FOREST TREE NURSERYMEN'S MEETING

AT THE
BRITISH COLUMBIA FOREST SERVICE - GREEN TIMBERS NURSERY

NEW WESTMINSTER, B. C.

August 12, 1952

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The meeting opened with a few remarks and words of welcome from Chairman Webster.

Chairman Webster: Now, in order to start the ball rolling today, we are going to call on Leo Isaac to discuss the advantages of carefully selected tree seed. It has always been a marvel to me that we spend as little time as we do to select the seed that we plant in a nursery to raise seedlings, and later spend anywhere from $15.00 to $25.00 per acre to plant our forest land. It then takes anywhere from 30 to 100 years to raise the trees, and yet so little time and effort is often used in selecting proper seed. I don't think we have anybody better qualified to bring this subject before us today than Leo Isaac. It is yours, Leo.

Mr. Isaac: I would just rather sit down here and tell stories and chew the fat for a while than read a paper, but he didn't tell us we were going to have ladies present. It is better to read my paper, I think. I will read it fast and then we can chew the fat afterwards.

THE ADVANTAGES OF CAREFULLY SELECTED TREE SEED

by

Leo Isaac

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The vast virgin forests of North America are gradually being cut away and converted into managed stands. The movement is well under way in the United States and advancing in the same direction in Canada. For the most part, foresters and timberland owners have been content to accept such regeneration as came in naturally regardless of parentage or even of species. For early artificial reforestation, any seed source was acceptable. But the rising costs of timber growing and increasing competition for land use have forced owners to recognize that it is necessary and profitable to secure the best seed for a given site.

Forestry is the last great industry based on a growing organism that has not improved the wild stock under management. The filbert grower does not go out and gather wild hazel nuts to produce his planting stock; instead, he buys the most highly developed strain of filberts he can find, that will thrive in his soil and climate. The same is true of the stockman, the farmer, the orchardist and the oyster grower. But the forester, for the most part, has not even learned to select the best of the wild strains or to match his seed source with his climate and soil.

The time has come when the importance of a forest nurseryman's work will depend upon the forest that is produced from the stock that he raises. His job should extend far beyond the weeding, watering and fertilizing of seedbeds. He should strive for the best seed obtainable for the stock that he produces.

Why Strive for Better Seed?

Normally the cost of seed is not more than 1 to 2 percent of the total planting cost per acre. Therefore, if the cost of good seed was double that of poor seed, the amount would still be negligible. In the long run, it costs practically as much to plant, protect and pay carrying charges on a poor tree or stand as it does on a good one. If an average stand will pay its way under management, a better stand is certain to pay a more handsome net return, and a poor stand is just about as certain to leave a forest-growing venture in the "red." One other point, if you plant the wrong tree seed, you will not detect it until it is too late to make a change and you are stuck with it for a lifetime. There are now upwards of 3 million acres of deforested lands in the Douglas-fir region in need of full or partial planting and each year's cut will leave a little more in the same condition.

Farsighted foresters at the University of Washington visualized this entire situation in 1946, and persuaded me to gather what information there was available on the subject. It was published in this bulletin in 1949, "Better Douglas Fir Forests From Better Seed."

What evidence do we have of superior strains of forest trees? What are the climatic limitations of different species? What is the difference in net return from seed from a good source or from a poor one? How important is all this to the nurseryman, the forester and the forest industry of the Northwest? How can we go about getting better tree seed? These are some of the questions we will try to answer.

Strains of Northwest Tree Species

Geneticists feel that it is no longer necessary to prove that there are superior (and inferior) races or strains of forest trees in our native wild stands. Strains may vary in tree form, growth rate, hardiness or other characteristics or a combination of them. Differences become so fixed that they are recognized as hereditary characteristics and will be transmitted to the seedlings produced. Variations in Scotch pine in western Europe are perhaps the best known, but there are many others.

To make it more realistic, I will cite evidence from our own species right here at home. In our Douglas-fir heredity study, seeds collected above Bridal Veil, Oregon, forty years ago have produced a young stand in the Wind River plantation just across the Columbia River (25 miles) that is one-fifth larger than the stand grown from seed collected in the immediate vicinity of the plantation. The Oregon seed was collected from a good stand while the Wind River seed was collected from a scrubby stand.

In our ponderosa pine test-of-strains plantation, there is one lot of seed from a slow-growing, brushy strain on the Steilacoom Plains below Tacoma, Washington, and another lot from a fine timber strain in the Willamette Valley above

Portland, Oregon. There is not a very great difference in climate between the two areas. At 22 years of age, the Willamette Valley trees, although a year younger than the others, are a third taller and have already lost their lower limbs. The Steilacoom Plains trees have rough boles and still have heavy limbs all the way to the ground.

When our Douglas-fir growth bulletin (No. 201) was published in 1930, 89 percent of the site I Douglas-fir was found below 1500 ft. elevation and none was found above 2000 ft. Since searching for superior strains during the past 2 years, we have located four areas where site I growth is occurring above the 3000 ft. elevation. These are superior strains without any doubt.

Climatic Limitations of Trees

From the standpoint of thrift and growth, climatic suitability is as essential as a good strain. When moved far out of their natural climatic range, trees not only make poor growth, but are highly subject to disease and insect attack, and mortality is high from these and other causes. There are countless examples in the literature, but for the sake of better understanding, I will cite cases from close at home.

Douglas-fir grows from sea level to timberline here in the Northwest, but the low elevation seed will not produce a good forest on the mountain top. At an elevation of 3000 to 4500 ft. on the Mt. Hood National Forest, a plantation was established in 1915 from seed collected at elevations below 1000 ft. This plantation has been freezing off regularly just above the snow line and is developing into a scrubby stand. An adjoining plantation put in a few years later from seed collected at a 3800 ft. elevation withstands the climate and is developing into a good forest.

Douglas-fir from Colorado seed, planted at the Wind River Arboretum at Carson, Washington, grew well at first, but gradually became affected by rabdocline, adelopus and the common diseases until all but two trees are dead at 35 years. Immediately adjoining, native Douglas-firs of equal age are healthy and twice as large. In the same Arboretum, lodgepole pine and Western larch brought from the Blue Mountains in eastern Oregon are practically dead, while the same species native to the vicinity are healthy and growing well.

But trees can be moved great distances with safety if care is given to climatic requirements. The classic example is the introduction of Monterey pine into Australia, New Zealand, South Africa and South America. It is healthy and making phenomenal growth in these countries. Douglas-fir, when by accident or design, is properly suited to a planting site, is outdoing all other species in European plantations in both volume and quality. The same is true of some of our other Northwest species, but for every successful introduction, there are many failures if extreme care is not taken to match climates.

Climatic Guides

We recognize that trees have climatic limitations and that there are superior strains and superior individuals to select from, but what can the nurseryman or seed collector do about it, what rules can he follow to get better seed?

Climatic limitations are recognized, but specific ranges for our species have not been worked out. Average annual and minimum temperatures and summer rainfall appear to be the most important factors. Based on European studies and practice and some observations here at home, a tentative scale has been set up for Douglas-fir that may serve as a guide until some more positive data is available. It is explained in detail in my bulletin, "Better Douglas Fir Forests from Better Seed." In general, it provides that seed should come from a site not more than 2° F higher or lower in average annual temperature than the planting site, and that the seed source should not be more than 500 feet higher or lower in altitude. Where a coast line or topography or other factors interfere, it may be necessary and desirable to use wider limits, but in the meantime, these guides set up safe limits within which to operate.

Maximum temperatures do not appear to be important, but minimum temperatures do. Trees moved to a climate with more than a few degrees colder minimum temperatures are often killed off by frost when winter temperatures are colder than the average.

Comparable rainfall just prior to and during the growing season is far more important than equal annual precipitation.

Selecting Superior Stands and Elite Trees

Identification of superior stands or superior individual trees is a more intangible factor than the determination of climatic limitations. But a recent group of visiting American foresters report that it is this phase of forest culture that is currently being given most attention in western European countries where trees are being raised as a crop from seed. Superior stands are set aside as seed sources. Heavy limbed, poorly formed or slow growing trees are considered bad pollen parents and are removed. Exceptionally fine specimens are designated as "elite" trees and these are hand pollinated for seed production or propagated by rooting or grafting and planted in isolated patches as seed orchards.

Until the progeny has been tested side by side with others, there is no positive way to identify a superior strain or stand. That test takes years and has been done for only a few stands in the Douglas-fir region. There is another way that superior stands can be identified. It is less positive but can be done immediately and should be used while the longer type field tests are under way. There is a site classification for our forest trees that tells us about what height and diameter growth to expect for a given rainfall, growing season and soil. If a stand is found that is better in form and making faster growth than expected in that locality, and if similar trees have grown there for several tree generations, it is reasonably certain that it may be classed as a superior stand. If possible, seed should be collected from such stands. Dr. G. S. Allen and other scientists have determined that Douglas-fir and other conifers seldom, if ever, self-pollinate. Therefore, it is apparent that just so far as bad pollen parents can be removed from a stand, the offspring should improve. For that reason, scrubby, badly formed and slow growing trees should, if possible, be removed from seed producing areas.

The identification of the "superior" or so-called "elite" seed tree is a perplexing problem and the "Doctors disagree." In a mature stand, the tree with a clean straight bole, a good crown and faster growth than its neighbors can

easily be classed as a superior tree, but from the seedling stage up to commercial size, classification is far more difficult. From the literature and from contacts with foreign foresters, the following characteristics of an "elite" tree have been assembled:

1. It must be faster growing than its neighbors or faster than the average in a stand.

2. It must have a full and vigorous top crown, but must have fewer and smaller limbs on the lower crown than its neighbors or than the average of the stand.

3. It must have a clean straight bole with good form.

4. Needles and crown should be thrifty and full, but should not be overly dense.

5. Large clear spaces between nodes are desirable.

6. Limbs in the upper crown should stand at right angles to the stem or droop slightly rather than to point upward.

Field tests alone will tell us how nearly correct these specifications are and if they are usable; that will take years and in the meantime, all of us should look for more and better ways of identifying our best seed trees.

Many Europeans are not satisfied with securing the best seed possible; they seek to further improve their planting stock by eliminating weak individuals that show up in the nursery beds. Some parent trees produce rather uniform stock; others do not. With proper uniform spacing in the nursery beds, the weaker individuals will show up. These should be culled out in the nursery, either in the beds or at "lifting" time; but poor trees that escape notice should be thrown out in the planting operation. No positive figures are available, and it will vary with strains; but it has been estimated that it will be profitable in the long run to cull out 15 to 20 percent of the weaker individuals in the growing of Douglas-fir planting stock. L. I. Barret, on a recent trip to Europe with other American foresters, found one Swedish nurseryman culling up to 70 percent for the production of some special stock; but this is, of course, an extreme case. Barret also reported that Professor Gron of the Danish Forest School had a 500-acre forest of good strain Douglas-fir from which he sold $10,000 worth of seed last year.

An interesting story of seed source recently came out of England. In 1827, David Douglas collected Douglas-fir seed while at the Hudson Bay Post at Vancouver, Washington. He sent half of the lot to San Francisco to be later shipped around the Horn with other seeds, the other half he attempted to carry overland. Two trees were grown in Scotland from the seed sent to San Francisco, and one began producing seed about 1850. This seed was well suited to the locality and hundreds of acres of good plantation have been established from it in the British Isles and Denmark. When Dr. Champion from Oxford and Dr. Larsen from Denmark were here a few years ago, they asked about the source of this seed. For a hundred years, European foresters have been trying to find that strain of Douglas-fir in the vicinity of San Francisco. We search the Hudson Bay Company and Douglas' records and come to the conclusion that the seed was collected on the plains outside Vancouver, Washington.

What Is the First Step Toward Getting Better Seed?

Until specific superior strains have been identified for localities and seed collection areas designated and improved, the best formula for getting the best seed for a given planting site is as follows:

1. Select a better than average (or the best) stand in the vicinity of the planting site where seed collection is possible. Within a 100-mile limitation, a good stand is more essential than closeness to planting site.

2. Seed from an equal or slightly lower elevation is said to give the best growth rate although considerable leeway is permissible.

3. Gather cones, not from the trees with the heaviest crop, but from those with best form and growth rate. Since trees are cross pollinated, all will produce some good, some average and some poor seedlings, but the highest percentage of good trees is likely to come from the best parent.

Foreign foresters are demanding seed from specific strains and climatic zones. Pennsylvania and some other States have set up seed source rules. The U.S. Forest Service is making rapid progress in its seed source program, and tree farms and industrial nurseries have taken special steps to get the right seed for a given site, but we still have a long way to go before we get the best seed into all our nursery beds.

Mr. Isaac: Now, I purposely made this paper short enough so we would have a long time for discussion, and I knew this gang would have a lot of questions and that is more fun than reading the paper anyway. I would like to devote any time there is left - if there is any - to hearing what someone else has to say about it.

Mr. Adams: Now, Woodbridge Metcalf down in California sent a copy of a letter to us recently from Pennsylvania, where they were setting up seed plantations, and they were going strictly on climatic control and we wrote back to them and suggested that they also consider soil condition, that this should be a factor that could enter into it.

Mr. Isaac: Well, if trees grow on sterile soil for 50 to 100 tree generations and make poor growth there, they seem to acquire that habit of slow poor growth, not in one or two generations but in many generations. They seem to acquire that habit of poor slow growth, and it becomes fixed. That shows up in our pine plantations that we got off of the sand plains below Roy, Washington. They continue to grow slowly and to have that limby character, while the pine from growing stock on a good soil a little ways off, that has grown there for several generations is developing the other form. Now, we have a sort of mild contradiction right there in that same location. There is a lot of that fir on those gravel plains, that is first generation fir, that has migrated into that area since the first settlers came in there, and you don't find any old trees in the vicinity, and that is slow growing poor fir, but that tested in plantations is making average growth. It isn't making good growth, but it isn't making as poor a growth as the parent stock is making, so it hasn't been there enough generations to become "fixed," as the geneticists say.

Chairman Webster: Leo, I want to ask you a question about that specific Fort Lewis area. Do you feel, if you were going to plant trees in the Fort Lewis gravel bench that it is better to collect your seed from that area or to collect a better strain of seed from a better site and plant your seedlings back in that area?

Mr. Isaac: I would collect from the best strain I could find somewhere in that immediate vicinity, but I wouldn't go right out in the worst of it where it is growing poor.

Chairman Webster: Well, wait a minute. You say "immediate vicinity," do you mean Fort Lewis vicinity, or would it be better to go further up to the Capitol Forest area or east to where we have a better site and better growth?

Mr. Isaac: I would go out around the fringe east of it where you have better than the average, but I wouldn't go way out into a good soil. I don't know how correct that is, but I would be a little bit afraid if you went out in a good deep soil you might have difficulty with them. We have a few little tests that kind of bear that out.

Don Lawrence, when he was working on his Doctor's degree, lived in the Columbia Gorge and he used to work in the summers to get some information ready for his thesis, and he went to the upper end of the Gorge and got fir from a dry, hot, more or less sterile site, and brought it down there and planted it in a nursery bed back of his house. Then he went to the lower end of the gorge in a deep soil on a nice site and got seed from that strain and planted them in the nursery bed. His wife is a botanist also, or a physiologist, and they went up on Mt. St. Helen's to trace the return of vegetation on the lava flow up there in ash deposits, and they got so fascinated with that, they forgot about their seed beds down in Bridal Veil, and stayed up there a couple of weeks longer than they expected to and didn't tell anybody to water them, and when they came down the seedlings from the upper end of the gorge were still alive and growing pretty well, but the seeds from the lower end of the gorge were dead, from the deep rich soil. Then they dug them up and examined them, and they found the seedlings that had been growing in the lush, moist soil had a flat spreading root system, and a big crown, and when the drought came along they couldn't take it. The other ones that had grown in the upper end of the gorge for many generations had smaller crowns and were shorter, stubbier trees, but had deeper penetrating root systems and they survived. If you went too far out of this gravel soil, you might get that much difference and have difficulty in survival.

Chairman Webster: Now, another question, this time relative to elevation. I believe I understood you to say that if you were planting seed on a fairly high elevation, it might be better to collect your seed on about that elevation or a little bit lower. How much lower? In other words, how much lower elevation seed would we put on high elevation sites? What is your limitation? Is it by temperature or is it by elevation?

Mr. Isaac: It is temperature that governs. You could go way down if you could get the same temperature.

Chairman Webster: Do you know what the temperature change would be in feet of elevation?

Mr. Isaac: Normally it is about one degree for 300 feet.

Chairman Webster: About one degree for 300 feet. Well, according to your theory then you shouldn't plant trees from a given seed elevation more than 600 feet above or below that elevation.

Mr. Isaac: Well, that is what I set up. I went a little below that. I just took a shot in thin air and said 500 feet below or above, and that is about two degrees in temperature, and I got that European experience, some of their species they only allow one metre -- or a hundred metres, 300 feet in some of their stricter rules over there. Others go quite a little further.

Chairman Webster: That is 300 feet either way, you mean?

Mr. Isaac: Yes, and the Swedes have a regular sliding scale where if you go north a certain distance, you can't go 500 feet up, you can only go 400 feet up. If you go a little further north, you can only go 300 feet up, and if you go still further north, you can't go any above your elevation. If you go still north of that, you have to find something at a lower elevation, depending on your average annual temperature.

Now, nobody has got that sewed up, Mike, but we know there is a pretty definite balance in there, and we kind of hit at 500 feet to set a safe limit within which to work until somebody proves differently.

Chairman Webster: I think it is important that we do get it sewed up fairly definite as rapidly as possible, and that is going to take time, but it is an important factor. Right out of our own nursery -- and I am sure you other fellows have the same problem -- we are asked to furnish seedlings for many sites and elevations. It sometimes becomes quite a problem and it is one on which we should know our limitations as rapidly as can be determined.

Mr. Isaac: The European foresters threw one at me that was a bit puzzling. They said seed collected in a locality of long slopes had a wider tolerance, would build up a wider tolerance range than seed collected in a flat country. This would be built up over the centuries, and they said the reason for it was, in the first place, pollen would drift rather long distances up and down these slopes and cross pollinate the trees, and then the tree best suited would survive out of a lot and in the next generation this would be repeated and that these strains that develop on long continuous slopes had a wider climatic tolerance range than the others. I don't know how right they are, but that is the one they put up to me.

Chairman Webster: It sounds reasonable, because you have a continuous air drainage from top to bottom of slope and vice versa.

Mr. Isaac: Yes, and wind blows both up and down the hill. In the night time it is flowing down and off of the slopes and in the day time it is flowing up and over, and pollen will go up as well as down.

Mr. Taylor: You spoke of grading -- if the trees are grown from seed of mixed size, don't you run into quite a lot of confusion from defective seed size being mistaken for genetic variability? In other words, the seeds with the biggest sperm give a temporary appearance of vigor that belies what is inherent in the seedling, and that if the seed is graded pretty closely for size, it would help in the grading for genetic quality.

Mr. Isaac: If you mix seed from young and old trees, usually -- I would rather ask a seed man about that, or a nurseryman -- usually seed from young trees has bigger cones. The younger trees have bigger cones and bigger seeds, and if you mix those with seed from old trees, where the cones and seed are smaller, you are likely to have a great difference in seed size, and consequently a difference in seedling vigor the first year, but I don't believe nurserymen usually mix seed to that extent. I don't know how much variation you follows have in seed size within a given seedbed.

Mr. Corson: We did find some individual differences at the beginning of the size of the seedlings, but by the end of the summer there was no differentiation, because of variation in seed size.

Mr. Isaac: We ran it too. I guess they run about the same time, and we found it for Douglas-fir during the first season, but by the end of the second season where we produced 2-0 stock that almost disappeared, and when we put it out in plantations, we tested it further and within five years in plantations that difference in seed size was entirely gone.

Mr. Salisbury: That is exactly the same thing we found in Ponderosa pine.

Mr. Taylor: Would you say 2-0 stock was old enough to select better seedlings?

Mr. Isaac: 2-0 seedlings?

Mr. Taylor: You can select better seedlings properly?

Mr. Isaac: You mean can you select them better at two years than at one?

Mr. Taylor: No, are they old enough at two to select them with any degree of accuracy?

Mr. Isaac: Oh, I think two years old is old enough. I think two years is better than one, and if they didn't get too big, three years would be better than two. Ask a nurseryman -- I am just an ordinary forester.

Chairman Webster: I am not necessarily a nurseryman, but I don't think you can select seedlings at two years old very much one from the other. What do you think about that, Charlie Rindt?

Mr. Rindt: I was just going to say I think Carl is best suited of anybody to answer his own question. I think he has a point there that we don't know anything about. Maybe he does. He has worked with a lot of different seeds, but if we separate the seeds by size, such as was done in California, and such as you did here with Douglas-fir, we have seeds or trees coming from seeds with the same size, all having a pretty even start. Now, if you have large seeds and small seeds mixed, and the small seed got away to a poor start and the big ones got away to the best start, your small seedlings would always be kind of suppressed in the seed bed, and whether it had good possibilities for a superior tree or not, it would be culled out because it never got a chance to show its head. Now, that is in my thinking. I think that could happen, but I don't know anyone who has ever tried it.

Mr. Isaac: That is what the Europeans said. They said if you throw out all your small stock, you are going to throw out some stock that is hereditarily good but couldn't get up because of a bad start, but you will also throw out a lot of natural scribs.

Mr. Rindt: You know, from the voice of inexperience we sometimes get quite a bit of knowledge. That was driven home to me by Frosty's wife. She was working on a nursery sorting table and throwing away these small seedlings, and she said it did not make sense to her, being a practical woman, to throw these small seedlings away from a bed of large seedlings when she was saving seedlings from a bed of smaller seedlings that were over-all smaller than the ones she was throwing away from the big beds, and I think she has an idea there that could be worked on to advantage.

Mr. Isaac: These Europeans said the more crowded your bed was the more you were likely to throw away some good stock. If your beds are widely spaced, if your seedlings are well spaced, then most seedlings have a chance to demonstrate whether they are vigorous or not, but if you crowd your beds and then cull your trees, you are likely to waste quite a few good trees. That was their conviction.

Mr. Nagle: Some other factors I have observed in producing trees, particularly for windbreak trees. I have worked with locusts a great deal, and it will definitely help to separate your seeds. You grade out your seeds in different sizes and plant them separately because their germination pattern is different, and the smaller seeds apparently have harder seeds and germinate slower, and planting mixed seeds you get a lot of variation in the time they germinate and you get a lot of variation in size and frequently the later germinating seedlings fail to survive due to cultivating, hot sun and things like that, so there is a definite advantage in that respect in grading seeds. Now, whether or not that same variation in germination pattern exists in all other seeds, I am not sure. It does in American arbor vitae. We have raised quite a little American arbor vitae and we at least have a particular job in getting uniform germination out of that, in that seed germinating, say six weeks later than other seed is definitely a disadvantage, and at the end of even a couple of years a lot of seedlings are likely to be graded out.

Chairman Webster: Do you stratify that seed, John?

Mr. Nagle: Yes.

Chairman Webster: And it still doesn't make any difference?

Mr. Nagle: That's right.

Mr. Haddock: There is some documentation in support of the investigation Charlie made and some work that was done by Fowler about twelve years ago. They found by grading seed sizes they did get better seedlings from both groups.

Mr. Isaac: It is a funny thing but the biggest seed, as I recall, didn't produce the best plantation.

Mr. Haddock: I don't recall.

Mr. Isaac: It was the middle seed, wasn't it, that produced the best trees?

Mr. Corson: Right now a lot of that differential disappeared in those plantations. The biggest seed produced the biggest seedlings to start with, but it was the middle size seeds that developed the best plantation both in survival and growth. That was a complete surprise to me and I couldn't understand it.

Mr. Stubbs: Well, personally, the point I wanted to raise was in culling out stock in a nursery. We are using nothing but physical characteristics to cull our stock on. Any man that is breeding beef doesn't knock a calf in the head because it is born with a wrong color or something. Actually he selects his stock, his parent stock, and goes on that basis, and I think we are trying to use physical characteristics here to pick out hereditary characteristics, and I think we are actually barking up the wrong tree.

Mr. Isaac: Well, they say that for vigor you can do some good pretty early, but when you come to pick for other characteristics like a stockman does, for shape and other things, then you have to wait until the trees are further developed. But they claim that for vigor, you can start quite early and do pretty good at it, but not for anything else.

Mr. Cameron: There is cross-pollination we have no control or knowledge of in our trees. It doesn't exist; for instance, in the raising of stock, they can actually control their parents, whereas we don't in our natural grown seed.

Mr. Stubbs: Well, does it necessarily follow that a fast growing tree will be a fast growing tree in infancy? There is no reasoning there.

Mr. Isaac: You mean that it won't continue to be a fast growing tree?

Mr. Stubbs: No, what I am saying is that although a tree will be a fast growing tree at 30 years of age, maybe it wasn't necessarily a fast growing tree at infancy. It may be a slow starter.

Mr. Isaac: It may be. We have our growth plantations that we have been following for 35 years and some of them were started pretty early, and the trees that were dominant in the beginning continue to retain a high percentage of dominance.

Dr. Wright: I just wanted to make a remark about seed size. Ordinarily in nursery practice, where you have a small seed that produces a rather weak seedling, your losses from damping off and root rot are going to be heavier than they are from a vigorous seedling. However, I think with seed stratification, at least with conifers, seems to pretty well wipe that out, and as far as I can see, the beds are pretty uniform now, regardless of the size of the young.

Mr. Youngberg: I think one thing that is quite often overlooked in the grading of seed is the fact that seed size isn't always the important factor. Actually, the weight of the seed, as far as the initial rate of growth the first year, is quite often more definitely related to the weight of the seed, which doesn't necessarily always follow that the large seed is the heaviest. You get quite a lot of large seed that is quite often light seed. I think the grain-producing people do most of their grading strictly on the basis of the weight. They have the specific gravity measures that they use, and they grade their seed according to their seed according to the weight. On the basis of that, they select their seed for their crop, and I think the same thing -- well, actually it has been tried in grading jack pine seed and there was definite differences in the germination pattern and in the size of the seedlings produced. That again was with a mixed lot of seed, but there were extreme differences at the beginning from seeds of different weight, and in those weight classes there was quite a bit of variation in size due to the fact that some of the large seeds were not necessarily full and they were light and they went through and were graded as light seed. So seed size isn't all that it is cracked up to be.

Mr. Isaac: Early collected seed, collected a little too early, size for size, is usually lighter than later collected seed. Size for size, later seed is heavier, as you say, and I think is a better seed.

Mr. Augenstein: We raise Engelmann spruce, and if anyone is acquainted with Engelmann spruce, it grows very erratically in the seed bed. You have one tree an inch tall and one four or five inches tall in the second year. The group of Germans that were over here a few years ago told me if you find the tree that produced the seed that raised the tall tree, it will always do that. A year later, Karlberg from Sweden was here, and he said it is not true. We got the Germans and Swedes fighting. I was wondering if anyone knows anything about that around here?

Mr. Isaac: Well, I don't. Maybe Charlie does.

Mr. Rindt: That is the characteristic of all spruces. They have great variation, and while I have never run any tests that are tied back to the seed tree, I think that you find that variation right within the single cone.

Chairman Webster: We have time now for one more question. This is very interesting.

Mr. McDaniel: You fellows that raise Ponderosa pine seedlings, in your second year you have noticed a lot of times you have the big husky seedling put on its more or less mature needles. I wonder if any work has ever been done on separating the two to five percent of large ones and planting them in an isolated spot for good seed trees. I have wondered about that. They will probably be thirty to forty percent bigger in diameter and height than most of your general run of seedlings in the beds. Has anything ever been done on that? I know I have asked the School of Forestry years ago to try and isolate an area and take those picked seedlings that have put on their mature needles and take them right out of the old beds.

Chairman Webster: I can tell you what our experience was and it was very sad. We picked out the sports, as I called them, from the seed beds. They were two-year-old, however, and developed very large the second year. They were a foot or more above the other seedlings in the beds. We took them out and planted them on a special site and the rabbits got the whole bunch of them within a matter of a few days.

Mr. McDaniel: In the fall of the first year you will have a seedling here and there four to six inches high put on its mature needles.

Chairman Webster: It is something worth following through, and we will try it again in our nursery sometime. Well, I think we had better pass along now and, Leo, I want to thank you for a very excellent contribution. We have all enjoyed it, I am sure.

Now another subject, gentlemen, that is intensely interesting to every nurseryman is maintenance of soil fertility. That is one problem that has plagued every nurseryman, how to manage your soil and keep it where you want it all the time. We have a comparatively newcomer to the group in Chet Youngberg. When I say "newcomer" you have been out here a year and a half, I believe. Where did you come from originally, Chet?

Mr. Youngberg: Wisconsin.

Chairman Webster: Chet was with Weyerhaeuser Timber Company, and he has just advised me that he has taken a position with the Department of Agriculture at Oregon State College to handle the subject of forest soil for them, but today he is going to handle our subject on Maintenance of Nursery Soil Fertility. Chet Youngberg.

Mr. Youngberg: They tell me - to get the last work on Leo's subject, to get in the plug on this question of seed weight. There has been some experience that has been gained in the last few years in connection with soil fertility studies; there have been some side issues that have been noted and that is in connection with the weight and quality of seed produced on fertile soils versus infertile soils. The general consensus of opinion to date that has been gathered today anyway is on your more fertile soil the seed produced is generally

Mr. Youngberg: heavier, has more nutrients and has a better germination pattern than seed produced on infertile soils. Now it doesn't necessarily always hold as in very fertile soils versus medium soil fertility, there is generally not much difference, but when dealing with very infertile soils versus the rest of the range of fertility, there has definitely been shown to be a factor that is involved in the quality of the seed produced on those sites.

I would say that I am a newcomer to the field out here, but probably one of the few natives of the State of Washington that has been working in Washington, at least of the ones I have come across so far.

MAINTENANCE OF NURSERY SOIL FERTILITY

by

Chet Youngberg

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The need for intensive control of soil fertility factors is greater in forest nursery practice than in almost any other branch of plant production. Nursery soils are subject to an exceptionally heavy drain of nutrients because harvesting of the densely grown crop removes the entire plant and portions of the soil. Leaching caused by irrigation and in this region by heavy winter precipitation is also an important cause of depletion of nutrients. The deficiency of plant nutrients is corrected by use of animal and green manures, composts, direct application of fertilizer salts prior to seeding and liquid fertilizer applications. The success of these treatments is dependent upon the maintenance of a reasonably high exchange or nutrient holding capacity in the soil, proper adjustment of soil reaction and provision of an environment suitable for mycorrhizal fungi and other desirable organisms. This in turn is often complicated by our choice of insecticides fungicides and weed killers. It is not difficult to visualize the delicately balanced environment that modern technique has designed for the production of nursery stock. The quality of this stock cannot be evaluated on the usual basis of size and amount of dry matter produced, but only by its ability to survive in the struggle against adverse environmental influences, parasitic organisms and browsing animals.

The problem we are faced with, then, is how to provide a favorable environment in which seedlings of satisfactory physiological quality may be produced. From the standpoint of soil fertility factors this environment should approach that found where any given species is naturally attaining optimum growth. At one time some European foresters believed that seedlings to be planted on infertile sites should be grown under similar fertility conditions in the nursery. This proved to be a fallacy when starved and unbalanced seedlings failed to survive when planted in the field. On the other hand, equally disastrous results have been experienced with the use of heavily fertilized stock.

The question naturally arises as to what is a desirable level of soil fertility for Douglas fir seedlings. At your meeting last year Dr. Wheeting stated that "the requirements of trees for nutrients can be guessed at from the analyses of their ash." Actually this is better than a guess and is a step in the right direction. However, we can go a step farther by investigating the fertility status of soils supporting productive forest stands. This is no new approach, but was advocated by Hilgard, an early American soil scientist, and has been used successfully