

TREE BREEDING AS A FOREST MANAGEMENT SUPPLEMENT — ECONOMICAL, SOCIOLOGICAL, AND ECOLOGICAL CONSIDERATIONS

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To set the stage for my remarks, I would like to tell a story I recently heard. The top management of a large corporation has just ordered installed two IBM machines in the accounting department. Two middle-aged men — the office manager and his assistant — received the news with some misgivings. They felt that things were progressing well in their office; the accounting was being done adequately at an acceptable cost by a room full of attractive secretaries. As these men viewed the attractive labor force, the manager was overheard to remark to his assistant, "Do we really want to replace all this with a computer?"

There are several aspects of this story that might apply to the many forest industries and foresters: (1) change comes more frequently from top management and usually for economic reasons — less often for sociological or ecological reasons; (2) lower echelon personnel are often reluctant to change because things are satisfactory as they are; and (3) many of us are locked into a stereotyped notion of what an office should be like — or of what a tree, a board, or fiber should be.

It should be no surprise to most of you here when I say that the forest industries have always been interested in tree improvement — in reverse order to what most geneticists consider as tree improvement!

In 1605, Captain John Weymouth of the British Royal Navy nosed his ship into one of the harbors of what is now the coast of Maine. His men cut samples of northern white pine timber, which he took back to England. Captain Weymouth's efforts to inform his countrymen about the quality of the timber in North America were highly successful — especially with the

Royal Navy. Suitable trees in the New England forests were marked with the king's broad arrow and thus reserved for the exclusive use of the Royal Navy (Simmons 1949). Thus began industry's interest in the superior tree!

The search for and the use of the superior tree by industry throughout our history, for legitimate and commendable reasons, also led to the reduction of a desirable genetic base from which to perpetuate our future timber supplies and continues today in many areas. The term for this rather distasteful timber harvesting technique is "high-grading."

Like the office manager and his assistant, forest industries and foresters have responded to and accepted change only when they have found it economically necessary. Large-scale planting was not undertaken until the lack of wood resources became a very real possibility. Innovation in logging techniques came on the scene only when the economics of wood production dictated a change, or because the lack of labor made it physically impossible to harvest a sufficient quantity of wood. The same might be said of tree improvement; acceptance by industry and foresters resulted when it became economically attractive or necessary, or because a potential shortage of raw material required a new approach to plantation management. Dr. Ernst Schreiner advocated and promoted tree improvement and breeding in the New England area 30 to 40 years ago. But industry's tremendous capacity for innovation in utilization standards that would make the plentiful lower grades of fiber more acceptable made tree improvement unattractive then. Apparently, the same situation holds true today. Dr. Schreiner

wrote me “. . . the growth potential of the present forest is sufficient to supply the needs of the north-eastern industries without the need of silvicultural management; taxes are so low that there is no need or incentive to invest in silvicultural or tree improvement practices that could increase the per-acre production of fiber and timber.”

Dr. Robert McElwee of the Virginia Polytechnic Institute, Blacksburg, Virginia, recently wrote me concerning his efforts to set up a cooperative tree improvement program in Maine. “Primarily for the north-east, and I suspect also the Central States, the main hindrance to any meaningful tree improvement is economics. By this, I do not mean that growth rates are so slow that tree improvement is not justified, but rather that land-holding patterns are such that despite sizeable outputs in terms of paper and other products, increased production is not needed and cannot be justified where other production costs also increase. For example, Maine produces sizeable quantities of paper annually as well as many other forest products. Ninety percent of the timberlands in Maine are in eight owner-ships, the largest being 2¼ million acres owned by one company. It is easy to see that with minimal growth rates of ¼ to ½ cords per acre annually, and many sites far exceed this, cut is under growth. Currently in Maine, cut is 60% of growth with natural regeneration and 70 - 90 year rotations. Similar cut-drain ratios are found in other New England states and to me there is no way to justify additional expenditures for any silvicultural practices, including tree improvement.” Does this cut-drain ratio apply to the North-Central Region?

The rather substantial strides in cottonwood culture in the Mississippi Delta came about as a necessity to generate local fiber and eliminate excessive transportation costs. Fortunately, tree breeders and tree improvement specialists had many of the necessary answers to start an operational tree improvement program.

The Texas, Florida, and N.C. State University programs were established in the 1950's at the specific request of industries who came to the universities and asked them to undertake a cooperative effort. To quote Dr. Zobel, Director of N.C. State University Cooperatives, “The Cooperative Tree Improvement Program was initiated in 1956 at the School of Forest Resources at N.C. State University at the request of 11 pulp and paper industries. There are now 22 members. Though the cooperative was initially an industry program, the

state forestry organizations of North and South Carolina and Virginia requested to join and were admitted.”¹ The story on southern hardwoods is similar —

“During the past decade, two factors have largely been responsible for intensified interest in southern hardwoods. First, the quality of hardwoods have been depleted to the point that the demand can no longer be met; and secondly, advance technology within the pulp and paper industry has made hardwood pulp a necessity instead of a liability for the manufacture of specialized products. As a result, the hardwood cooperative was formed in 1963 with 10 charter members. . . . The present membership is 17 industry cooperators and one state forestry organization. Perhaps the greatest impetus to the success of the Tree Improvement Programs has come from the members of the cooperative themselves. Dozens of special studies have been initiated dealing with all facets of tree improvement. . . . These made possible research results and information useful in forest management and mill operations that could not have been otherwise available. The activities of the program can be broadly described as follows:

(1) Applied tree improvement involving seed production, seed orchard establishment, and genetic improvement of trees used in regeneration.

(2) Research on wood qualities, wood variation, and inheritance.

(3) Training of graduate students, accompanied by research activities of a very diverse nature, from theoretical quantitative genetics to seed orchard management.

(4) Basic research on inheritance, quantitative genetics, population genetics, speciation, wood properties, and others. (*Note the priority.*)

“The tree improvement program is a mixture of applied and basic research. Impressive results have been obtained in a short period of time because the program has a central theme: IMPROVE PINE BY WHATEVER METHOD POSSIBLE.

¹ *Tree Improvement Short Course, North Carolina State Univ. at Raleigh, Jan. 1971.*

"The objectives of the hardwood research program differ markedly from those for which the tree improvement cooperative was formed. The reason for this divergence is that hardwoods had been ignored over the past half century while basic information on regeneration, management, yields, and inheritance patterns were being obtained for the southern pines. Consequently, it becomes necessary to derive basic information before any program dealing with hardwood tree improvement can be launched. The basic philosophy of the hardwood research group, however, is to discourage deep involvement in hardwood tree improvement until basic information is obtained."¹ McElwee emphasized this last point with reference to New England —

"The second deterrent (is), despite all the ballyhoo to the contrary, (that) very little meaningful research is available as background with regard to species, site quality, soils data, and other types of information necessary before tree improvement can be meaningfully implemented."

Dr. Ray Goddard of the Florida Tree Improvement Cooperative says: "In my opinion, tree improvement is attractive to industry only when they are involved in large scale artificial regeneration. A few companies will support basic research on a limited scale but widespread acceptance comes when they can see rather direct application to their own needs. In any region with little or no intensive management, or where primary dependence is on natural regeneration, there is little incentive for support of tree improvement." The N.C. State Cooperatives discourage participation unless landownership totals a minimum of 200,000 acres.

So, as in the case of the IBM machines and the secretaries, economies must be apparent and the physical base must be sufficient (but not too large) to justify a change — in this case, tree improvement.

To paraphrase Gertrude Stein: a tree is a tree is a tree is a tree. And like the office manager, foresters are reluctant to change because things are progressing as they are. Many of us are content to produce the same old tree in the same old way; we are locked into a stereotyped notion of what a tree is and how we should plant, grow, and harvest it. If we get fiber, fine; if we happen to reap a little grade so much the better. Philip Larson, Chief Research Plant Physiologist, Rhineland, Wisconsin, puts it very nicely (Larson 1972):

"Unfortunately, our forestry traditions regarding the growing, harvesting, and utilizing of trees have not left us in such a favorable position to cash in on the green revolution sweeping agriculture. We are still pretty much dependent upon the tree nature gave us. Even today, our concept of an ideal tree is essentially an imitation of the ideal tree growing in a natural forest. Because of past tradition of timber abundance, we haven't felt the need to really put our imaginations to work to seriously consider how we might alter or restructure a tree to produce more wood."

I have been, and am, an advocate of agri-forestry — the use of agricultural land for the production of fiber and quality along with food crops, if necessary (White 1971). The economical, sociological, or ecological considerations have not made this practical yet, but these pressures may require such intensive use of land in the future. It seems to me that the sooner we embark on an agricultural type of forestry program, the better acceptance we may have by the environmentalists. We may be permitted to utilize our professional knowledge to provide them with the things they will not do without. I see no reason why foresters should not consider growing wood on agricultural ground; the farmer, the horticulturist, and the orchardists do not rely on wildland to produce consumer needs — nor does society expect them to! So all we need now is for Phil and I to get together — he with his nontraditional concept of tree growth, and my heretical suggestion of the use of agricultural land — and we could make a significant contribution to future wood requirements.

Using these concepts, I can visualize tremendous increases in wood productivity, a considerable reduction in land base with consequent savings in taxes, transportation, personnel, and harvesting costs. What might the economies be if, instead of our traditional dependence upon whatever wood fiber is available, a mill could count on fewer species, genetically tailored for the product, and intensively planted, cultured, and harvested? How much does it really cost industry to harvest, transport, and utilize the myriad of species from far-flung, unmanageable holdings? Agri-forestry would permit the ultimate in the utilization of personnel and resources — possibly to the point where fiber could be planted, grown, and harvested on a 24-hour-a-day basis, utilizing all the benefits of fertilization, irrigation, and genetically improved stock. The forest fiber land base could be greatly reduced and yet produce a greater volume of wood. Surplus lands could be devoted to other uses, and we would perhaps be able to

relieve social and ecological pressures while making economic gains. Tree improvement in the South was conservatively estimated to make genetic gains of 5 percent, but indications at this point are that gains are in the 10- to 15-percent range.

Agricultural forestry is not such a far-out concept. In the South we are only a step away, and most of the tree improvement work is confined to lands that are intensely managed and cultured. Historically, much of the present acreage devoted to forestry was agricultural land that came to us because of past abuse and subsequent abandonment. I am certain we cannot depend on this type of salvation in the future!

In 1966 I made a simple survey of five Central States forest industries asking for remarks for the 5th Central States Tree Improvement Conference. In essence, I asked what the present and potential interest might be for the use of improved planting stock. In a nutshell, the replies followed this vein: We cannot economically justify a tree improvement program because we do not own land or contemplate owning land, and the short tenure of farm ownership negates any tree improvement gains that would accrue when providing improved stock to the small landowner. The price that we are able to pay for wood does not justify the farmer's use of improved planting stock, and we lack the basic silvicultural knowledge to utilize improved planting stock even if the landowner were interested in growing timber. All firms agreed that genetically improved stock would ultimately result in reduced costs to the mill due to the uniformity of raw materials.

For this paper, I resurveyed those same companies — I have nothing encouraging to report now. One is no longer purchasing wood; ecologically induced economic pressures dictated other methods of production using another source of raw material. Essentially, the response is as follows: We have an interest, but not an active one. Corporate policy is not to own land. This rules out any long-term program such as tree breeding or tree improvement because we lose control when improved stock is outplanted on lands not owned by our company. Our lack of enthusiasm in sponsoring the tree improvement program is also due to the fact that there are Forest Service Experiment Stations throughout the country who do this type of research, and also to the economic squeeze.

As an employee of one of those mills in 1966, I made this comment (White 1966): "In addition to and concurrently with the development of superior trees.

increased research is required in the mechanics of site preparation, planting, and the culture of trees. The improved stock will be of little value if we do not know how to, or cannot afford to, plant and care for it." My remarks then hold for today — tree improvement must be a total program of mechanics, biology, and economics if it is to be accepted and utilized. As Webb (1972) has pointed out, "Do not expect selection and breeding to make up for poor nursery management, poor seedling handling, and poor planting methods."

To summarize, tree improvement and tree breeding will be utilized by industry when they can be economically justified (don't call us, we'll call you). They will be utilized when raw materials are in such short supply that there is no other recourse (crisis oriented), when landownerships are sufficiently large (not too large) for intensive management, when large-scale planting is the norm rather than the exception, or lastly, if and when sociological and ecological pressures give us no other alternative (help us, what do we do now?!). The surveys I have made and the comments I have heard from others indicate to me that this will be the pattern for the development of a tree-improvement program. Until refined forestry practices are necessary in any given area, the people involved in tree breeding and tree improvement can make the greatest contribution by developing a complete program of applied and basic research that can be implemented when the call comes. A research program must start with the nursery and seed source and proceed through the final crop, always stressing the economic values to be gained. Sell the top management on the merits of tree improvement and work intimately with the field forester. His understanding and acceptance of research activities are necessary to the implementation of research findings. Studies that approach operational size will minimize the stigma attached to the greenhouse and pot culture, looked upon by many field foresters as being entirely impractical and therefore nonoperational.

I would hope that these comments and observations, although rather bleak, will offer you some guidelines for the development of meaningful tree-improvement programs acceptable to the industry.

To conclude, I would like to quote from a letter I recently received from Dr. Bruce Zobel:

"The major change in the attitude of tree-improvement programs has been the switch in the attitude of tree improvement as a research effort to an operational level. Now all members

of the cooperatives put it on the level with site preparation, nursery operations, or planting; it is purely operational. Economically, it has been shown to be one of the best investments in forestry operations.

"The theme of our co-ops has been industry participation. Instead of their giving us the money and having us do the work, we ask only for enough funds to do guidance and analysis and the members do the work. This way they feel a proprietary attitude about what is done and they look upon the activities as "our program" rather than "the" or "a" program. If someone has to go out and beg the industry to support a program, it is certain to fail. The need and the enthusiasm must come from the members of the co-op."

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