The Influence of Juvenility on Plant Propagation

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Vegetative propagation of woody tree species is often difficult, mainly because of poor rooting. For example, the effects of age, clone, and nutrient level on the rooting of *Picea abies* is shown in Table 1.

Table 1. Rootability in cuttings taken from *Picea abies* trees of different ages, clones, and nutrient levels.

Clone	Age	Nutrient level	Rooting (%)
F470	3	normal	82
1801	10	poor	23
1802	10	poor	11
1803	10	poor	0
1804	10	poor	14
1805	10	poor	6
1806	10	poor	13
1807	10	poor	1
1808	10	poor	1
1809	10	poor	8
1810	10	poor	14
1811	10	poor	30
1812	10	poor	7
1813	10	poor	30
1819	12	normal	24
1820	12	normal	20
1821	12	normal	27
1822	12	normal	51
1823	12	normal	45

The rooting percentage of cuttings from 12-year-old trees ranged from 20 to 51%, while cuttings from 3-year-old trees (clone F470) rooted with a mean of 82%. The effect of nutrient level (normal vrs. poor) is seen by comparing the 10-year-old material (poor nutrient level) with the 12-year-old material (normal nutrient level). Better rooting was achieved in the older material—which should give lower rooting, but the normal nutritive level altered the rooting response. Even with improved rootability of the *Picea* cuttings by treatments such as a better nutrient level of the mother-stock material, it is still difficult to obtain satisfactory rooting results with mature material.

One way to avoid the problem of rooting loss associated with aging is to propagate from juvenile material. However, because valuable genetic traits are only known in most cases at maturity, cutting propagation is of limited value.

In seedling populations, variation in genetic traits is continuous. Therefore, through selection and vegetative propagation large genetic gains can be achieved.

However, if these selected plants are propagated sexually, the seedlings will exhibit large genetic variation when compared to the vegetatively propagated mother material. Therefore, the only way to retain the superior genetic traits is by vegetative propagation after rejuvenation of the mother material.

To bring back the ability of aged tissue to root easily, there is a need to understand the aging process in plants. Information on the biochemical basis of the aging process is limited, but physiologically it is known that tissues increase in maturity with increasing distance from the roots.

In practice, there are several ways to return the tissue back to an easier rooting condition. From a practical point of view, rejuvenation or reinvigorization can be achieved by:

1) Hedging. This practice is the most widely used method. As with shoot proliferation from axillary buds in micropropagation, the treatment results in reinvigorization, but adventitious shoots also can be induced. With hedging the aging process is arrested at about the age defined by the distance from the root.

2) Adventitious shoot formation. Adventitious shoots are usually juvenile. Suckers are usually adventitious, but epicormic and stump sprouts can be either adventitious or axillary.

3) Epicormic shoots, stump sprouts and suckers. Such shoot types arising close to the roots and are the most juvenile.

4) Grafting. Repeated regrafting on juvenile seedling rootstocks has resulted in rejuvenation of some species.

5) Tissue culture propagation. This can lead to either adventitious shoots or shoot production from axillary buds. Tissue culture propagation will usually results in reinvigorization, but if adventitious shoots are induced, the tissue will be rejuvenated.

Practical work in our tissue culture laboratory on *Crataegus*, *Tilia*, *Prunus*, and *Quercus* have shown, by use of axillary micropropagation, a high degree of reinvigorization. At this stage in our work we haven't been able to conclude anything about rejuvenation.