SCION STORAGE AND GRAFT PROTECTION IN THE SPRING GRAFTING OF RED PINE

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Deep-freezing of coniferous scions prior to grafting was investigated in 1952 by the Forest Tree Breeding Institute at Ekebo, Sweden. It was found that deep-frozen scions were superior in health and percent take to scions held in cold storage.

Protection of the finished graft was attempted by the author when he worked with propagation of Scots pine in southern Sweden in the spring

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of 1950. At that time a few grafts were protected with a single glassine bag, but the grafts so protected died rather quickly due to excessive heat. Moist cotton placed in the glassine bag only delayed death a few days, Dr. C. C. Heimburger of the Ontario Department of Lands and Forests in Maple, Ontario, has rather successfully used for many years a double bag consisting of a glassine bag to retain moisture under a kraft paper bag to provide shade. The author has, since 1951, experimented on a small scale with the double bag, but instead of the glassine bag, whose water-retaining capacity is not very great, has used a polythene bag and added the kraft paper bag for shade. This double bag has been very satisfactory and was included in the experiment together with other protection devices.

The experiment was made up of two parts, The first part was an investigation of cold storage and deep-freeze storage for winter-cut red pine scions. The second part dealt with protecting and shading the finished graft, using two types of bags, a cardboard cylinder, and an unprotected control.

MATERIALS

The scions were collected from mature trees at various points in Canada and the United States during the winter months (from January 15 to March 20). Some lots were almost a month in shipment, and certain of them were damaged either by "heating" or by excessive drying. It was necessary, therefore, to segregate the scions into two groups: (1) healthy, and (2) damaged in shipment.

The rootstocks used were 2-1 Scots pine planted in the spring of 1950.

METHODS

Storage of Scions

When the scions arrived at the Petawawa Forest Experiment Station they were stored outdoors until they were graded, During March the scions were cut into 5-inch lengths and three-quarters of their needles were removed. They were then dipped in a 1-percent Cemesan-M solution and each lot divided into two parts. One group, to be kept in cold storage, was packed in boxes with peat moss. The containers were placed in a seed storage room with ice packed around them. The temperature was planned to be just above freezing (33° to 35° F.). However, the freezing unit broke down and the temperature in the storage room rose at times to 45° F. Although there was ice around the boxes at all times, the high temperature made the scions wetter than was intended, The other group, to be held in deep-freeze, was packed in a mixture of snow and sawdust, wrapped in polythene film, and stored at a temperature of 0° F. in a freezing locker, The scions were placed directly in the locker without being quick-frozen and were removed from the locker in June. Only 2 days' supply was removed at a time and usually was left in a cellar for defrosting for 1 day before grafting° When grafted, the

deep-frozen scions had a fresh and crisp appearance, while the scions from the cold storage room were soggy, dull, and somewhat soft.

Grafting

For greenhouse grafting, as well as for grafting out of doors, timing is one of the most important considerations in securing good survival. Our rule-of-thumb is to graft tolerant conifers (such as spruces, firs, and white pine) at the time of first root elongation, and out of doors, where the roots are less handy as indicators, at the time bud swelling begins. Intolerant conifers such as red, jack, and Scots pines should be grafted when the shoots of the rootstocks are elongating.

Our grafting was done from June 7 to 17, 1954. Leader elongation of the rootstocks was 4 to 5 inches, or about one-fourth of the total growth. The work was performed with a crew of 6 men: 2 men cleaned the rootstocks of needles and tied on the different protection devices, 3 men grafted, and 1 man waxed. Grafting was started at 5:00 a.m. The work was carried out in the early part of the day, as past experience has shown that grafting in the cooler forenoon, or in overcast weather, resulted in a higher survival than grafting in the hot afternoon. The summer of 1954 favored the survival of the grafts as the weather was abnormally cool, wet, and cloudy. The results might, therefore, not be quite typical for what can be expected in a more normal, dry and hot summer.

The grafting technique used was side grafting, also called veneer grafting. The scion was usually grafted on the leader formed in 1952. Occasionally this leader would be too thin for the quite thick red pine scion. In such cases scions were grafted on the 1951 leader. The scions were tied with raffia and waxed immediately. The current leaders were cut back to reduce diameter growth. If this were not done, callus formation would be vigorous and the scion might be "walled off." Reduced diameter growth also delays the strangling of both rootstock and scion by the raffia.

Protection of Grafts

To test the possibility of increasing survival by protection of the graft, both cold storage and frozen scions were given the following protection: (1) poly bag plus kraft paper bag, (2) kraft paper bag only, (3) cardboard cylinder, and (4) no protection.

The poly bag was made up from a 6 1/2-inch polythene tube. The tube was pulled down over the top of the rootstock and tied below the branch whorl under the graft. The tube was cut above the top of the rootstock and tied to seal in moisture. The poly bag thus made was then protected with a 25-pound kraft paper bag tied below the enclosed branch whorl. In this way three things were accomplished: (1) a mechanically strong bag, unable to slide off in high wind, was produced because it was "locked" below a branch whorl; (2) additional shade and moisture were secured inside the bag by including the branch whorl below the graft; and (3) the kraft

paper bag provided shade for the poly bag, This last feature seems quite important as previous experience has taught us that the most active tissue in an unshaded poly bag, i.e., the new growth and to some extent also the old growth of the rootstock, is killed ("cooked") by excessive heat and moisture. The scion, being more dormant, may not be killed in this unshaded poly bag, at least not within the first week, However, in this experiment we were interested in keeping alive the part of the rootstock above the graft, The kraft paper bag was, therefore, added to provide additional shade, When the poly bag plus kraft paper bag was removed 6 weeks after grafting, the new growth of the rootstocks displayed all colors from succulent green to withered brown, In the latter case it appeared that the old growth (from 1952) was sound and the cambium alive and active.

Protection with one kraft paper bag only was done with a 25-pound kraft paper bag which was tied below the branch whorl under the graft. Here, also, a branch whorl was included to give additional shade and moisture. Although shade was abundant and moisture probably somewhat increased, this bag was very hot, dry, and brittle in the bright noon sun. However, the new shoots of the rootstock were quite sound when the bag was removed 6 weeks after grafting.

The cardboard cylinders, 4 inches in diameter and 9 inches long, were made from old file covers. This cylinder was designed to shade only the graft and at the same time provide ample aeration to avoid excessive heat, The cylinder was slipped over the top of the rootstock and tied at the desired level. No extra branch whorl was included.

RESULTS

A survival count made in the middle of October brought out several interesting features. At that time 73 successful grafts had been killed by the white pine weevil (Pissodes strobi), The weevil attacked and killed the Scots pine leader, sometimes above and sometimes below the grafted scion, The damage was fairly evenly distributed to all protection treatments. The grafts so killed were excluded from the summary.

Although total survival on July 17 was 74 percent, survival had dropped to 58 percent by October 15.

Storage Methods

Deep-freeze storage is superior to cold storage for scions intended for outdoor grafting in the first part of June if scions are cut early in the winter when the trees are absolutely dormant and are subjected to no more than a short period of defrosting for preparation and grading prior to deep-freezing.

For the whole experiment, the deep-frozen scions survived 13 percent better than the cold-stored scions. Those scion lots which were damaged in shipment gave a take of 33 percent, which was only half that of the healthy scions (68 percent).

To analyze the results more closely, the different lots of scions were sorted out into three groups. The first group includes scions of good health, the second group includes poor scions damaged in shipment, and the third group includes healthy scions that were given cold-storage treatment only.

The influences of the cold-storage and deep-freeze treatments, and of the four protection methods, are most apparent for healthy scions. For these, the deep-frozen scions averaged an 80-percent take and the cold-stored scions 57 percent.

If the scions deteriorated during prolonged shipment, or were cut too late in the season, deep-freezing prior to grafting did not improve survival. The survival of such poor scions was generally low and the variation considerable; some lots suffered complete mortality. Over the whole experiment, survival of poor scions was 33 percent.

Protection Methods

A poly bag plus kraft paper bag was the best method of protection. Compared with the control, the poly bag plus kraft paper bag gave an increase in percent take of 17 percent for good deep-frozen scions and 34 percent for comparable cold-storage scions. For poor cold-storage scions it nearly doubled the take from 22 percent to 42 percent, and for the healthy scions which were given the cold-storage treatment only, the increase was from 51 percent to 91 percent. Thus, the poly bag plus kraft paper bag gave a take of 89 percent for healthy deep-frozen scions, 74 percent for comparable cold-stored scions, and 91 percent for locally collected scions which were given the cold-storage treatment only.

Protection of the grafts with one kraft paper bag only was inferior to the poly bag plus kraft paper bag by about 6 percent. However, compared to the control, it gave an increase in percent take of 10 percent for good deep-frozen scions, 27 percent for good cold-stored scions, and 25 percent for scions which were given only the cold-storage treatment.

Protection of the grafts with a cardboard cylinder was only slightly beneficial. Compared to the control, it gave an increase of 6 percent for cold-storage scions (both good and poor), and only 3 percent for comparable deep-frozen scions.

Thus, the bag protection generally gave a higher take than the cardboard cylinder and the control. For all deep-frozen scions the bag protection was superior by approximately 10 percent, and for all cold-storage scions by approximately 25 percent.

Measurements made on June 28 gave an indication of the temperature differences at the grafts (table 1).

Table 1.--Temperature at the grafts with different kinds of protection, June 28, 1954

Treatment	Temperature at grafts	
	Morning	Noon
	Degrees F.	Degrees F.
Poly bag plus kraft paper bag	72	100
Kraft paper bag only	70	99
Cardboard cylinder	77	86
Control	76	86

It appeared that the two types of bag protection were cool in the morning owing to evaporating dew. At noon they were both quite hot, and while the poly bag retained the moisture and had a relative humidity of 100 percent at all times, the kraft paper bag was dry, Temperature appears to be a less critical factor than relative humidity in influencing the take of grafts. The take of the kraft paper bag protection may have been higher than that of the unprotected grafts because the relative humidity within the bag was higher than that of the atmosphere for the greater part of the day The bag not only provided shade but also prevented rapid dissipation of the moisture from the enclosed transpiring branches.

Growth pattern as related to protection treatments was somewhat obscure but one point was brought out quite clearly: the scions protected with a cardboard cylinder grew the most. The cardboard cylinder apparently creates a favorable climate for shoot elongation but not for callus formation.