PLANT BREEDING WITH A PURPOSE

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The performance of any plant is made up of two components: environmental and genetic. Most woody ornamental research and nursery practice has been directed toward improving the environmental or cultural component. Relatively little attention has been given to genetic improvement. Some of the reasons for this are obvious, others are not.

More rapid progress can generally be obtained by improving cultural conditions rather than by plant breeding. The relatively large size and long span between generations require relatively large investments of both time and money for genetic studies of woody plants. To be economically successful; cultivars of woody ornamental plants must be adapted to broad geographic regions. This complicates testing of new cultivars and many receive only limited testing before they are introduced. In some cases most of the actual testing is done by the consumer.

Most plant breeders working with crop plants have definite indexes to measure their accomplishments such as, bushels per acre, pounds per plant or board feet per year. With ornamental *plants we do not have such clear indexes. Most ornamental* characteristics are difficult to measure or evaluate. The large number of different kinds of ornamental plants is another deterent to genetic improvement. The number of species which an individual can investigate at any one time is limited.

There are also advantages to breeding woody ornamental plants. The diversity of plant materials provides many species that have been subjected to very little if any genetic study. This makes improvements much easier than in the highly selected populations with which most plant breeders work. This makes it possible for amateurs or hobbyist to make significant contributions; many outstanding cultivars have been produced by amateurs.

Since most woody plants can be asexually propagated only one outstanding individual need to produced to form a new clone. For seed-produced plants once parental strains have been developed that will produce genetically superior seedlings they will continue to produce them almost indefinitely.

Although the initial investment may be relatively high, once the cultivar (either clone or seedling) is developed, genetically superior plants can be produced at the same cost as standard cultivars. Thus, genetic improvement may be less expensive in the long run than improved cultural practices that depend on periodic inputs of labor and supplies.

DEVELOPING NEW CULTIVARS

Most of the cultivars of woody ornamental plants grown today are not the products of systematic breeding programs but were discovered as chance seedlings or mutations. Discovering a plant of unusual merit which is worthy of propagation is not too difficult. The hard part is promoting it and getting it accepted in the trade. Superior chance seedlings or mutations that arise from time to time should not be ignored. However, a more profitable approach to genetic improvement for most nurserymen is to increase the percent of saleable plants and improve the grades by gradually improving the genetic make-up of his stock. With a fundamental knowledge of genetics this can often be done at little additional expense. New genetic types arise from two main sources, mutation and seed produced from the union of male and female gametes.

Mutation. A mutation is caused by a gene change. It is the ultimate source of all genetic variability. Mutations are recurrent; that is they don't happen just once but they reoccur. Although no studies of mutation frequency have ever been done with woody plants, we can assume from studies of other plants that the frequency of mutation is between 1 in 1,000 and 1 in 100,000. The frequency varies among species and even among cultivars in the same species. Most mutations are recessive. This means that many mutations would not show any visible effect until two plants that both contain the recessive gene are crossed.

Although we generally think of mutations as something beneficial, most mutations are harmful. Most of the mutations that we notice have fairly striking effects but the majority of mutations have very small effects and many of them produce no visible effect on the plant at all. Since most mutations produce no visible effects it is reasonable to assume that a small genetic gain could be made by selecting only the best plants for propagation when cuttings are being taken from production areas. On the other hand it has been shown that you can rapidly decrease the genetic potential by taking cuttings from the poorest plants.

Mutations are of practical importance for several reasons. First it is the only way to obtain new cultivars from clonally propagated material. New types obtained in this way are much more frequent in some plants than in others.

Seedling Selection. Seedling selection offers the greatest potential for new cultivars. Most of our cultivars originated in this way and it is reasonable to assume that most new ones will also originate this way. Developing new cultivars that can be propagated by seed is an especially challenging area and one that has been badly neglected. Experience with some cultivars of woody plants indicates that this might not be as difficult to achieve as is generally believed.

Most ornamental seedlings are grown from seed collected wherever it is available. Seed collectors are paid for the quantity of seed they collect. The only selection that is done in most cases is to select the plants from which it is easiest to harvest seed.

Species of woody plants that occupy a wide native range tend, through the process of evolution and natural selection, to develop genetically different types within that range. Although this has been known for a long time it has generally been ignored by nurserymen. Selecting the right seed source or origin can produce as much or more genetic gain as almost any single factor. Some examples of trends that may occur in wide-ranging species are; southern seed sources are generally faster growing than northern, are more susceptible to winter injury, show less fall color, and grow later in the fall; seed sources from dry areas are usually slower growing, deeper rooted, and have larger seeds than those from wet areas. These trends generally hold true over wide geographic ranges. However, for species with small ranges or for small regions within a larger range these characters tend to occur at random.

A small genetic gain can be obtained by selecting parent trees within a stand. However, the gain will be limited since there will be some interbreeding and because selection differentials will generally be relatively small.

Seed orchards or seed rows are a good way of obtaining seed of known quality, and offer many possibilities for genetic improvement. Many selection techniques can be employed to obtain the parents for inclusion in seed production area. The commonest method is to select superior seedlings from the nursery seed bed.

In making these selections it is important to select for only a few characters at a time. The reason is fairly simple — if you are selecting for one character is is easy to choose the best plant in 10. If you select for a second character there will only be one chance in 100 that the same plant will be best of 10 in both characters. A third character makes it one chance in 1,000. If very many characters are selected for, then the selection differential for any one character approaches zero.

You obtain a certain amount of gain by this mass selection procedure. The amount of gain will depend upon how the character is inherited and the amount of selection pressure you can apply. If selected seedlings can be isolated from other plants of the same type, you can generally double the amount of gain by eliminating interbreeding with non-selected types. If seed is kept separate for each plant in the seed production area and planted separately, then a large additional gain can be expected by evaluating the seedlings and thinning the parent plants that produce the poorest seedlings.

Improved cultivars can be used as parental plants in a seed production area. However, you must have at least two cultivars that can cross-pollinate to avoid in-breeding. Advanced generation selection from seedlings produced in this kind of an arrangement will be limited due to in-breeding unless new genetic material is introduced.

SUMMARY

In summary, you should use only the best material available for a seed. Be aware of seed source differences when obtaining seed for seedling production. Know your objectives, know what characters you want to improve and select toward that goal. Attempt to improve only a few characters at a time. Avoid inbreeding problems by maintaining adequate population size or introducing new genetic material.

MODERATOR FORDHAM: Thank you, Gary for a very informative talk. Dr. Batcheller has a plant he would like to describe for us.

DR. BATCHELLER: The plant is a dwarf schefflera, *Schefflera arboricola*, or some of you may refer to it as *S. octophylla*. This tropical shrub grows to a height of 4 to 8 ft, upright in youth, mounding in age with a spread equal to its height. The palmately compound leaves are rich, dark green and are closely formed on the stems. The petioles are usually as long as the leaf is wide, which is 4 to 8 inches. The nine unequal leaflets radiate from the petiole in a horizontal manner. The flowers, green to yellow, ½ inch in size, are born in terminal panicles. The fruit is a fleshy drupe with 4 to 6 seed which germinate readily in the greenhouse.

The plants do best in a moist humus soil on the acid side. In San Diego plants will grow outside in protected areas. The most outstanding use is that of an interior plant. The plant holds its leaves, and is easily kept in a compact form by pinching or the taking of tip cuttings. Tip cuttings root best if the base is cut two ways for ¼ inch before the use of a hormone and using a rooting medium of 30% peat and 70% Sponge Rok, under mist or in a sweat box.

MODERATOR FORDHAM: Henry Verkade has a plant he would like to describe for us.

HENRY VERKADE: In 1960, Peter Brouwer, a Connecticut nurseryman, observed an unusual plant in a block of seedlings from seed of *Pieris floribunda*. The seedling proved to be hardy in the field; in some of the coldest winters of the past 10 yr it was uninjured whereas plants of *P. japonica* suffered damage.

Morphological traits tend to confirm that it is a F_1 hybrid between *P. floribunda* and *P. japonica*. It is seed and pollen sterile; mature capsules never form after flowering. This lack of seed set apparently gives the plant more vigor and better annual flower bud set than is common among the currently available fertile pieris cultivars. The plant is full and dense with shiny, dark green leaves; young foliage is yellow green. Plants of the hybrid have been relatively free of lacebug damage but in laboratory and field tests it is readily attacked under high predation pressure. Flower bracts and buds are prominent in winter. Flowers are white, urn-shaped bells held on a branched, horizontal, but arched racemes.

Observation of the original plant and it's propagules over several years have proven it to be hardy in Connecticut. It grows rapidly when small, but vegetative growth is reduced after the plant matures and flowers. It stays within bounds once established in a foundation planting. It can be propagated from cuttings and has been given the name 'Brouwers Beauty'; a patent has been applied for by Peter Brouwer. Plants and cuttings are available from Peter Brouwer's Nurseries, 106 Gardener Ave., New London, CT 06320.

MODERATOR FORDHAM: John Roller has a sweetgum that he would like to tell us about.

JOHN ROLLER: This sweetgum is shaped like an ice cream cone and is about 5 ft tall while trees of the same age are 25 to 30 ft tall and 5 to 6 inches in diameter. I'm not sure what the origin of this seedling is but it is the oddest sweetgum I ever saw.

MODERATOR FORDHAM: Thank you, John. The last speaker for this section of the program is Dr. Phil Barker from Logan, Utah who wants to tell us about a maple.

PHIL BARKER: The plant I will describe for you is *Acer grandidentatum*, commonly called the big-toothed maple. It is a plant which I think has been overlooked. It is perhaps best planted as a tree-shrub and has good fall color but, as it gets older, the fall color is reduced. The color varies all the way from a clear yellow to an intense red, depending upon individuals. The time of fall coloring also varies among individuals.

MODERATOR FORDHAM: The final speaker for this session is Mr. Jim Wells.

JIM WELLS: What I wish to show you are some flowers of the new Windsor hybrids which we have planted in our nursery. The plants are extremely vigorous and have good blooms. Their exceptional characteristic is their fall color; a bed of them in the fall is quite spectacular. We have about 35 clones of these deciduous azaleas and should have them available next year.

Another plant I would like to show you is a new magnolia from England called 'Leonard Messel'. It is a hybrid of *Magnolia stellata* and the flowers are really quite pink. I am propagating it and should have it available this spring.

Finally, I have a new rhododendron sent to us from Canada. It is a cross between 'America' and 'Dr. Ross'. It doesn't have a name but we are currently calling it "Ameross", just to have a name to put on the label. It roots very easily and grows vigorously. It buds heavily at the two-year stage but as yet we don't know how hardy it is.

Friday Evening, December 6, 1974

QUESTION BOX

The Friday evening session convened at 8 p.m. with Mr. Jim Wells, Mr. Edward Bunker, and Mr. Richard Martyr serving as moderators.

MODERATOR WELLS: We have a large number of questions to go through this evening and, in addition, some people have requested time to show some slides. We will begin this evening's program with a few general questions. Dr. Elton Smith, in your paper, was the fertilizer applied broadcast or band-placed?

DR. SMITH: The work I reported at these meetings was a broadcast application, but we have done it both ways.

BEN DAVIS: Dr. Smith, from your paper I understood that you're recommending only 3 lb. N/yr, but for shrubs you're going to 5 to 7 lb. N/yr. Why the lower rate for trees?

DR. SMITH: This is somewhat difficult to answer. At the higher rates, we had taller trees with darker green foliage and other "plus factors" but what really counts is caliper. The 3 lb. rate is based on caliper but I believe there is more to this than just caliper and we may have to look at some of these other factors in later studies.

MODERATOR WELLS: Dr. Noel Jackson, in regard to resistant pathogens — will alternating fungicides prevent or delay resistance build-up?

DR. JACKSON: Yes, this is the only way we presently have of avoiding the build-up of resistant pathogens and this is the recommendation which we're following.

MODERATOR WELLS: Case Hoogendoorn — dwarf *Viburnum carlesii* can be rooted but it is difficult to get it through the first transplanting and it's first year. Will you comment, please?