Comments

Tree Planters' Notes

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Cover: Preparation for lifting at Elkton Nursery Oregon (photograph by the late Steve Omi, USDA Forest Service, Coeur d'Alene, ID).

The Value of Seedling Quality Testing

Ever since people began planting trees, it has been recognized that seedlings need to be in good condition if they are to survive transplanting and thrive afterwards. Deciding what constitutes "good condition" — and tailoring nursery practices to produce it— has been very much an art. When plantations failed and there were disputes between nursery managers and their customers over whose fault it was, it was one person's word against another's, with no objective way to settle differences.

In the 1920's, morphological grading standards were developed based on height, caliper, shoot-to-root (S/R) ratio, and lack of obvious deformity or mechanical damage. This was a major step forward, but it was still decades before the system was vindicated by sound field experiments. Questions like "How tall is tall enough?" or "How much survival do you lose if the S/R ratio is above a certain number?" had to be answered for many different species on many different sites in many different climatic zones.

Even then, there were unexplained failures of stock that had met all of the grading criteria. In the late 1950's, Ed Stone was the first to propose physiological testing as a means to measure the condition of seedlings to determine their fitness for lifting, storage, and outplanting. Since then, his "root-regenerating capacity" has evolved from something measured in a 28day controlled environment pot test to something measured in a 7- to 14day test in a mist chamber. Now known as "root growth potential" (RGP), it is regularly measured operationally, and the results can be in hand in time to make management decisions about the stock.

There is still much debate about the value of the RGP test, but one must keep in mind that every test is based on certain assumptions, and no single test will tell everything you need to know about the condition of a seedling. In this case, the big assumption is that when outplanted, a seedling has a limited time to make root contact with the surrounding soil, otherwise it will desiccate and die. In much of western North America, where most of the seedlings are spring-planted and summers are normally dry, that is a good assumption. In other areas where summer rain is reliable, it may not be.

In the last 15 years, other tests have been developed that measure different aspects of seedling physiology and rest on different assumptions about what seedlings must do to survive. One example is the chlorophyll fluorescence test. This measures the functioning of photosystem II, and it has been shown that a wide variety of agents can impair its function, including heat, cold, drought, and herbicides. The test can distinguish active, dormant, and dead leaves, and it can be run in a matter of minutes using portable equipment that in recent years has declined in price dramatically.

Another characteristic that is tested for is cold hardiness, which can be measured in a variety of ways. The one I prefer is by electrolyte leakage. This test can be adapted to any tissue in the seedling, can provide results within 3 days, and is precise and amenable to rigorous statistical analysis. The assumptions underlying this test are that seedlings must become hardy

enough in the fall in a timely manner to tolerate the lowest temperatures they will experience, either outdoors or in cold storage, and not lose their hardiness prematurely in the spring. In addition, experience has shown that cold hardiness is related to, and is a good proxy for, other important attributes such as RGP, bud dormancy, and general ability to tolerate environmental and mechanical stress.

Cold hardiness testing is coming into use operationally to determine in real time when seedlings are ready to lift and pack into cold, especially frozen, storage. The ability to measure the condition of the seedlings quickly will make it possible for nursery management to respond appropriately to year-to-year variations in weather and be able to identify damage if it occurs. Cold hardiness tests can also tell how well seedlings are maintaining their dormancy during storage, shipping, and outplanting.

With the ability to measure quickly— and not have to guess at— the condition of seedlings and their fitness to tolerate nursery operations, shipping, and outplanting, nurseries and reforestation programs are rapidly moving toward a firmer scientific foundation and better accountability in all phases, and away from being practiced as an art.

Richard W. Tinus
USDA Forest Service
Southern Research Station
Flagstaff, Arizona

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