FOREST PRACTICE AND TREE IMPROVEMENT IN THE NORTHEAST

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The Silvicultural Background

If the benefits of genetic improvement of tree species are going to find their way into application in the forests of the Northeast, it will, in general, be necessary to follow silvicultural pathways different from those that are fashionable with hard pines in the Southeast. It is almost axiomatic that the use of genetically improved material depends on the planting of nursery-grown stock. Financial success with planting of trees for wood products is most likely to be achieved with species, usually representing very early successional stages, that grow rapidly in the juvenile stages. Most, but not all, of the species looked upon as valuable in the Northeast are of middle or late successional status; they are adapted to establishment as advance growth, grow slowly when young, and show most rapid growth at some later stage. Conversely, most of the pioneer species, such as gray birch, pin cherry, pitch pine, and aspen, which are the northern successional counterparts of loblolly and slash pine, are viewed as little better than weeds.

Tree improvement involving loblolly and slash pine looks so promising in the South that it has become too fashionable to accept the customary silvicultural procedures for these species as the means by which all genetic improvement of the forest should be carried into application. The southern pines naturally grow in pure, even-aged, single-canopied stands. After drastic site preparation or the hot fires which they are adapted to follow in nature, they grow rapidly in height and quickly surmount the rest of the vegetation.

If the same procedures are to be imitated very precisely in the Northeast with reasonable promise of early recovery of the high initial costs, it will be necessary to use species with rapid juvenile height growth such as the exotic larches, red pine, the true poplars, jack pine, pitch pine, and the hybrids of pitch and loblolly pine. These changes in species would be technically feasible, but it seems doubtful that they would be universally desirable in terms of the overall strategy of forest management.

Regional economies tend to specialize in activities that they can do better than those of other localities. In the case of the Northeast, greatest comparative advantage appears to lie in the production of long-fibered softwood pulp from spruce and fir and in the variety of wood products that can be manufactured from the diffuse-porous hardwoods typified by birch, maple, and beech. In view of the greater severity of the white-pine blister-rust in other regions, it seems logical to anticipate that similar regional advantage could be derived from growing soft pine products from eastern white pine. There is no great point in joining competition with the South and Northwest in supplying large

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quantities of dense softwood of high strength; it is not easy to beat the southern pines and Douglas-fir as far as these characteristics are concerned, and that is what we would be trying to do with the exotic larches and hard pines. The Great Lakes Region already has a corner on the aspen market and nobody seems disposed to alter the situation.

The kind of "scorched-earth" silviculture that is useful in establishing pioneer species has some important shortcomings as far as the Northeast is concerned. The initial costs would be higher than they are in the South and West. Most of the soils, certainly those of New England and the mountainous areas, are rocky and not well suited to the machines used for site preparation and planting. The climate offers far fewer days when prescribed burning could be conducted. The drastic disturbance necessary to eliminate the well-high omnipresent advance growth would encourage the vigorous weedy pioneers at least as much as it would the planted species. The need that would exist for controlling such species as gray birch and pin cherry in connection with planting represents an added cost of establishment which has no real analogy in the silviculture of southern pines. Finally, there would be the very real and growing problem of convincing a skeptical public of the virtues of truly complete clearcutting and site preparation in a region where such unsightly activities are not demonstrably essential.

Silviculture in the Northeast is built around ecological concepts and circumstances different from those of other parts of the country. Within the region they are accepted as so much a commonplace matter of course that those who follow them tend to be surprised and inarticulate when faced with what is to them an astonishing need to explain and justify them. Most of the valuable forest species of the Northeast are preeminently adapted to becoming established as advance growth capable of vigorous response to release upon the removal of the trees above them. A climate favorable to the regeneration of a profusion of species has created a situation in which reliance can ordinarily and sometimes too blithely placed on the pre-existence of a new and desirable stand under any stand that might be cut.

Reliance on advance growth reaches the ultimate in the sub-boreal red spruce--balsam fir type of the Northeast. Here one can cut the larger trees periodically almost ad _infinitum_ and, given a moderate amount of solicitude in skidding, the seedlings and saplings of the lower stories well up from below on demand. It is easily possible to start over again with heavily cut stands that are still the equivalent in tree size to 15-year-old plantations. If one cuts really clear, eliminates the advance growth, and plants, he may very well find the planted trees lost beneath pin cherry or mountain maple that will set things back 15 years or more. There is scant basis for any notion that Northeastern paper companies should clearcut and plant spruce and fir for pulpwood simply because they do so with hard pines in the South.

About the same situation applies to most other forest types. Most, but not all, of the valuable species of the northern hardwood type and those of the misnamed oak-hickory type depend upon advance growth. White pine develops best from advance growth deliberately developed through variants of shelterwood cutting. The genetical improvement of trees, like other aspects of silviculture, is not an end in itself. The most important reason for planting improved genetic material is that, if one has reason to plant, it is folly to use anything but the most suitable genotypes available. In most stands in the Northeast there is more to be gained by the proper tending and thinning of overdense stands of natural reproduction than by wiping the slate clean and starting new ones.

So far, I have painted with a broad brush in an attempt to indicate why the application of genetics in Northeastern forestry has not commanded the enthusiasm accorded it elsewhere. If the situation is examined in more detail, there is reason to believe that tree improvement, while not a universally applicable tool of silviculture, could commonly be as valuable as any others that are used.

Opportunities for Application of Tree Improvement

Conventional Planting

The most important reasons that exist for conventional forest planting in the Northeast lie in the reforestation of wastelands and in the conversion of hardwood stands on unsuitable sites to conifers. Most of the planting of the past has been done on abandoned agricultural lands and there are but few limitations on the kind of conifers that can be grown on them. The reforestation of spoil-banks, borrow-pits, and the highway cuts and fills that modern society seems to produce in alarming amounts calls for at least as much ingenuity as can be mustered.

A major part of the clearcutting and planting of southern pines that has taken place recently has not been in the replacement of good stands but in the conversion of derelict hardwood stands. An analogous situation exists in many parts of the Northeast. Good hardwoods are in such short supply that we have come to realize that there is not much virtue in converting stands on good sites to conifers. However, the region abounds in sites which support hardwoods but not in the style to which we would like them to be accustomed. In the spruce-fir region there are large areas of the mixedwood type that now produce modest amounts of low-quality hardwood and scattered softwoods of good vigor. These sites, which are too wet for acceptable hardwood production, are more productive for spruce and other conifers than the even wetter kind of natural softwood sites. Farther south a similar situation exists on many dry or moderately dry sites where oaks now abound but where white pine and other conifers would grow almost as well as they do on the best sites. In other words, the region has more millions of acres of hardwoods than of good hardwood sites. The correction of this situation calls for a substantial amount of planting, and the use of genetically improved planting stock could greatly assist in providing a badly needed increase in the reward to such costly endeavors.

Innovations in Planting

Where type conversion or true reforestation is involved, it is logical to anticipate that many of the stands would be of pure composition, especially if the sites were poor enough to render hardwood control comparatively easy. On the other hand, there are many sites, including some of the very best, where the planting of genetically improved material could be made more feasible if we broke out of the stereotyped idea that all planted stands must be pure or even composed entirely of planted trees.

Foresters shy away from planting in the Northeast mainly because the establishment and care of conventional plantations is very costly. Even in the South, planting is coming to be increasingly expensive. Part of the reason why we think of planting as costly is simply because we usually work ourselves into a trap by planting 800- 1,200 trees per acre when we can bring only about 600 at best, and sometimes as few as 150, to merchantable size. We could cut the per-acre cost substantially if we more often switched to the approach of the mixed stand and did not condemn ourselves to planting a lot of trees that serve only as trainers and die of suppression or, worse yet, hamper the growth of the trainees after the purpose is served.

If we only planted the limited number of trees that we really wanted to form the main crop or first crop of large trees, and used the natural regeneration to act as trainers, we would not only economize on planting but we would also reduce the need for precommercial thinnings in the overstory species. The question of whether the subordinate species were cut back or left to grow after the harvest of the planted trees of the main canopy would depend on the potentialities of the subordinates for additional useful growth. This strategy could be made to work only if the planted species were of distinctly more rapid juvenile height growth than the subordinate species. If the initial difference in growth rate were not large, the whole effort might become bogged down in ruinously expensive release work.

The planted components of such stands would seem amply worthy of efforts at genetic improvement and the benefits of such efforts would come faster simply because of the limited numbers of plants required per acre. Most of the species involved would be those which behave as emergents in present forests. In the northern hardwood forest, the promising emergents would be white ash, paper birch, and black cherry. In more southerly areas where oaks predominate, yellow-poplar, black walnut, and a blight-resistant hybrid chestnut would have suitable attributes. However, in these and many other forest types, success would depend on proper control of the fast-growing stump-sprouts of other hardwoods.

The exotic larches should be promising candidates in association with a wide variety of other species, including hardwoods. Red, jack, and pitch pines can keep appropriately far ahead of some conifers. White pine would develop as an emergent only in association with spruce, fir, and hemlock; it would have to be suitably resistant to the white pine weevil and, in the more northern localities, to the blister rust and the pine-spruce aphid, <u>Pineus</u> pinaea. Most forest types which are characteristically of mixed composition include promising species which behave as emergents, although a species which is an emergent on a given kind of site and in a specific part of its range is not necessarily an emergent elsewhere.

Another way of eluding the high cost of planting is direct seeding. In the vast majority of species, however, this would be a profligate waste of the costly seed produced in carefully tended seed orchards or seed-production areas. Nevertheless, there could be exceptions. The small seeds of the birches, for example, are produced in great abundance and are easy to establish by direct seeding. It would seem possible that genetically improved birches could be established at reasonable cost by direct seeding even if each pound of seed was costly to produce.

<u>Total-Tree Concept</u>

The time-horizons of tree improvement work are long enough that it is perhaps prudent to put a few bets down on the kind of nearly complete wood utilization envisioned in the experiments with sycamore silage in the South and the "total-tree concept" which Professor Harold Young, of the University of Maine, has been promulgating. I have the impression that the sycamore silage scheme tends to involve sites that society could put to better use either in agriculture or in the production of kinds of hardwood timber that are already in short supply. Our forest soils may hold up better if one were content with snipping the trees or brush off at the base. In any event, this general approach should be most productive with kinds of woody vegetation that can occupy the growing space almost continuously, and that have foliage of high photosynthetic efficiency. The logical rotations would probably terminate shortly after the time the lowermost foliage began to succumb to shade. American beech would be an excellent species for this purpose if the appropriate technology appears. Since it regenerates from root suckers, full occupancy by very dense stands is almost continuously possible. It is very shade tolerant and, therefore, presumably of high photosynthetic efficiency. Such other root-suckering species as sassafras, the aspens, black locust, and sumac could be suitable possibilities; at least none of these are as demanding with respect to soil conditions as sycamore.

Reduction of Losses

If we may return to less distant visions, it is significant that some of the important forest trees of the Northeast are so plagued with pests that reductions in damage through genetic improvement would be advantageous even if moderate reductions in growth were associated. Existing silvicultural and chemical means of controlling the white pine weevil are cumbersome at best and, in the central part of the range, the damage is severe enough that it is difficult to stimulate enthusiasm for growing this traditionally valuable species. White pine is one of the fastest growing species of the spruce-fir country yet its culture is almost totally discouraged by blister rust and the pine-spruce aphid. The growing of balsam fir is rendered very precarious by the triple threat from early heart-rots, spruce budworm, and the balsam wooly aphid. The reinstatement of a hybrid substitute for the American chestnut in even a few of the oak forests of the Northeast would have advantages distinctly more important than providing an answer to the classic query, "Do you think the chestnut will ever come back?"

Finally, it is worth noting that shade trees are fully as important to people as trees for forest products. The loss of the American elm to the Dutch elm disease has done as much as anything to harm the visual quality of life in the cities and towns of the Northeast. If that were not loss enough, we are now beset with the serious consequences of the susceptibility of maples to damage from the salting of roads.

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There are really plenty of challenging opportunities for useful application of tree improvement in Northeastern forests. However, this application is not likely to be achieved through exactly the same silvicultural procedures that have proven effective elsewhere. The notion that improved genetic material must always be planted in pure stands as if it were hybrid corn may simply be just an unnecessary stumbling-block in the way of progress in tree improvement. Practically all silvicultural management based on blind adherence to standard operating procedure has come to grief sooner or later. The use of genetically improved trees is not likely to be an exception. While we need to be wary of elegant variation as an end in itself, we have to strain our powers of analysis and imagination to cope with all the problems encountered with changes of time and place.