In summation, we believe the ideal tree would have the following:

1. Be 2-0 stock with sturdy stem and healthy, well-developed crown.

2. Be resistant to disease, frost damage, and wildlife.

3. Be of fast-growing, plus-tree stock.

(End of Paper)

As the last speaker of the day, Chairman Deffenbacher introduced Dr. Ernest Wright, Pathologist, Division of Forest Disease Research, U.S. Forest Service.

Dr. Wright explained the work of the pathologist, who is called in when seedling losses occur in the nursery. He stressed the careful examination what is made on the site to determine the exact cause of the losses. A number of cultures are then taken to be certain the ocular observations are correct. Re-isolation of the same fungi from artificially infected seedlings is final proof of pathogenicity. He said that the pathologist cannot do much about the damping off while it is in progress, but he can do research on the active disease, and plan for the future.

Dr. Wright's paper follows:

PATHOLOGICAL RESEARCH IN THE FOREST NURSERY

by

Ernest Wright, Pathologist
Pacific Northwest Forest and Range Experiment Station

It is the purpose of this paper to dispel the mystic halo which sometimes surrounds the nursery pathologist and to explain his curious antics, as well as his unusual aroma at times.

The nursery pathologist is essentially a soil biologist. The diseases which infect nursery seedlings are primarily fungi that live in the soil and are dealt with accordingly. The essential part of the problem is to determine the cause of the loss. This may appear to be a simple matter. Unfortunately such is not the case. Let us assume a not-too-hypothetical situation.

A forest nursery, which our pathologist has had under surveillance for some time and which has had no alarming seedling losses, suddenly develops an acute case of what appears to be damping-off. Now the pathologist is in his glory as well as in a state of anxiety. He arrives at the nursery and immediately gets down on all fours and starts crawling thither and yon among the seedbeds like a bloodhound with his nose close to the ground. He carefully digs out a number of seedlings, whips out a hand lens, and examines each seedling very intently. Yes, this fellow is a queer egg to the casual observer, but he is not as daffy as he appears. What is he looking for? Surely he should be able to determine damping-off without such peculiar activity. He would be unwise and foolish if he did not make these careful examinations because what appears to be damping-off could easily be chemical injury, insect, or mechanical damage, sunscald, frost, drought, or a combination of more than one factor. Each shows specific symptoms.

If it is chemical injury, the tops of the seedlings may appear burned, and the rootlets will be crooked and blunt. Insect or mechanical damage is evident by the appearance of minute wounds of various types. Sunscald usually shows definite heat lesions which start at the ground and extend up the stem. The lesions are usually light in color and their boundaries sharply defined, and they tend to be on the south or west sides of stems. Frost injury first manifests itself by a dropping of the cotyledons, or needles, which eventually turn reddish-brown. Drought shows a characteristic wilting of the entire plant. When more than one factor is involved, there is usually a semiparasitic fungus present, such as a mold or a Fusarium.

To define real damping-off: the loss may occur before emergency or a short time thereafter. Damping-off lesions on the stem are most common on seedlings less than two weeks emerged. The infected plant falls over, and damping-off lesions will be found at the ground line, extending down the root. The discoloration or constriction has no definite border and passes gradually into normal tissue. Sometimes mycelia, or very fine strands of fungus hyphae, can be observed under the hand lens. Usually the nursery pathologist is not satisfied with an ocular examination. He then examines the infected seedlings under a microscope or a binocularscope. Thus he can tentatively determine the causal fungus. If it is a Pythium or other Phycomycete the hyphae are colorless, have few (if any) cell walls or septations, but sometimes have characteristic spores. If the causal fungus is Rhizoctonia, the hyphae are coarse, light brown in color, have cell walls or characteristic septations where the mycelia branch, and no spores. If Fusarium or certain molds are present, the hyphae may be colored and have septations. Characteristic spores are present in great abundance.

But the pathologist will not be satisfied with any of these ocular determinations. He will proceed to isolate from the seedlings which he has collected. He will probably make at least 25 cultures, usually more. In culturing, he carefully washes the seedlings, cuts them with a small scissors above and below the lesion, sterilizes the cut pieces in mercuric chloride or hypochlorate, passes them through at least two changes of sterile water, and finally inserts them into agar with sterile forceps. The agar is contained in previously poured Petri dishes or test tubes. Malt agar and potato dextrose are common media used. The cultures are placed in incubation at 70° to 75° F. and permitted to remain there for several days (to a week or more). During this period, the cultures will be examined several times and contaminating molds, if present, are removed. At the end of a week or 10 days the parasitic fungi will have grown from the pieces of seedling into the agar, and a small part of the fungus colony can then be removed aseptically for identification under a compound microscope. Later the fungus colonies will assume a characteristic appearance, and a tabulation can be made to determine the percentage of each parasite present. If it should happen that a majority of the cultures develop Rhizoctonia or Pythium, or both, the pathologist is more certain that his ocular observations were correct and that the seedlings actually were damping-off.

Consistent isolation of one fungus from the diseased seedlings is only circumstantial proof of pathogenicity. The usual procedure is to test the isolate or isolates by inoculating seedlings grown under sterile conditions in a greenhouse or laboratory. Re-isolation of the same fungi from these artificially infected seedlings is final proof of pathogenicity.

The pathologist knows that not much can be done about reducing damping-off while it is in progress. He may advise cultivation and may try various dusts or chemical applications in the hope that he can check the present losses, but he knows this is very unlikely and he therefore plans for the years ahead. A series of small plot treatments will be established, using those chemicals, fertilizers, or soil amendments which may prove effective in controlling future losses.

Establishment of these chemical tests sometimes gives the pathologist that peculiar aroma because he will work with anything from tear gas to mercuric compounds. Additional concurrent tests are made to determine soil and water acidity, soil fertility, biological balance in the soil, etc., to complete the picture.

How soon the pathologist will come up with a satisfactory control will depend on many factors. In time he will be able to devise some practical means of reducing the damping-off or root-rot losses in your nursery. So tolerate these pathological antics, even though they may appear peculiar.

Today we have a few slides which we will show you, illustrating some of the losses suffered in Pacific Northwest nurseries. Also, I have a few damping-off fungi in Petri dishes and a slide under a microscope containing a Fusarium. During the recess, we will be glad to show you these to give you a somewhat better idea of how pathologists work.

(End of Paper)

Dr. Wright concluded by passing around Petri dishes containing damping-off fungi, and he invited the members to view a slide containing Fusarium, which he had set up under a microscope.

After Dr. Wright had finished, there was a general discussion on cold storage and survival. Problems discussed were: better packing material for the seedlings for shipping; length of time they can be held in cold storage; and the amount of drying that occurs. Also discussed were refrigerated trucks for hauling, proper handling when planting, and the proper time for planting.

The discussion was as follows:

Cold storage is coming into vogue. It has the advantage of letting you use the seedlings as you require them. A number of studies on cold storage of Douglas fir, ponderosa pine, noble fir, and sitka spruce have been carried on. Good results had when storing at 33° to 35° temperature with high humidity (90% plus). Ponderosa pine was found to be the best under storage followed by noble fir, Douglas fir, then sitka spruce. Six months seems to be the maximum period of safe storage.

Question: Does shingle tow damage roots?

Mr. Deffenbacher: You would get better wetting of the shingle tow to buy in large lots. We could detect no injury to roots from the use of shingle tow and we did get good results.

Question: Are the problems different at each nursery?

Mr. McDaniel: Each storage plant should be examined separately and compared to other plants. I think this cold storage is the answer to the dilemma of producing seedlings at the time of the year they are requested.

Mr. Deffenbacher: One other thing, when you put your seedlings in bundles in storage, always date them as to the date you put them in. Hold a small reserve of these seedlings over and try them in your nursery and see what the survival is.

Mr. Eide: I heard they were considering refrigerated trucks for the preserving of good conditions of seedlings. It might be rather expensive.

Answer: It might be kept in mind.

Mr. Tedrow: More trees die in the time they are lifted out of the dirt in the nursery and the time they are put into the ground. If there is anything that can be done to offset that loss, I think it would be buying an awful lot.

Dr. Wright: One method would be to take them out in smaller lots. Trees should be examined in storage as they come out and before they are planted in the fields.

Mr. Tedrow: The tree should be alive before the individual puts it into the ground.

Mr. Metcalf: Dr. Stone feels that one-half of the trees that are planted in California are dead when they are put into the ground. Dr. Stone recommends late spring planting. The trees should not be moved out of the nursery until new little roots show. There is a certain timing, and that gives them a much better vigor to survive adverse conditions. You need the best possible stock. For every place there is an ideal time of the year when the roots will take hold quickly and give the seedling a good survival.

Mr. Long: I think it is very important that we get the trees to the man alive, no matter how much it costs.

Mr. Silen: There is good success with polyetheline bags for shipping. It lets in the air but keeps the water in.

Mr. Rindt: The ideal condition would be to take the plant out of the nursery and plant it; but because of the areas and the conditions we are planting, we have to develop ways in which we can handle trees satisfactorily. There are ideal conditions, but the nurseryman must do a good job under all conditions.

Comment: I don't like the refrigeration, but there is something to the idea of moving the trees when the roots are growing.

Comment: We have been unable at times to get up here because of the snow and get the trees for planting. Refrigerated stock is very necessary in certain instances if you are going to get the unusual locations planted.

Swede: It doesn't matter when you plant. It is the manner in which you handle the plants that matters. This is my experience.

Mr. McDaniel: The proper foremanship is necessary and it is good, but that could be better. A lot of the poor survival is poor workmanship in the field.

Mr. Eide: We have poor work even though we have good foremen in the field. If we could arrange or could start a program where they could reward a fellow for planting so many trees, it would give the fellows a little more incentive - a pin or something similar to encourage them to do a good job.

Mr. Metcalf discussed problems encountered in planting seedlings in California involving the adverse conditions in that climate. He felt that late spring planting obtained better results in that area.

It was generally agreed that the ideal plan is right from the nursery plant into the field, but because of the areas and the conditions of the planting, methods must be developed for handling trees satisfactorily.

Mr. Silen offered to distribute information concerning forest tree seeds to those who wanted it. He asked those people who requested it to give him their names and the material would be sent to them.

Mr. Eide from the Col. W. B. Greeley Forest Nursery extended an invitation to those who might be interested to attend the formal dedication of the Nursery on August 27.

Chairman Deffenbacher asked for the wishes of the group as to where the next meeting would be held. Mr. Homer Ward, Washington State Division of Forestry, extended an invitation for the meeting to be held at Olympia, and moved that the meeting be held there. The motion was seconded. There was general discussion on other possible locations. It was voted to have the 1958 meeting in Olympia, sometime between August 10 to 20.

The meeting adjourned at 4:00 P.M. The group spent the remainder of the day at the Wind River Nursery, where nursery problems and techniques were discussed.

FIELD TRIP BY NURSERYMEN
August 24, 1956

The group was given first-hand information by Leo Isaac of the Pacific Northwest Forest and Range Experiment Station on studies started in the 1920's. The group was shown heredity plantations of Douglas fir and ponderosa pine and spacing plantations of Douglas fir. After touring the many plantations, the group was served a picnic lunch at Government Mineral Springs. After lunch, Ranger Olson of the Gifford Pinchot National Forest took the group to a regular plantation where "on the ground discussions" were held of tree placement, seed sources, planting techniques, and many other planting problems.

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