

THE COOPERATIVE INDUSTRY-NORTH CAROLINA STATE  
TREE IMPROVEMENT PROGRAM

Dr. Bruce Zobel, Professor, Forest Genetics  
R. C. Kellison, Liaison Geneticist  
North Carolina State, Raleigh, North Carolina

Introduction

There is so much activity in the Cooperative Program that it is difficult to know just what to cover in the 15 minutes allotted. No matter what approach is taken, however, the Tree Improvement Program will have a real effect on nurseries and nursery practices. In the first place, we have found a nursery-seed orchard combined operation to be the most efficient. Use of nursery equipment and manpower in the nursery program can well be dovetailed in the seed orchard operation. As more valuable seed is produced, nursery operations will have to shift to make maximum use of each seed available. This may well mean more care, wider spacing in the nursery, and handling larger plants.

The Cooperative Program

The Cooperative Program was initiated in 1957. It is now composed of 16 industries with land holdings in 10 states, as well as two state forest services. The objective includes the development of strains of trees with desired characteristics and to produce seed of these strains on a commercial scale. Improvement consists of both yield and quality--in fact, the more important objective is to improve tree quality. A third objective is to produce trees better adapted to grow economically on poor or marginal sites or under severe conditions of insect or disease attacks.

What Has Been Accomplished

It gives me pleasure to be able to get up before this group and report, not what we hope to do but what has been done. In our few years of operation, the Cooperative Program has established seed production areas of loblolly and Virginia pine and Fraser fir; however, the major effort has been devoted to the establishment of over 60 separate seed orchards on 750 acres, potential capacity of these orchards is about 300,000,000 trees annually. These orchards contain trees of a number of species of pine, including loblolly, pond, Virginia, slash, longleaf, shortleaf, white, and even a few pitch pine for hybridization purposes. Action has now been taken to start a Fraser fir orchard for producing seed for Christmas trees. In addition, orchards of sweetgum and yellow poplar were started but were taken over by the Hardwood Cooperative Program under the direction of Bob McElwee.

Some of the older seed orchards are coming into production and we expect this year to get over two million seeds. Total production will build up rapidly and in the next couple of years a significant amount of the planting done by the industries will be from seedlings produced from seeds from the orchards

We (meaning all of us in forest genetics) now have enough data on inheritance that we can confidently speak of gains to be expected. Our ideas of predicted gains when the program was started now appear to be much too conservative. For example, we talked about gains in yield in the order of 5 percent--recent data indicates it may well be 10 percent and certain studies have shown yield gains even higher. Yields from wood improvement have been much greater than hoped; for specific gravity alone, gains in yield from the seed orchard can be from 50 to several hundred pounds a cord. Additional improvements such as tracheid length are considerable and very important but it is difficult to put a monetary value on them.

Improvement in tree form, especially bole straightness, is considerable. The numerical values for improved limb size, limb angle, or pruning **ability** are not available but progeny tests indicate that real good improvements may be achieved. Improvements in drought and cold resistance have been good and we are most optimistic about better disease resistance (especially for fusiform rust). There are indications that more efficient strains of pines exist that produce "more with less" or that take fuller advantage of fertilizers, as Dr. Davey outlined.

All told, the gains as we see them now have exceeded our fondest hopes. Those already definitely proven will more than pay for the cost of the tree improvement effort.

#### Problems

One never undertakes anything new without encountering problems. Most aggravating and serious is graft incompatibility. About 10 percent of all clones of all pine species used have shown some degree of incompatibility, from a small amount to 100 percent loss of the clone following grafting. We do not yet know how to combat this although some (but not nearly enough) effort has been expended. This problem has caused a great loss of efficiency in the seed orchard program.

Uses of chemicals for insects and weed control are a real problem. How much to use, when to spray, how to cut down costs plague us. "New" insects have appeared, ranging from a really "tough" scale to a small worm that apparently lives on female pine "flowers." Even though it seems every time we move some new disease or insects are found, it is not safe to use sprays blindly which have not been tested on pines. Weed killers sometimes don't discriminate only against weeds. Hurricanes, winds, hailstorms, and especially unseasonal freezes all are problems similar to those encountered in any orchard.

We have learned the hard way--do not put a seed orchard on too good a site nor put it north of the species range. Grafting is not simple; each species and each new orchard site brings up its own set of problems. Cone harvesting methods, both safe and efficient, have not been determined. These and many other problems face us daily.

### New Trends in Industry Affecting the Program

Many changes in forest management or forest utilization have profoundly affected the Cooperative Tree Improvement Program. For example, since direct seeding has been adopted as a standard procedure by several companies, size of seed orchards has been drastically increased which, in turn, has necessitated the revision of progeny testing. The general shift of interest to more pine species has been very important in the program. For example, in our area of operations much less emphasis is being placed on slash pine and much more on longleaf pine. The "lowly" Virginia pine has now come into its own with six seed orchards now established and large planting programs underway. Pond pine is receiving increased attention. Each of these species presents new problems and new challenges.

The increased emphasis on wood quality and high-grade and specialty papers has caused industry to re-evaluate certain of their objectives. Working with wood is not simple--each industry has its own formula for desired wood qualities, and each seed orchard is oriented in that direction. Important wood qualities have been found to be strongly inherited, making this a very fruitful approach. Many very large wood studies are underway and major species are under scrutiny as to desirability and yield under different conditions for different products. Many straight genetic studies of wood qualities are under way, ranging from specific gravity to cellulose yields.

With increasing interest and reliance on seed orchards, industry is undertaking more intensive management of the seed orchards. Fertilization and irrigation are being given good tests as well as other cultural treatments to stimulate seed production and health of the grafts. Each of these steps is a "shot in the dark" with no previous experience on which to rely but of major interest to operation of a seed orchard in an efficient manner.

### All! Progress

Despite all the problems and changes, progress has exceeded our fondest hopes. We will flounder under certain conditions, and we will make mistakes, but the Tree Improvement Approach is here to stay--with its resultant effects on regeneration practices including nursery procedures.

DISCUSSION TO: Bruce Zobel

- Q. You didn't mention anything about resistance to insects, I wondered if you have found any correlation between - say a genetically superior gum-yielding tree and resistance to insects?
- A. (Zobel) No, the only work of any amount that has been done on insects has been done on the tip moth. We were right in the middle of that when I left Texas--trying to determine why some trees are more susceptible to tip moth than others. Then the bark beetle--there is some pretty good indication that the kind of gum, I don't know whether it's the amount or kind of gum, makes a certain tree more resistant to a certain kind of beetle than others. The field of insect resistance is untouched. We have practically no work being done on it, or if there is any, it's so young that we don't have anything about it yet.
- Q. Is there any concern in the trees that are being grafted, with respect to the wind-throw, as they get larger and larger?
- A. (Zobel) No, we have found that there is concern that the trees would be weak and break at the graft union. Actually, the graft union itself is stronger than the tree. If you take the tree and cut it at this section and try to break it, it always breaks either above or below the graft union. Now, there has been some wind-throw when the people have grafted on potted stock and planted the potted stock and it didn't have normal root development. But, our program has mostly been on either nursery or field grafted stock. One of our orchards had 2 hurricanes go over it in a matter of 2 weeks, 100 mph, and out of about 60 acres, we lost about 7 trees. These trees broke off above ground. They did not blow over. Some of the other orchards that the hurricanes hit had been derived of the potted stock--they were all laying down flat. But, there is nothing inherent in grafting that makes them blow down easily.