SUCCESSFUL GRAFTING OF YELLOW-POPLAR...

a matter of timing

RICHARD M. EVANS and EYVIND THOR1
Department of Forestry
University of Tennessee

The University of Tennessee has been involved in a yellow-poplar improvement program since 1960. The State Division of Forestry joined this program in 1967. Through the joint efforts of both organizations, six grafted seed orchards have been established in Tennessee. During establishment, differences were noted in grafting success among grafting dates. Data analysis revealed that grafts made later in the spring usually had better survival rates.

Procedure

Scion wood used for grafting was collected from the University of Tennessee's selected yellow-poplar (Liriodendron tulipifera L.) clones from early January to late February. During the early years of grafting, scion wood was obtained from the original selected trees, but in the later years some was available in the University's grafted breeding orchards. Scion wood was obtained from vigorous growing branches of the upper tree crown.

All scion wood was labeled and put in plastic bags at time of collection. A small amount of damp sphagnum moss was placed in each bag prior to cold storage at 40 degrees F. Grafting was done on 1-1 or 1-2 yellow-poplar transplants in the nursery at Knoxville.

All grafts were side grafts, and care was taken to insure matching of scion and understock cambiums. Grafts were placed on vigorous branches or high on the main stem, depending upon scion fit. All grafts were wrapped with rubber grafting bands and thoroughly coated with melted grafting wax.

Yellow-poplar was grafted during March and April of 1964, 1965, 1966, 1969, and 1970. The smallest number of grafts for any one date was 120 and the maximum was 347. Surviving grafts were recorded at the end of the growing season.

A regression analysis was used to determine the relationship between percent survival and degree days. Degree days (D.D.) was arbitrarily determined as the sum of each day's maximum temperature in degrees F., minus 40 degrees F., from March 1 till the date of grafting. The average 'daily high temperatures were obtained from the United States 'Weather Bureau's "Climatological Bulletins," for the University of Tennessee's weather station located 5 miles from the nursery.

Results and Discussion

Table 1 gives the D.D. value for each date of grafting and number of times grafts experienced temperatures less than 32 degrees F. Degree days were used as an indirect measure of physiological activity and hence grafting success. However, from past experience, the number of days with frost was also expected to be related to graft mortality.

Table 1.—Degree days, days with temperature less than 32° F., and percent survival for each grafting date.

Date	*Degree days*	*Days grafts experienced temp.<32° F.*	*Percent survival*
March 6, 1964	108	3	10.5
March 13, 1964	265	2	31.8
March 18, 1964	381	2	19.7
April 10, 1964	856	0	52.3
April 7, 1965	670	0	48.0
March 22, 1966	552	1	23.3
March 29, 1966	646	0	31.6
April 4, 1969	661	0	32.6
April 15, 1969	955	0	22.9
April 15, 1970	1044	0	60.9
April 22, 1970	1268	0	42.1

Figure 1.

1 Assistant in Forestry and associate professor, respectively.

A regression and correlation analysis between D.D. and percent survival was made. In the linear regression equation,

$$Y = 14.62 + .029X$$

Y is percent survival and X is D.D. The regression coefficient (.029) was significantly greater than zero (.05 probability level).

The correlation coefficient (r), the measure of the degree of association between D. D. and percent survival, was .659. The coefficient of determination (r^2) indicated that 43 percent of the variation in graft survival is associated with the variation in D.D. The t-test for the correlation coefficient indicated significance at the .05 probability level.

The results of this analysis indicate that in March and April the greater the number of D.D. prior to grafting, the greater the graft survival. This relation is shown by the regression line in Figure 1. Since D.D. gives an indication of the understock's physiological activity, it (is possible) that greater understock physiological activity increases the chance of graft survival. Percent survival may tend to decrease with an increase in D.D. much over 1,300. However, no measurements in this range were obtained.,

An explanation of the relationship of D.D. to graft survival may lie in the essentiality of callus tissue for graft union. Sussex and Clutter (1959) stated that in spring just before "bud break," callus proliferation, essential for successful graft union, occurs most readily and diminishes through summer and into the winter.

The effect of timing in grafting success has been discussed in the literature. Jett and Thor (1969) grafted dormant yellow-poplar scions to both dormant and non-dormant rootstock, reporting over 30 percent survival of grafts made on non-dormant rootstock compared to 12 percent on dormant rootstock. Churchwell (1965) field-grafted dormant yellow-poplar scions in March and April. He reported that only 5 percent of the early grafts (March 24) made successful unions, as compared with 85 percent of the later grafts. There was little difference in survival among the April grafting dates. Thor (1965) obtained best results by field grafting yellow-poplar during early April using dormant scion wood.

Dates with low grafting success were accompanied by below-freezing temperatures (Table 1). In the case where grafts experienced freezing temperatures on three occasions, graft survival was 10.5 percent. Where grafts experienced 1 or 2 days of freezing temperatures, graft survival averaged 24.9 percent while it averaged 41.5 percent when they never were exposed to temperatures below freezing.

The exact relation of the number of freezing days to graft survival is difficult to define. There are two possible explanations: (1) Late freeze may kill the scion or (2) the number of freezing days are negatively related to physiological activity of understock and scion. Two similar grafting dates, April 15, 1969 (955 D.D.), and April 15, 1970 (1044 D.D.) experienced no freezing temperatures, yet showed different rates of survival, indicating that other factors besides freezing temperatures influence graft survival.

Literature Cited

Churchwell, N. R.
1965. The vegetative stage of stock and scion are important factors when field grafting yellow-poplar. Tree Planters' Notes No. 70 pp. 27-29.

Jett, J. B. and E. Thor.
1969. Formation of graft unions in yellow-poplar. Tenn. Farm and Home Sci. Prog. Rpt. No. 70. pp. 7-11.

Susses, I. M. and M. E. Clutter.
1959. Seasonal growth periodicity of tissue explants from woody perennial plants, *in vitro*. Science 129:836-837.

Thor. E.
1965. Improvement pf yellow-poplar. Proc. 8th So. Conf. For. Tree Impro. pp. 38-45.