RHODODENDRON SPECIES PROPAGATION AND EXPERIENCES RELATED TO DORMANCY

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The inadequacies of rhododendron species propagation thoughout much of the past century created the situation which necessitated the formation of the Rhododendron Species Foundation (RSF). The 6 or 7 hundred different species of rhododendrons is a diverse group of wild plants — inhabiting regions from the North Polar land areas to tropical equatorial New Guinea, comprising plants ranging in size from mere ground creepers to trees over 50 feet tall, with leaf size from ½ inch to over 30 inches, and with flowers in all colors except blue. While the diversity, charm, and natural beauty of species rhododendrons increased demand, the supply of these plants remained limited and, too often, unreliable. Natural reproduction from seed, by which most wild rhododendrons have been introduced into cultivation, yields a varied progeny-especially seed collected from garden plants which often have been fertilized with pollen from a different species or hybrid. Vegetative propagation, which reproduces the qualities and characters observed in the original plant, has been difficult by rooting cuttings and expensive, together with complications by using grafting.

In 1964 the Rhododendron Species Foundation was established to collect, preserve, and distribute species rhododendrons. Scions of verified and, where possible, superior forms have been obtained from British gardens that contain extensive collections of plants grown from seed collected in the Himalayas and western China, the center of rhododendron distribution in the wild. These scions are grafted or, if of the more readily rooted smaller leaved types, are rooted and grown on to form the nucleus of the collection. With these imports and selections from American gardens and wild collected material from Japan, Korea, Taiwan, Europe, and North America the RSF has established a collection of some 430 species and a total of over 20,000 plants. These are now located at its permanent home and garden site at Federal Way, Washington.

Aside from gathering all of this material, the Foundation obviously has needed to improve upon past propagation practices in order to realize its goal. It has been necessary to extend to the field of wild rhododendrons, the advances made in the commercial hybrid rhododendron realm which, through rooted cuttings, can supply large quantities of reasonably priced and popularly acceptable plants. The vegetative propagation of species rhododendrons is not radically different from that of hybrid rhododendrons. The success in increasing the production of species at the RSF is the result of varying existing methods rather than innovating greatly different ones. In fact, the greatest benefit of general value from a review of the RSF experience comes from the demonstration of the potential of carefully tailoring general practices to the specific requirements of individuals plants.

The steps in standard rhododendron propagation from rooted cuttings practiced at the RSF include the following:

1.) Cuttings taken are of the current season's (less than one-year old) growth.

2.) Leaves exceeding two inches in length are trimmed to about that length to maintain more uniform bench spacing.

3.) Cuttings are submerged in a benomyl solution for a minimum 5 minute soak.

4.) Cutting length is shortened to 3 inches for average size (½" to ¼" diameter) cuttings and proportionately shorter to 1½ inches for the smallest cuttings.

5.) The lower ½ to 1 inch of the stem is wounded to a depth just below the cambium to expose two lines of cambium tissue.

6.) Cuttings are dipped, to the extent of the wound, in a powder or liquid rooting hormone preparation — with IBA content ranging from 0.1% to 1.6%.

7.) Cuttings are placed in greenhouse benches with 4 inches of a ½ coarse peat and ½ perlite medium, with bottom heat maintained just above 70°F, and with misting governed by an electric leaf device.

8.) When root development has progressed to form a 1½ to 2 inch diameter root ball, cuttings are transplanted to greenhouse benches with a ½ sawdust and ½ peat (with fertilizer) medium.

9.) Rooted cuttings are encouraged to grow through the late winter and spring in the greenhouse benches with a minimum air temperature of 58°F, supplemental light and periodic liquid fertilizer application.

10.) Young plants are moved out, mostly to a lath house, in June to adjust to outside conditions and to harden off for the winter.

Adjustments and alterations to these procedures have been necessitated by characteristics found in many species which either are not present or are not critical in commercial hybrid production — a diversity hardly surprising in view of the fact that barely one dozen species figure in the parentage of the great majority of standard hybrids. Lacking hybrid vigor, the wild plants can not be expected to so easily adjust to any slighting of their requirements, so more precise treatment is required. Further, many commercial hybrids were selected, in part, because of the ease with which they would root from cuttings.

Perhaps the least mentioned, yet potentially most limiting, factor affecting species rhododendron propagation success is dormacy. The dormancy traits of a species, the condition of the stock plant relative to dormancy at the time cuttings are taken, the response of the cuttings to propagating, especially the greenhouse environment, whether to encourage, discourage, or inhibit the initiation or satisfaction of dormancy, the conditions necessary to satisfy or overcome dormancy, and the relationship of dormancy to root growth and to initiation are all possible factors in propagation and are mostly undocumented. What we have observed is that the nature of dormancy varies greatly among rhododendron species, and that problems with the propagation of some species have been overcome by altering methods in a way to avoid dormancy as a negative factor.

One frequently encountered dormancy-caused problem is the inability or slowness of cuttings to make new growth after rooting. These cuttings have gone into a state of dormancy, and not being subjected to the period of winter cold which would naturally satisfy dormancy breaking requirements, will not renew growth under greenhouse conditons, or will do so only after being maintained under optimum growing conditions for an extended period. This problem has been encountered most widely in the propagation of deciduous rhododendrons, and particularly the deciduous azalea species (included within the genus) and the popular Knaphill-Exbury hybrids. A dormancy habit, so elaborate as to include the shedding of all foliage, is not likely to be easily reversed once begun. So it is important that the propagator work with material that is not dormant or is not placed under conditions where it will tend to go dormant.

With many deciduous azalea species, particularly the American natives, such as *Rhododendron calendulaceum* (Michx.) Torr., our experience shows that it is particularly important to take cuttings early, beginning in May, as soon as growth has fully extended, and to encourage rapid rooting with bottom heat near 73°F. An early rooting cutting will have more long summer days in which to produce top growth before decreasing day length can trigger the onset of dormancy. After being induced to make this first flush of growth, most cuttings will increase in vigor and produce succeeding flushes in the greenhouse throughout the winter and early spring, even though under conditions of decreased light in which the later rooting cuttings will not initiate growth.

While avoiding the onset of the dormant state is the usual procedure in propagating some rhododendron species, others are successfully increased using cuttings which are at the end of the dormant period. The group of deciduous azalea species centered around *R. schlippenbachii* Maxim., can be propagated from leafless cuttings of nearly 1-year-old wood, taken in early April just as the vegetative buds swell and the flower buds are showing color. With dormancy satisfied, growth inhibitors have ceased to govern and the buds need only warmth to extend into full growth. The naked cutting produces its new leaves soon after being placed in the propagating bench, then initiates roots, and will be ready for transplanting in the normal length of time. A new flush of growth follows transplanting, after which the plant is best left to experience normal dormancy and mild winter cold. Besides other deciduous rhododendrons, such as *R. semibarbatum* Maxim. and *R. mucronulatum* Turcz., which have been propagated by late winter cuttings, some evergreen species also may be produced from cuttings taken at the end of dormancy. Cuttings of *R. fargesii* Franch. and some forms of *R. wardii* W.W.Sm. seem to be at peak physiological condition to root, grow, and survive when taken in late February.

The propagation of all deciduous rhododendrons is not so hampered by dormancy. The so-called "three-leaved" Japanese azaleas, represented by *R. reticulatum* D. Don ex G. Don, can be propagated from firm cuttings of vigorous growth taken from August to November. Apparently their dormancy is not so profound and leaf drop is a more casual affair. Thus, vigor readily overcomes the tendency to cease growth towards fall.

On the other hand, many evergreen species (Table 1) have failed to grow after rooting or after being grafted. This problem is most frequent in cuttings taken in July and August and transplanted in October and November. Cuttings taken at the same time, but transplanted in late January or February, will often commence growth sooner, as will cuttings of the same species taken in October and transplanted in February. Apparently, the early transplants, being removed from under the mist while daylength is still decreasing, continue to produce dormancy-inducing growth inhibitors, which the mist leaches from cuttings in the rooting bench. The later transplants are removed from mist at a time when increasing daylength is apt to overcome dormant tendencies and new growth is more easily stimulated. The fall cuttings, though well into a state of dormancy, may be leached of the inhibiting compounds while under mist, and again emerge at a time of increasing daylength. Much research is needed to verify this hypothesis, but the problem is best minimized by timing the removal from mist after the middle of January. In grafting, the failure of late summer and fall grafts to produce growth is best avoided by waiting until February, after natural cold requirements are met, to begin propagating troublesome species. An alternative method, when the timing of availability of cuttings is beyond the propagator's control, is to graft in the fall. Then, after mending and air-hardening is completed, the plants are placed in a greenhouse with a minimum temperature near 32°F to allow an amount of cold that often will be sufficient to overcome dormancy. This treatment may also succeed with grafts that have failed to grow during their entire first year.

Table 1. Evergreen rhododendron species difficult to bring into new growth.

A. Most difficult — *R. basilicum* Balf. f. & W.W. Sm., *R. clementinae* Forrest, *R. coriaceum* Franch., *R. giganteum* Forrest ex Tagg, *R. hylaeum* Balf.f. & Farrer, *R. longesquamatum* Schneider, *R. mallotum* Balf.f. & Ward, *R. praestans* Balf.f. & W.W.Sm., *R. sidereum* Balf.f., *R. taliense* Franch., and *R. watsonii* Hemsl. & E.H. Wils.

B. Moderately difficult — *R. argyrophyllum* Franch., *R. barbatum* Wallich, *R. cerasinum* Tagg, *R. crinigerum* Franch., *R. cyanocarpum* (Franch.) W.W.Sm., *R. eclecteum* Balf.f. & Forrest, *R. falconeri* Hook.f., *R. fictolacteum* Balf.f., *R. hodgsonii* Hook. f., *R. insigne* Hemsl. & E.H. Wils., *R. macabeanum* G. Watt. ex Balf.f., R. strigillosum Franch., R. succothii Davidian, *R. uvarifolium* Diels., and *R. wightii* Hook.f.

A different problem appears to be related not so much to dormancy as to the need for certain species to follow natural annual growth cycles. Continuous forcing of flushes of growth under artificially maintained optimum conditions yields increasingly distorted growth. Leaves may be fewer in number but larger in size and misshapen, often puckered and with wavy edges. Stems and petioles are frequently enlarged. Such growth is often produced from lateral buds. In some other species, the apical buds develop, but the new shoots lack lateral buds. If the newly shoot's lone bud at the apex develops into a flower bud,

Table 2. Species of rhododendron for which a normal rest period is vital.

A. Those which, when forced excessively, produce distorted growth — *R. albrechtii* Maxim., *R. callimorphum* Balf.f. & W.W.Sm., *R. campanulatum* D.Don, *R. eximium* Nutt., *R. lacteum* Fanch., *R. schlippenbachii* Maxim., and *R. viscidifolium* Davidian.

B. Those which, when forced excessively, produce "blind" shoots — *R. anthopogon* D.Don, *R. collettianum* Aitch. & Hemsl., *R. lyi* Levl., *R. manipurense* Balf.f. & G. Watt, *R. roxieanum* Forrest, *R. souliei* Franch., *R. viscidifolium* Davidian, and *R. wardii* W.W.Sm. (some forms).

the end result is a barren growth. Simply allowing the plants a normal rest period and forcing no more than one or, at the most, two flushes of growth annually avoids these unwanted results.

There is much more to be learned about dormancy, how it is triggered, how it operates, and how it can be overcome or taken advantage of in the propagation of species rhododendrons. But the propagator who adjusts his timing or treatment of cuttings in consideration of dormancy is likely to experience success in producing these plants.

MYCORRHIZAE IN RELATION TO ROOTING CUTTINGS

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It has been stated by Zahner (1965), and probably by others before, that "In the natural environment, there exists no organism that lives like a hermit." Ponder that statement for a moment, and then let's consider plants and their associations with other organisms as a example. Certainly no plant in nature lives alone, but instead is surrounded, both above and below ground, by a myriad of microorganisms covering their roots, branches, leaves, and flowers. Some live in close association with the plants becauses of the chemical exudations from roots and leaves that support the microbe's life processes. Consider if you will, however, the intimate association that exists between plant roots and mycorrhizal fungi. Such associations are nearly universal, such that mycorrhizal associations are the rule not the exception. Healthy rootlets of most vascular plants growing in natural soil are inhabited by these beneficial fungi in a state of symbiosis. We are just now beginning to understand the nature of these fascinating associations, and what some of the implications are to the propagation, growth and survival of plants.

It is important to understand that there are two main types of mycorrhizae: ectomycorrhizae and endomycorrhizae. The key differences between these two types are that ectomycorrhizae generally form a thick mantle of fungal hyphae on the outside of the root tips, and the hyphae penetrate between the root cortical cells. (3).

These fungi are most often mushroom-type fungi (Basidiomycetes) that can be grown in culture. When they colonize roots, they often induce extensive proliferation of roots,