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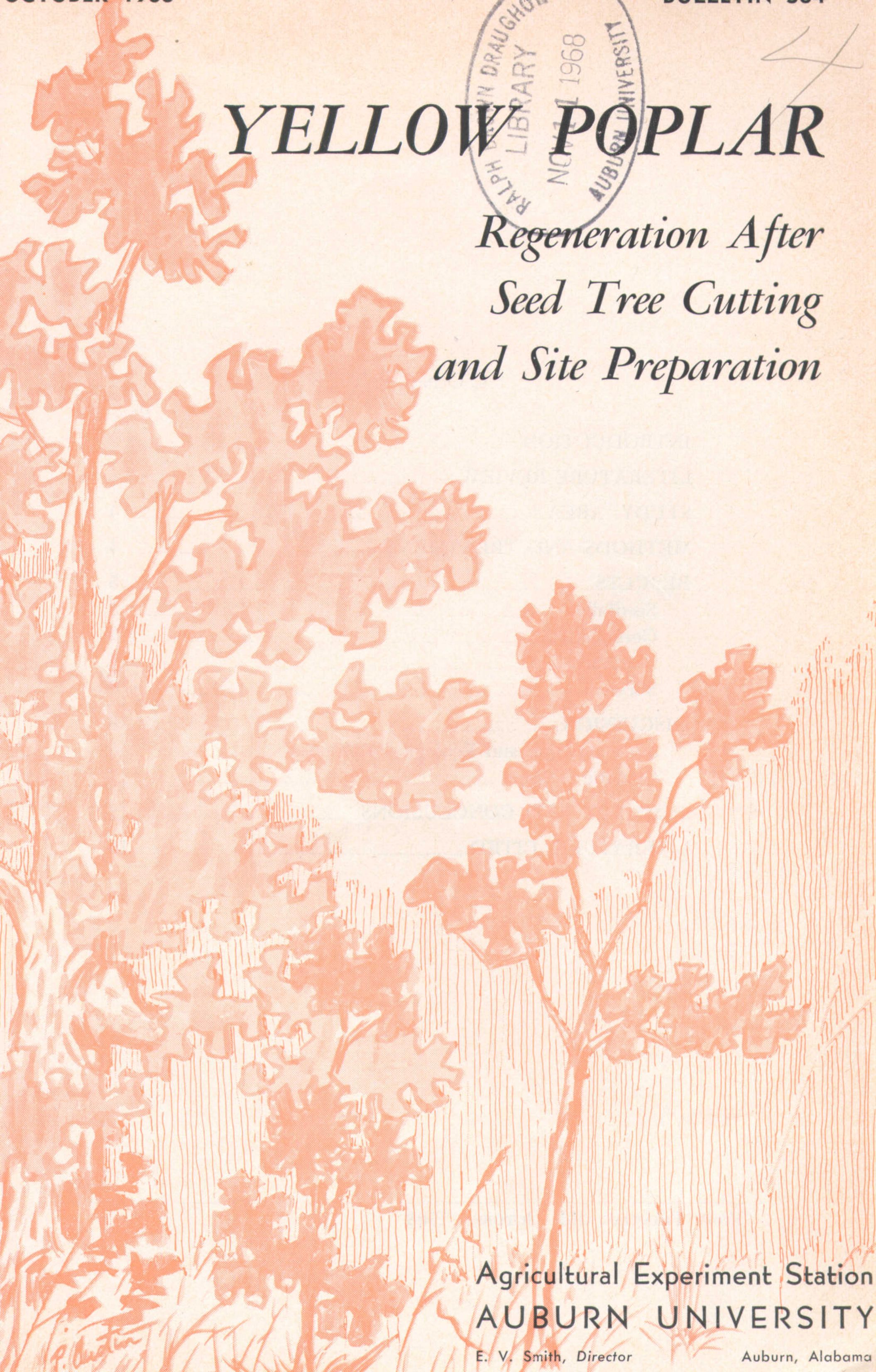
YELLOW POPLAR

Regeneration After Seed Tree Cutting and Site Preparation



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YELLOW POPLAR

Regeneration After Seed Tree Cutting and Site Preparation

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INTRODUCTION

SMALL STREAM bottoms in Alabama are capable of growing good quality hardwoods.

Yellow poplar (*Liriodendron tulipifera* L.) is one of the most valuable hardwoods grown in such bottoms. The yellow poplar's desirable growth patterns, low susceptibility to serious disease and insect pests, and adaptability to numerous uses all contribute to its desirability.

Logging practices and wildfires have destroyed or greatly reduced the amount of yellow poplar occurring in these small stream bottoms. Present conditions too frequently consist of mixed hardwood stands with cull trees and jungle-like understories of vines and low-value species and only a remnant of the former yellow poplar component. Good seed trees are frequently scattered.

This paper reports a study of the effect of various methods of seedbed preparation, following seed tree cutting, on germination and survival of yellow poplar. The effects of certain climatic factors were also studied.

LITERATURE REVIEW

Conversion of these low-volume, low-value stands to potentially highly productive stands of yellow poplar has many problems.

Seed production is usually abundant from yellow poplars with diameters greater than 5 inches DBH, but percentage of viable seed is very low, ranging from 1 to about 30 per cent and averaging around 10 per cent *(2,6,10,11)*.

Indications are that local topography and winds are the main regulators of seed dissemination *(2,4,7,10)*. Depending on the natural factors present, established reproduction is generally unsatisfactory at distances greater than 2 to 5 times the height of good seed trees.

The abundant seed and the ability of the seed to remain viable in the litter layer for more than 1 year favors regeneration *(2,3)*. However, successful regeneration usually has been limited to areas with adequate moisture, a seedbed of mineral soil, sufficient direct sunlight for early growth, and some shelter *(2,5,10)*. Information as to the amount and type of seedbed preparation needed has been inconsistent. In some areas satisfactory reproduction has been obtained following ordinary logging operations whereas in other areas more intensive site preparation has been required.

STUDY AREA

The area studied is situated in northern Fayette County, Alabama, on the Upper Coastal Plain. Soils are of the Mantachie series, consisting primarily of local alluvium, and are deep but imperfectly drained. Plots were located along a narrow bottom of a minor, intermittent drainageway covering approximately 4 acres.

During 1960, all merchantable timber was cut except for the scattered yellow poplar. Only 10 of the yellow poplars were seedbearers. These were concentrated at the ends of the stand, leaving the center void of seed trees. A dense understory of vines, brush, and nonmerchantable species of hardwoods was present.

METHODS AND TREATMENTS

Over a 4-year period, 1960-64, seeds caught in 63 seed traps, each with an area of 2 square feet, were counted and recorded by total and by number of sound seed. Soundness was determined by cutting each seed.

Treatments were as follows: bulldozing, with mineral soil exposed by scraping the surface; double disking, with mineral soil seedbed prepared with a heavy farm-type tractor and gang disk;

and no preparation, as a check. In the latter case, all litter and vegetation were left undisturbed except for the removal of large tops from felled trees. Treatments were completed during the early part of September 1960.

A 10-inch rainfall during a 2-day period in February 1960 caused flooding, with rapid runoff over much of the treatment area. Erosion and silting were prevalent on areas where mineral soil had been exposed. Consequently, results of treatment were considered to be destroyed, based on the original objectives, and seedbed preparation treatments were repeated prior to the 1961 seedfall period. Neither silting nor erosion was a factor on the check plots.

RESULTS

Seedfall

Total annual seedfall ranged from less than 1,000 seeds per acre at distances of 5 chains to more than 600,000 seeds per acre within 1 chain of a good seed tree. Distribution of filled seed, Figure 1, occurred in satisfactory numbers – 1,000 to 10,000 per acre – up to 3 chains from a good seed tree in the direction of the prevailing wind and 1.5 chains in all other directions. Where seed trees were more than 4 chains apart in the direction of the prevailing wind or 3 chains apart in other directions, dissemination of sound seed was unsatisfactory for desirable yellow poplar establishment.

The greatest seedfall occurred during October and November each year. Approximately 90 per cent of the samaras fell during this period. The percentage of sound seed was slightly higher for seeds falling early – 11 to 13 per cent – than for seeds falling later in the season – 7 to 10 per cent. The overall average of sound seed amounted to 9 per cent. Seed trees more than 12 inches DBH had similar volumes of seed production during the 4-year period while trees 7 to 12 inches showed increasing seed production during the same period.

Germination

During the first year following treatment, 1962, germination was considerably better on the areas treated by either method of scarification than on areas left unscarified. Germination averaged 2,646 seedlings per acre on the disked area, 2,187 per acre on the

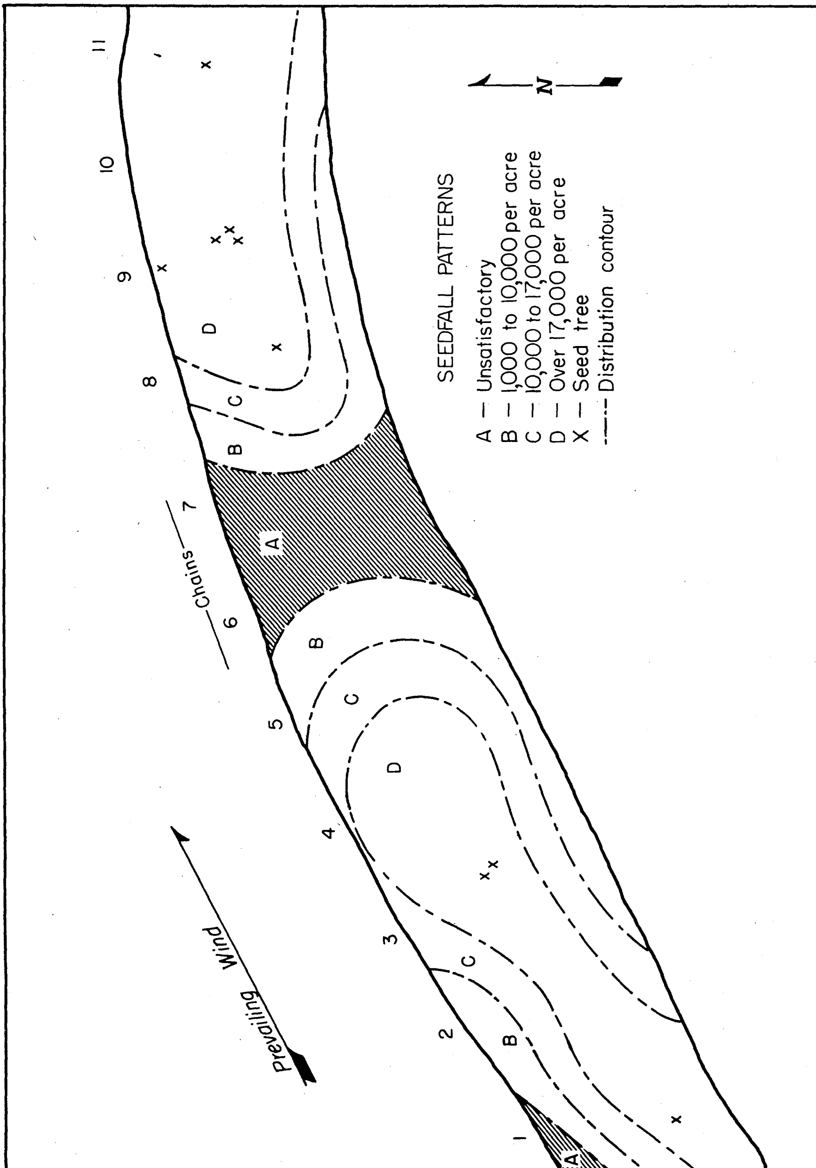

FIGURE 1. Distribution of filled Yellow Poplar seed.

bulldozed area, and 42 per acre on the check, Figure 2. Second-year germination was reduced on scarified areas to a per acre average of only 563 on disked plots and 602 on bulldozed plots.

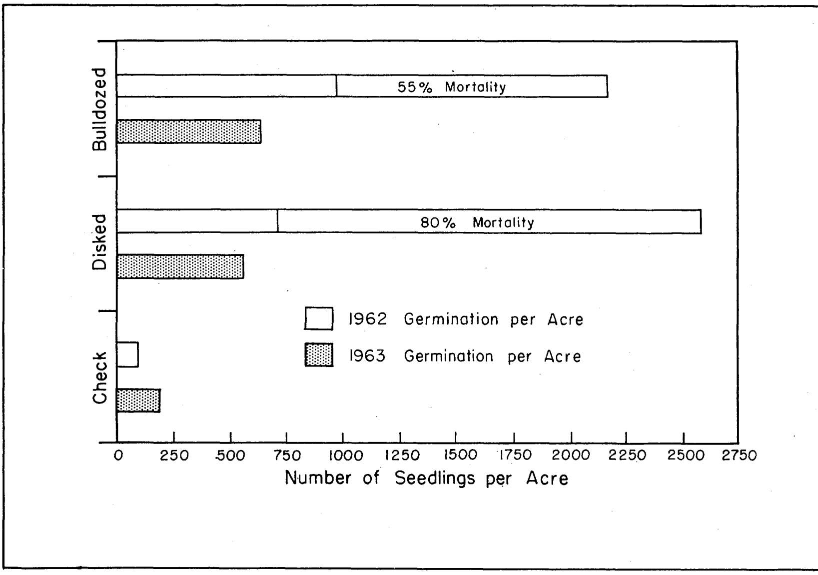

FIGURE 2. 1962 and 1963 germination and 1962 mortality.

Check area germination increased to 125 seed per acre, still an unsatisfactory amount.

Most of the germination came early on exposed soil. Approximately 60 per cent occurred on scarified areas during May of each year. In contrast, where the mineral soil was not exposed, the greatest portion of the germination – 58 per cent – occurred one month later, Table 1.

TABLE 1. GERMINATION BY PERIODS OF YELLOW POPLAR SEED AVERAGED OVER 2 YEARS

Treatment	Germination			
	Total	May	June	July-August
	Number	*Per cent*	*Per cent*	*Per cent*
Bulldozed	2,791	55	36	9
Disked	3,209	66	31	3
Check	167	25	58	17

Mortality

The difference between germination during 1962 and the survival count made early in 1963 indicated mortalities that varied greatly by treatment. First year mortality on disked areas averaged 2,118 seedlings per acre (80 per cent) as compared to 1,208 per acre (55 per cent) on bulldozed areas and none on the check areas, Figure 2.

Survival

Tallies made of all surviving seedlings during the spring of 1963, 1964, and 1965 indicated that the number established was reduced from the first year to the third year but at a decreasing rate. In 1965, established seedlings on bulldozed plots totaled 542 per acre, on disked plots 142 per acre, and on the check only 52 per acre, Figure 3.

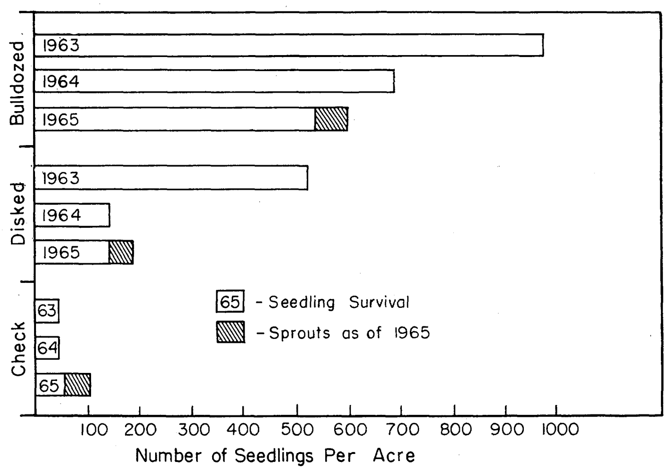

FIGURE 3. Survival of Yellow Poplar seedlings by years and of sprouts at 4 years.

DISCUSSION

The sampling design did not adequately represent all aspects of the original objectives. However, valuable information that indicated acceptable trends and the complexity of factors critical to the establishment of yellow poplar was obtained.

Site Condition and Ecological Responses

Site treatments and resulting conditions were as follows: (1) bulldozer treatment left a bared mineral soil scraped and somewhat compacted by the bulldozer blade. Many stumps of small saplings sheared off by the bulldozer blade were left. (2) Disking treatment left a bared, loose mineral soil with small, irregular furrows. Small stumps were disked into small pieces but a number of small saplings escaped the disk. Organic matter was partially incorporated into the soil. (3) The check area was left with many small saplings, shrubs, and vines, plus a 2-4-inch litter layer, and a 1-inch layer of partially decomposed organic matter.

The bare soil apparent during the spring and early summer of 1962 on prepared sites was partially covered with vegetation – sprouts, forbs, grasses, and vines – by late summer and early fall. In other words, the effects of scarification had partially disappeared by the second year after treatment. By the third and fourth year, vegetative responses on the scarified plots made these areas appear similar to the check plots except for size of saplings. Surviving yellow poplar seedlings were subjected to heavy competition on check plots, but some competition was also obvious on scarified plots.

The measure of ecological responses was made by a tally by plots (4, 2-milacre subplots) of all stems by height class and species and by a visual estimate of ground area covered by grasses, forbs, and vines. Grasses and forbs had a similar response on either method of scarification – 25 and 32 per cent coverage – but were low on the check areas – 6 and 21 per cent coverage, respectively. The percentage of area covered by vines was similar under all treatments, Table 2. The yellow poplar seedlings had less competition for light from vines on scarified areas than from vines on check areas. The reason for this was the tendency of vines on the scarified areas to lie close to the ground while those on the check areas were more dense and covered all levels of other vegetation.

Four years after establishment, a difference was found in the number of stems over 5 feet tall on the check plots as compared to scarified plots. The number per acre averaged 4,084 on the check plots, 2.3 times more than the average of 1,771 on the disked plots, and 3.8 times more than the average of 1,063 on the bulldozed plots, Table 2. Considering woody vegetation alone, check plots had more and bigger stems of all species except pine and the desired yellow poplar.

TABLE 2. VEGETATIVE CONDITION OF PLOTS 4 YEARS AFTER TREATMENT

Treatment	Size	Stems per acre							
		Shrub[2]	Pine	Poplar	Gum	Maple	Oak Hick.	Other trees[3]	Total
		No.	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Bulldozed[1]	Under 5′	2,062	2,104	521	333	83	167	458	5,728
	Over 5′	458	104	63	21	42	21	354	1,063
	Total	2,520	2,208	584	354	125	188	812	6,791
Disked[1]	Under 5′	687	2,895	188	63	167	63	521	4,584
	Over 5′	479	708	0	104	63	0	417	1,771
	Total	1,166	3,603	188	167	230	63	938	6,355
Check[1]	Under 5′	1,687	646	83	375	1,250	417	1,042	5,500
	Over 5′	1,146	250	21	354	896	63	1,354	4,084
	Total	2,833	896	104	729	2,146	480	2,396	9,584

[1] In addition to the species listed, bulldozed plots had area coverage of 25 per cent grass, 25 per cent forbes, and 33 per cent vines; disked plots had 29, 32, and 29 per cent, respectively; and check had 6, 21, and 31 per cent, respectively.

[2] Shrubs include elderberry (*Sambucus canadensis* L.), farkleberry (*Vaccinium aboreum* Marsh.), and sumac (*Rhus typhina* L.).

[3] Other trees include dogwood (*Cornus florda* L.), sourwood (*Oxydendrum aboreum* D.C.), sassafrass (*Sassafras albidum* Nees.), persimmon (*Diospyros virginiana* L.), etc.

Climatic Factors

The multiple effects of high air and soil temperatures and related moisture deficiency appeared to have an adverse effect on seedling survival. Erratic weather conditions in 1962 may have influenced mortality *(10)*. Precipitation from April through August totaled 18.7 inches, only 3.6 inches less than the area average for this period. However, two extended periods without rainfall occurred during this time, one in May and one after August 6. Both reduced available soil moisture in the top 2 inches of some plots to below the wilting point levels for periods ranging from 5 to 8 days *(8)*, Figure 4. For this study, a wilting point of between 4 and 5 per cent moisture content was assumed *(12)*.

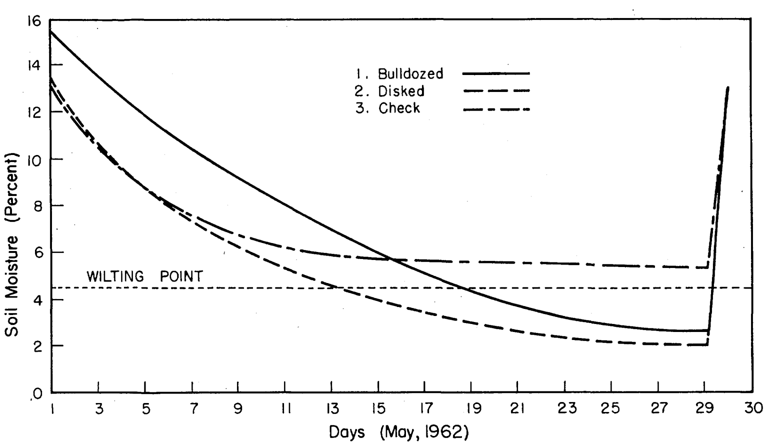

FIGURE 4. Moisture depletion in top 2 inches of soils during 29 days without rain (10, 12).

Areas where vegetation and litter had been removed and soil exposed to high evaporation rates showed a soil moisture depletion in the top 2 inches only to below the indicated wilting point level during both drought periods. Available moisture in the check area, with its protective covering of green and dead vegetation, never reached this point, Figure 4. Wilting point on disked areas, where mortality was the greatest, was reached 5 days before the wilting point on the bulldozed areas.

Air and soil temperatures taken during the first year following establishment varied by treatment. Air temperatures were taken on a covered maximum-minimum thermometer placed 4 inches above the ground. Highs for the year averaged 109.7 degrees on the bulldozed plots, 107.2 degrees on the check plots, and 101.0 degrees on the disked plots, Table 3. A portable soil thermometer was used to record soil temperatures at 2 inches. Soil temperatures reached a maximum high of 105.5 degrees on the disked areas, 101.0 degrees on the bulldozed areas, and 90.0 degrees on the check areas, Table 3. Average highs for the year showed similar trends; 92.8 degrees, 88.8 degrees, and 83.2 degrees, respectively.

TABLE 3. MAXIMUM AIR AND SOIL TEMPERATURES DURING THE 1962 GROWING SEASON[1]

Treatment	Temperatures in Degrees Fahrenheit			
	Air		Soil	
	Avg.	*Max.*	*Avg.*	*Max.*
Bulldozed	109.7	120.0	88.8	101.0
Disked	101.0	120.0	92.8	105.5
Check	107.2	120.0	83.2	90.0

[1] Air temperatures taken at 4 inches above the surface on a maximum-minimum gauge and soil temperatures taken at 2 inches below the surface on a portable soil gauge. All temperatures read about 3 p.m.

Soil temperatures appeared to be directly related to seedling mortality whereas no correlation appeared with air temperatures. Results might have been somewhat different if air temperatures had been taken at the ground level instead of 4 inches above (9). Interaction of the climatic elements and soil conditions seems to be a critical factor affecting mortality.

SUMMARY AND CONCLUSIONS

In northern Alabama, most of the dissemination of yellow poplar seed occurs during October and November. Local topography, seed tree height, wind intensities, and wind direction are major factors affecting the extent and distance of dissemination. Maximum distances of satisfactory seed fall in upland bottoms range downward from 3.5 chains in a windward direction to only 1.5 chains in other directions.

Seedbed scarification aided germination, particularly during the first year following treatment. Seedbed preparation by disking appeared to be the most beneficial to germination, but it was also the method that was the most critically affected by early drought. Beneficial effects of scarification were not as evident the second year after treatment and had nearly disappeared by the fourth year, indicating that establishment should be attained within 2 years after treatment.

The high first-year mortality of new seedlings in the scarified plots appeared to be related to the interacting factors of air temperatures, soil temperatures, and drought-induced soil moisture depletion. After the first year, competition from other vegetation became a factor affecting mortality.

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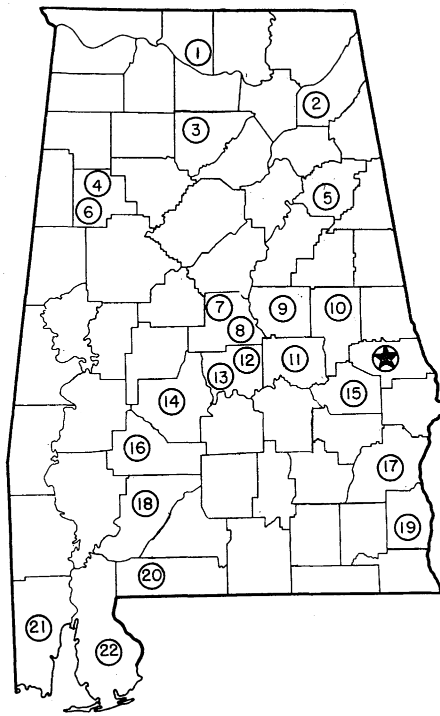

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