SEED CERTIFICATION AND PROGENY TESTING

Clayton E. Posey, Assistant Professor
Department of Forestry
Oklahoma State University, Stillwater, Okla.

SEED CERTIFICATION

According to the statements of the International Crop Improvement Association, the purpose of seed certification is to maintain and make available to the public sources of high quality seeds and propagating materials of superior varieties, so grown and distributed as to insure genetic identity. Only those varieties that contain superior germ plasm are eligible for certification.

Our past mistakes in seed collection and seed movement between geographic areas continues to yield "sour grapes" as far as rate of growth, form and susceptibility to various damaging agents are concerned. Most foresters are aware of the consequences of poor seed practices, but this awareness does not necessarily eliminate the poor practices. As an example, just last year an industrial organization bought shortleaf seedlings from Oklahoma and planted them 800 miles east of their native habitat. This occurred in spite of the fact that there was a shortleaf seed source plantation in the area of the industry's holdings which indicated rather plainly that Oklahoma shortleaf was far from being the best for that area.

In many cases, a lifetime is required to grow a mature forest. If we use the wrong seed we must live with that mistake for a lifetime or suffer the expense of a new start. There is no place in the economic world where care and absolute integrity are more essential than in the production of forest tree seed (4).

Whatever the method or procedure used for seed certification, the first requirement will have to be that the majority of seed and seedling users actually want certified seed (4). However, when we begin to produce certified seed it will only be as good as the honesty and integrity of the seed producer.

The German seed certification law of 1934 required owners to eliminate stands and individual trees of undesirable races, to use only seed from certified forests or stands, and to refrain from using, selling, or giving away seed obtained from undesirable stands. The law further provided heavy fines or imprisonment for infractions, and stipulated that no one would be compensated for losses resulting from enforcement of the law (1).

In this country the production and use of certified forest tree seed is strictly voluntary. Several states, including Oklahoma, now have forest tree seed certification standards. Certification should first consider climate or point of origin. It should then consider tree form, growth rate, wood quality, and resistance to various damaging agents. Most certifying agencies consider several classes of forest tree seed as follows:

1. Seed from proven seed orchards.
2. Seed from unproven seed orchards.
3. Seed from wind-pollinated plus trees.
4. Seed from seed production areas.
5. Seed from high quality stands of specified geographic source.

When our thousands of acres of seed orchards get into full production and we begin to get substantial progeny test information, seed from seed production areas and from good stands of known geographic source will probably not qualify for certification.

Many certification standards include requirements for seed handling, germination, purity, etc. They also include provisions for inspection to insure that the certification standards are being followed.

The certifying agency should also state the age at which a trait is certified. For example, a particular clone might be certified for superior growth based upon 10-year-old progeny. The relative superiority may change with age so that the same clone certified at age 10 would not qualify at age 50.

PROGENY TESTING

Statements that seed or seedlings are "superior" are meaningless. Superior for what trait? Superior to what? How much superior? We must have positive identification of this superior germ plasm to know its value. The purpose of a progeny test is to evaluate the parents based upon the performance of their offspring. Progeny tests may be either wind-pollinated (one-parent) or control-pollinated (two-parent) tests.

Some organizations have gotten into tree improvement without realizing all the potentials and in some instances the costs. It is felt by some people that when the seed orchard is established all is well. Let us take a quick look at the three initial stages at which we can make gains in tree improvement.

1. Selection of superior phenotypes and establishment of a seed orchard.

2. Progeny testing and resultant elimination of clones not genetically superior.

3. Determination of specific and general combining abilities for each clone.

It is felt by many geneticists that the potential gain is much greater through progeny testing and utilization of combining abilities than through phenotypic selection. In short, an expensive seed orchard without follow-up with sound progeny testing is a poor investment.

General combining ability is a measure of the average performance of a clone in a series of crosses. This tells us how well each clone will combine with all the other clones to give a better product from the whole seed orchard. Specific combining ability is a measure of the performance of a single specific cross based upon deviation from the average. General and specific combining ability are based upon individual traits, i.e., a given clone may have high general combining ability for straightness but low general combining ability for specific gravity. In forest tree improvement we can not afford to make rapid gains for one trait and lose in other important characteristics.

TYPES OF CROSSES MOST USED

The most reliable technique for selecting the genetically best clones in an orchard would be to make all possible individual crosses. This would involve $\frac{n(n-1)}{2}$ specific crosses where n = number of clones in the orchard. For a 25-clone orchard, this would require 300 crosses. This technique, called a diallel, would give complete information on general and specific combining ability and would give an estimate of inbreeding effects. Most organizations can not afford such a complete and detailed test.

The least reliable technique for selecting the genetically best clones would be the use of a mixture of pollen from several select trees. This would be the same as a one-parent progeny test because the male is not known. This type of test allows utilization of general combining ability only. It is the simplest, least time-consuming, least expensive, and yields less information.

A compromise between the diallel and the polymix would be the use of the tester method. Several of the best (usually 4-6) clones are selected and used as testers (males). Each of the testers would be crossed with all the other clones. This technique would give general combining ability and some specific combining ability because we would always know both parents.

As a personal opinion, any organization that uses a progeny test that yields only general combining ability will wish later that they had operated differently. This business of tree improvement will progress much farther than the seed orchard stage that we are in now, but we will probably use much of the same germ plasm for a long time. We need to know as much about the genetic value of our select trees as we can possibly afford.

DESIGN OF PROGENY TEST

Each progeny test must be designed to meet its own specific objectives and must run many years for complete evaluation. The primary requisite of a progeny test is that it be sound in statistical design, including replication and randomization. If all the crosses are not available in any one year, then replication in both time and space may be necessary. For long term tests, it is wise to have more replications to start with than is statistically necessary because replications may be lost over a long period of time. Except for unusual circumstances, it is probably best not to use square plots. Square-plot designs generally yield less information but cost more. A row-plot design with many replications requires fewer trees per cross, samples more of the site variation, and gives more information per dollar spent than the square plot.

An extremely good reference to follow for minimum progeny test requirements is provided by the Committee on Southern Forest Tree Improvement (3).

CHECKS FOR COMPARISON

We must include check material in a progeny test to know what our clones are superior to and to what degree they are superior. Many of our important timber species vary with latitude, elevation, rainfall, and other environmental factors. This variation requires that we test our clones against local stock. The material to be tested must be representative of that which will be certified and the type of checks used to test for superiority need to be specified by the certifying agency. If a progeny test is not completely established in a single year, then a uniform check should be included to get a measure of year-to-year differences. One or more of the following types of checks would be included in most well-designed progeny tests.

1. Standard cross between specified clones.

2. Stock from seed production area seed.

3. Stock from seed drawn from a large lot representing the areas in which the test will be established.

CHOICE OF PLANTING SITE

The location of the progeny test planting site should be selected carefully. Since most tests will be long term, there should be surety of permanent ownership or a long term lease agreement. Accessibility of the site and security of the planting should also be considered. The planting site should be as uniform as possible because the more variable the site the more replications required for a sound test and thus greater cost in planting, maintenance, and measurement.

NURSERY AND CULTURAL PRACTICES

It is extremely important for survival estimates ar.d for evaluation of juvenile traits that all material be grown and handled in a systematic manner. All stock, both test and check material, should:

1. Be grown in the same nursery.

2. Be grown in replicated plots within the nursery.

3. Receive the same cultural treatments.

4. Be lifted, graded, handled, and planted in the same manner.

In most instances, the spacing of the planting and the cultural practices applied to the progeny test stock should be the same as will be recommended for the certified stock. This requires considerable forethought as to what management practices will be 10 to 50 years in the future.

CHARACTERISTICS TO EVALUATE

The decision as to which traits to evaluate should be made before the design of the test is definitely established. For example, some traits, such as figured grain or stem straightness, can be evaluated without the use of checks. The minimum age for trait evaluation should also be established (2). Based upon present knowledge the following characteristics could be considered for evaluation in the southern pines. Other traits may be added or some deleted depending upon the objectives of the organization conducting the test and the species involved.

1. Diameter and height.

2. Crown characteristics.

3. Limb angle and limb diameter.

4. Stem straightness.

5. Pruning ability.

6. Wood characteristics (specific gravity, tracheid length, and wall thickness).

7. Resistance to various insects and diseases.

8. Resistance to drought.

RECORD KEEPING

Adequate records should be taken to ensure that there is no loss in economically important traits that are not being considered for certification. Such a loss should be made known to the purchaser so that he can weigh it against the gain for the certified traits. For example, if a 'strain of trees has an increase of 40 percent in resistance to a disease, but simultaneously a reduction in growth rate of 10 percent in volume, the buyer should be informed that he can expect a smaller volume growth in return for the increased resistance to the disease (2). Complete records must be made available to the certifying agency before they can certify the seed. Another reason for having complete, accurate records is that most tree improvement programs are designed to yield small improvement in many traits. These small gains in many traits when added together yield an appreciable difference in financial yield over the rotation age of a forest. Very few foresters can tell a 10 percent difference in limb diameter, volume, or any other trait just by observation when many replications are involved. Records must be kept in a systematic manner to insure that they will be useable several decades hence.

PLACE OF NURSERYMEN IN SEED CERTIFICATION AND PROGENY TESTING

As stated previously in this discussion, certified seed will not become a reality until the users of seed and seedlings see the need of high quality stock, and then demand that it be provided. This places the nurserymen right in the spotlight. If seed and seedlings are of low quality, who gets the blame? If there are methods to make seed and seedlings better and the methods are not utilized, who gets the blame? You are right, you get the blame. Tree improvement programs offer the nurserymen a real opportunity to excel in a fairly new endeavor. At least 10 of the southern state forestry organizations have tree improvement programs underway. Many of the forest industries that have nurseries have given the responsibility of tree improvement to their nurserymen. Those of you who are not involved in tree improvement probably will be in a few years. The user of your product will demand certain quality. If you cannot meet the demands, he will go elsewhere or, in some instances, he will do the job himself. I am sure, however, that you can and will meet the challenge.

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Discussion

COMMENTS (Farmer). I think in hardwoods we are going to use a little more primitive method. We won't be doing any two-parent progeny testing in oaks. For 5 to 10 years, we are going to rely in a very basic way on the one-parent progeny test.

COMMENTS (Posey). The difficulty with hardwoods is that each group of hardwood is just as different from the next group of hardwood as pine is from hardwood.

Q. (Williams) How do you get around the problem of maintaining a uniform check material over a period of years?

A. (Posey) Normally, as the crosses for the progeny test are made, additional crosses are included to provide uniform check material. For example, one might choose to cross tree number 10 with tree number 18. The resultant seedlings from the cross (10 x 18) would be used as a genetic or uniform check to be used in each year's plantings, thus providing a comparison between years.

Q. (Cloud) In the nursery production of these progeny test seedlings, if you have some areas of seedlings that demonstrate a chlorotic condition, would you top dress the chlorotic seedlings with a small amount of fertilizer or would you have to apply that same amount to all the progeny test seedlings whether they need it or not? By the same token, would you have to apply irrigation water to all replications whether they need it or not?

A. (Posey) Progeny test seedlings should be grown in as uniform an area as possible, and replicated. It is best not to have one replication in an area where they are unhealthy and another replication in a distinctly better location.

Q. (Cloud) If you do have that condition existing, would you apply or top dress all the progeny test seedlings?

A. (Posey) I believe I would.

COMMENTS (Farmer). If it's replicated this would be taken care of.