MASS SELECTION IN NURSERIES

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This is a somewhat altered summary of a talk I gave at the Intermountain Nurseryman's Association meeting in Missoula, August 6, 1975. At that time I presented a review of some of the literature which made high intensity selection of run-of-the-mill nursery seedlings look very promising in terms of genetic gain. I've since seen more literature and talked to more people and I look at the picture quite differently now. With the extremely varied environments in the Rocky Mountain area, which are generally so different from the environments in nurseries, relative performance in seedbeds could change considerably before rotation age.

Mass selection or phenotypic selection (preserving apparently unique individuals from a large group for future generations) has been very successful with annuals. Selection in grains began at least three thousand years ago. Hanson et al. 1972, using recurrent mass selection developed resistance in two populations of alfalfa to three diseases and two insect pests while maintaining general vigor and genetic diversity.

But with annuals, the rotation is one year and the offspring environment is usually very similar to that of the parents.

So what about mass selection with young trees? Following are some examples and comments about mass selection of conifer seed, seedlings and saplings.

Most workers find seed source to be especially critical in an improvement program. Nanson, 1969, did a rather extensive review of work in nursery mass selection and found correlations better with seed from small localized sources than with a mixture of a group of sources. Squillace and Silen, 1962, in a test over a wide range of the ponderosa pine zone (Washington, Oregon, Idaho) show 36% of the variation within a plantation is due to seed source. The native parents in more moist areas with higher growing season temperatures produced the faster growing progeny.

A keypoint with mass selection from a large group of seedlings is the number of parents composing the seed lot. A squirrel cache collection may contain cones from only one to three parents. Without knowing what composes a seed mix while making a high intensity selection, one might end up choosing the offspring of very few parents. Genetic diversity would then be seriously reduced. It follows that it would be better to make sure a defined number of parents provide the seed for a seed lot. The more parents the better.

Another possible effect of the source is environmental preconditioning. Bidwell, 1975, points out that in certain plants, stress may produce effects that are carried over one or more generations and behave as if they were inherited factors. The genetic basis of stress response is

only now beginning to receive adequate study. Due to environmental effects on the metabolism, translocation, and growth of the parents, the composition of their seed may be subsequently effected. Thus, the experience of the parents may be transmitted to their offspring without the intervention of genetic mechanisms of any sort. Some of the differences we see in seedlings might be a reflection of environmental preconditioning.

A number of studies with many conifers have compared various characters with height such as seed weight, seed size, crop year and in germination date. Generally the evidence shows a good correlation with early height, but the correlation drops off rapidly after about age five.

Many southern pine workers have shown 2-0 height to be a fairly reliable indicator of mature height, where the environments of the nursery and plantations are similar.

A rather large test with ponderosa pine in 1935, Callahan and Hazel, 1957, included seven hundred parents and showed 38% of the variation in height at age fifteen could be attributed to the height at age two. The field plantation was very near the nursery however, with the environment quite probably very similar.

LaFarge, 1975, in recent work with loblolly and slash pines strongly suggests that field tests be run regardless of nursery performance. He suggests we might very well expect genetic differences expressed under optimum nursery growing conditions to be different from those exhibited in the field where trees are subject to more stress.

Brown et al. 1961, demonstrated differences in crown characteristics of loblolly pine expressed at an early age are affected too much by the nursery environment and approach uniformity after out-planting.

Successful mass selection is more likely in the plantation than at the nursery. Oliver and Powers, 1971, working with ponderosa pine found differences in height between future crown classes were small but noticeable in the sapling stage. The differences became progressively larger as the stands developed.

Steinhoff, 1974, suggests that for rotations of fifty years or more with western white pine or ponderosa pine, selection efforts would have low reliability at ages fifteen to twenty, but, the basic data indicates that culling of the poorest and saving the best could begin at age ten.

Intensively managed European forests are routinely overstocked (up to 4 M per acre) with selection for height as they are thinned. Weyerhaeuser is using this technique on some of their more productive coastal Douglas-fir sites.

We will see some interesting data in the future for ponderosa, lodgepole, and western white pine, where seedlings were measured in the nursery at age two, and out-planted to a number of planting sites where they have been for quite a few years.

Perhaps we can get into early selection in certain cases, when we have more data on nursery measurements and mature heights. For the present, however, the different nursery environment and the lack of correlation from early heights to maturity leave us somewhat in the dark.

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