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SURVIVAL AND GROWTH OF YELLOW-POPLAR SEEDLINGS DEPEND ON DATE OF GERMINATION[1]

Abstract. A study of yellow-poplar seedlings showed that early survival and growth were best among stems that originated in May and early June. Few, if any, seedlings that emerged after 1 July were in favorable competitive condition 3 years later. This indicates that clearcuttings made for maximum natural regeneration of yellow-poplar should be carried out in fall and winter to permit early germination in the spring.

On good sites in the Appalachians, vegetation develops rapidly after clearcutting. After a year or two, the ground is so occupied that there is little space for additional seedlings to develop. Tree seedlings that do not get an early start have reduced chances of survival. This situation may be especially important in the case of yellow-poplar (*Liriodendron tulipifera* L.). Yellow-poplar seed germinates from spring to early fall,[2] but small seedlings do not appear to survive well after the first growing season.[3] Yellow-poplar is intolerant and does not develop well unless it gets a jump on the competition.

To determine whether or not time of germination affects initial development and early survival of yellow-poplar seedlings, a 3-year study was carried out on the Fernow Experimental Forest near Parsons, West Virginia. The study was begun early in the spring of 1966 in a number of openings that had been made the previous fall in a 65-year-old stand.

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[1] Published with the approval of the West Virginia University Agricultural Experiment Station as Scientific Paper No. 1055.

[2] Tryon, E. H., and K. L. Carvell. ENVIRONMENTAL FACTORS AFFECTING YELLOW-POPLAR SURVIVAL UNDER A YOUNG STAND. Castanea 25: 69-73, illus., 1960.

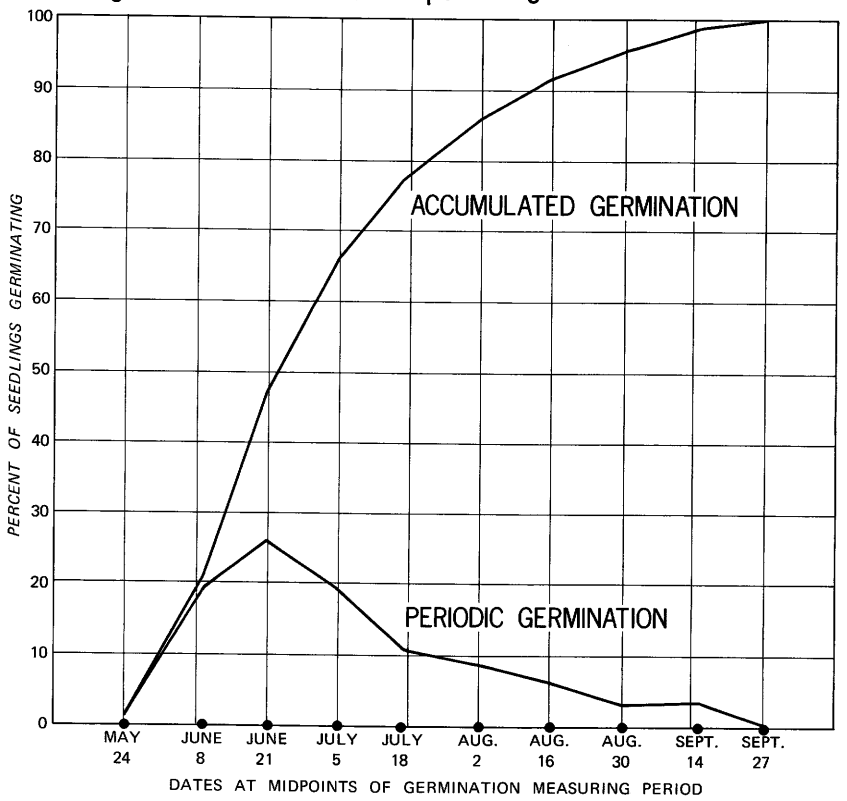
[3] Phillips, J. J. SOME EFFECTS OF COMPETITION ON THE SURVIVAL OF YELLOW-POPLAR. USDA Forest Serv. NE. Forest Exp. Sta. Res. Note 134, 4 pp., 1962.

The study area has an annual rainfall of 55 to 60 inches and an annual temperature of 48 to 50° F. Site quality is excellent: site index for yellow-poplar is 90 to 100 feet.

In the center of each of five of the openings, a 4-milacre plot was laid out. Light measurements were made in each plot in the first and second growing seasons. Light intensities were averages of readings taken throughout the day. Readings in the three sunniest plots averaged 45 percent sunlight; in the two most shaded plots, they averaged 25 percent.

Seedling tallies and height measurements were made of yellow-poplar stems at 2-week intervals from May to mid-October during the first growing season following logging. At each measurement new seedlings were identified by a small wire stake stuck into the ground nearby; different colored wires were used for each measurement period. During the second and third growing seasons, only spring and fall tallies were taken. The study was terminated in October 1968.

Figure 1.—Accumulated and periodic germination curves.



Results

Germination. — Germination started about 24 May and was completed by 21 September—a 4-month span. Some variation in starting dates existed between plots; germination began 1 to 2 weeks earlier on the three sunniest plots than it did on the two shadiest ones. The peak of germination came about 21 June (fig. 1) by which date about 50 percent of germination had taken place. Sixty percent of the seedlings had appeared by 1 July and 85 percent by 1 August. In all, 35 yellow-poplar seeds germinated per milacre the first season. This represents a rate of 35,000 per acre. More seedlings appeared on the shady plots than on the sunny plots. A few seedlings came up the second year, but none of them survived. We observed no germination the third year.

Survival. — In all, 40 percent of the seedlings that germinated the first year survived to the end of the third growing season. A higher proportion —49 percent—survived on the three sunnier plots. On the shady plots, only 33 percent survived. Mortality varied by seasons on all plots (fig. 2). It was heaviest during the growing seasons; 34 percent the third summer

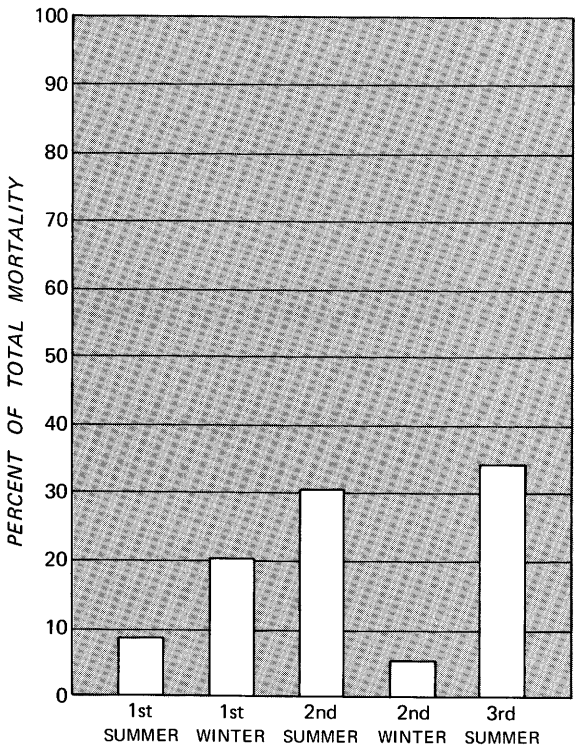


Figure 2.—Seedling mortality, by seasons.

and 30 percent the second. Mortality was 20 percent the first winter and 6 percent the second.

Seedlings from early-germinating seeds survived better than seedlings originating late in the season (fig. 3). At the end of the third growing season, between 65 and 70 percent of the seedlings that appeared in May of the first year after winter cutting, were still alive; between 40 and 45 percent of those that had come up during the last half of June survived; while less than 20 percent of those appearing after 1 August survived.

Summer mortality appeared to result largely from competition, plus some killing the first growing season by damping-off. Winter mortality was due mostly to unidentified causes, but some specific instances of frost heaving and smothering by litter were noted.

Height growth. — Height growth on the three sunniest plots appeared to approach height growth in large clearcuttings; but after the first

Figure 3.—Survival after 3 years, by germination.

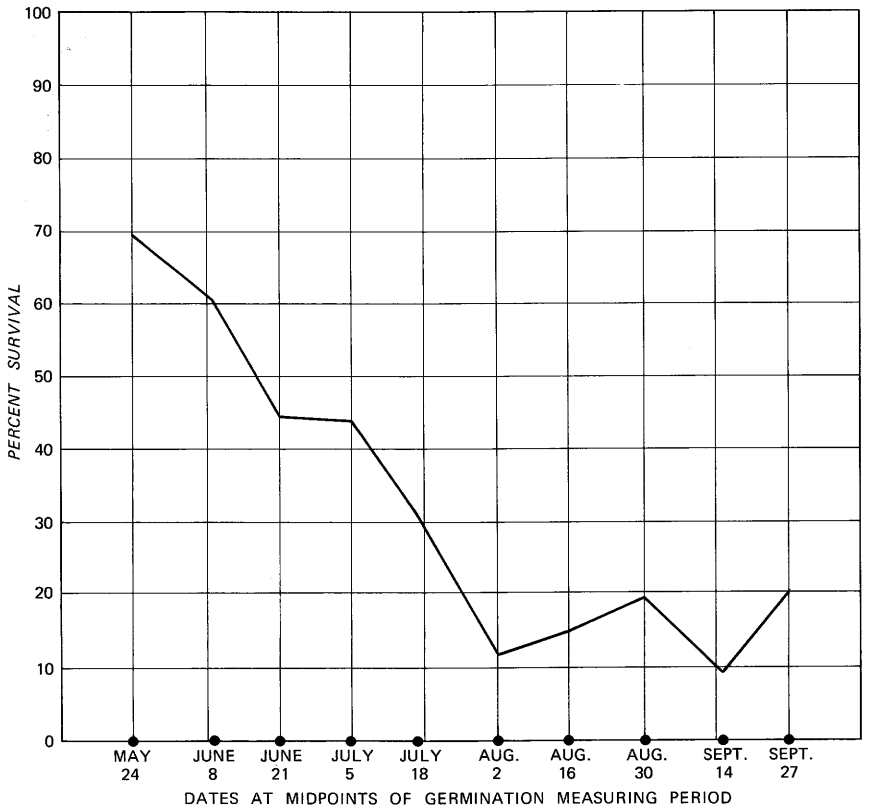
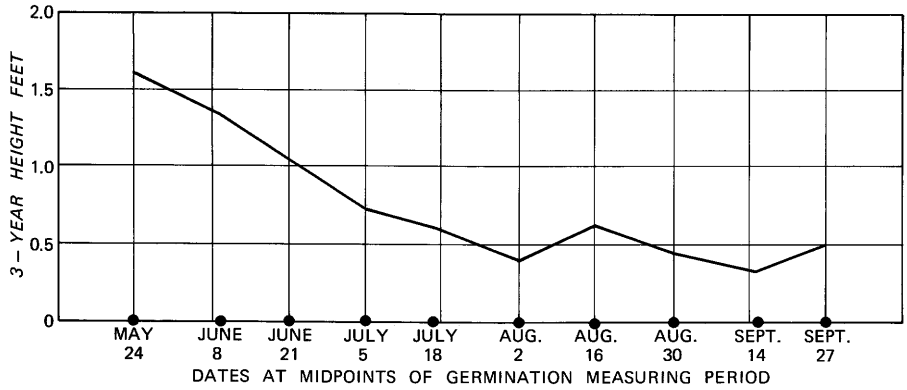


Figure 4.—Average 3-year height of seedlings by germination period.



year, height growth on the two shadiest plots definitely showed the effect of shading. However, on all plots, 3-year height of seedlings was strongly related to the date they originated (fig. 4). At the end of the third growing season, surviving seedlings that resulted from seed germinating the first week in June were 70 to 75 percent taller than those that came up the last week in June, and they were 210 percent taller than those that originated the last week in July.

At the 3-year measurement, utilizing only the three sunny plots, we estimated that those seedlings that were over 2.0 feet tall were in a good competitive position and would have a chance to survive to maturity. Fifty-six percent of those that came up during May were in this class (417 per acre) while only 14 percent of the stems originating in June were over 2.0 feet tall (1,833 per acre). None of those that appeared after 1 July had attained this height.

Summary and Discussion

The results of this study indicate that survival and height growth of yellow-poplar seedlings, in competition with other vegetation that develops simultaneously in newly clearcut areas, are dependent on time of germination. A high proportion of those seedlings that appeared before mid-June competed well with the flush of new vegetation. Most seedlings that came up after 1 July lost out in the race for growing space.

The practical implication of these findings is that the old stand should be logged between the end of the growing season (preferably after yellow-poplar seeds ripen) and 1 May of the following year to favor yellow-poplar reproduction. This would promote maximum germination and

some development of yellow-poplar seedlings early in the growing season before strong competition from other plants develops. Logging in the spring and early summer results in late summer seedlings, which do not survive well, and competing vegetation is able to get a head start on seedlings originating the following year.

This restriction on time of logging becomes less important in areas where the yellow-poplar seed source is extremely plentiful and where site conditions are ideal for this species. However, where the situation is not so favorable for yellow-poplar, control of time of logging might provide the needed advantage.

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