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Northeastern Forest Experiment Station
FOREST SERVICE, U.S. DEPT. OF AGRICULTURE, 102 MOTORS AVENUE, UPPER DARBY, PA.

GERMINATION, SURVIVAL, AND FIRST-YEAR GROWTH OF BLACK CHERRY UNDER VARIOUS SEEDBED AND SUPPLEMENTAL TREATMENTS

In Pennsylvania and New York there are 2,350,000 acres of plantable land that could be utilized for growing timber for future needs.[1] Much of this plantable land lies on the Allegheny Plateau — a region that is eminently suited to growing black cherry (*Prunus serotina* Ehrh.). On the Allegheny National Forest alone, 26,000 acres are classed as plantable. Besides this, the even-aged management program recently adopted on the Forest calls for clearcutting about 3,000 acres each year. Although these cut areas are expected to regenerate naturally for the most part, some of the acreage very likely will require artificial restocking.

Because black cherry is the most valuable timber tree on the Allegheny Plateau, methods for establishing this species on the plantable lands and on the clearcuttings hold particular interest. However, the planting of hardwood species has not generally been successful anywhere in the Northeast. Direct seeding of hardwoods has not been tried extensively; a few trials in the past with black cherry on the National Forest were not successful. Nevertheless, we need a reliable method for regenerating black cherry artificially; and, in terms of probable costs and general feasibility, direct seeding offers considerable promise. So a study was undertaken to determine some of the effects of seedbed and certain supplemental treatments on black cherry germination and first-year growth on an open, grassy site.

[1]United States Forest Service. TIMBER RESOURCES FOR AMERICA'S FUTURE. U. S. Forest Serv. Forest Resources Rpt. 14, 713 pp., 1958.

The Study

The study site was an old field on the Irvine Demonstration Forest near Warren, Pennsylvania. A rank cover of mixed grasses, goldenrod, and other forbs was present. The soil is a moderately well to somewhat poorly drained silt loam. The site is similar to much of the open land on the Allegheny Plateau.

Ripe seed for the study was collected September 17, 1961. It was cleaned by mashing the fruits in a potato ricer under running water. The cleaned seed was then spread to air-dry until October 5. At that time, part of the seed was sown in the fall seeding phase of the study. Another portion of the same batch of seed was stratified in sand out of doors over winter for use in the spring seeding phase. This seeding was done on April 18, 1962.

The study involved 20 treatment combinations. These were applied in a randomized block design consisting of 4 blocks of 20 plots each for each sowing season. The plots were 3 by 3 feet, and were contiguous within blocks.

The 20 treatments were combinations of 5 methods of seedbed preparation and 4 supplemental treatments. The seedbed preparations were:

1. No treatment.
2. Scarified—surface litter mixed with soil.
3. Spaded—surface litter turned under.
4. Scalped—plants and surface litter removed.
5. Burned—surface litter consumed by fire; ashes left in place.

Each plot was sown with 25 seeds at 6-by-6-inch spacing. A template was used to facilitate even spacing. Seeds were embedded flush with the soil surface on all seedbeds except the spaded ones; there they were placed about 1/4 inch deep.

The supplemental treatments were:

1. No treatment.
2. Vegetation clipped twice during the growing season at seedling height, to simulate machine mowing.
3. Fertilized with slow-acting magnesium ammonium phosphate of 8-40-0 analysis at the rate of 1 ounce per plot. In the fall seeding, the fertilizer was simply dropped through the holes of the template after the seed had been sown. In the spring seeding, the appropriate amount of fertilizer was placed in a hole punched about 3 inches deep at each seed spot before sowing.
4. Fertilized and clipped—combination of treatments 2 and 3 above.

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The supplemental treatments were:

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Fertilized and clipped—combination of treatments 2 and 3 above.

Observations of total germination were made once each week during June and the first 2 weeks of July. Thereafter, germination was checked once every 4 weeks until leaf fall in October. The height of the tallest seedling on each plot was measured to the nearest 1/10 inch in October.

Analysis of variance was used to test differences in germination and first-year height growth. The arcsin transformation was used on germination percentages. The figures for the tallest seedling on each plot were used in the analysis of height growth. Orthogonal comparisons were made for both germination and height data. Because season of sowing was not randomized in the layout of plots, it could not be tested statistically.

Results

Germination. — Germination on all prepared seedbeds averaged 22 percent in the fall seeding and 17 percent in the spring seeding, or about 20 percent for both seasons combined. On the untreated beds, the figures for fall and spring seeding were 3.5 and 3.0 percent respectively (table 1). In the statistical analyses for each season, the four seedbed preparations combined were significantly (1-percent level) better than no preparation in both instances. There were no significant differences among the four preparation methods.

Height growth. — First-year height growth was relatively poor under all treatments, and the differences when reduced to averages were not striking (table 1). Because the table values are based upon the one

Table 1.—Average germination and first-year height growth, by treatment groups

Treatment	Fall sowing		Spring sowing	
	Germination	Height	Germination	Height
	Percent	*Inches*	*Percent*	*Inches*
Seedbed preparation:				
None	3.5	2.3	3.0	2.2
Scarified	21.0	2.4	17.7	2.3
Spaded	20.0	4.0	18.5	3.2
Scalped	25.0	3.3	16.2	2.4
Burned	21.2	2.5	16.5	2.3
Supplemental treatments:				
None	—	2.3	—	2.0
Clipped	—	2.2	—	2.0
Fertilized	—	4.4	—	2.9
Clipped and fertilized	—	3.3	—	3.3

tallest seedling in each plot, mean heights for all seedlings would have been even less than those values.

Analyses of the height data showed some significant differences among treatments in both the fall and spring seedings. All differences mentioned below were significant at the 1-percent level except where noted otherwise:

1. Growth was better on spaded plots than on scarified plots. Mean heights were 4.0 inches and 2.4 inches respectively on the fall plots, 3.2 inches and 2.3 inches on the spring plots (the latter difference was significant only at the 5-percent level).
2. Growth was better on fertilized spaded plots than on spaded plots with no fertilizer. Mean heights were 5.9 inches and 2.4 inches respectively on the fall plots, 4.6 inches and 2.2 inches on the spring plots. No growth response to fertilizer was evident on the other seedbeds.
3. Growth was better in the spring seeding on plots that were spaded, fertilized, and clipped than on similar plots that were not clipped. Mean heights were 6.2 inches and 3.0 inches respectively. Clipping showed no significant effect on the fall-sown spaded and fertilized plots, nor on plots in any other treatment combination in either season.

Seedling survival. — The numbers of seedlings present after one and two growing seasons depended mostly upon the number that germinated. Some mortality of course occurred, but it was rather evenly distributed among treatments. Well over half of the original seedlings still survived after 2 years (table 2).

The spaded seedbeds showed a tendency toward lower survivals than seedbeds treated otherwise; and the number of seeds germinated revealed a similar pattern (table 2). Except for the check plots, survivals were highest on the scalped seedbeds and lowest on the spaded ones. At the end of the second summer, 78 and 73 percent of the seedlings were still living on scalped beds in the spring and fall seedings, respectively, compared to 51 and 52 percent on the spaded beds.

Discussion

The poor seedling establishment on the study plots is believed to be due to a combination of seed losses to rodents and poor germination caused by not covering the seed enough to prevent drying. A few seeds that became so dry that they returned to dormancy were missed by the rodents and then germinated the second spring. Other seedings and

Table 2.—Percentage of germination and survival, based on number of seeds sown, by seedbed treatments and season for each sowing

Treatment	Germination		Survival			
	Spring sowing	Fall sowing	Spring sowing		Fall sowing	
			1st season	2nd season	1st season	2nd season
None	3.0	3.5	2.0	2.0	3.0	1.2
Scarify	17.7	21.0	13.5	11.0	16.5	12.2
Spade	18.5	20.0	11.0	9.5	14.0	10.5
Scalp	16.2	25.0	13.5	12.5	22.5	18.2
Burn	16.5	21.2	11.5	6.8	18.8	16.0
All plots	14.4	18.2	10.3	8.4	15.0	11.6

sand-flat tests with portions of the same batch of seed demonstrated that the seed was good: germinations as high as 73 percent were obtained.

The poorer germination in the untreated plots, as compared to all treated plots, is believed to have been due mainly to drying of the seed. Even though the seeds were pressed into contact with the litter or living plant crowns on the soil surface, this loose material probably allowed the seeds to dry excessively.

Height growth of the seedlings obviously was poor. Competition from the grass and associated broadleaf plants undoubtedly was an important limiting factor. This effect of competition was strikingly demonstrated on some extra seedbeds that were hand-weeded throughout the growing season. These beds, which adjoined the study plots and were seeded at the same time, produced cherry seedlings up to 32 inches tall the first summer without fertilizing or any other treatment.

The response of black cherry to weeding was similar to that reported for hybrid poplars by Schreiner.[2] He found hybrid poplars to be particularly susceptible to the inhibiting effect of grass and other weeds: trees could not be successfully established on old fields without eliminating the sod and weeding for at least 1 year. Experimental evidence indicated that the inhibiting effect of grass on hybrid poplars involves something more than mere competition for moisture and nutrients.

[2]Schreiner, Ernst J. VARIATION BETWEEN TWO HYBRID POPLARS IN SUSCEPTIBILITY TO THE INHIBITING EFFECT OF GRASS AND WEEDS. Jour. Forestry 43: 669-672, 1945.

The herbaceous species on our study plots recovered quickly in all treatments. The first-year recovery was somewhat less on the scalped plots where roots, stolons, and seeds in the surface layer of soil were physically removed, but it was not enough less to noticeably affect growth of the cherry seedlings. The clipping and fertilizing treatments definitely did not provide the essential conditions for good seedling growth.

It appears that drastic reduction and continued suppression of the herbaceous competition for at least 1 year—and perhaps longer—are required. Repeated cultivation is one proven way of accomplishing this. However, the necessary weed control might also be achieved with herbicides; and this possibility is being explored in current studies.

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