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Selecting the Proper Seed Source of Ponderosa Pine

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A FORESTER faces many problems in selecting the proper seed source of ponderosa pine. He wants a seed source well adapted to all of the conditions of his planting site—one that can tolerate all of the extremes of heat, cold, and drought; that can resist the ravages of insects, diseases, and animals; that can produce the most of the desired product in the shortest time.

Where does a forester look for such seed? Usually he first gives the local sources the once-over. After all, they are cheaper to procure—no expensive travel. Furthermore, they are most likely to be well adapted to the local climate and living conditions. If he strays too far from home, he's likely to be tempted by some exotic sources. They may look good on their home grounds, but, alas, he's likely to be disappointed. Those extra nice features will not last or will not look so good when he takes that foreign stock home and compares it with the natives. At least, this has been the experience of foresters who imported exotic strains of ponderosa pine.

Seed source studies were started many years ago when Forest Service researchers installed plantations of many different ponderosa seed sources in northern Idaho, Colorado, Arizona, Washington, Oregon, and California. The design and completeness of these tests leave much to be desired. Yet, practically without exception they substantiate the old silvicultural maxim, "Local seed source is best."

Imports, more than natives, were prone to suffer from all factors of the planting site environment. Maladjustments to cold, heat, day length, drought, insects, diseases, and animals variously took their toll The result was reduced growth or deformed trees. On many sites, introductions completely failed. Foresters have learned from these tests to stay close to home when collecting seed of ponderosa pine.

Climate critically affects performance of ponderosa pine. Scientists recently have found that climates of seed source and of planting site should be the same. Specifically, two of my Forest Service colleagues, A. E. Squillace and R. R. Silen, have found temperature and precipitation to be critical climatic factors. These facts have emerged from their re-examination of the 30- and 45-year-old seed source plantations in Washington, Oregon, and Idaho. Their findings soon will be in print, but they have kindly permitted me to give you their highlights.

The trees in their plantations that grew most rapidly came from localities where the precipitation and temperature patterns match the climatic pattern of their planting sites. Squillace and Silen recommend matching seed source and planting site both for total precipitation from September through June and for seasonal distribution of precipitation—September-through-June as a percent of annual precipitation. Further, they recommend matching both the average spring temperature and the seasonal temperature spread—July minus January temperatures. How closely do they have to match? Exact climatic tolerances cannot be provided for the agreement needed between site of seed collection and of planting. If a forester finds major differences in these characters, he should beware. Remember, "local" sources should be best adapted to local climate.

Within the "local" area, the forester will want to choose the particular site from which seeds will produce the most rapid-growing progenies. In the mountainous West where ponderosa grows, elevation is critical in this regard.

The choosy forester will collect seed within 1,000 feet of the elevation of his planting site. Liddicoet and I have just completed an analysis that illustrates this point. We used 20-year data from a comprehensive study of the influence of elevation on ponderosa pine. This study, carried on at the Institute of Forest Genetics, included only trees growing on the west slope of the Sierra Nevada Mountains in California, but the results probably pertain to areas where ponderosa pines have an extensive and continuous elevational range.

Briefly, this is what we found. Seed trees growing at 1,000 to 2,000 feet elevation produced the fastest growing progenies at both a low (960-foot) and a middle (2,730-foot) elevation plantation. At 2,730 feet, growth rates of the different sources showed the greatest variation. Selecting a 5,000- or 7,000-foot source for this plantation would have led to a 13 to 22 percent loss in height growth in 20 years; the diameter loss would have been similar; the volume loss even greater. At the high plantation (5,650 feet) the high-elevation progenies have overtaken the middle-elevation progenies. Up to 12 years, the middle-elevation progenies had performed best. Now the high-elevation seed sources seem to have the most promise for the long run. Of course, it's the long run that interests a forester.

Maximum growth is not the only asset to be realized by the elevation-conscious forester. Using high-elevation seed sources for high plantations will help reduce the amount of lean and stem breakage of the trees. In the California test, low- and middle-elevation sources suffered considerably more stem deformities at the high-elevation planting than did local high-elevation stock. This probably is related to the stockier stems we found to be inherent to high-elevation sources. Low-elevation trees are inherently slimmer, giving them a higher form factor.

Our data did not indicate any relationship between elevation of seed source and offspring branchiness or needle retention. This does not mean that these two characters are not subject to genetic control. It does mean that the populations from each elevation had the same average expression. Selecting certain individuals at each elevation might help in the improvement of these characters.

This brings us down to selecting the individual. The forester searching for seed trees in the proper neighborhood has many personal preferences for individual characters. Most foresters have an ideal tree in mind. This may be one with the best size or shape for a particular product, or one hav-

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ing general desirability for many uses. Height, diameters, form factors, shapeliness of limbs, and many other features come to his mind. He has his ideal before him, makes his choice, and permits as few compromises from his ideal as possible. But as he does this, he probably will stop and ask himself, "Will the offspring be as good as this parent looks?"

Here research cannot come to the rescue with an answer. We have some long-term tests under way. These are designed to tell foresters whether selecting seed trees for growth, branch, wood, or other specific characters will pay. I might add that we have some tests and data available now on which to base the answers for ponderosa pine, but we do not have the money or manpower to crank out the answers. Most of our efforts in forest genetics research in the immediate future should be turned to studies of the inheritance of individual characteristics. Until we know the heritability of each character, our efforts to select and breed better trees will be blind shots in the dark.

Growth rate, branch and wood characters, and disease resistance are characters subject to genetic control. We may be able to select profitably for them in the future. Support for such a statement has been forthcoming from tests on other pines around the world. They lend encouragement. For some characters, foresters may be able to select ponderosa seed trees that will produce better than average offspring. For the moment, a forester working with ponderosa pine should not become emotional and let a nicely rounded, clear log, a high form factor, or a shapely limb raise his hopes too high. Remember that much of beauty is only "skin deep"; it is what is inside that counts. The geneticist's goal is to help you tell what is inside from a glance at the outside.

From what we know at the moment, this is what I would recommend. Collect seed within an elevational zone of 1,000 feet above or below your plantation site. I would not reach out more than 50 miles, certainly not more than 100 miles, within this elevational zone.[1] Actually, the closer to home the better. Pick seed from average or better trees. Do not let an easy conquest lead you to lower your standards. Pass up those easy-to-climb, cone-heavy trees outside your bailiwick. Most important! Plan ahead on the seed collection job. Do not be afraid to pay a few extra pennies to collect the right seed. Those pennies will multiply many times over during the course of a 100-year rotation. If I were you, I would give immediate thought to starting one or more small seed production areas on my own lands. You can afford to grow a few trees just for seed. Grow your own seed and be sure of an adequate supply of locally adapted stock.

[1]One might say that this is exactly what we have been doing for the past 20 years. In 1939 the U. S. Department of Agriculture approved a Forest Seed Policy that set up these same limits. Recommendations were best guesses at that moment. The facts now provide a sound basis for continuing our present practice. Twenty years from now, new facts may lead to more refinements.