WHAT WE KNOW ABOUT AIR LAYERING

by

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Air layering is one important method used to obtain vegetative propagules from desired stock. The desirability of using this method over others depends to some extent on the use to be made of the propagules. If they are to be used as clonal stock in a seed orchard, the method that gives the greatest number of "takes," or one that gives the earliest flowering would be selected. Where clonal stock is to be used ail a means of testing certain characters of a parent tree, such as gum yield or growth, and the influence of the rootstock might cause complications, grafts cannot be used--only air layers or rooted cuttings arc suitable. In trials thus far on older southern pines, air layering has been more successful than the rooting of cuttings.

Layering, or the growth of roots on a plant branch, occurs naturally on many plants, including many of the conifers. Layering in nature occurs when branches come in contact with the ground and are covered by soil, moist litter, or moss.

According to Cooper (1911), Mayr noted that members of the genera Abies, Picea, Pinus, Larix, Pseudotsuga, Chamaecyparis, and Cryptomeria had all been observed to reproduce by layering. In Scotland a specimen of Picea excelsa had many natural layers from the trunk and others from the primary substems so as to form a double series of young trees in two concentric circles around the parent trunk. Cooper also refers to Vogtherr, who speaks of the layering habit occurring frequently, though often overlooked, in moist habitats in northern latitudes and in mountain regions.

A method of layering whereby roots are induced to form on a part of the tree not in contact with the ground has been in use by the Chinese for some 20 centuries. It is known to the horticulturists as air layering, Chinese layering, marcottage, mossing off, or vegetative propagation from gootes. In air layering, a handful of moist sphagnum moss or other moisture-holding material is placed around the stem where a wound or girdle has been made, and this in turn is covered by moisture proof wrappings. The branch or stem is usually completely girdled to inhibit the translocation of photosynthate material through the phloem tissue. The phloem and cambium should be removed, but all xylem tissue should be left intact.

During 1940-1941 Lasschuitt (1950) induced root formation on branches of Pinus merkusii by air layering. This species of pine grows in the jungles of Indonesia. Lasschuitt had noticed adventitious roots growing along the wounds of a split in a forked tree. This observation prompted him to attempt to induce rooting on branches with wound stimulation. He rubbed mechanical wounds with a mixture of leaf mold and soil from a pine

site containing mycorrhiza. The wounds were packed with 5 to 10 kilograms of this mixture which was held in place with mats. During the dry season this rooting medium was watered. After 8 months, 7 of the 75 air layered branches had roots.

Wyman (1952) compiled a large list of plants according to their rooting ability from cuttings and their ability to root when air layered. None of the plants listed were of the genus Pinus, but it was interesting to note that some of the plants that rooted with difficulty as cuttings were easily rooted when air layered.

A primary prerequisite to successful air layering is keeping the medium around the wound moist at all times. As a wrapping material, polyethylene plastic functions well in areas of fairly high relative humidity, as at the Lake City Research Center, and without the necessity of additional waterings.

Root stimulation with such growth regulators as indolebutyric acid and naphthalene acetic acid has been successfully carried out on many members of several coniferous genera by Kirkpatrick (1940). Although a few genera, including Cedrus and Pinus, failed to give very positive responses to this type of stimulation, other genera gave good rooting response within 2 to 3 months.

Singh (1953) found that as he increased concentrations of B-indoleactic and a-naphthalene acetic acid from 0.25 to 1.0 percent he got progressively better rooting responses in air layering mango trees, while untreated controls did not root at all.

Mergen (1955) initiated an air layer study at Lake City in 1952-1953 on slash pine trees ranging in age from 5 to 17 years. The study was designed to determine whether or not 0.8 percent indolebutyric acid in talc (Hormodin No. 3) aided root formation in air layers, and what effect time of air layering had on rooting. By making 2 air layers in each of 26 trees, a treated and untreated layer per tree, and by doing the air layering at 3 different times during the year (October 22, May 15, and August 6), he found that not only did he get more rooted branches (84 versus 50 percent) using the indolebutyric acid stimulant, but he also had over twice as many roots per branch when rooting did occur. Data of air layering had its greatest effect on time elapsed before first root development: for those air layers that were made in October, 23 weeks passed before the first roots appeared; when air layering was done in May, roots appeared within 6 weeks; and air layering done in early August showed the first roots in 8 weeks.

Hoekstra ran an air layer study on slash pine (publication pending) at Lake City to determine the relationship of tree age, concentration of indolebutyric acid, and time of year of air layering. The study was set up statistically with a split plot design to test the following variables; tree ages 6 and 23 years; 3 indolebutyric acid concentrations, 0.4 percent,

0.8 percent, and 1,2 percent; and 2 times of air layering, July 1 and September 1. After the air layers had been in the trees 12 weeks they were cut down and rooting determinations were made.

Highly significant differences were found between concentrations of indolebutyric acid and between dates of application as they affected the occurrence of roots. The highest acid concentration, 1.2 percent, gave the highest rooting percent for both age classes--93 percent in the 6-year-old ortets and 78 percent in the 23-year-old ortets--when layering was done on July 1. The range in rooting success varied from 16.7 to 93.7 percent, thus emphasizing the effectiveness of the treatment combination.

When number of roots per successful air layer was computed, it was found that the average per treatment ranged from 3 to 33.8. It appears that the acid treatment was most effective on 6-year-old trees in July.

From the results of this experiment it appeared likely that the optimum concentration of indolebutyric acid had not been reached for either age class. Hoekstra set up a supplementary study using 1.2 and 1.6 percent indolebutyric acid and 1.2 percent naphthalene acetic acid. On the 6-year-old ortet 150 air layers were made, 50 for each treatment, The 1.2 percent concentration of naphthalene acetic acid killed all of the air layers, and the 1.6 percent concentration of indolebutyric acid had a depressing effect on rooting, indicating that the 1.2 percent concentration of indolebutyric acid was at the top of the response curve for young slash pines. Ninety air layers were made in the 23-year-old trees, using the same growth regulators and concentrations. It appears the air layers were taken down a bit too early, since only 6 branches had rooted at the end of 12 weeks. However, of these 6 rooted air layers 5 had been treated with 1.6 percent indolebutyric acid. The inferences to be made from these data are weak, but it is not at all unlikely that older trees need more stimulation to produce roots than do young trees.

Zak (1956), working with shortleaf and loblolly pine seedlings, layered 10 of each species using 0,8 percent indolebutyric acid as a growth regulator. After 53 days the greatest rooting response difference between the two species was in number of roots formed per successful layer, Whereas shortleaf produced an average of 15.5 roots, the loblolly produced only 6.6 roots. The knowledge of species differences in response to variou stimuli should be of value to those who plan extensive projects involving air layers on several species.

A unique use of air layering to root needle fascicles has been attempted by Zak with some success. His best results were obtained by loosening a slab with an upward cut about 1/2 inch long and 1/16 to 1/32 inch deep beginning below the needle fascicle, the cut slab being held away from the stem with a piece of toothpick. Hormodin No. 3 dust was sprinkled into the wound. Sphagnum moss was applied and the treated area wrapped with polyethylene plastic. The method should be useful if it can be made to work on older trees, and if the propagules can be induced to put on height growth.

When Zak air layered 8- and 9-year-old shortleaf pine grafts using 0.8 percent indolebutyric acid, he was able to get only 1 of 33 branches to root after a 65-day time lapse. The one successful air layer formed only one short root. Since the original scion parents were 35 to 40 years old at the time of grafting, it appears that young grafts react to vegetative propagation in the same way as adult trees from which the scions were taken. This senescent response is not the kind hoped for in clonal plantations, but perhaps all is not as bad as it appears.

At Lake City this past summer some 1500 air layers were made in the course of 3 different studies on several ages of slash pine. The entire program was conducted using 1.2 percent indolebutyric acid as a growth regulator, as recommended by Hoekstra.

An irrigated seed orchard of high-gum yielders will be outplanted with air layers and grafts of proven high-gum yielding genotypes in the spring of 1957. Two hundred and fifty air layers were made on 10-year-old rooted cuttings and 3-year-old grafts. The cuttings were taken from two 27-year-old trees and one 18-year-old tree in 1944. Thus far, 34 air layer propagules have been cut down and potted from these cuttings, while 113 still remain alive in the trees. The air layering was done in June and July of this year and the first ones were potted in the middle of October. Since the primary interest is to get plantable propagules, the air layers are not cut down until at least four roots are visible along the inside edge of the plastic. At this writing, many remain in the trees without visible roots, but they are otherwise vigorous in appearance. Plans are to leave them a full year so that we can find out whether they will root or die.

An interesting growth phenomenon was noted at Lake City in 1955. Fifteen 6-year-old air layer propagules and ten 23-year-old air layer propagules were outplanted in the station nursery to observe how well the propagules could stand outplanting. Thirteen months later only one of the propagules had died. The surprising thing to note, however, was that the propagules from 6-year-old trees had averaged 3.0 feet o growth, while the propagules from the older trees averaged less than 1 foot of growth.

As a result of the afore-mentioned observation, an experiment is being conducted to test the outplanted growth response of air layers from trees 5, 10, 20, and 40-years of age. Included also will be air layers from 10-year-old rooted cuttings. At least 5 trees per age class have been air layered with 10 air layers each for a proposed outplanting. Air layering was done during the first 2 weeks in July using 1.2 percent indolebutyric acid.

Over 20 percent of the air layers from each age class, except the 40-year-age class, have been cut down and potted thus far. If roots form on the air layers of the 40-year-old trees, the propagule plantation will be established. Succulent scion material from trees within all of

of the age classes will also be grafted and established in the plantation to determine what differences in growth might be expected within an age class from air layers or grafts.

Air layer success for 1956 cannot be fully evaluated yet, as all the returns have not come in. In the rooted cutting plantation, where 214 air layers were made, 30 percent of the layers died within 3 months and another 15 percent died within the next 3 months. Air layer mortality on 5-, 10-, 20-, and 40-year-old trees has ranged by age groups from 30 to 65 percent thus far. All air layers that have not died on the 5-year-old trees are now rooted (36,percent success from 70 made).. Thirty percent of the air layers have rooted on the 10-year-old trees with a possibility of another 12 percent coming in (50 air layers installed). Twenty percent of the air layers on 20-year-old trees have already rooted and 48 percent are still in the trees (88 air layers made in this age group). Not one of the 42 air layers placed in five 40-year-old trees has rooted yet. However, 42 percent are still alive and may root by next spring.

An interesting thing to note is that air layers made in late June and early July began showing roots the last week in September and continue to root even now. Some individual trees have already had air layers rooting over 2 months apart, with more to come. This development causes researchers to wonder whether it *is* wise to rate the rooting respond of a species or age group to various treatments over a relatively short period of time--say 50 or 70 days--as.we have been so prone to do:

In conclusion it would probably be appropriate to mention several problems that confront the worker who wishes to air layer:

1. The reduction of mechanical breakage of air layer branches in the tree.

2. Greater rooting success of air layers, especially in older trees.

3. The reduction of the rooting time between the first and last rooted air layer in a given tree.

Basically, we need a better understanding of the nature of the stimulus that causes rooting.

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