OPPORTUNITIES AND NEEDS FOR IMPROVEMENT OF NORTHEASTERN HARDWOOD SPECIES

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With such an all encompassing title as has been assigned this talk, I can suggest a dozen other tree improvers who should be giving this paper. I should have asked them all to write such a paper -- then we would really have a start on the opportunities and needs of hardwood improvement. Personally, I feel a bit out of place suggesting tree improvement programs to the NEFTIC group. That's somewhat like inviting a spinster to speak about planned parenthood. Pardon me for such an unfortunate comparison, I certainly hope this will be more productive.

As part of my work in the Northeast Area, I have discussed the improvement of hardwoods with foresters, tree improvers and the general public. Individuals are often quite emotional about some favorite species and what traits should be genetically altered. These discussions are the basis for my talk today. I will just mention the species and characteristics that are most prevalent in Northeastern thinking, with no pretense to detail just how we should go about improvement. If I have neglected to mention the species you are working with or omitted one that deserves intensified efforts, please accept my prior apologies and make your suggestions and criticisms known.

At best, we can expect to improve a species only to the extent that may already exist as natural variation in individuals or such as may be introduced through hybridization. Our present lack of information regarding genetic traits and the range of existing variation represents one area of opportunity (3) (4). We should select, study and bring together all sorts of interesting individuals exhibiting economic and biologic extremes.

The areas which offers the greatest possibilities for practical improvement include:

A. Stem form, with such contributing factors as apical dominance, straightness, number of branches, branch angle, size of branches, some other less obvious traits such as dormant buds and sub-surface defects.

B. Improved growth rate and vigor.

C. Wood pattern or structure, including figure, twist and spiral grain (2), wood density and cell structure.

D. Resistance to damage by frost, insects, disease, snow and ice, wind, sunscald.

If we consider particular species for each of these general areas I think we can develop additional interest and deeper meanings. As time permits we could well discuss priorities by species. I would appreciate your comments.

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Apical Dominance .--When considering species that maintain a strong tendancy toward a single, dominant stem throughout the crown one might list sycamore, sweetgum, European black alder, tulip poplar and many poplar hybrids. While these species often exhibit ideal apical dominance there is still room for improvement. Individuals exhibiting this trait are much more co non than those found among birch (1), elms, oriental chestnuts, or walnuts. I don't think improvement will be any easier for species expressing strong apical dominance, we may however find plus phenotypes sooner.

A major problem appears to be the failure of most of our planted hardwoods to maintain apical dominance. We need to know the reasons for this loss, since this affects straight stem form.

Multiple terminal buds often contribute to the formation of large irregular branches or multiple stems. A tree may show desired recovery after the loss of one terminal bud but produce multiple leaders at several other points. We need trees that regularly form a normal, single, terminal bud and after being subjected to mechanical injury demonstrate their ability to suppress other buds in the adjacent area. Such recovery of the dominant bud must give rise to a leader free of sweep and crook. Ideally a few years' growth should cover any evidence of a previous abnormality.

Straightness .--Here is a most important characteristic and certainly an easy one to judge. This trait is strongly influenced by mechanical injuries and the individual's response to damage as was previously noted. Most progeny tests demonstrate straightness to be strongly inherited. Such an opportunity cannot be overlooked. Selections should be free from crook, sweep and lean. We need to seriously reconsider any individual that isn't straight. After all if a tree isn't really straight, we have weakened our position by including a crooked tree.

Number of Branches .--This seems to be one type of variation that could be advantageously utilized. Certainly I don't want to imply that thin, loose crowns should be selected. However, the density of the crown should depend on numerous second and third order branchlets, not a preponderance of branches on the bole.

Epicormic sprouts are also considered under this trait; such sprouting varies greatly by individuals. In dense stands this tendancy may not be expressed. I would suggest we screen our selections for such sprouting. The plus tree should be encouraged to sprout by releasing it from crown and root competition and by pruning mechanically (perhaps up to half of the live crown length). This treatment may eventually become standard silvicultural practice in hardwoods. I believe this to be a valid and worthwhile test to aid in selecting mother trees.

A list of the chief offenders -- species that represent our greatest possible gains over epicormic sprouting includes: white oaks (in fact any oak), tulip poplar, maples, yellow birch and black cherry.

I would like to point out the strong influence height growth-rate has on the number of buds and branches per unit length of stem. Let's assume the number of buds on next year's leader is already determined in this year's terminal bud (excluding the chance of damage or a second flush of growth). Let's compare one individual that grows five feet during each year with a tree increasing only a foot in height each year. Assuming normal development, the slow grower would take nearly five times as long to reach a given height and probably set five times as many buds within that stem segment. Even if all these buds do not develop many will continue as dormant buds, able to sprout when .properly stimulated.

Branch Angie .--This opportunity for improvement is bound up with size and number of branches. Just a few generalities "other factors being equal) should be noted. Acute-angle branches tend to break under snow and ice loads while flat branches often appear to slough off the weight. Acute branch stubs seem to exhibit a higher incidence of infection after breakage. Under normal stand conditions acute angle branches persist longer before they are shaded out, therefore the resulting logs tend to exhibit larger knots than flat-branched trees. This is accentuated during processing as acute angle knots are cut diagonally rather than straight across.

Size of Branches .--Once again nearly all species could stand improvement for this trait. Certainly small-branched selections should be sought out -- but not at the expense of growth rate. Larger than average branches may be tolerated or even necessary if we desire rapid growth. This would be especially true if our selection exhibited far fewer than the average number of branches. I would rather prune a few heavier limbs mechanically than many fine ones.

Except for stressing the need for additional studies, we must look carefully for evidence of dormant buds and sub-surface defects in all our selected individuals.

Growth Rate .--Fast growth seems even more desirable in hardwoods than in softwoods; many products of many species of hardwoods may actually improve when grown rapidly. Rapid growth-rate is often overlooked in the scramble to locate a "quality selection". Additional stress should be placed on this aspect. Vigorous trees tend to be less susceptible to attacks by pests or extremes in moisture or temperature, Although we can't forget quality in our haste to produce cellulose, neither should we sacrifice growth to our bias for "pretty trees" (fine-limbed, small-crowned, self-pruned, straight boles that had no place to grow but up).

Growth differences become even more apparent in plantations. The need to bore to the pith to determine age may also be avoided; just bore a prize hardwood and you soon incur all sorts of wrath!

Wood Pattern and Structure .--This area for improvement of wood traits requires some type of destructive sampling to reach into the tree and down to the cellular level. Studies are needed to determine the cause and the effects of formations such as gelatinous fibers, tension wood, and shifts in springwood/summerwood ratios. A program for genotype preservation should be set up so that a tree which may be harvested or die unexpectedly is still represented as a clone and able to serve as a breeding parent.

Resistance to Damage .--If the letters of inquiry that cross my desk are any indication of the general public's concern for tree improvement, chestnut would be far ahead as the preferred species. This closely follows the number of articles found in popular publications. Personally I feel this to be a very pressing need and we should yield to it. Dr. Jaynes might not agree with me, but I would think we might find contributions and funds relatively easy to obtain for continued chest nut breeding. Certainly most old-timers have strong sentiments about this; they hope for breeding efforts to produce resistant hybrids. Based on some of the more promising individual clones, we may not be too far from reaching our goal.

The American elm is another species seriously threatened by disease. A cooperative international effort with sufficient funding should enable us to create a suitable hybrid elm substitute for our native species. Our black locust should be improved so as to be less susceptible to the locust borer. Black walnut and sycamore sources less susceptible to anthracnose might show a marked improvement in growth rates. Black walnut, yellow poplar and sweetgum sources should be selected to include resistance to frost damage. Some improvement might come from individuals that break dormancy later in the spring.

Priorities .--Another method for placing priorities on particular species could be based on the quantities of hardwood nursery stock produced. If this were the case we should be spending our time on such species as black locust, European black alder, poplar hybrids, and pioneer white birch species. Most of these hardwoods are grown in Pennsylvania for spoil bank revegetation where they will have to endure extreme temperatures, great exposure and low pH. Other widely grown nursery species include black walnut, Chinese chestnut, cottonwood, tulip poplar, sweetgum. If we took the buyer's needs to heart we would consider the seed source. We would refrain from collecting bushy, hedge-row trees or risking our luck by purchasing seed on the market. Whatever the species we should be working actively at its improvement not just talking.

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