Gibberellin affects rooting of hybrid poplar clone NE-277

by
R. D. Shipman
Associate Professor of Forest Ecology The Pennsylvania State University Park, Pa.

Gibberellic acid, when applied at optimum concentrations, appears promising for improving root development on hardwood cuttings of known parentage, as shown in the following exploratory investigation, with in-creased demand for quality hardwoods by the wood-using industries, the need for hardwood planting stock will also increase; consequently, nurserymen and forest landowners may reasonably make a greater use of vegetative cuttings in their reforestation programs. It is apparent that more precise information on the feasibility of using growth-promoting substances is needed, particularly w ill regard to concentration and application method when applied to cuttings, seed, or seedlings.

Since 1950, considerable research has been conducted in the United States with gibberellic acid, the natural product of an Asian fungus Gibberella fujikuroi. In 1926, Eiiehi Kurosawa filtered the mold off Gibberella solution. applied it to plants, and obtained the typical stem elongation. Pure crystals were initially extracted but were found to he fursarie acid (a substance highly toxic to plants) instead of gihberellic acid, a growth stimulant.

investigations on the use of gibberellic acid have indicated an improvement as well as inhibitory effects on the growth of various tree species. Leak (3) was unable to find a favorable growth response on 1-month-old yellow birch seedlings using 100 parts per million (ppm.) gibberellic acid. Bilan and Kemp (1) treated 1-year-old seedlings of loblolly pine with 1, 2 arid 3 percent aqueous solutions of gibberellin. They found a favorable height growth increase, proportionate to the higher concentration of gibberellin in the solution. In a review of literature on the effect of gibberellic acid. Welting (6) concluded that its effect on conifers is generally negative. Nelson (4) was able to significantly increase the height growth of cuttings of American sycamore and eastern cottonwood: on the other hand. the same treatment exerted a negative influence on the growth of white pine and Arizona cypress.

Methods

Sixty cuttings (ramets) were obtained from the tipper half of the crown of a 3-year-old hybrid poplar NE-222 (Populus deltoides x P. nigra cv. Caudina). At the time of collection, this sample tree measured 3.1 inches in diameter and 24.6 feet in height. On March 23, 1960, 36 cuttings were random Is chosen from the parent population cool then measured for stem diameter and total length. The average stem and length measurements were 4.9 millimeters and 19.3 inches, respectively. A preliminary analysis indicated homogeneity of variance among the sample cuttings for these two parameters.

Gibberellic acid, in aqueous solution, was applied with a camel's hair brush to each of six randomly selected cuttings at concentrations of 25, 50, 100, 250. and 2,500 ppm. The remaining six ramets were not treated (controls). On duplicate cuttings for each of the above concentrations, gibberellic acid was applied to (1) top and basal 3 inches, (2) basal 3 inches only, and (3) top 3 inches only. Applications of the acid solution were made only once, at the beginning of the test. After treatment, the cuttings were inserted in sand-filled pots to a depth of 6 inches and placed in a greenhouse. All putted cuttings received the same amount of water during the course of the experiment. At monthly intervals, the puts were rearranged on the greenhouse bench to minimize any effects due to position.

Five months after planting, the treated cuttings and controls were washed free of the sand medium, and examined for root development. The data were analyzed in a completely I randomized design Its the analysis of variance and by Duncan's Multiple Range Test, employing ovendry weight of roots as the response parameter (2).

Results and Discussion

Statistical analysis after a 5-month period indicated significant differences (.05 level) among the six gibberellic acid concentrations with respect to weight of roots developed. The greatest amount of root mass (by weight) occurred at the 50 and 250 pint, concentrations, but only the 51) ppm. rate was significantly better than the untreated controls. These results, although nut conclusive, confirm the work of others that optimum root development with gibberellic acid lies in a rather narrow- range of concentration. Although this growth regulator improved rooting when applied to a single hybrid• differences in root development may reflect inherent auxin concentrations within the individual ramets at time of treatment. There is a suggestion from these results that the relationship between sorting and concentration level applied may be curvilinear. For example, concentrations of 0 and 2,500 ppm. were apparently too low and too high, respectively, and optimum levels occur somewhere between 50 and 250 ppm. The average weight of roots based upon oven-dry measurement of the six concentrations tested is given in Table 1. The failure of the 100 ppm. level to fall on the optimum concentration curve remains unexplainable in this experiment. A study by Polscer (5) showed deleterious effects from the use of a 100 ppm. foliar spray of gibberellic acid on Norway spruce. On yellow poplar, however. growth was increased using the 10 ppm. and 100 ppm. foliar sprays.

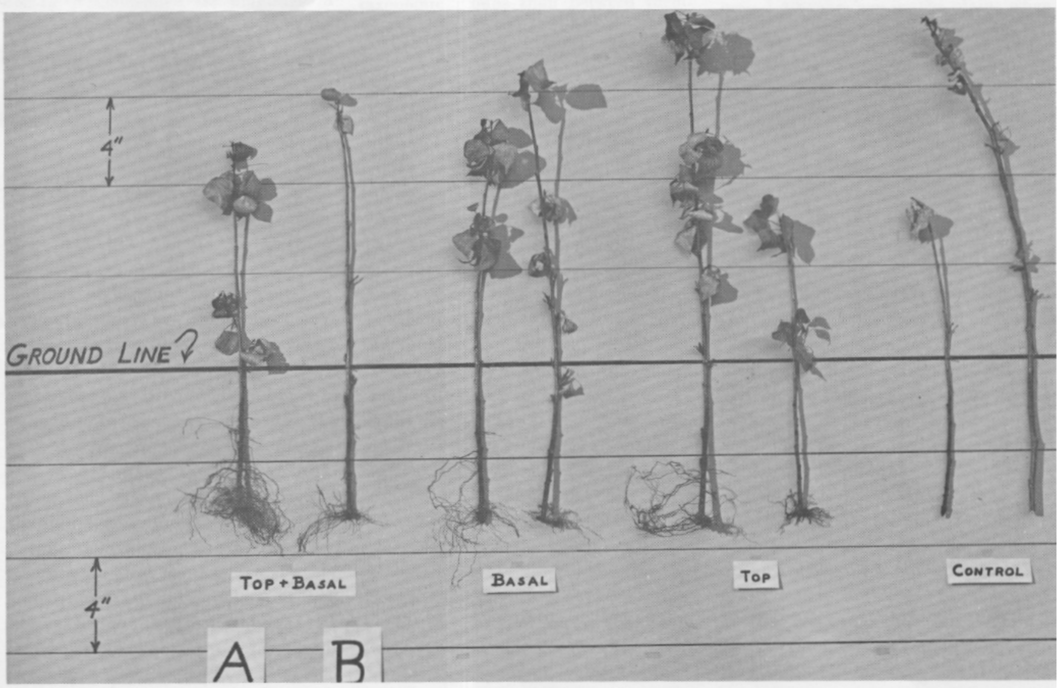
Although the analysis of root development among the three positions of application was non-significant, all of these treatments were significantly better than the untreated controls. As shown in Figure 1 and Table 1, by combining the "best" concentrations of 50

TABLE 1.—*Ovendry root weights developed on cuttings of hybrid poplar NE-222 treated with gibberellic acid.*

Concentration	Stem Treatment: Top and basal 3 inches	Basal 3 inches	Top 3 inches	Sum root wts. by concentration[1]
(ppm.)	g.	g.	g.	g.
0 (controls)	.03	.01	.00	.09 (control)
	.05	.00	.00	
25	.00	.05	.04	.16
	.03	.04	.00	
50	.06	.04	.00	.26*
	.06	.05	.05	
100	.03	.00	.02	.14
	.02	.03	.04	
250	.06	.02	.05	.22**
	.03	.04	.02	
2500	.00	.00	.00	.04
	.00	.00	.05	
Sum root wts. by treatment (excluding controls)	.29	.27	.26	—

[1]Single asterisk indicates a significant difference from the control and 2,500 ppm. rates at the 5 percent level. Double asterisk indicates a significant difference from the 2,500 ppm. rate at the 5 percent level.

Figure 1.—Representative cuttings of hybird poplar clone NE-222 *(Populus deltoides* x *P. nigra cv. Caudina)* showing rooting effects of gibberellic acid treatment A) 50 ppm. B) 250 ppm.



and 250 ppm., the greatest amount of roots was developed on cuttings treated top and basally (.21g). Following in descending order were basal only (.15g), top only (.12g.) and least with untreated controls (.09g.).

Literature Cited

1. Bilan, M.V. and A.K. Kemp. 1960. Effect of gibberellin on height growth of one-year old seedlings of Loblolly pine. Forestry 58:35-37.

2. Duncan, D.B. 1955. Multiple range and multiple F tests. Biometrics, 11:1-42.

3. Leak, W.B. 1960. Gibberellin reduces root growth of yellow birch seedlings. J. Forestry 58:321.

4. Nelson, T.C. 1957. Early responses of some southern tree species to gibberellic acid. J. Forestry 55:518-520.

5. Polscer, K.F. 1960. The effects of gibberellic acid on three eastern forest tree species. Unpublished. M.S. Thesis in Forestry, 63 pp. The Pennsylvania State University.

6. Westing, A.H. 1959. Effect of gibberellin on conifers: generally negative. J. Forestry 57: 120-122.

Undercutting depth may affect root-regeneration of lodgepole pine seedlings

G. F. Dykstra
Research Forester

British Columbia Forest Service
Victoria, B.C.

Toppling and taproot malformation of transplanted lodgepole pine has been observed in research and production plantations in British Columbia. Tree toppling is a term used to define instability in young stands; trees are not completely windthrown but lean at carious angles and continue to grow. lodgepole pine may form a basal sweep or sabre form which is apparently interrelated with toppling and windfall. Racal sweep and toppling tray he caused by the lack of development and growth of a dominant taproot after the primary taproot has been severed, such as in root pruning, undercuttings and lifting. The study discussed in this article may help determine the extent of pseudo taproot regeneration and show- the growth and development of the root system in relation to the common nursery practice of undercutting.

The objective of this study was to determine the distribution of dry matter in relation to depth of undercutting.

Methods

The lodgepole pine was grown from seeds planted in 4-inch diameter perforated, polyethylene tubes. The potting mixture was a 4:2:1 parts by volume ratio of loam, Kind, and peat respectively. The tubes were 2 feet long and supported by a wooden framework. The undercutting treatment was made 6 weeks after germination while the trees were making active shoot growth. Cutting depths were at 3, 6, and 12 inches below the root collar. The seedlings were then allowed to grow for 2 months. At harvest, the length of taproot was measured. The root system was then cut into 3-in eh sections starting at the root collar, aril the oven dry weight of the sections was determined.

Results and Discussion

At harvest there were no significant differences in total root weight, shoot weight, or shoot-root ratio among undercutting depths. However, there were significant differences after undercutting in taproot growth (figs. 1 and *2)* and the 3-inch depth grew most in length and dry weight subsequent to

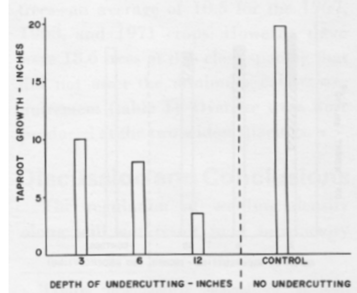


Figure 1.—Taproot length growth of lodgepole pine seedlings in relation to depth of under-cutting.