EFFECT OF GRAFT TYPE ON 6-MONTH SCION SURVIVAL OF FIELD GROWN DOUGLAS-FIR GRAFTS

by

Donald Copes, Plant Geneticist

ABSTRACT

A study on field survival after 6 months of top-cleft, splice, and side grafts revealed that graft type and technique were not significant sources of variation when 80 mm. or more of cambial contact connected the stock and scion.

Thousands of grafts are made each year to establish and maintain Douglas-fir seed orchards. A number of different graft types are used. Each orchardist soon adopts or devises the graft type that he assumes to be the best, easiest, or quickest to make. If use of one graft type can be shown to consistently result in higher 1st-year survival, considerable dollar savings can be made each year. It has been previously reported that 1st-year graft survival in Douglas-fir grafts was closely correlated with length of cambial tissues shared between the stock and scion. Length of cambial tissue varied between graft types, so role of graft type on 1st-year survival could not be assessed. The following report presents results of a subsequent experiment designed to investigate graft type influence on early survival.

METHODS

Grafting technique, location, and age of rootstock, graft position on the stock, and time of year of grafting were the same as described for the 1966 grafts (see footnote 1). These details are not considered to have enough influence on the outcome of the study to warrant repetition. Each graft type was cut with 40 and 80 mm. of cambial contact, whereas cambial contact in the 1966 study varied between graft types from 23 to 256 mm. In addition, only three types--top-cleft, side, and splice (fig. 1)--were made, rather than seven types.

Figure 1. -- Stock and scions prepared for the top-cleft, splice, and side graft types.
Poor grafting technique (mismatched treatment) was simulated by matching only one longitudinal surface of the scion with one cambial surface of the rootstock. Each mismatched graft had all of its 40 or 80 mm. of cambial contact on the one matched surface. Good grafting technique (matched treatment) was simulated by matching both longitudinal cambial surfaces of the scion with the two cut surfaces of the rootstock. Forty- and 80-mm. matched grafts had 20 and 40 mm., respectively, of cambial contact on each side.

In 1967, 20 grafts of each graft type—top-cleft, side, and splice—were cut with 80 mm. of cambial contact. Within each graft type, 10 grafts had two matched cambial surfaces and 10 had only one matched cambial surface. In 1968, 40 grafts of each graft type were cut to 80 mm. of contact and another 40 grafts of each type were cut to 40 mm. of contact. Within each combination of graft type and cambial contact length, 20 grafts were made with the matched cambiums and 20 with the mismatched cambiums. We recorded 6-month survival in mid-September after all growth had ceased.

RESULTS

Survival for each graft type and length of cambial contact are given in table 1. Survival of the 80-mm. grafts of all three types was 97 percent in 1967 and 1968, but survival of the 40-mm. grafts in 1968 was 82 percent. This difference between the 40- and 80-mm. grafts was significant at the 0.05 level. A significant difference between matched and mismatched cambial aligned grafts was not found in the 80-mm. grafts, but the difference between matched and mismatched 40-mm. grafts was significant at the 0.05 level. The 40-mm. mismatched grafts had a survival value of 92 percent, but 40-mm. matched grafts had 73-percent survival, an unexpected result to be subsequently discussed.

At 80 mm. of cambial contact, graft type did not significantly influence survival in 1967 or 1968. Greater variation due to graft type was exhibited at 40 mm. than at 80 mm. Matched splice grafts averaged only 65 percent, but matched side and cleft grafts had survivals of 75 and 80 percent, respectively. Within all three graft types, the 80-mm. grafts survived better than 40-mm. grafts (table 1).

DISCUSSION

Graft type had greater influence on survival when cambial contact was limiting (40 mm.) than in 80-mm. grafts in which all three graft types had high survival. In matched grafts at 40 mm., cleft grafts had 15-percent-higher survival than splice grafts. The cause of this variation is not known, but improper alignment of the cambial edges is probably more critical at short cambial lengths. As is apparent in
Table 1.—Survival percent 6 months after grafting by graft type, and length and alignment of stock-scion cambial contact, 1967 and 1968 grafts

<table>
<thead>
<tr>
<th>Graft type</th>
<th>1968 grafts</th>
<th>1967 grafts, 80-mm. length</th>
<th>Graft type means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40-mm. length</td>
<td>80-mm. length</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mismatched</td>
<td>Matched</td>
<td>Mismatched</td>
</tr>
<tr>
<td>Cleft</td>
<td>1/95</td>
<td>1/80</td>
<td>1/100</td>
</tr>
<tr>
<td>Side</td>
<td>95</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Splice</td>
<td>85</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>Mean</td>
<td>92</td>
<td>73</td>
<td>98</td>
</tr>
</tbody>
</table>

1/ Percentages based on 20 graft samples.

2/ Percentages based on 10 graft samples.
figure 1, the two straight cambial zones of the cleft graft may be
easier to match exactly than the curved zones of the splice and side
grafts. Lack of a perfect stock-scion fit within the matched and
mismatched grafts would reduce the length of cambial contact to less
than 40 mm. and may have a greater effect on survival than a similar
reduction in an 80 mm. graft.

Higher survival of the 80-mm. than the 40-mm. grafts was as ex­
pected (see footnote 1), but the difference between the 40-mm. matched
(73 percent) and mismatched (92 percent) grafts was unexpected. Mis­
matched grafts survived much better than they should have considering
their length of cambial contact. Figure 2 of the 1966 study (see
footnote 1) indicated that about 93-percent and 67-percent survival
should have occurred for 80- and 40-mm. grafts, respectively. An
examination of the unions in September 1968 revealed that most 40-mm.
mismatched grafts had healed across both the 40-mm. matched surface and
the 40-mm. mismatched surface, and had actually formed 80-mm. matched
grafts rather than the 40-mm. mismatched grafts. Healing of the 40-mm.
mismatched surface occurred because an abnormally cool, wet spring
following grafting resulted in a longer than normal period for union
establishment. Healing of much of the additional 40 mm. of mismatched
surface explains why the so-called 40-mm. mismatched grafts survived
almost as well as the 80-mm. grafts. The same situation could not pre­
vail for 40-mm. matched grafts because the cut surfaces totaled only
40 mm.; no additional surface was available for further union develop­
ment. Thus, only the matched 40-mm. grafts present survival data for
grafts with just 40 mm. of cambial contact, in which case the 73-percent
survival is close to the 67-percent survival of the 1966 grafts.

A healing of the mismatched surface occurred in the mismatched
80-mm. grafts and resulted in many grafts having between 80 and 160 mm.
of cambial contact rather than the desired 80 mm. In this case, little
additional survival occurred because 80 mm. was already adequate cambial
contact for high survival; the additional cambial contact over 80 mm.
was merely surplus.

CONCLUSION

Three graft types--top-cleft, splice, and side grafts--were made
with each graft having 40 or 80 mm. of cambial contact shared between
the stock and scion. Only 73 percent of the grafts that actually had
40 mm. of cambial contact survived 6 months, and 97 percent of the
80-mm. grafts were alive. Field survival data indicated that graft
type and grafting technique were not significant sources of survival
variation when at least 80 mm. of cambium connected the stock and scion.