

A Look Ahead - Mass Propagation Of Hardwoods Asexually

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Before looking ahead, I suppose it is well to look back to see where we have been in the mass propagation of hardwoods. Basically for the most part hardwood propagation has been done by growing new trees from seed and to a much lesser extent by grafting and even less yet by cuttage and layerage. All methods of which have had their problems.

Seed propagation has had great appeal and has been widely and almost universally used due to the ease with which new trees can be produced and the abundant volume that can be achieved. Seed propagation has had its problems though. Frequently, difficult internal rests in seeds are encountered that are difficult to break or which do not respond well to the same treatment year after year. This may be due to inefficient and variable treatment methods or variability in the type or amount and depth of the rest. Another problem encountered is the variability amongst all hardwood seedlings in a population due to the lack of any type of pollination control. This results in a very high genetic variability or heterozygosity since almost all of our hardwoods are cross-pollinated. This allows for all types of growth habits and great variation in speed of growth and great variation in wood quality. Extreme variation in type is undesirable when using intensive and expensive cultural methods as it greatly reduces the production potential that could be realized.

Another problem encountered in seed propagation is the lack of a source of good viable seed that can be relied upon to grow. Obtaining good seed is frequently a hit and miss proposition due to inadequate or poor quality sources.

Grafting of hardwoods has a great many problems as well. It has had the usual problems, of course, of high labor input in performing the graft, exacting environmental conditions needed to get the graft to take, the growing anyway of a seedling population along with its aforementioned problems to use as understock for grafting, and precise timing of the grafting operation. All of these problems, plus in spite of all care in hardwood grafting, the very low percentage of successful takes which has added to the per unit cost of producing a tree that has been formidable when multiplied on a mass basis. Grafting has had great appeal because of the high uniformity that can be achieved along with the selectivity of tree type that can be exercised at the desire of the propagator or tree farmer,

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Layerage has had the same advantage of uniformity, but has probably had even greater problems in the economics of it. Although the Europeans have increased a good many difficult species by layerage in somewhat rather large quantities, it has not generally been practiced to any great extent for increasing hardwoods in this country. Generally, large areas of land are needed upon which to grow the stool blocks and only a relatively small number of layers can be made from an individual plant. Also, maintenance and cultivation of the area is made difficult by the layers. Layers generally take a long time to root besides. All of which adds up to low volume and high cost per individual unit produced.

Cuttings have had wide appeal not only for the uniformity that can be achieved, but also because of the ease with which a large number of cuttings can be made and the economical use that can be made of the cutting wood; thus, small sized blocks maintained for use as cutting material can produce large volumes of cuttings. For those species that will respond to rooting from dormant hardwood cuttings, these have been the most economical to use as only a short callusing period is required before lining out. Unfortunately, very few of our hardwoods show any tendency to root from cuttings of any kind, let alone dormant cuttings, even in spite of what we know about chemical root growth regulators and stimulants. Hormone and auxin treatments have generally not been successful in getting hardwood cuttings to root.

Now, let's take a look at what possibly can be done about better mass propagation of hardwoods. Since seed propagation has had wide appeal, it becomes quite obvious that the establishment of seed orchards would be highly desirable for several reasons.

1. Under proper isolation, pollination control could be exercised.
2. Since both the male and female parent could be controlled, only those individuals that are superior need to put in the seed orchard.
3. A reliable source of seed of good germination quality would also become available.

In conjunction with the seed orchard idea, some breeding work could be done to select out superior types and also to select lines that produce progeny of high superior uniformity. This would give almost the same uniformity that we now get from cuttings or grafting, but would be accomplished through the seed.

Another possible approach from the seed angle, is more work being done to establish lines that are highly apomictic such as our citrus or bluegrass. An apomictic seed is just simply a vegetative or asexual seed that produces an offspring just exactly like the mother plant. Some of the walnuts have been suspected as being apomictic. Apomixis also promotes high uniformity.

Grafting techniques of many types have been used to propagate woody plants. Many of them have been cumbersome, time-consuming and difficult to execute, besides not giving very good results. Grafting techniques need to be very simple in nature and easy to execute and at the same time give a good percentage of success. I have done some work myself in grafting hardwoods by the Nurse-seed technique. In this technique one grows or germinates seeds such as oak acorns for a few weeks. Essentially the technique is to take a dormant scion piece that has been wedge shaped at the base and insert it into the germinating seedling axis in such a manner as to replace the developing shoot or epicotyl on the germinating seed and seedling; then wrapping it and putting it away to callus for awhile. This technique shows promise of giving a good percentage of success and being quick and easy to execute. There are several modifications of the basic idea that may, also, prove useful,

I'm sure other grafting ideas will be worked out that are simple in nature such as a stapling technique with grapes.

I don't know that much more needs to be said about layerage, except that perhaps in very special cases more use could be made of it in this country than is presently being done.

With cuttings it appears that several things should be done. First, of all, we can definitely say that more good research work needs to be done on the understanding of the rooting mechanism and what stimulates it into activity or what holds it back. This would be especially helpful for our difficult to root species. Along this line it would appear that more work needs to be done on root cuttings. For example, propagators in Europe are using root cuttings extensively to propagate elm and aspen clones. It is well known that many of the apples can be propagated from root cuttings and I would suspect chestnut might be propagated from root cuttings. I have seen hickory propagated from root cuttings very readily. Root cuttings about the thickness of a lead pencil cut into 4-6" lengths are placed in moist peat moss to callus at warm temperatures for several weeks. After callusing has taken place, new roots and shoots will be initiated on the hickory root. Along this line of thought we need to take into consideration the breeder as there is no doubt but what one could breed and select for rooting ability. Chestnut is a prime example of this. I have had reports

of chestnut selections in Europe that will root as readily from hardwood cuttings as willow . Also, many of the hardwoods will root from stem cuttings readily during the first few years after growth from seed, but quickly lose this ability to root after two to four years This is especially true of the oaks and to some extent of some of the walnuts. Furthermore, I have no idea what the situation might be with root cuttings in the early growth of a tree from seed. Perhaps , propagation ability is retained for a much longer period of time by a root. In other words , more work done on the understanding of juvenility and maturity in stems and roots would also be quite beneficial.

In the years ahead hardwood trees may be multiplied asexually by various tissue culture techniques . Researchers working in California and Wisconsin have been able to successfully propagate oak, orange and aspen by this technique. Tissue culture will, no doubt, be useful for culturing the embryos of difficult hardwood tree crosses so that further breeding work can proceed. Tissue culture may also be useful in producing haploid trees from pollen grains which can later be used in further breeding work.

In 1952 the University of Wisconsin compiled a report on Forest Tree Breeding in Sweden and other European countries This is almost 20 years ago and most of these tree breeding stations had been in existence in the 30's before World War II. There were 1.1 tree breeding stations mentioned in this report in 52. I doubt if we could find more than 2 or 3 in this country today actually doing work on forest tree breeding at the present time. Hopefully, more attention will be devoted to the genetic improvement of our hardwoods.