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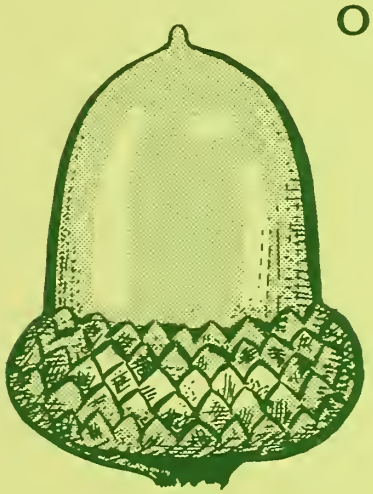
SEEDING and PLANTING TESTS of NORTHERN RED OAK in WISCONSIN



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ACKNOWLEDGMENTS

This study was conducted on the Hardies Creek Timber Harvest Forest in southwestern Wisconsin. This 53-acre property, owned by the State of Wisconsin, is one of 10 timbered areas under the cooperative management of the U.S. Forest Service, the Wisconsin Conservation Department, and the University of Wisconsin Extension Service.

Of the many people who have worked on this project over the years, special acknowledgment is due Dr. J. H. Stoeckeler and the late Harold C. Bell of the Lake States Forest Experiment Station, and Eric P. Jensen of the Wisconsin Conservation Department.

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INTRODUCTION

Much more must be learned about the silvicultural management of the mixed-oak forests of the Lake States region. This is particularly true when an overstory of northern red oak is to be replaced by a new crop of the same species.

Recent studies show that the small-block clear cut and the shelterwood system both hold promise for regenerating oak woodlands in Wisconsin.[1] [2] These preliminary tests indicate that enough seedlings of northern red oak (*Quercus rubra* L.) and other desirable hardwoods exist to restock the stand, *providing* they can force their way through a tangle of competing herbaceous plants and shrubs.

The final evaluation of these two cutting methods cannot be made for another 10 to 15 years. They may or may not provide adequate natural regeneration of the more desirable tree species. In the meantime, the possibility of obtaining northern red oak reproduction by artificial methods is being studied. This paper reports some early results of recent tests.

ESTABLISHMENT METHODS

Direct Seedings

Direct seeding is one way to keep northern red oak in the mixed hardwood forests of Wisconsin. Under certain conditions such seedings can be quite successful.

In order to test the feasibility of regenerating this species by planting acorns, 1,250 seed spots were established on a forest clearing in the spring of 1952. Of these seed spots, 500 were fenced against rabbits; 250 of them were also protected with cylindrical screens[3] to prevent squirrels, chipmunks, gophers, and mice from eating the acorns. The other 750 seed spots had no protection.

The test was made on the Hardies Creek Timber Harvest Forest. Three acorns were planted 1 to 2 inches deep in the mineral soil of each seed spot. This seed had been collected on the same Forest during the 1951 season and was stratified in sand over winter so that it would not dry out or freeze.

Plantings of 1-0 and 2-0 Nursery Stock

Only a portion of the acorns collected in 1951 was used for the direct-seeding tests the following spring. The balance of this stratified seed was sown in beds at the Hugo Sauer Nursery in Rhinelander, Wis. The resulting stock thus became available as 1-0 and 2-0 seedlings in 1953 and 1954 respectively.

Six hundred 1-0 trees, averaging 5.3 inches in total height, were planted in 1953 on a forest opening adjacent to the one where the direct seedings had been made a year earlier, and in 1954 two plots of 2-0 stock with an average total height of 9.5 inches[4] were also established on the Forest. One of these, involving 268 seedlings, was planted in a part of the stand that had been clear cut a few years earlier. The second one, comprising 306 trees, was planted on abandoned agricultural land. Both the 1-0 and 2-0 nursery stock were hand-planted, using mattocks and the hole method, in 18- by 18-inch scalps (fig. 1).

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[1] *Scholz, Harold F., and DeVriend, A. J. Natural regeneration on a 2-acre mixed-oak clear cutting 5 years after logging. U.S. Forest Serv., Lake States Forest Expt. Sta., Sta. Paper 48, 11 pp., illus. 1957.*

[2] *Scholz, Harold F. Present status of oak management in Wisconsin. Iowa State Univ. Jour. Sci. 34: 649-660. 1960.*

[3] *Stoeckeler, J. H., and Scholz, H. F. A cylindrical screen for protecting direct seedings of forest tree species. Jour. Forestry 54: 183-184. 1956.*

[4] *These averages are based upon a 120-tree sample for 1-0 stock and a 116-tree sample for 2-0 stock.*

FIGURE 1. — Planting northern red oak seedlings with the mattock-and-hole method.

INITIAL SUCCESS

Direct Seedings

At the end of the first growing season, one or more northern red oak seedlings occupied 806 of the 1,000 seed spots that were open to possible depredations by rodents. If a minimum of one tree per spot is considered satisfactory stocking, the seeding was 81 percent successful. One or more small oak trees were also established on 237, or about 95 percent, of the spots screened against rodents.

Actually, the losses caused by animals were less than anticipated. In earlier tests on the same area, the success ratio for screened as compared to unscreened seed spots was about 1.6 to 1.0. The difference between the two treatments was substantially smaller in 1952, being in the ratio of about 1.2 to 1.0. Losses due to rodent depredations were small enough in both instances to raise a question as to whether screening costs can be justified in terms of the added benefits. However, such losses might be more serious on large-scale seedings, especially in years when acorns generally are in short supply. This point merits further study.

Plantings of Nursery Stock

There was no first-year mortality for either the 600 1-0 northern red oak seedlings planted in 1953 or the 574 2-0 trees planted in 1954. This does not mean that they all escaped damage, but merely that none were killed.

SURVIVAL AND GROWTH AFTER THE YEAR OF ESTABLISHMENT

The post-establishment mortality that occurred in the 1952, 1953, and 1954 seedings and plantings was primarily the result of competition from other vegetation or of animal damage. Except where corrective measures were taken, these factors also retarded the height growth of the young oak. Insect and disease losses were minor.

Effect of Competition

Northern red oak seedlings of natural origin frequently are killed or held back by overtopping herbaceous vegetation and woody shrubs.[5]

The seeding and planting tests in this study show that artificially regenerated oak is affected in the same way. Not only are some trees killed by too much shade, but also the height development of many others is restricted. The importance of shade is demonstrated as follows:

Each year from 1952 to 1959 the shrubs and herbaceous plants were cut ("weeded") to within 2 or 3 inches of the ground on the same alternate 5-row strips of the direct-seeded area. This treatment was also used on the open-forest sites that had been planted with 1-0 and 2-0 northern red oak nursery stock. Nothing was done to eliminate or modify the natural vegetative cover on the adjacent check areas.

When all of the trees were 10 years old from seed (at the end of the 1961 growing season) there was a clear indication that both survival and height growth were better on weeded than on unweeded strips (table 1). The data also show that 1-0 stock made better height growth but showed poorer survival than 2-0 stock. Some of these differences are very striking when viewed on the ground, but their statistical significance could not be determined because of the unreplicated character of the study.

The principal shrubs on the Hardies Creek Timber Harvest Forest area are gray dogwood (*Cornus racemosa* Lam.), raspberry (*Rubus strigosus* (Michx.) Maxim), blackberry (*R. allegheniensis* Porter), and prickly gooseberry (*Ribes cynosbati* L.). As long as there is

[5] *Scholz and DeVriend, 1957; see footnote 1. Also Scholz 1960, see footnote 2.*

TABLE 1. — *Survival and height growth of northern red oak in weeded and unweeded strips*

Character of planting and treatment	Survival of 1st yr. stocking after—		Average total height of all seedlings	
	5th yr. of age	10th yr. of age	5th yr. of age	10th yr. of age
	Percent	*Percent*	*Inches*	*Inches*
Direct seedings[1]				
Weeded trees (20 rows)	79	74	21	74
Unweeded trees (20 rows)	74	68	15	50
1-0 nursery stock[2]				
Weeded trees (10 rows)	88	84	28	100
Unweeded trees (10 rows)	80	56	14	63
2-0 nursery stock[3]				
Weeded trees (5 rows)	97	95	22	75
Unweeded trees (5 rows)	98	94	17	47

[1] *Total trees at the end of the first year (1952) were: weeded, 843; unweeded, 765*

[2] *Total trees at the end of the first year (1953) were: weeded, 200; unweeded, 200.*

[3] *Total trees at the end of the first year (1954) were: weeded, 129; unweeded, 139. These totals do not include the 2-0 trees that were planted on abandoned farmland.*

a sparse-to-moderate stocking of these "brush" species they do not seem to inhibit the development of forest regeneration too drastically. However, when any of them form dense colonies, the seedlings of northern red oak and other tree species find survival difficult.

There is no way of determining, at this time, whether the somewhat suppressed trees in the unweeded rows eventually will be overtopped by the more vigorous oak in the weeded strips. If this happens, it may be necessary to reassess the benefits of weeding in terms of growth potential as well as survival.

Blackberry probably offers the most dangerous competition to a young stand. In an unweeded, 5-row strip of the direct-seeded area, all except 11 percent of the northern red oak trees that were present in 1952 had disappeared by 1961 in one of these bramble patches. The survival was 67 percent of the first-year stocking in an adjacent weeded strip. The corresponding 1961 survival values for 1-0 nursery stock were 30 percent when the young trees had to compete with dense thickets of brush and 98 percent where such shrubs were controlled by annual weedings.

The old-field planting of 2-0 stock was characterized by excellent survival (95 percent 8 years after planting) but poor form (fig. 2) and rather disappointing height growth. Apparently, the small trees were inhibited by the heavy sod of bluegrass and weeds which occurs on this area. Whatever the cause, the 10-year-old oak (in 1961) averaged only 37 inches tall. The same lot of nursery stock did much better on an open-forest site. There it averaged 47 inches and 75 inches tall on unweeded and weeded strips, respectively (table 1). Additional study is needed to determine how form and growth rate in plantings of small oak can be improved on old fields and abandoned pastures.

Animal Damage

Data from the 10-year regeneration tests suggest that animal damage to small oak seedlings is cyclic. Most of it occurred during two winters, those of 1954-55 and 1955-56. Complete records of all injured and uninjured trees were kept during the latter year. A summary of these data shows that 67 percent of 1,379 trees under observation was damaged to some degree by rodents, deer, or mechanical factors (table 2).

FIGURE 2. — The 10-year-old northern red oak trees on this open, soddy, old-field site are characteristically limby and multiple-stemmed.

TABLE 2. — *Animal damage comparison in fenced and unfenced seed spots—winter of 1955-56*

Category	Area unfenced or fenced only to exclude deer (750 seed spots)		Area with rabbit-proof fence, excludes all animals except mice (500 seed spots)	
	No.	*Percent*	*No.*	*Percent*
Undamaged trees	130	19.3	321	45.6
Damaged trees:				
By rabbits only[1]	228	33.8		
By mice only[1]	158	23.4	379	53.8
By both mice and rabbits[1]	140	20.7		
By deer	3	[2] 0.4		
Non-animal (mechanical injury, disease, insects, etc.)	16	2.4	4	0.6
Total	675	100.0	704	100.0

[1] *There is no particular problem in identifying these two kinds of animal damage. Rabbits clip the twigs and stems with a clean, slanting cut, whereas mice girdle the bark and wood with a series of undulating bite-marks.*

[2] *Only 20 out of 30 rows of seed spots were subject to deer damage, but even on an adjusted basis it is very doubtful whether this kind of injury would exceed 1 percent.*

It is evident from table 2 that rabbit damage can be eliminated in new seedings and plantings of oak by the proper type of fence (fig. 3). However, there is some question whether this added expense can be justified in terms of ultimate benefits. True, rabbits killed some of the small oaks and slowed the growth of many more. However, of greater importance is the fact that most of the trees recovered quickly, though they were top-clipped, side-clipped, or even cut back to the ground.

The actual height difference between fenced and unfenced trees amounted to 16 inches at the end of 10 years (fig. 4). On the area subject to animal injury, the small trees averaged 54 inches tall. Where rabbits were kept out by a fine-mesh woven wire fence, the oak seedlings had an average total height of 70 inches. It is doubtful, though, that this extra margin of growth spells the difference between success and failure. For, by 1961, even on that part of the seeding subject to rabbit injury, 45 percent of the trees were 4.5 to 14.0 feet tall and another 33 percent were in the 2.0 to 4.5-foot range. While some of these juvenile oaks may be damaged further by animals or competing vegetation, it seems reasonably certain that the majority will survive.

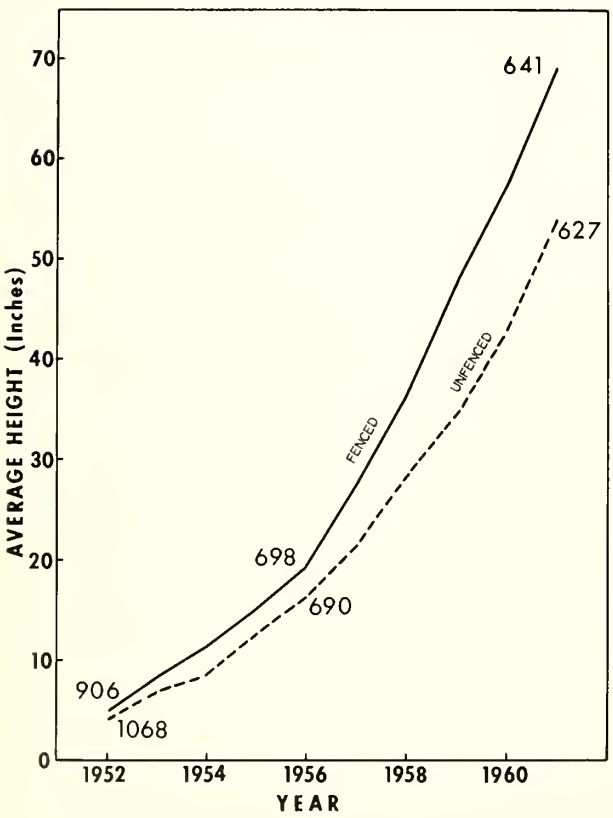
DISCUSSION

Preliminary field tests are encouraging, for they give considerable assurance that the mixed-oak forests in Wisconsin can be regenerated artificially with this valuable timber tree if the need arises. The choice of methods — direct seeding or planting nursery stock — will depend upon personal considerations, comparative costs, and the availability of nursery facilities, among other things.

Shrubs and herbaceous vegetation killed some of the young oaks in the test and retarded the height growth of many others. Yet, these losses were reduced and the average height growth was stimulated by the simple expedient of annual weedings which cut the competing plants back to within 2 or 3 inches of the ground.

While some problems were encountered

FIGURE 3. — The combination of fencing materials shown here protected a direct seeding of northern red oak from rabbits. It also kept out deer.



during these tests, in every case countermeasures could have been taken that would have assured a higher level of success. For example, squirrels, chipmunks, and mice destroyed the acorns in many seed spots. But these losses were virtually eliminated when the spots were protected with hardware-cloth cylinders.

Likewise, rabbits cut back the tops and lateral branches of many of the small northern red oak on areas that were not fenced. Mice girdled and side-clipped the twigs of other seedlings, but these tiny rodents can be controlled by trapping or poisoning. In a few cases, deer ate the tops of seedlings, but such damage, like that caused by rabbits can be eliminated by properly constructed fences.

FIGURE 4. — Rabbit damage comparison. Average height growth of fenced and unfenced northern red oak seedlings. Weeded and unweeded areas combined. The numbers along the trend lines indicate the number of living trees at the time of measurement.

When these various problems require further study, formal experiments can be designed to investigate them. In the meantime, the results obtained from the 10-year tests on the Hardies Creek Timber Harvest Forest will be helpful to the practicing forester in southern Wisconsin or elsewhere in the mixed-oak forest region. There is now fairly good assurance that northern red oak can be maintained as a key species in this hardwood complex. Natural regeneration is preferable, but if the need arises this particular oak can be kept in these stands by direct seedings or by planting 1-0 or 2-0 nursery stock.

SUMMARY

1. A series of regeneration tests, involving direct seedings of northern red oak and out-plantings of 1-0 and 2-0 nursery stock of the same species, is in progress on the Hardies Creek Timber Harvest Forest in southwestern Wisconsin.

2. There were some depredations of acorns by rodents in direct seedings. These losses were reduced somewhat by protecting the seed spots with hardware-cloth cylinders. Eighty-one percent of the unprotected spots were stocked with one or more seedlings at the end of the first growing season, compared to 95 percent for screened spots. There is, thus, a question whether the added benefits of using the screens are worth the extra cost.

3. Overtopping shrubs and herbaceous vegetation had an adverse effect upon seedlings and nursery stock. When this competing cover was cut back annually to within 2 or 3 inches of the ground, both the survival and total height of the released trees were better than on adjacent unweeded check strips.

4. During two out of nine winters, extensive damage was done to both seeded and planted northern red oak by rabbits and mice. Deer also nipped the tops of a few trees. While animal damage caused some mortality, its chief effect was to set the trees back for a year or two and reduce their average total height.

5. When all the factors of success and failure are evaluated, one must conclude from these 10-year artificial regeneration tests that it is perfectly feasible to maintain northern red oak in the mixed-oak forest type by direct seedings or by planting nursery stock, if natural regeneration proves inadequate.

Scholz, Harold F.

1964. Seeding and planting tests of northern red oak in Wisconsin. Lake States Forest Expt. Sta., St. Paul, Minn. 7 pp., illus. (U.S. Forest Serv. Res. Paper LS-7)

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