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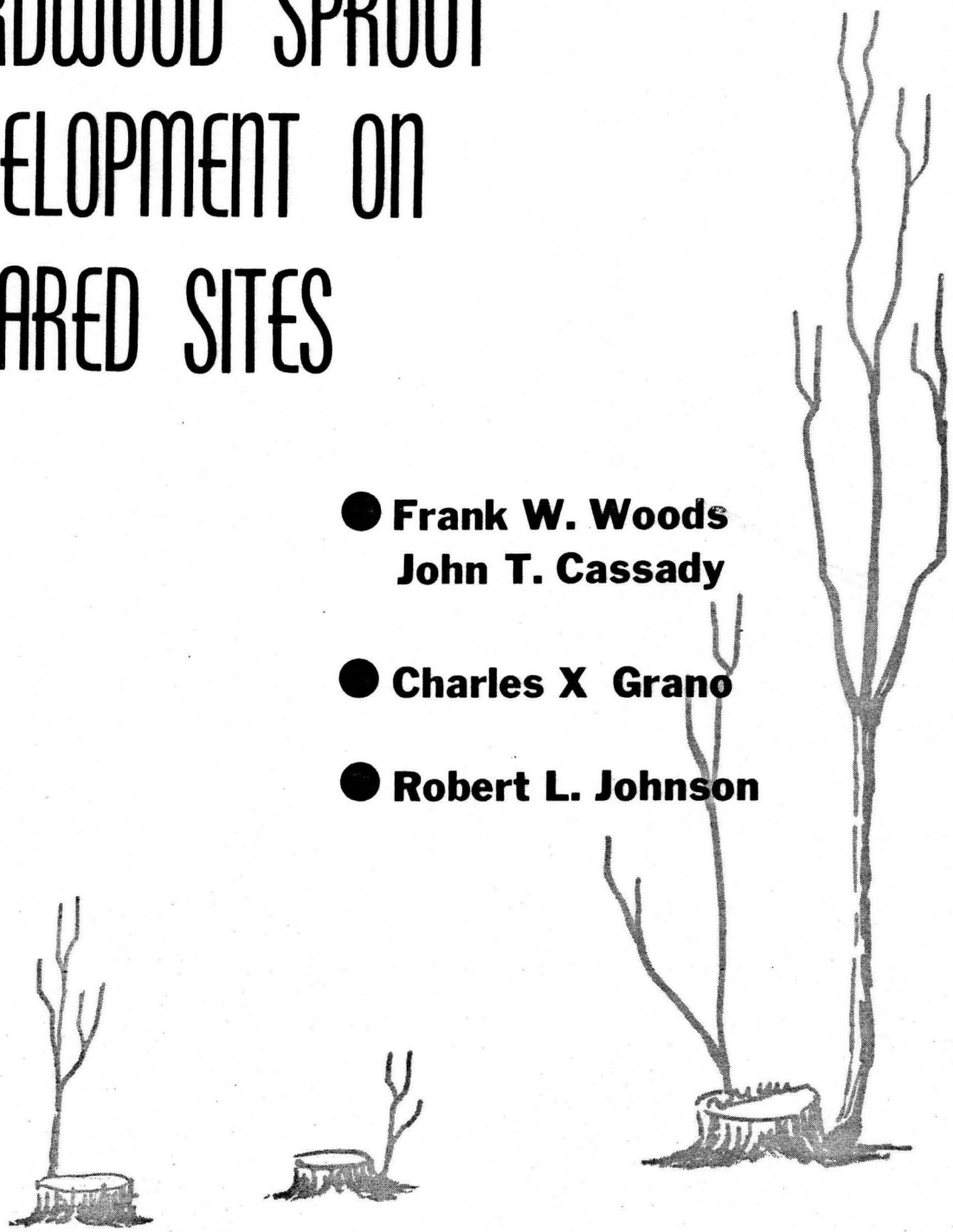
HARDWOOD SPROUT DEVELOPMENT ON CLEARED SITES

● Frank W. Woods
John T. Cassady

● Charles X Grano

● Robert L. Johnson



SOUTHERN FOREST EXPERIMENT STATION
Philip A. Briegleb, Director
FOREST SERVICE
U. S. DEPARTMENT OF AGRICULTURE

Clearing forest land of undesirable vegetation, with a view to obtaining desirable trees, is becoming increasingly common in the South. Bulldozers and other heavy equipment are generally used in such efforts. Success is measured largely by the degree to which recovery of the unwanted plants is prevented or slowed.

This Occasional Paper contains three articles on the general topic of site-clearing. The first describes the response of scrub oaks cut and recut at varying intervals; the aim of the study was to secure information on the timing of stand-conversion operations in the sandhills of western Florida. The second article deals with the speed of hardwood resprouting in the understory of a pine forest in southern Arkansas. The third briefly describes a bulldozing operation in the Mississippi Delta, where the intention was to encourage hardwoods of better species and quality than those already present.

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SPROUTING OF SANDHILLS SCRUB OAKS FOLLOWING CUTTING

Frank W. Woods [1] **and John T. Cassady**
SOUTHERN FOREST EXPERIMENT STATION

Turkey and bluejack oaks in the sandhills of western Florida were cut four inches above the ground in May, and rootstock sprouts were removed twice thereafter during the same growing season. Removals at 6 or 8 weeks apart were better than those at 4-week intervals.

This paper reports a study of periodic removal of oak stems and resulting sprouts at selected time intervals. The object was to determine the most effective intervals for site-preparation treatments aimed at controlling scrub oaks on west Florida sandhills. On these dry sites complete eradication of existing vegetation is essential to the establishment of pine forests.

METHODS

The study tract, on the Chipola Experimental Forest in northwest Florida, is representative of large areas in the sandhills. Turkey oak *(Quercus laevis* Walt.*)*, bluejack oak *(Q. incana* Bartr.*)*, and wiregrass *(Aristida stricta* Michx.*)* dominate in the scrubby vegetation. A few longleaf pine *(Pinus palustris* Mill.*)* seedlings, saplings, and flat-topped residual trees are scattered over most areas. The predominant soil series is Lakeland sand, deep phase, with excessive internal drainage.

The study design was a randomized complete block, with two blocks of 6 treatments applied to two oak species and replicated in time by similar studies begun in 1955 and 1956. Turkey oak and bluejack oak were studied separately within each block. Each species treatment was applied to 10 single-stemmed, healthy-looking trees from 1.5 to 3.0 inches in diameter, measured 4 inches above ground. Small trees were chosen because they sprout more vigorously than large trees.

Initially, each stem, except in the check treatments, was sawn off 4 inches aboveground. The resulting sprouts were counted, measured, and removed at specified times for two growing seasons, as described below:

Treatment

1. Stems cut off 4 inches aboveground at beginning of study; all sprouts removed one year later.
2. Stems cut at beginning of study; sprouts removed at 4-week intervals, i. e., 4 weeks and 8 weeks after initial cut. Third and final sprout removal one year after initial cut.
3. Same as treatment 2 except that first-year sprout removal was at 6-week intervals.
4. Same as 2 except that first-year sprout removal was at 7-week intervals.

[1] Field work was done while Dr. Woods was on the staff of the Marianna Research Center, Southern Forest Experiment Station, Marianna, Florida. He is now a member of the School of Forestry, Duke University, Durham, N. C.

5. Same as 2 except that first-year sprout removal was at 8-week intervals.

Control. No treatment during the first year; stems were cut at a height of 4 inches in May of second year, at same time as final removal of sprouts in all other treatments.

A 2-week treatment was planned, but no sprout growth was produced within that interval.

The number and length of sprouts on each stump were recorded weekly during the first growing season, and monthly during the second. Sprouting ability was summarized by adding together the length of every sprout on a stump and then averaging all stumps in the treatment.

Stump and rootcollar samples were sectioned to determine the origin and development of sprouts.

RESULTS

Sprouting during the first season

Figure 1 illustrates the average sprout growth (total length of sprouts per stump) of turkey oak during the first growing season under selected treatments. Bluejack oak showed a similar pattern but greater sprout length in all cases.

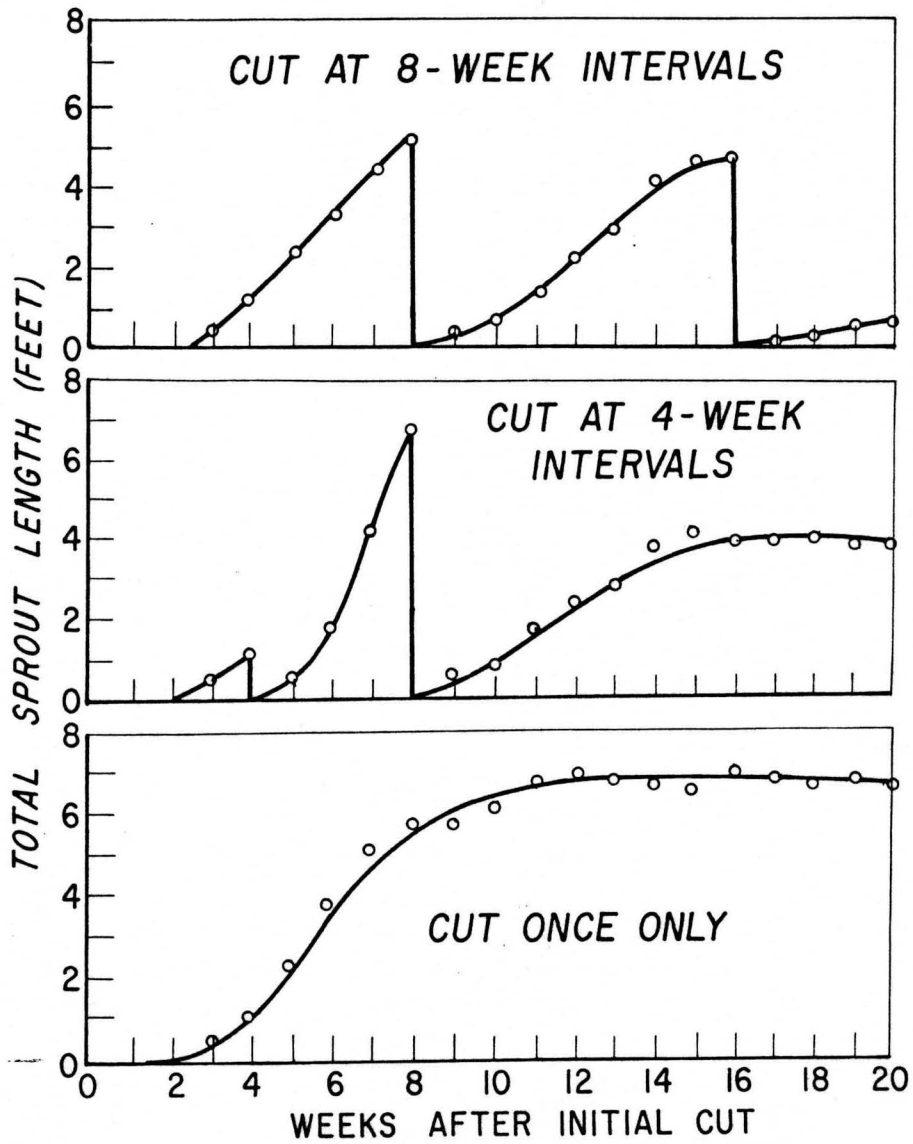

Figure 1.—
Average total length of sprouts on turkey oaks.

The initial cut for each treatment was made when leaves were fully developed—May 26, 1955, in the first study and May 15, 1956, in the second. Sprout growth immediately after the initial cut was the same under each treatment—there was no measurable growth during the first two weeks and only 12 to 15 inches during the second two weeks. Thus, in sprout removal at 4-week intervals, the first removal was wasted on a few small sprouts, and this removal came during the period of maximum sprout development, as illustrated by results of the cut-once-only plots. Removal after just 4 weeks increased the rate of sprout growth, so that at 8 weeks after the initial cut the stumps in the 4-week treatments had as much total sprout growth as the cut-once or 8-week treatments.

The first measure of treatment success was total sprout length at the end of the first growing season, which is represented by the twentieth week on the charts (fig. 1). The cut-once-only treatment resulted in about 6 feet of sprouts per stump; the 4-week intervals had about 4 feet; and the stumps cut at 8-week intervals averaged less than one foot of total sprout length.

The 6- and 7-week intervals gave results similar to 8-week intervals.

Variation in the total number of sprouts per stump (fig. 2) followed the same patterns as in total sprout length. At the end of the first season the treated stumps averaged about 14 sprouts if they had been cut once only, 17 sprouts if cut at 4-week intervals, and 3 sprouts if cut at 8-week intervals.

Sprouting during the second season

In May of the second year, sprouts were again removed from all plants cut the first year and oaks in the check treatment were cut for the first time.

These second-year measurements, with the check treatment for comparison, gave an indication of the effect on sprouting vigor caused by the first-year treatments. Total sprout growth in mid-July of the second season, two months after cutting or sprout removal in May, was selected to illustrate the final effects of first-year treatments; sprout growth was near maximum by mid-July.

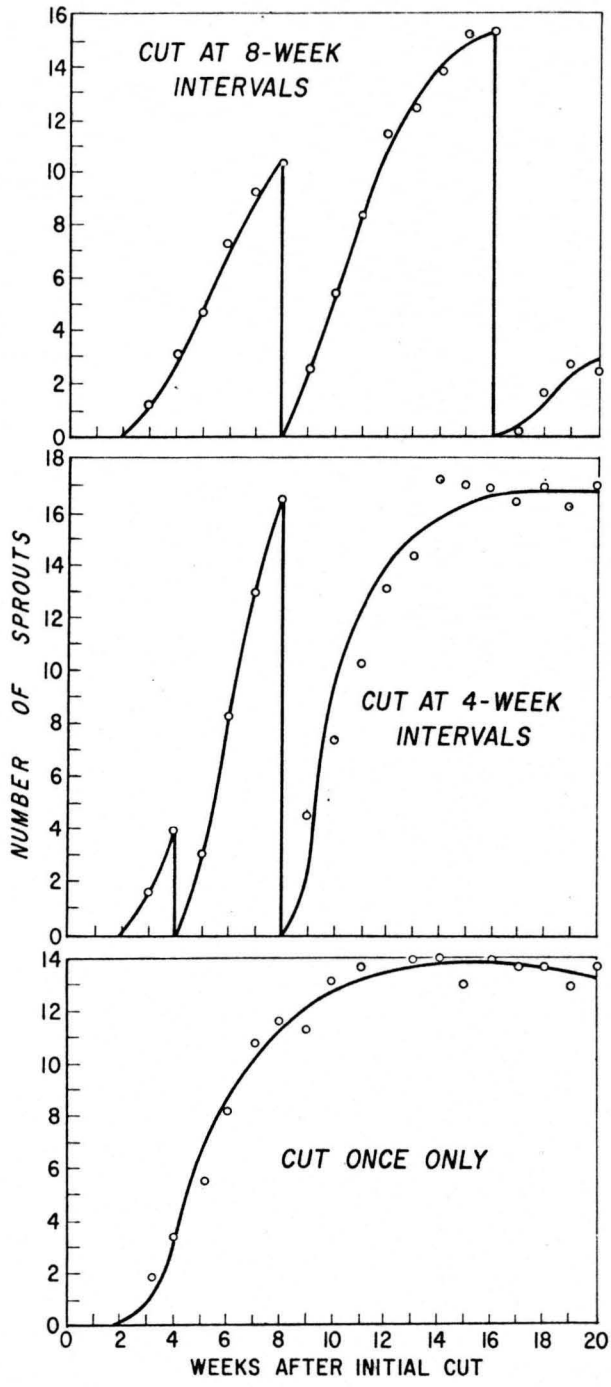

Figure 2.—*Average numbers of sprouts per stump, on turkey oaks.*

Figure 3 shows clearly that sprout removal at 6-, 7-, or 8-week intervals reduced sprouting considerably more than removal at 4-week intervals or cutting once only. Treatment differences for turkey oak were highly significant

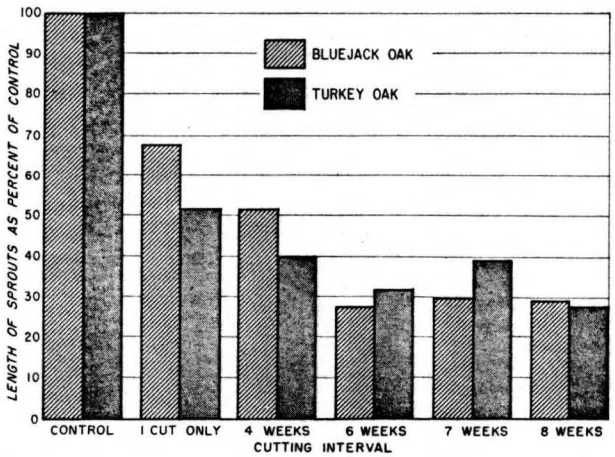

Figure 3.—*Relative total length of sprouts per stump in the second season following different cutting regimes (length of sprouts on controls taken as 100 percent).*

as tested by analysis of variance. Data for bluejack oak were not analyzed but were quite similar to those for turkey oak.

Stumps killed by cutting treatments

As might be expected, many tree stumps were killed by repeated sprout-removal treatments (table 1). Progressively higher mortality resulted from removal at increasing intervals.

Table 1.—*Dead stumps at end of second season*

First-year treatment	Bluejack oak	Turkey oak	Total
	Percent	*Percent*	*Percent*
Check—no first-year treatment	2.5	2.5	2.5
Tops only removed	5.0	12.5	8.8
Four-week intervals	5.0	25.0	15.0
Six-week intervals	17.5	25.0	21.2
Seven-week intervals	27.5	15.0	21.2
Eight-week intervals	22.5	35.0	28.8

Origin of sprouts

Cross-sections of treated oak stumps indicated that the first sprouts after initial cutting were from dormant buds. Development of the buds was evidenced by radial traces from the pith to the cambium. After the first sprouts were removed, a callus (primordial tissue) formed at the termination of bud trace over the injured wood and became the source of many new buds and sprouts. Resprouting from the callus started quickly after sprout removal but at least two weeks were required for sprouting to develop from dormant buds in a freshly made stump.

DISCUSSION

There is abundant evidence that rootcollar sprouts, epicormic branches, and water sprouts originate from dormant buds. This is true for broadleaved woody species (Schreiner, 1933) as well as for conifers (Stone and Stone, 1954). These latent buds connect with the primary xylem and move outward to the same extent that the tree grows in radius each year (Roth and Hepting, 1943). Some bud traces divide at various points in their outward migration, so that the number of subsurface buds increases as the tree grows (Hahne, 1926). Terminal shoots cause these buds to remain dormant, apparently through the action of auxins which move basipetally. When the source of auxins is removed by cutting or some other action, dormant buds may start to grow (Doorenbos, 1953).

External factors, such as the loss of leaves, sudden exposure of stems to light, and increased bark temperatures, may interrupt the downward movement of auxins sufficiently to stimulate growth of dormant buds. Such effects occur more in some species than others. Adventitious buds, which do not connect with the primary xylem, develop only at the site of injuries (Voss, 1935). They originate on callus tissue which forms during the healing process (Burger, 1931). Burger asserted that rootcollar sprouts originate from adventitious buds, but this investigation indicates that the initial stump sprouts are entirely from dormant buds. Once the initial sprouts are removed, callus tissue forms and succeeding sprouts are nearly all from adventitious buds.

APPLICATION

This study was planned on the hypothesis that scrub oak stems and sprouts must be removed at least three times during a single season to obtain a satisfactory kill. Later work indicates that two removals may be adequate under certain conditions. Where three treatments are needed, the first may be accomplished quickly and cheaply by prescribed burning as soon as leaves are full grown in

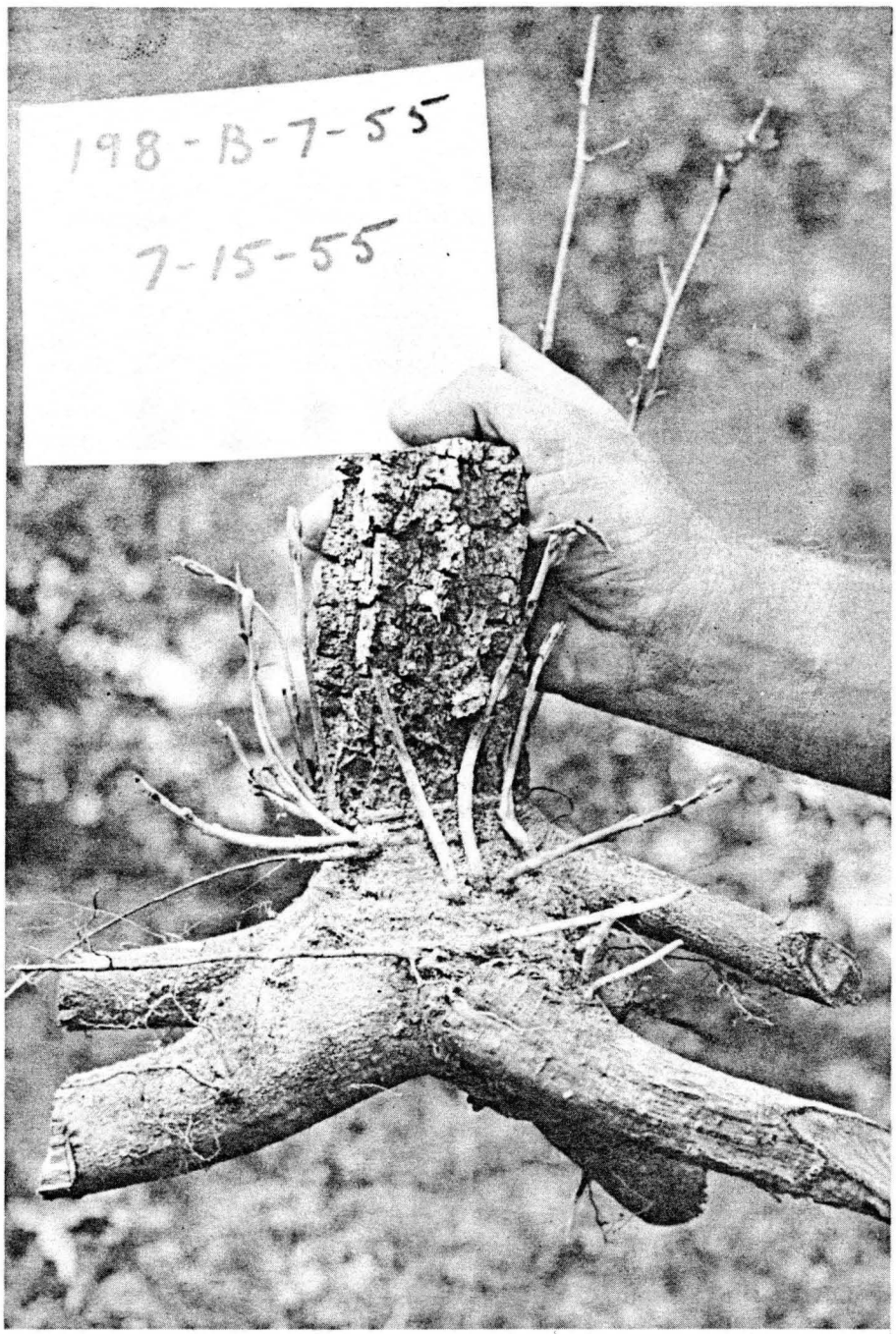

Figure 4.—
Sprouts always originated at or above the root-collar, never on roots.

spring, provided that there is enough fuel to defoliate the oaks and kill small stems. The second and third sprout-removals are best carried out by heavy doubledrum brush cutters that push over and chop woody plants into the ground. The same treatment destroys wiregrass and herbaceous vegetation. In this study, three top-removal treatments were made to represent experimentally the timing of three mechanical site-preparation treatments. However, the experimental techniques were much gentler and much less destructive to scrub oaks than the heavy equipment, which usually uproots and partially buries the stumps.

Follow-up studies with chopping equipment have produced very satisfactory kill of scrub oaks with two cuts spaced 6 to 10 weeks apart during the main growing season. Prescribed burning 6 to 10 weeks before the first chop usually gives even better control.

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HARDWOOD REOCCUPATION OF BULLDOZED SITES

Charles X Grano
SOUTHERN FOREST EXPERIMENT STATION

Hardwood thickets in south Arkansas were bulldozed and observed to study site reoccupation by sprouts. First-year sprouts were few, and the tallest averaged 1.8 feet. After 3 years one-fourth of the area was overtopped by sprouts; after 7 years half was overtopped by sprouts averaging 6 feet tall.

Very dense hardwood thickets in south Arkansas pine-hardwood stands were bulldozed clean, down to mineral soil, and observed for seven years thereafter to follow the rate of site reoccupation by sprouts (fig. 1).

Figure 1.—1953: *Cleared area immediately after it was bulldozed to remove dense hardwood thicket.*

When the site was bulldozed in 1953 there were approximately 24,000 hardwood stems per acre under 3.5 inches in diameter. Some of these were more than 15 feet tall. Species present included southern red oak, post oak, mulberry, witch hazel, red maple, sweetgum, blackgum, sassafras, dogwood, sumac, hickory, persimmon, elm, ash, wild plum, and Hercules-club. Thirty-one percent of the stems were mulberry and witch hazel, 17 percent were oaks, and 15 percent were gums. The oaks and gums were the largest trees present.

The soil is a sloping phase of Caddo silt loam. A 20-inch top layer of light brown silt loam grades into a very compact silty clay loam and silty clay. The clay layer impedes internal drainage, but a gently sloping topography provides good surface drainage.

Rainfall was less than normal and soil moisture in short supply during the 1954, 1955, and 1956 growing seasons. During the next three years soil moisture was very favorable, and in 1960 it was only slightly deficient.

A sparse growth of small sprouts appeared one year after treatment; the taller ones averaged 1.8 feet. At the end of the second year they were 3.0 feet. In 1956, 24 percent of the area was overtopped by hardwood sprouts, the tallest averaging 4.0 feet (fig. 2). By 1960, the sprouts had increased in number and size to

Figure 2.—1956: *About one-fourth of the area has been reoccupied by hardwoods. The tallest sprouts average 4 feet in height.*

Figure 3.—1960: *Fifty-two percent of the area has been reoccupied by hardwoods. Tallest stems are 15 feet, the average is 6 feet.*

such an extent that they overtopped 52 percent of the area. Some of the stems were 15 feet high, but they averaged 6 feet (fig. 3).

Less drastic mechanical treatment than bulldozing clean resulted in much greater and more rapid hardwood reoccupation, as illustrated in figure 4. In 1953 this area, which is part of the same study reported above, was given a combination treatment—one pass with a brush cutter hooked ahead of a light disk. Three years later 58 percent of the area was once more overtopped by hardwoods and, by 1960, 92 percent was reoccupied. The disk used was too light; a larger one with an adequate tractor would have been more effective.

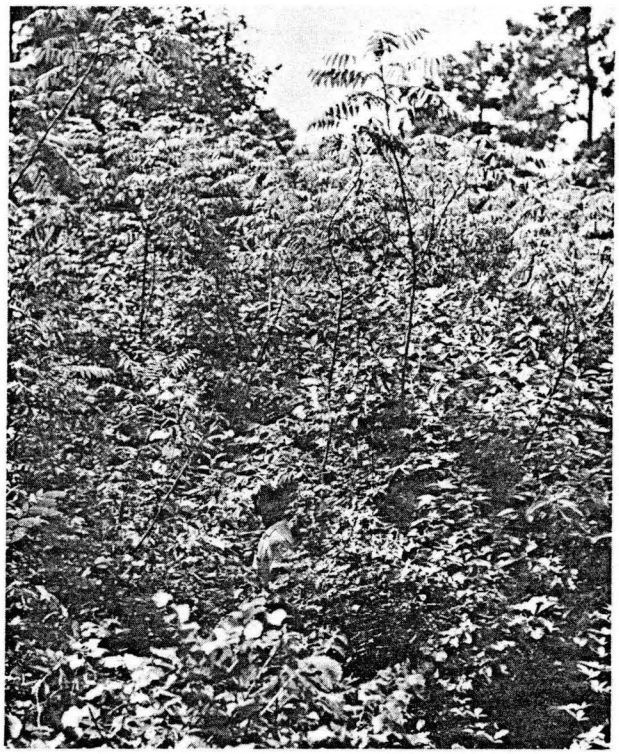

Figure 4.—1960: *Small hardwoods on this site were leveled in 1953 with a brush cutter and a light disk—a less thorough treatment than bulldozing. Ninety-two percent of the area is now reoccupied by hardwoods — the tallest are 25 feet in height, the average 10 feet.*

HARDWOOD SPROUTS DOMINATE BOTTOM-LAND CLEARINGS

Robert L. Johnson
SOUTHERN FOREST EXPERIMENT STATION

Five years after they had been cleared of all aboveground vegetation, openings in a stand of bottom-land hardwoods were dominated by sprout trees, mainly bitter pecan and green ash.

Six openings in a bottom-land hardwood forest near Stoneville, Mississippi, were bulldozed clear of all vegetation in the fall of 1954. The openings, which averaged 1 by 1½ chains, had been created by selective logging and by deadening of all culls larger than 4 inches in d.b.h. The bulldozer cut off all remaining plants—vines and small cull trees—but left underground roots largely undisturbed.

One opening was on a well-drained ridge; the others were on poorly drained flats. The soil was Sharkey clay.

Two years after treatment, sprouts of bitter pecan and green ash were the most common trees, but were growing in association with annual weeds, vines, and briers. Other tree species included Nuttall oak, overcup oak, American elm, willow oak, hackberry, and persimmon, all of which were present in the surrounding overstory.

After five growing seasons, green ash and bitter pecan almost completely dominated four of the openings on the flats. In the fifth, trees were being suppressed by similax and trumpet-creeper vines. On the ridge, green ash sprouts were competing with seedlings of cedar elm and willow oak. Trees of desirable species and form numbered between 2,000 and 7,500 per acre. Dominants among the bitter pecan and green ash were about 1½ inches in d.b.h. and 15 feet tall.

From these observations, it appears that light bulldozing after logging in similar mixed hardwood stands will stimulate reproduction by root sprouting. The composition of the new stand will be governed by the most prolifically sprouting species, not necessarily the most desirable; in this test, green ash and bitter pecan comprised 65 percent of the commercial species present after 5 years.

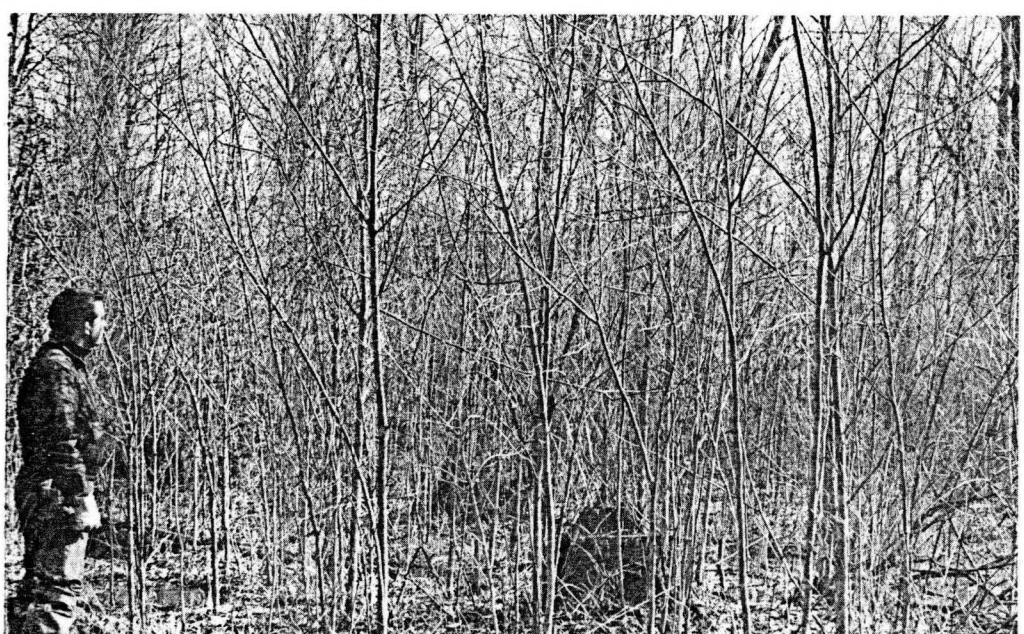

Figure 1.—
This area was scraped bare of all vegetation 5 years ago. It now has about 7,500 trees per acre, mostly green ash and bitter pecan sprouts. Dominant trees are about 1½ inches d.b.h. and 15 feet tall.