seeding tests on old fields in southeastern Ohio. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 71, 2 pp.
- (32) Pruett, E. 1959. Mulch around newly planted trees can be detrimental. U.S. Forest Serv. Cent. States Forest Expt. Sta., Sta. Note 132, 2 pp.
- (33) Rodenbach, R. C., and Olson, D. F., Jr. 1960. Grading yellow-poplar planting stock is important. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 147, 2 pp.
- (34) Sluder, E. R., Olson, D. F., Jr., and Jarrett, T. W. 1961. Tests on direct seeding of oak in the Piedmont and southern Appalachians of North Carolina. U.S. Forest Serv. Southeast. Forest Expt. Sta., Sta. Paper 134, 12 pp., illus.
- (35) Walker, L. S. 1961. Black plastic "mulch" for pine planting. U.S. Forest Serv. Tree Planters' Notes 45, p. 1.
- (36) Wallihan, E. F. 1949. Plantations of northern hardwoods. Some factors influencing their success. Cornell Univ. Agr. Expt. Sta. Bul. 853, 31 pp., illus.
- (37) Wells, C. G. 1961. Underplanting tests in pine stands. U.S. Forest Serv. Southeast. Forest Expt. Sta. Res. Note 160, 2 pp.
- (38) Williams, R. D. 1964. Release accelerates height growth of yellow-poplar seedlings. Jour. Forestry 62: 95-97, illus.

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