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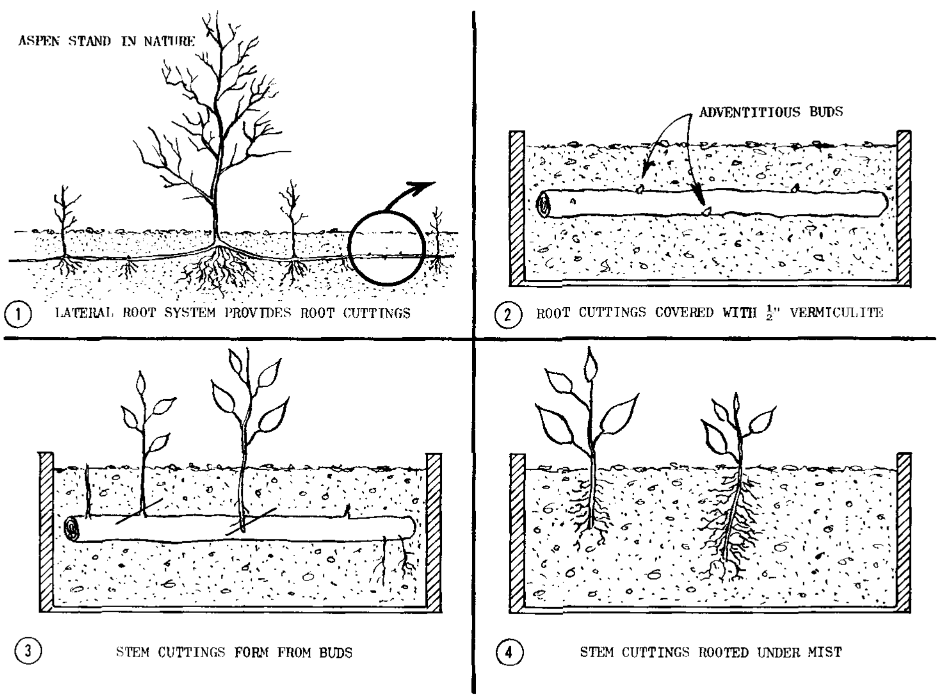
Vegetative propagation of

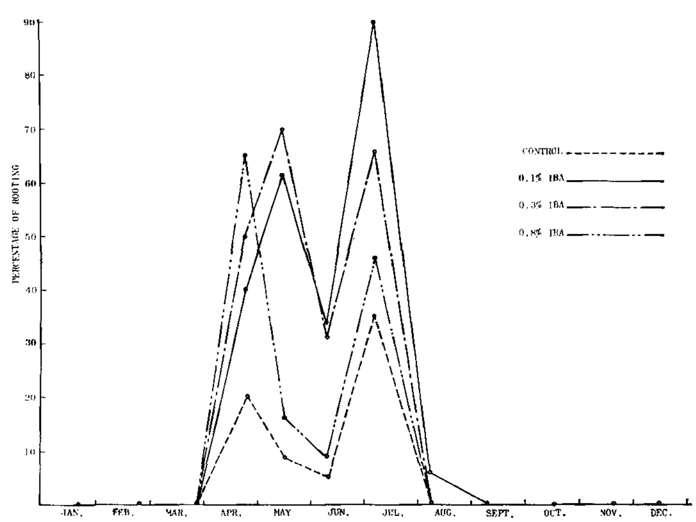
QUAKING ASPEN

SKETCHES OF QUAKING ASPEN ROOT SYSTEM, ADVENTITIOUS BUD DEVELOPMENT, AND PROPAGATION OF STEM CUTTINGS FOR NEW TREES.



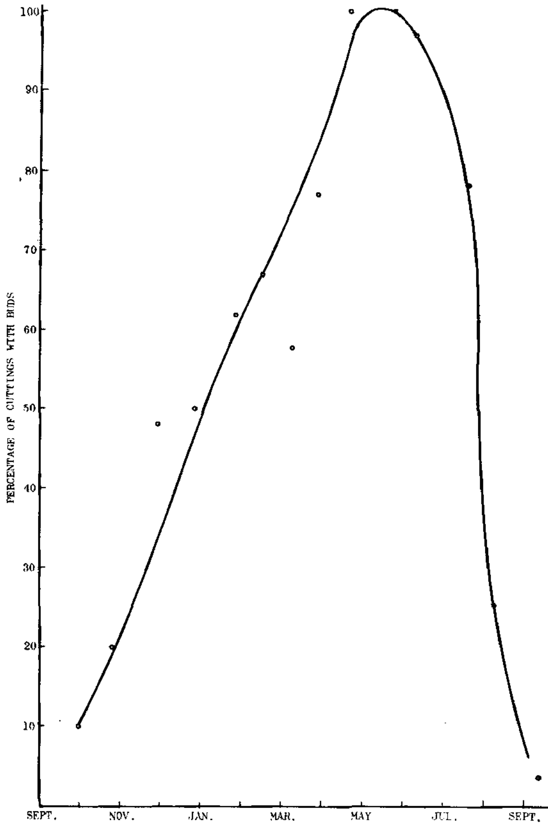
Although Quaking Aspen, Populus tremuloides **Michaux,** is not an economically important forest tree in California, it does show promise as a landscape tree, particularly because of its wide distribution and demonstrated hardiness in many climatic zones. Studies on Quaking Aspen indicate that vegetative propagation of this difficult-to-root species may be commercially feasible. Rooting of stem cuttings varies from 0 to 100% depending upon the time of year and the clone from which cuttings are taken. Cuttings treated with indolebutyric acid (IBA) have a higher rooting percentage than do the controls. Age of wood is the most important factor in rooting of Quaking Aspen. Every adventitious stem taken from root cuttings of mature trees rooted under intermittent-mist conditions with IBA treatments, whereas stem cuttings from mature trees rooted only in the greenwood state. Hence, rooting of adventitious shoots may prove the best method for commercially propagating Quaking Aspen.

GRAPH 1. ROOT INITIATION PERCENTAGE FOR ASPEN STEM CUTTINGS



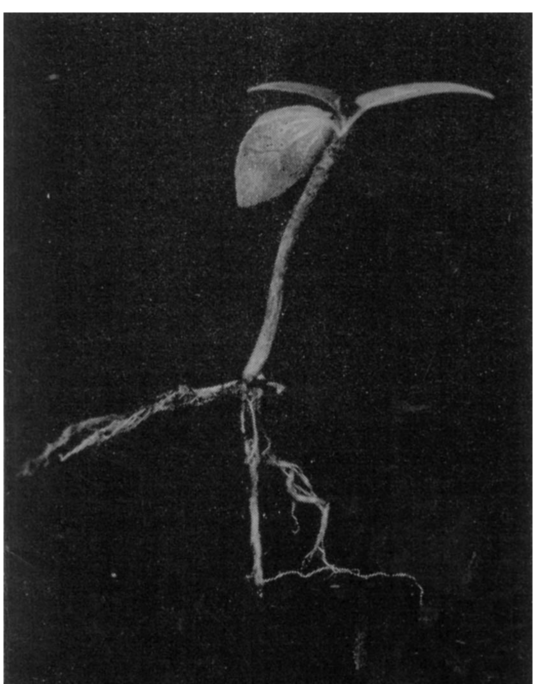
Adventitious tree on old root system of Quaking Aspen.

GRAPH 2. ADVENTITIOUS BUD INITIATION ON STEM CUTTINGS



QUAKING ASPEN is the most widespread tree in North America. This tree is found growing from coast to coast, from within the Arctic Circle to the northern tropics, and from sea level to above 10,000 feet. In many parts of the United States and Canada, Quaking Aspen is the first tree to return to a burned or heavily logged site. Moist mineral soils laid barren by logging operations or fire are ideal for germination of aspen seeds. Seedlings sprout quickly and propagate vegetatively by runners. Spreading quickly into pure stands, these trees help prevent soil erosion and allow slower growing conifers a chance to become established and eventually overtop and replace the aspen. Contrary to its role in most other forest areas of the United States, Quaking Aspen does not play an important part in the reforestation cycle in California. California Quaking Aspen are confined to coniferous forest areas where soil moisture is higher than normal, such as along stream beds, mountain meadows and spring-fed hillsides.

Rooting of cutting from an adventitious shoot (⅔ actual size).

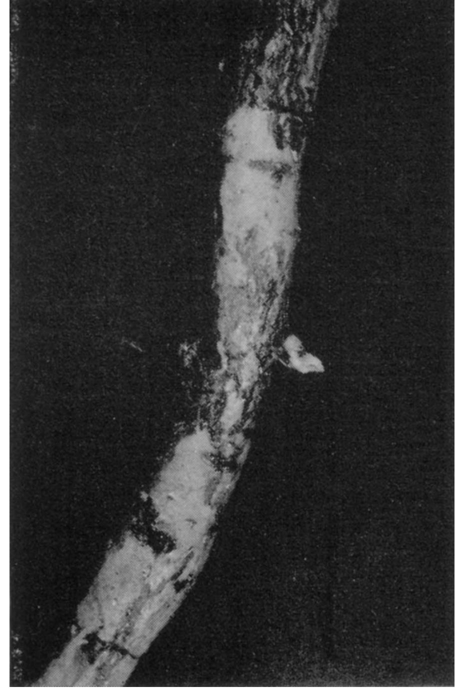


Most members of the genus *Populus* root easily from cuttings; however, Quaking Aspen is difficult to root by cuttings. Seed collection is also difficult, as seed is produced in the spring while the trees are in snow cover. Seed viability is high but of short duration, normally no more than three weeks. The natural reproduction is believed to be primarily by suckering and only occasionally by seed. Suckers appear along shallow, lateral roots, which may extend 80 ft or more from the parent plant or clone before suckering occurs. Because of the preformed root system this method of reproduction gives aspen a highly competitive position in the plant community. Suckering occurs most heavily in late spring or early summer as the snow thaws.

Stem cuttings

Clones for cutting material were selected in the Lake Tahoe-Truckee River area in the Sierra Nevada of California, and in the Picaho del Diablo area in the Sierra de San Pedro Martin, of Baja California. Root and stem cuttings from the Sierra Nevada clones were taken at monthly intervals. Only one collection date (in April) was possible for the Sierra de San Pedro Martin clone.

Twenty hardwood cuttings were subjected to various periods of storage and different levels of auxin treatments. Storage periods were six and twelve weeks at 65° to 70°, 40° to 50°, and 32° to 40°F. The cuttings were placed in plastic bags containing moist coarse redwood sawdust. The bags were sealed, three were stored in total darkness and another three were stored in light. Cuttings were treated by quickly dipping them into solutions of 0, 1,000, or 4,000 ppm IBA or by dipping the basal ends into talcum powders containing 0.1, 0.3, or 0.8% IBA (Hormodin 1, 2, or 3, respectively). Three groups



Adventitious bud formed on a root segment of Quaking Aspen.

for each treatment were then placed in each of the following cultural treatments: (1) field conditions: (2) greenhouse sand bed with 70°F bottom heat; (3) under intermittent mist with bottom heat in vermiculite and perlite (1:1); (4) in a greenhouse in polyethylene bags; and (5) in vermiculite and perlite (1:1) with bottom heat of 70°F. None of the Sierra Nevada clones rooted regardless of treatment. However, hardwood cuttings taken in April from the Sierra de San Pedro Martin clone rooted 100% in all treatments. The difference among clones indicates a high degree of variability in ease-of-rooting in Quaking Aspen.

Greenwood cuttings taken during the growing season, from bud break in April to mid-July when shoot elongation ceases, rooted to a varying degree depending upon IBA concentration and the stage of growth. Treatments included solutions of 0, 1,000, 2,000, 3,000, 4,000, and 5,000 ppm IBA (quick dip); and Hormodin 1, 2, and 3. IBA concentration was an important factor influencing the percentage of rooting during the active growth period. The effects of IBA concentration varied with the time of year and maturation of the wood (graph 1). The sharp drop in rooting percentage for June was correlated with extremely rapid stem elongation during this period.

Adventitious shoots

In nature, adventitious buds form on the lateral root system of Quaking Aspen, perhaps in response to injury to the parent plant. The adventitious shoots developing from these buds are relatively easy to root when they are still in the juvenile stage. Stem cuttings were made from such shoots when they were 1 to 3 inches long (see sketches) and rooted in a greenhouse with intermittent mist, 70°F bottom heat, in vermiculite and perlite (1:1). Regardless of IBA concentration used, all of the cuttings rooted in two weeks. The 1,000 ppm IBA (quick-dip) treatment had the most vigorous root system. Higher IBA concentrations caused deterioration at the base of the cuttings, and less vigorous root growth.

Rooting of adventitious shoot from a root cutting (¼ actual size).

Adventitious bud formation on root cuttings was most active from late December to mid-June although bud initiation occurred throughout the year (graph 2). Root segments, 3 to 18 inches long and ⅛ to 2 inches in diameter, were used in various tests. Segments of approximately ½-inch diameter produced the highest number of adventitious buds (up to 600 from one 18-inch-long root cutting taken in April); however, the percentage of these buds that will form viable shoots for rooting is unknown.

High variability in adventitious bud initiation was found among different clones. New methods are being sought to improve bud initiation on root cuttings since this material may prove most feasible for commercial propagation of Quaking Aspen.

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Eight-month-old tree from adventitious bud cutting.

Soil desiccation and fumigation for

ARMILLARIA ROOT ROT IN CITRUS

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Numerous unsuccessful attempts have been made to replant sites in citrus groves where trees have been infected with *Armillaria mellea.* The original rootstock, sweet orange, is susceptible. Some sour orange rootstocks are resistant to the disease, but cannot be recommended because of susceptibility to tristeza (quick decline). Troyer citrange and trifoliate orange are most commonly replanted now, but both are extremely susceptible to *Armillaria mellea.* An Ichang hybrid has shown resistance in greenhouse tests and is now being field tested.

When old infected roots remain in the soil, roots from newly planted trees can grow in close enough proximity to become infected. The fungus moves up some of the roots, eventually girdling the crown just beneath the soil surface. The infection then continues to spread throughout the rest of the root system and eventually to the roots of adjacent trees. Troyer replants planted in infected soil have been observed to survive from four to eight years before becoming girdled. By this time, much money and effort have been expended with only limited crop returns.

Mature trees

When mature trees are infected but not yet killed, spread throughout the grove has been controlled for many years by removal of the soil from around the base of the trunk and crown roots. Exposure of the large crown roots stops the advance of the fungus up the root system at the point where the roots are exposed to air. When excavated before being girdled, trees have continued to produce economic fruit crops for many years.

However, if the trees are not producing economic crops or are dead due to