

TREE IMPROVEMENT AND ENVIRONMENTAL FORESTRY

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I was invited to talk to you about some of the things tree improvement can do to help our forest environment. Now I do not claim to have a corner on the market for ideas that geneticists can use in our environment, and I know that a number of scholarly papers have been presented previously on this subject.

For example, the 1968 program of the Sixth Central States Forest Tree Improvement Conference, held at Carbondale, Illinois, concentrated on improving ornamental trees and shrubs. In fact, one of NEFTIC's staunch members, Henry Gerhold, gave a paper at that Conference on breeding ornamental Scotch pines for resistance to air pollutants (Gerhold and Palpant, 1968).

Way, way back, Ernie Schreiner (1946) spoke to members of the National Shade Tree Conference about problems of growing trees in the urban environment. He spoke of selection and breeding for improving the tolerance of trees to the harsh soil and atmospheric conditions found in urban areas.

In those early days, Schreiner talked a lot about a national "Shade Tree Service" and about the need for genetic improvement of urban trees. And speaking to the New Jersey Federation of Shade Tree Commissions (1966), he coined a term-- "amenity trees"--which brings up the subject of my presentation for today: the amenities or those benefits to man that are derived from trees.

THE FOREST ENVIRONMENT

However, before I get on the subject of amenities, I would like to talk about our environment a bit--particularly here in the densely populated coastal corridor of the Northeast. Even though people live literally everywhere in this area, over half of the land is still forested or covered with trees.

We have a great resource of trees here, which are a vital part of the human environment. Our concern should be to better utilize, protect, reinforce, renew, and improve this resource. And along with this concern is the need to consider the social and economic aspects of the environment as related to the amenities, aesthetics, recreation, water, and other benefits derived from trees and forests the populated areas.

Our forest environment, in the face of machines, highways, housing, power plants, airports, industries, and cities, is a fragile resource. We have always had physical destruction of forests, even from the earliest Colonial days. But now we have an even more insidious destroyer in the form of air pollution--which worsens as the years go by.

To me, it is apparent that air pollution cannot be allowed to continue increasing as it has. As foresters and biologists, we cannot stop it by breeding

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trees. However, I am confident that during the next few years our colleagues in other sciences will devise ways to stem the tide in the battle against air pollution. It will never be eradicated, but it can and must be controlled.

We can help maintain and improve our forest environment by conducting research on the various aspects of this environment. And, tree improvement for resistance to air pollution is one of the ways we can help, as well as tree improvement for the amenities and aesthetics--and against insects and diseases.

FOREST ENVIRONMENTAL RESEARCH

Many universities, industries, and public agencies are conducting research today that directly or indirectly adds to our knowledge about the forest environment. I would like to describe a special effort that the Forest Service is making here in the Northeast.

On July 1, 1970, the Northeastern Station embarked on a new venture, a research program called the Pinchot Institute of Environmental Forestry Research. The objective of this new program is to determine how trees and forests in the densely populated areas of the Northeast can best serve the needs of the people without destroying the forest environment. Are we giving adequate planning and attention to obtain the fullest value of these trees and the other elements of this environment? How can the forest environment improve the quality of urban living?

The Pinchot Institute is an organization or consortium of a dozen or more leading northeastern universities and the Forest Service. An environmental forestry research program, funded by the Forest Service and planned by the consortium, will be conducted partly by the universities (with grants) and partly by an in-house research program at the Northeastern Station. Research programs by the Institute will include:

Improving amenities derived from trees and other forest vegetation--including the role of trees and forests in reducing noise, temperature, air movement, and air pollution.

Protecting trees from destructive actions of man and other agents--including insects, diseases, fire, and the physical impact of man.

Genetic improvement of intensively used forest vegetation in urban areas.

Landscape tending and the management of ecological systems.

Improving recreational opportunities and benefits in forests accessible to urban centers.

Improving municipal forest watersheds and their management for urban water, recreation, and other uses.

Improving wildlife habitat for spectator enjoyment--with emphasis on nongame species.

And, improving decision-making models involving social and ecological analysis of forest vegetation in these areas of increasing human pressures.

THE ROLE OF TREE IMPROVEMENT

Now I come to tree improvement and its role in the forest environment. There are many ways that genetics can help the forest environment. By selection and breeding we can improve the survival and growth of trees in the cramped, toxic, and xeric soils often encountered in urban areas and along highways. Similarly, trees can be selected and bred for resistance to various air pollutants, and to diseases and insects that may become effective because of a predisposing effect by air pollution. Some of the more common and serious air pollutants that affect trees are sulfur dioxide, ozone, nitrogen oxides, fluorides, and PAN (the photochemical peroxyacetyl nitrate).

It is well known that some individual trees are naturally more resistant to a specific air pollutant than other trees in the same stand. This fact points the way for careful selecting, testing, and breeding of trees for specific air pollutants.

Then we can turn things around and ask what effect trees have on reducing air pollution. Trees take in CO₂ and other gases from the atmosphere and emit air that is richer in oxygen--and with less of the other gases that may be undesirable, like SO₂ and the nitrogen oxides. If geneticists can develop trees more resistant to air pollution, will these trees also be more efficient at removing the same pollutants from the air without serious damage to the trees?

Another form of pollution is noise. Studies have shown that noise in some urban areas and along thoroughfares is a serious problem. And though direct engineering attacks on these problems are a must, trees and other forest vegetation can reduce noise levels significantly. For example, studies by the Forest Service in New York State² and on the Great Plains³ show that, on the average, a 100-foot strip of trees will reduce noise by 6 to 8 decibels. And, it is known that different species, densities of stands, and combinations of trees and other plants affect the level of noise. It also seems likely that selecting and breeding trees might also result in additional significant noise abatement.

Tony Federer⁴ has estimated that evapotranspiration from one well-watered tree produces a cooling effect equivalent to 10 room-size air conditioners operating 20 hours per day. And, because of the lack of trees in most cities, the presence of heat-absorbing buildings and streets, and the greenhouse effects of air pollutants, the air temperatures may be up to 20 F higher in cities than in nearby forested parks or woodlands. Trees also affect the air temperature by shading or preventing the sun's rays from reaching the ground and by re-radiating energy back to the atmosphere.

I am not quite sure in my own mind just how a geneticist could improve trees to make more efficient air conditioners out of them. But, I will throw the problem out to you for what it's worth.

² Leonard, Raymond E. Forests and noise abatement paper presented at the National SAF meeting in Philadelphia, October 2, 1968.

³ A preliminary report of a study conducted by the University of Nebraska and the Forest Service, USDA. February 1970.

⁴ Federer, C. A. Reduction of summer city temperatures by trees. Paper presented at the National SAF meeting, Philadelphia, October 2, 1968.

LITERATURE CITED

- Gerhold, Henry D., and Edgar H. Palpant. 1968. Prospects for breeding ornamental Scotch pines resistant to air pollutants. Proc. Central States Forest Tree Improv. Conf. 6:34-36. Carbondale, Illinois.
- Schreiner, Ernst J. 1946. Tree breeding for desirable qualities and disease resistance. Proc. Nat. Shade Tree Conf. 22:56-59.
- Schreiner, Ernst J. 1966. Guidelines for selecting and producing genetically better trees for street and park planting. Proc. N. J. Fed. Shade Tree Comm. Ann. Meeting:38-43.