METHODS OF MEASURING SEED QUALITY

Rodger Danielson
Seed Laboratory
Oregon State University
Corvallis, Oregon

INTRODUCTION

My talk today deals with methods of monitoring seed quality. By the time seed arrives at the seed laboratory for routine testing the quality of that seed lot is largely already determined. Today I would like to acquaint you with various laboratory tests available which can be used to monitor seed quality at any point in the process from cone collection through extraction, drying, processing and storage.

Seed quality begins in the field. In the case of tree seeds the "field" is quite scenic.

In a way of review, the factors affecting seed quality can be grouped under the broad headings of environmental, biological, and mechanical. Some of these controlling factors, such as weather, are beyond our control. Others, such as moisture and storage temperature, are easily controlled. We should be aware of how seed quality can be influenced and be ready to avoid those conditions which have an adverse affect on seed quality.

Seed quality is normally expressed in one of the following ways. Purity relates to mixtures of species which can occur in the field or in the processing plant. Levels of inert such as pitch, cone scales, etc. may also adversely affect seed quality. Germination is probably the most important aspect of tree seed quality and is one which is easily affected by poor cone collection practices, poor drying, processing or storage conditions. One very important aspect of tree seed quality is vigor. A good measure of tree seed vigor is speed of germination, which is necessary for producing good stands in either the greenhouse or nursery bed. Seed size is often indicative of high quality seed, but not always.

There are five laboratory tests which measure seed viability, directly or indirectly. I'd like to review these tests with you and comment briefly on each.

The germination test is the basic test used to evaluate seed viability. Seeds are planted under controlled conditions of light and temperature and the percentage of seedlings germinating are determined. This test may not relate to field performance, unless the conditions of the field are controlled to match those of the germination test. I would expect that greenhouse production would relate better to laboratory germination than nursery production. One disadvantage of the germination test is that it is slow. On the other hand, the germination test can provide you with a measure of dormancy and vigor -- both of which are important measures of seed quality. Germination reports from our laboratory show weekly counts under both stratified (chilled) and non-stratified (check no chill) conditions. By comparing total germination at any given count with other lots, you can soon develop a knowledge of which lots are vigorous and which are not. The degree of dormancy is measured by the performance of the seeds under chill and no chill conditions. Dormant seeds germinate slowly without chilling prior to germinating.

Tetrazolium testing has been practiced in the United States since the early 1940`s. It is a chemical test in which live tissues stain red and dead tissues remain unstained. TZ testing of most forest tree species can be conducted within 48 hours, which makes this the quickest of all "quick tests" for measuring seed viability. I believe that one application of the TZ test would be to monitor seed viability prior to cone collection. This has not been extensively done, but the process could save large amounts of money and time if the seeds were found to be dead or otherwise damaged. This would require that one of the field foresters be trained in the TZ technique. He would sample cones prior to collection and make an on the site evaluation of quality. Another possibility would be to collect the cones and send them to a laboratory for seed extraction and evaluation.

Hydrogen peroxide testing was developed for tree seed testing by Ching and Parker in 1958. This is a very simple test to perform, but is not as rapidly conducted as the TZ test. Seeds are soaked in 1% $H\ 0_2$ after cutting the radicle ends. After 7 or 8 days roots will emerge and the seedlings are evaluated. Like the TZ test, this test could also be used to evaluate cone collection sites. I believe the best application of this test is in lieu of a germination test when time does not permit a complete germination test. For instance, if you wanted to evaluate certain lots prior to nursery sowing and only had a week, this would be a good test.

The excised embryo test is the most difficult to perform. It can be completed within a week, however, which makes it a useful quick test. Embryos are removed and placed under controlled conditions of light and temperature. Viable embryos will elongate slightly and their cotyledons will enlarge and turn green. Because this is a true growth test, it is preferred by some over some of the other quick tests.

The x-ray test may be the most useful of any test for evaluating seed quality. It provides six estimates of quality including the following three estimates of seed development: normal development, questionable development and abnormal development. Abnormal development would include such things as reversed embryo, immature embryo, no embryo development, etc. In addition, the percentage of empty seeds, broken seeds and insect damaged seeds are determined. When used in combination with a viability test, the x-ray test will enable you to completely evaluate the quality of your seed lot. X-ray would be especially useful in evaluating cone collection sites and in monitoring various processing techniques for mechanical damage and success of removing empty seeds.

Fortunately, our laboratory has several large wind-pollinated seed collections of individual trees from local populations. The collection chosen for study is from 309 parent trees by Crown Zellerbach Corporation near Vernonia, Oregon, in 1966, which was previously reported in sane detail [1] and for which we have 10-year progeny measurements on six outplanting sites. Another collection consists of 15 trees near Sweet Bane, Oregon, repeated over 3 seed crops for which 15-seed samples were weighed. Fran these collections, most of the preliminary questions regarding sizing effects could be answered.

Procedures

Seed weights from the 15 open-pollinated trees in a natural stand near Lebanon, Oregon, were available to estimate how seed weight from individual trees varies from year to year. The mean of 75 seeds (15 from each of 5 replications) for each tree were graphed (fig. 1). The 1968 collection was ranked from highest seed weight to lowest, and collection years 1970 and 1971 were graphed over this ranking to show year-by-year variations. Thus, the variable outcome of truncating the array at any seed weight can be shown for families in this sample seed lot. Correlation analyses were used to determine between-year relationships for seed weight.

To determine genetic outcome of seed sizing, seed stores from 309 parent trees collected between April 12 and September 15, 1966, were available. This seed has been collected from wind-pollinated trees in a 35-year-old Coast Range stand along roads of the 80,000-acre (32 000 ha) Ed Stamm Tree Farm surrounding Veronia, Oregon. Evaluations range from approximately 400 to 1,700 feet (1200-520 m). Cones had been processed in 1/4-bushel (7.6 liters) lots with laboratory-scale equipment. Most of the lots had been cleaned to practically 100-percent full seed, but occasional lots dropped to 95 percent. A 100-seed sample of each parent had been weighed in 1966. The seed has since been stored in 3 x 5-inch (7.6 x 12.7 an) envelopes in cold storage at 0 F. Progeny measurements of total height and ground-line diameter were made on six sites in 1976.

1 Olson, Donald L., and Roy R. Silen. 1975. Influence of date of cone collection on Douglas-fir seed processing and germination. USDA Forest Service Res. Pap. PNW-190. Pac. Northwest For. and Range Exp. Stn., For. Sci. Lab., Corvallis, Oreg., 10 p.