## WEDNESDAY AFTERNOON SESSION

**September 9, 1970**

The afternoon session convened at 1:30 p.m. with Hans Hess as moderator.

MODERATOR HESS: The symposium for this afternoon is entitled "Seedage: Past, Present and Future." The first speaker is Dr. Harrison Flint who will discuss the importance of seed source. It gives me a great deal of pleasure to present to you Dr. Flint.

# IMPORTANCE OF SEED SOURCE TO PROPAGATION

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The problem of locating sources of seed for propagation of woody plants has not changed basically for many years. Solutions to the problem are gradually becoming easier, however, because of a better-organized commerce in seeds and better communications among plantsmen, largely through the efforts of organizations such as the International Plant Propagators' Society.

The related problem of deciding which of alternative seed sources to use is more complicated and less fully understood. It is sometimes thought that any plant or seed is equivalent to any other of the same name. Experienced plantsmen know that this is seldom true — in fact, have known for many years that selection of proper genetic material can be essential to success in plant cultivation.

**What is a plant species?** A plant species usually is a collection of individuals grouped together for purposes of classification because they have certain morphological features in common. This in no way implies that they are identical or even similar in all respects. An analogy can be drawn with *Homo sapiens*, the species that includes modern man. If we were to select an individual from this species to perform brain surgery, to compete in track events in the Olympics, or to write a poem commemorating an important occasion, we would not be content to accept just any individual selected at random. In the same way if we are to select an individual of red maple *(Acer rubrum* L.) for a specific landscape situation, why should we be content to use just any individual, knowing that this species, which inhabits most of eastern North America's temperate zone, is highly variable. For example, Dr. Thomas O. Perry of North Carolina State University's Forestry Department has observed tremendous differences in physiological response to temperature among individuals of red maple that are hardly distinguishable by outward appearance (24). Such

differences can relate directly to problems of adaptability. In this same species, *Acer rubrum*, we see in the nursery trade a considerable number of cultivars (horticultural varieties) that have been selected for form and foliage color from the diversity that is available within the species.

**Cultivars and seed sources.** Mention of cultivars, which in most woody plants are vegetatively propagated clones, may seem out-of-place in a discussion of the importance of seed source, but both are parts of the same picture. In many cases. it has been necessary to select extreme genetic forms and propagate them by cuttings or grafting to uniformly obtain desirable horticultural material. A familiar example is that of blue forms of *Picea pungens*. When seeds are sown, only a small number, if any, result in plants equal in color to the parent plant, and vegetative propagation has become the accepted means of producing highly glaucous forms.

We are seeing more and more selection of vegetatively propagated clones as named cultivars. Some are highly superior forms — others no better than previous selections — some even re-selections of the same genetic material under a new name, the result of incomplete checking of existing cultivars. We need more truly superior cultivars, but we should beware of carrying this process to a biologically unsound extreme. Today we are beginning, on a national scale, to heed the conservationists' call for preservation of diversity in biological material — for the sake of the diversity itself and for such pragmatic reasons as maintaining genetic pools from which resistance to new diseases and insect problems may be drawn. I am not suggesting that we are in immediate danger of creating problems in this respect, but as plantsmen we have a special obligation to serve as good stewards of the biological resources that we are directly concerned with, and we should carry this thought with us as we proceed.

Selection of seed sources is a less intensive process than selection of clones. Seed lines are usually reproduced at less cost than those of clones, which are propagated by vegetative means. Seed lines are, of course, more variable than clones, yet may possess considerable uniformity, often enough to insure consistent usefulness in a given situation.

In many cases the use of clones as cultivars might be preferable to selection of seed sources, but such cultivars do not presently exist. In other cases, there is no clear advantage to the use of clones, either because relatively little variation exists within seed sources, or because of unresolved problems in vegetative propagation.

**Kinds of variation.** Even a cursory look at the literature turns up many forms of expression of geographic variation within species. Let's look at a few:

Form and color differences have been observed in many conifers, well documented by P. den Ouden and B. K. Boom (21) in **Manual of**

**Cultivated Conifers.**

Differences in habit have been documented in *Robinia pseudoacacia* (12), *Ulmus americana* (7), and many other deciduous species.

Growth rate differences among geographic sources have been observed in many species. The forestry literature carries many such accounts resulting from seed source studies.

Timing of annual growth and response to photoperiod are often interrelated (29). Variation in growth response to photoperiod within species has been observed in *Liriodendron tulipifera* (10, 15), *Pinus monticola* (27), *Pinus strobus* (23), certain *Populus spp.* (22, 30), and *Tsuga canadensis* (20).

Annual growth patterns can be related to hardiness, especially in early winter (19). In the case of *Cornus stolonifera*, Smithberg and Weiser (26), working at the University of Minnesota, found that plants of geographic strains from widely different locations all had the ability to harden to great extremes but that plants from sources having mild climates hardened much more slowly than did those from colder habitats, and so were prone to damage in early winter. Hardiness-related differences in growth patterns also have been found in *Juglans nigra* (6) and several southern pine species (17).

Differences in hardiness, without specific observations of growth patterns, have been seen in *Acer saccharum* (14), *Fraxinus americana* (34), *Kalmia latifolia* (13), *Pinus ponderosa* (28, 31), *Pinus resinosa* (2),*Pseudotsuga menziesii* (9), and *Quercus rubra* (8),

The case of *Kalmia latifolia* was shown graphically by Dr. Richard Jaynes, geneticist at the Connecticut Agricultural Experiment Station at New Haven, who carried seedlings from several geographic sources overwinter in a cold frame. Plants from Alabama sources were killed, while those from New England sources withstood the winter without damage.

In a study recently completed at Purdue (8), hardiness of twigs of 16-to-18-year-old trees of *Quercus rubra* from 38 different geographic sources was compared. Hardiness during early winter closely related to geographic source, trees from northern sources hardening more than trees from southern sources.

Also related to growth pattern is the time of emergence of buds from quiescence in the spring. Researchers at the U.S. Forest Service experiment station at Carbondale, Illinois, and cooperating forest physiologists and geneticists at Purdue and other mid-western universities are interested in the problem of susceptibility of new growth of black walnut trees to late spring freezes, and hope to find sufficient variation in this factor to form a basis for selecting late-breaking trees. Such variation has been seen in many other woody species having wide geographic ranges.

In cases where the natural habitat of a species includes large variations in growing-season rainfall or in soil water-holding capacity, differences in drought resistance within the species may be expected, but very few cases of such variation have been documented, only one to my knowledge in a woody species (18).

In the same way, variations in soil requirements may exist in woody species that grow on a variety of soil types. Differences in soil pH requirements have been observed in soybeans (3). It would be interesting to know whether similar differences might exist in *Quercus palustris*. If lime-tolerant strains could be found, the practical value to landscapers in much of the midwest would be considerable.

Other differences found within woody species include seed germination requirements (33), seed quality (16), specific gravity of wood (25) — of interest in lumbering — and leaf form (1, 4, 5) — of interest in plant taxonomy and ecology.

Over the past 20 years considerable information on seed source has appeared in our Proceedings. In 1954 Laddie Mitiska described collection of seed from outstanding selected forms of upright *Taxus cuspidata*. In 1956, Aart Vuyk stressed the importance of seed source in mass production of forest tree seedlings. The following year, D. J. Hillenmeyer pointed out that considerable variation in hardiness can be found in *Osmanthus americanus*, and in 1958, Richard O. Hampton mentioned the seed source problem as it applied to propagation of virus-free stone fruit varieties and understocks. In 1960 Thor K. Bergh answered the question "Will Seed from Northern Plants Produce Plants Hardier than Those from Southern Regions?" by pointing out the importance (and difficulties) of selecting the proper seed source. He stressed the importance of adaptation and listed a number of forest species (some also ornamentals) in which important variations are known, including red pine, Scots pine, Siberian elm, western hemlock, slash pine, Engelmann spruce, Sitka spruce, and white spruce.

In 1967, Philip G. Haddock, Professor of Forestry at the University of British Columbia, reported to the Western Region on provenance testing in forestry, an activity designed specifically to evaluate genetic variation in tree species and its interaction with the environment. He described the economic importance to forestry of selecting well-adapted races. While horticultural applications differ somewhat, horticultural plantsmen are quite familiar with the phenomenon of economic loss resulting from the use of inappropriate genetic material.

C. E. Heit, seed analyst at the New York Agriculture Experiment Station at Geneva reported on the importance of seed source as well as seed quality factors in the 1964 Proceedings, and has published additional information more recently, in **The American Nurseryman**

(11). He has stated that selection of seed source, in conifers, is second in importance only to selection of the species to be grown.

**Selecting seed sources.** Faced with the problem of selecting appropriate seed sources, what alternatives are open to the propagator?

1. **Local sources.** The propagator who is a plantsman of some experience can find local sources of many native woody species. He can find these by observation on local trips, by letting others in his area know what kinds of seeds he is looking for, and often by accidental observations, if he has trained himself to recognize their significance.

Most propagators are also interested in exotic (non-native) species. Good sources of seed of these species may also be available locally, in the form of plants that have been cultivated in the area for some time, on public or private grounds. Many propagators in our own organization have gradually accumulated knowledge of such sources and are obtaining many seeds in this way.

With local seed sources, as with any other, the propagator must contend with good and poor seed years. Several members of our Society have reported collecting seeds in good years and storing them for two to three years or longer. The 1956 and 1957 Proceedings include several excellent articles on seed collection and propagation practices, and are worth re-reading.

W. C. Sherman reported to our Society in 1957 that Forrest Keeling Nursery had established seed orchards to give a more reliable supply of seeds of certain species than could be obtained elsewhere. This practice allows careful selection of seed parents and insures comparable genetic material year after year. Other propagators with predictable needs for the same species over a number of years might well follow suit.

2. **Commercial sources.** The most convenient way to obtain seeds, and often the most economical is to buy them from a commercial dealer, Many propagators use a small number of relatively large dealers as their primary source of seed of woody species. Such dealers usually have information on sources and sometimes alternative sources, in an attempt to respond to the needs of their customers.

Seeds of certain species can be obtained from more specialized dealers — sometimes small companies specializing in collecting native plants and seeds. It may also be possible to obtain seeds of some species by arrangement with plant nurseries who are collecting for their own use, but sometimes have surpluses.

Seed dealers are regulated to different degrees by the various states. In the 1964 Proceedings, C. E. Heit outlined what purchasers can expect from dealers regulated by New York State. When dealing

with an unfamiliar source, it may be advisable to do a little checking on the degree of regulation the dealer is operating under, and, if in doubt, the propagator may wish to arrange a germination test on his own.

3. **Non-commercial sources.** Seeds of woody species not available commercially sometimes can be obtained, in small quantities, from arboretums, botanical gardens, and other educational and research organizations.

Many arboretums and botanical gardens regularly exchange seeds on a reciprocal basis. Most of these are privately or locally supported, and are under no obligation to honor requests from outside individuals. Most attempt to honor reasonable requests if they are able to. It is probably a safe generalization that modest requests have a better chance of being honored than larger ones. Several commercial members of our Society have benefited greatly in this respect by establishing mutually cooperative stances toward arboretums and botanical gardens — including direct financial support in some cases.

There are problems and pitfalls in obtaining seeds from any source. Arboretums and botanical gardens are no exceptions. Most do a better-than-average job of labelling plants and seed collections correctly but few, if any, will guarantee identity of a seedlot. Likewise, germination and purity are not (and need not) be guaranteed as the seeds are not being sold. Some arboretums will send seeds that are of transient viability, if they are available, long after much viability has been lost, assuming that the propagator is aware of this and is interested in obtaining even a few seedlings. When seeds are from cross-pollinated trees, obviously no one is going to guarantee the identity of the male parent. When such seeds are collected from plants in large generic collections, the probability of hybridization in many genera is quite large. In other genera where hybridization seldom if ever occurs, the problem is less serious. Dr. Melvin Westwood, fruit geneticist at Oregon State University recently pointed out the magnitude of the problem he encountered in trying to obtain seed of natural species of *Pyrus* for his pear breeding program (32).

**Summary.** In summary, I would suggest that propagators should

1) be aware of the problems known to exist in selecting seed sources;

2) read and correspond with members of this Society as necessary to obtain as much up-to-date information as possible;

3) be alert to recognize new problems as they arise;

4) support the activities of arboretums, botanical gardens, and research institutions, read the information that they publish and discuss needed research with their staffs;

5) ask as many questions as necessary when obtaining seeds; and

6) occasionally look through back volumes of the I.P.P.S. Proceedings, to glean overlooked or forgotten information from them.

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MODERATOR HESS: Thanks very much, Harrison, for an excellent presentation. The next speaker of this afternoon's sym-