AIR-LAYERING OF NORWAY SPRUCE AND BLUE SPRUCE

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First I wish to explain the air-layering technique, and how this method of vegetative propagation differs from the rooting of branches by cuttings. In air-layering, as compared to propagation by cuttings, the branches are not removed from the tree but the roots are induced to form on the branch while they are still attached and part of the tree. In the forests, natural layering occurs in a large number of conifers when the lower branches become covered by litter, moss, or mineral soil. Black spruce trees, especially, produce roots on many of their side branches. In artificial layering the stem or branch is wounded at the place where root induction is desired. This wounding can consist of either scraping the bark down to the cambium very slightly, or by girdling the branch completely. Some plants respond quicker if the wound is treated with a hormone. After the wound is treated, a handful of moist rooting medium is placed around the wound and covered over with waterproof material. As a rooting medium, sphagnum moss, peat moss, or soil is used most frequently. Polyethelene or polyvinyl plastic sheets, waxed paper, oil cloth, and aluminum foil have been used as wrapping material. It is important that the medium should not be let to dry out during the rooting period. After the roots have appeared and have started to branch, the rooted air-layer is cut off below the girdle and potted in fertile soil. It is best to remove only the wrapping cloth and leave the rooting medium undisturbed during this potting operation. The potted air-layers should be kept in a shaded area for several weeks and watered frequently to minimize the shock. The great advantage of the air-layering method is that during the period of root formation the branch is still part of the tree and as such receives its water for transpiration through an undamaged stem. In addition to the water, the branch also receives mineral nutrients and growth regulators which are important in the formation of callus tissue and in the initiation of root primordia. Cuttings, on the other hand, have to rely on the material present in the cutting at the time they are severed from the tree.

During the growing seasons of 1955, and 1956, attempts were made to propagate Norway spruce (Picea abies L. Karst) and blue spruce (Picea pungens Engelm.) trees vegetatively by the air-layering method. Numerous reports of the successful vegetative propagation of Norway spruce have appeared in the forestry literature since the first successful experiments were reported by Deuber and Farrar (1940)[1]. All of these reports described experiments which dealt with the rooting of cuttings either in the greenhouse or in outdoor frames or with the multiplication by grafting. Because good results have been obtained by air-layering several species in the genus Pinus (Mergen, 1955)[2] experiments were designed to test the applicability of this method to the vegetative propagation of Norway and blue spruce.

[1] Deuber, C. G., and J. L. Farrar. 1940. Vegetative propagation of Norway spruce. Jour. For. 38: 578-585.

[2] Mergen, Francois. 1955. Air-layering of slash pines. Jour. For 53: 265-270.

The Norway spruce trees used were 7 years old and were growing in a plantation on the grounds of the Yale Forestry Research Center, Valhalla, New York. The blue spruce trees were growing in a plantation on the Broad Acres Farm in Shelton, Connecticut. The average age of the blue spruce trees was about 10 years. The following variables were tested in these experiments:

1. Time of Year. The air-layers were applied during three different periods: April, June, and August.

2. Effect of indolebutyric acid. Four concentrations of indolebutyric acid in talcum powder were tested: 0 percent; 0.5 percent; 1.0 percent; and 1.5 percent.

3. Type of wounding: Four types of wounds were used: (a) a girdle about inch wide was cut and the bark was removed down to the xylem; (b) same as (a) except that the girdle was 1/10 inch wide; (c) the bark was scraped off on one side of the branch down to the xylem for a distance of about 1/2 inch; (d) a 10-gauge steel wire brad was inserted under the bark in a horizontal position on the upper side and at right angles to the main axis of the branch. This was done so that a small wound was obtained which was nevertheless held open and prevented from healing over completely.

The air-layers were applied on side branches in the upper whorl of the tree. Those applied in April were located on the previous year's growth; those made in June were placed at the transition between the previous year's and the current year's growth, and those in August were made on the current years growth. When a girdle was used, the exposed wood was scraped with the back of a knife blade to remove any remaining cambium cells. This was done so that no callus bridges would occur. Moist sphagnum moss was used throughout the experiments as a rooting medium, and polyvinyl sheets (7 inch x 9 inch) were wrapped around the moss. The air-layers were held in place with "Twistems." These are wire ties which are covered with treated paper to prevent the wires from cutting in too much. The indolebutyric acid in talcum powder was applied by dipping a few moistened strands of sphagnum moss into the preparation, and wrapping these directly around the wound. A total of 640 air-layers were applied.

The following results were obtained:

1. Both Norway spruce and blue spruce responded to the air-layering method.

2. Norway spruce rooted easier than blue spruce and only a few of the blue spruce air-layers developed roots. On the average for the entire experiment, 15 percent of the Norway spruce trees developed roots as compared to an average of 3 percent of the blue spruce trees which rooted.

3. The best results were obtained when the air-layers were applied during April before active shoot elongation had taken place.

4. Of the four types of wounds tested the narrow girdle gave the best results. The wider girdle resulted in death of the branches above the girdle, while the scraping and the wound with the nail were not severe enough. These wounds callused over within a relatively short period of time.

5. Treatment of the wound with 0.5 percent indolebutyric acid resulted in a greater number of rooted air-layers, 30 percent for the treated ones versus 20 percent for untreated ones. In addition the roots started to form within a shorter period after treatment. Because of this earlier start the treated air-layers had a greater number of well-formed roots than the untreated ones at the time the air-layers were cut from the tree and potted. Concentrations above 0.5 percent were lethal.

6. The successful air-layers kept on developing rapidly after they were potted in a sandy-loam mixt ure.

7. On the air-layers treated with indolebutyric acid, the roots were grouped along the upper callus rim of the wound, while in the untreated ones some of the roots originated also along the part above the girdle which was covered with sphagnum moss.

Although these air-layers were applied on immature trees, the results should be applicable to older trees, namely that spring treatment of a narrow girdle with a weak concentration of indolebutyric acid will probably bring best results.