PROCEEDINGS OF THE 24th ANNUAL WESTERN INTERNATIONAL FOREST DISEASE WORK CONFERENCE

Coos Bay, Oregon
September 1976

Proceedings of the 24th Annual Western International Forest Disease Work Conference

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Compiled by:
Kenelm Russull

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SPECIAL REPORT

REPORTS AND WIFDWC BUSINESS

MEMORIUM

Dr. Nagayoshi Oshima, Associate Professor of Botany and Plant Pathology at Colorado State University, died unexpectedly of a cerebral hemorrhage February 21, 1976, in Fort Collins, Colorado. He was 48.

Oshima was born on October 20, 1927 in Tokyo, Japan. He received his B.A. degree at Tokyo University in 1951 and then migrated to the United States to complete his education. He majored in plant pathology, receiving the M.S. degree from Colorado State University in 1953 and a Ph.D from the University of Minnesota in 1957. He became a naturalized citizen of the United States in 1968.

After graduation from the University of Minnesota, Oshima began his research career at Colorado State University as a post-doctoral fellow, working on potato diseases, especially control of potato viruses, using antiviral chemicals applied to shoot tips in axenic culture.

In 1958 he was appointed assistant professor of botany and plant pathology and was appointed associate professor in 1969. Earlier this year, he received an additional appointment in the College of Forestry at Colorado State University as associate professor of forest and wood sciences.

Dr. Oshima's teaching responsibilities involved elementary and advanced courses in forest pathology and a field course in identification of plant diseases. Although forestry students were required to take the "service" course in forest ~~pathology, Nagy's reputation as a devoted~~ and kindly teacher soon established forest pathology as a course to look forward to enthusiastically and the advanced course, although not required, became a "must" on many a student's program. Nagy was never too busy to elaborate at length on any subject. Although he was never quite able to articulate masterfully words like "worm" and "lousy", students soon became adjusted to his accent and, indeed, it became his particular, unique trademark lending a certain delightful, unconventional touch to his presentations. More than most, he discussed a subject rather than lectured.

His method for obtaining disease specimens for forest pathology was effective if not unique. The students were asked to go into the "field", as part of their assignments and bring back specimens of plant disease. For foresters this was a real challenge and at times the laboratory looked more like a logging operation than a classroom.

Oshima's research responsibilities were also unique in their widely separated disciplines. His two experiment station projects were concerned with vegetable and forest diseases. He became an authority on diseases of dry beans in Colorado and frequently acted as an arbitrator and consultant during the recent bacterial bean blight epidemic in the State. He was also involved in studies on the control of Dutch Elm disease.

An avid fisherman, Nagy's advice and instruction were sought and obtained by many neophytes. He knew where the Rocky Mountain trout were biting and was acquainted with every type of lure, animate or inanimate.

Oshima was a member of several professional organizations including Sigma Xi, The American Phytopathological Society and the Colorado-Wyoming Academy of Science. He authored more than 100 popular articles and scientific reports in his fields of expertise. He also was on the editorial board of the Plant Disease Reporter.

Oshima is survived by his widow, Choko, sons, Mark and Ken, all of Fort Collins, and his parents, Mr. and Mrs. Nagaaki Oshima and a sister, Mrs. Isamu Amemiya, all of Tokyo, Japan.

September 20, 1976

Dear Mrs. Oshima:

The annual Western International Forest Disease Work Conference met during September 13-17, 1976, in Coos Bay, Oregon. Nagy has been a favorite Conference member for several years and we were all saddened by his sudden passing.

The WIFDWC members unanimously decided to contribute $50.00 to your sons' higher education trust fund. The check is enclosed.

We all remember Nagy's jovial face and excellent talks. He was a good friend of everyone at our conferences. I remember particularly well the paper he gave last year when we met at Missoula. His teaching rubbed off on many of us.

We hope you will allow us to share your loss in our thoughts and prayers, and lend our support whenever necessary.

Sincerely,

Kenelm Russell, Secretary, WIFDWC

October 18, 1976

Dear Mr. Russell:

The United Bank of Ft. Collins forwarded me the letter you wrote to me in care of them. My sons and I were most touched by your kind letter and generous gift. It will be very much appreciated when they start college in a few years.

We have fond memories of Nagy talking about the WIFDWC meetings he attended. I know he had been looking forward to attending this year also.

We are getting along fine and realizing how fortunate we are that Nagy left us so many wonderful friends of his such as you and your group.

Thank you very much.

Sincerely,

Choko Oshima

FORWARD

The twenty-fourth annual Western International Forest Disease Work Conference convened September 13-17, 1976, at the Thunderbird Motor Inn, Coos Bay, Oregon.

Right outside the motel windows, a log ship and two chip ships were busy loading. The port bustled with wood product activities. A few members were able to tour the log ship and talk with the friendly Filipino crew. They saw and learned how the Port-Orford-cedar logs were handled, where they went and American girls.

Tuesday morning, Chairman Lew Roth called the Conference to order; Mayor Robert Hale welcomed us to Coos Bay and Oregon State Forester Ed Schroeder gave the keynote address.

The meeting consisted of three field trips with the weather cooperating perfectly one day and not so cooperative another. A delicious salmon barbecue at the ocean capped the rainy day and the good food made up for the bad weather.

Wives who made the trip took a tugboat tour of the harbor and ended by having their pictures on the front page of the Coos Bay newpaper. They had a number of other interesting tours, including the old Simpson mansion. Their hostess was Lyn Roth.

Officers for the twenty-fourth Conference were:

Lewis Roth	- Chairman
Kenelm Russell	- Secretary-Treasurer
Larry Weir	- Program Chairman
Jim Hadfield	- Local Arrangements

Cover: The "*Triumph*" became a familiar fixture while we attended our meeting. It was loading the valuable Port-Orford-cedar logs for Japan.

CHAIRMAN LEW ROTH'S OPENING REMARKS

Colleagues, friends and guests. Welcome to the 24th International Forest Disease Work Conference, which I now declare officially in session. On behalf of members of long standing we welcome especially those of you who are with us for the first time. We hope you will catch something of the infectiousness of our group and will want to return again and will be in a position to do so. Our membership is open to all those who have as a major occupation the science or the practice of forest pathology.

The important contribution that this group makes to forest pathology is solidly documented by the excellence of its proceedings. This quality derives from sound program contributions, perceptive, spontanious discussion and above all, a herculean job on the part of the secretary. It continually amazes me how a group so informally organized can regularly come up with such a solid document. I want now to congratulate Jim Byler on the timeliness and excellence of the proceedings of the 23rd Conference. I know Jim has sweated over this compilation. Much of the anguish comes from difficulty in securing manuscripts from contributors. ———

Ken Russell (Wash. Department of Natural Resources) is this year's secretary. Please help him with this job in every way you can.

Now, I am sure I need not remind you that we are meeting in Coos Bay, Oregon, which, with its adjacent neighbor, North Bend, to the north is one of the major timber capitals of the world. I present with pleasure, for our welcoming address, the honorable Robert Hale, Mayor of Coos Bay.

You noticed in the 1975 proceedings an insert announcing the untimely death of Nagayoshi Oshima. After one has shared in WIFDWC for a while one comes to realize that the spirit and vitality of the organization lie not only with those present but also in the inspiration of former members. I ask that you now join in a moment of quiet reflection in memory of Nagay Oshima.

Now, at this early stage in the meeting when your suspicions of being put upon are small -- I hope, I would like to bring before you some thoughts, only sketchily, that I believe merit our periodic consideration. I might simply phrase this as the question: Exactly what are we (pathologists) worth to the forest manager? I think we are, or at least can be, worth a great deal, but certainly this capability has not flowered.

While I realize that many of our problems, especially the introduced diseases, have been extremely challenging, our record in the area of control has been something less than distinguished. Our effort on chestnut blight was a failure; blister rust a failure followed by a fiasco followed in turn by abandonment (in part at least) of a problem desperately calling for attention. And what of the elm diseases and oak wilt?

Surely we got off to a brillant start with the work of Robert Hartig. But in America when the work was placed in the mycological section of the Department of Agriculture we became caught in a philosophy and approach from which we have only recently escaped. Despite the essentiality of the work in mycology and the excellence of the research we lost our orientation toward the forest manager. This became especially true in the classroom, where the forest managers were being trained. There were a few notable exceptions, for example: Herman Von Schrenk and E.P. Meinicke, who persisted in the European silvicultural tradition and Dow Baxter, who in the university blazed a new trail into forest management from a sound foundation in plant pathology. I will not comment on the many fine contributions of notables among my peers: Willis Wagener, Stewie Andrews, Phil Thomas, Ray Foster, Toby Childs, Jim Kimmey and others whom we all revere so highly, but will wait for history to honor them as appropriate.

Never-the-less, in spite of our seemingly limited accomplishments, I believe there is emerging today a new capability to assist the manager, for example: Many managers confronted with the mistletoe problem are now dealing with it realistically from a sound understanding of basic principles. Computer programs are being developed to combine mistletoe impact data with inventory data and yield predictions. Aggressive action is beginning toward rots of the structural root system. Good spray programs are now available for control of many foliage diseases. These are but examples.

I recently reviewed reports of our disease control committee for the eight years of its existance and of its mistletoe committee for 12 years, asking of the listed items, is there anything here which if given to the manager could, with professional consultation, be put into effective use. I found nothing from 1964 to 1969; one item or 10% in 1970; nothing from 1971 to 1973; four items or 12% in 1974 and eight items or 40% in 1975, a genuinely encouraging trend. I think this is due to continue but at this time I would caution that we not lose our newly found capability through loss of our credibility.

At best our knowledge is fragmentary. It is inevitable that presentation of the fragments by people with differing perspectives will lead to inconsistencies. I, therefore, urge you managers to be understanding of this situation. It will be well, I believe, if we pathologists continue in general in our respectively assigned responsibilities, where the underlying facts are developed in research and their meaning is interpreted and projected by extension and control personnel. Releases of new "how to" material or new interpretations should be made whereever possible, only after thoughtful review by parties in both disciplines.

As an alternative, the validity of the scientists message to the manager can be tightened and consensus of all more nearly achieved where after an adequate technical foundation has been established, workers in the three disciplines can join in "development" studies. This pilot testing accomplishes the painful but necessary job of exposing the theory to the tests of operational and economic practicality. Where the research and recommendations are valid, theory becomes fact, the manager has a base of operation and the control specialist an excellent demonstration site. During the course of our meeting we will see something of an effort to follow this procedure.

WELCOMING ADDRESS

Robert Hale, Mayor of Coos Bay

Welcome to Coos Bay. Until you met here I was not completely aware of a group like yours active in Forest Pathology.

I am, however, very aware of our Port-Orford-cedar root rot disease, and hope that all of you came here to work on that problem. I can remember when Port-Orford-cedar was everywhere. I realize that complete control is not possible, but certain understandings about the disease have been learned in recent years to slow its impact.

The economics on this tree are unbelievable. We definitely favor its export when we consider the low returns it might receive under a domestic market.

I hope your Conference provides a good format for development of meaningful ideas towards solution of many of our region's forest disease problems.

While you are here, note the abundance of logs, chips and other forest products around our harbor. We are the world's largest forest products shipping port. Our total dry weight tonnage shipped is greater than Portland, Seattle, San Francisco and San Diego.

Welcome again from the citizens of Coos Bay!

KEYNOTE ADDRESS

by Ed Schroeder, State Forester
Oregon State Department of Forestry

How important is the Pathologist's role? In Oregon, cedar root rot and Douglas-fir root rot should receive high research and management priority. Also, our nursery losses are abnormally high. The Phipps Nursery, which grows 26 million trees annually, finds that it will be 7 million trees short this year. Not all of this loss was caused by disease, but an effective disease control program would cut it substantially.

Although there is a reasonable amount of disease control information available, the managing forester does not use it to his best advantage. Managing foresters do not adequately consider the importance of historical disease infestations of forest lands. Their management recommendations should account for the existing infestations in order to minimize the disease impact.

The program states that I am to deliver a "Keynote" address. The term generally implies pointing out a direction a meeting should take. Since you are assembled here in Coos Bay and will, unless the program suffers drastic revision, be discussing at least three of our major disease problems, it seems unnecessary for me to "Keynote".

I should like, if you will permit me, to dwell on the things that I feel forest managers and pathologists like you can contribute to the general health of forestry. To do this I shall draw heavily from Oregon experiences and its prevailing situation. I am sure that references to Oregon conditions will find their counterpart in the areas of the country you represent here today.

To set the stage, let me be very specific about the current situation here in Oregon. Since 1972 there has been a noticeable ground-swell of opinions, both pro and con, about depletion of the nation's forest resources. Because of the relatively unique position held by Oregon as a major supplier of the nation's softwoods, these opinions were of particular concern to the State Board of Forestry. In public meetings the Board heard concerns about the need for an overall plan in Oregon that would insure future timber supplies without <u>upsetting the environment</u>.

Projections on future timber supplies had been published by the U.S. Forest Service in 1972 that indicated the probability of a serious timber shortage before the year 2000. Criticism was leveled at the projection because it was felt the raw data base was poor and that information on forest management plans was lacking. The Board recognized the need for an overall plan and established the means to obtain the most accurate data possible on current and future conditions. Data collection took the form of providing answers to a number of key questions. In general terms these questions were:

(1) What are the policies related to forestry that are currently utilized by federal, state, local governments and the private sector in Oregon, and what changes might be necessary to coordinate these policies for the future?

(2) How much underproductive forest land exists and what can be done about it, if anything?

(3) Who is collecting data related to forestry, research or otherwise, in the state and where can this data be found?

(4) What is the current situation in relation to timber harvest and what are the projections for supplies in the future?

These questions will be answered in the Forestry Program Report for Oregon which will be released in the fall of 1976.

Some questions were farmed out to consulting firms, while others were handled by state agencies.

Dr. Carl Newport, of Mason, Bruce and Girard, a consulting firm, reviewed Oregon's forest policies and programs, and recommended improvements needed for their support. The project, like some of the others, received funds from the Pacific Northwest Regional Commission, which is a coalition of governors and their staffs from Oregon, Washington and Idaho.

Dr. Newport recommended that a framework of forest policy be developed that would cover the areas of: (a) management of state-owned lands, (b) protection of all forest lands from fire, insects and disease, (c) encouragement of forestry practices on private lands, (d) participation in federal forest land management, and (e) enforcement of forest laws.

The underproductive lands study took the form of a pilot-stage project designed to demonstrate data collection on underproductive forest lands. It was limited in size to forest lands west of the Coast Range in Oregon between Tillamook and southern Coos County where we are now. We knew that some of the best Douglas-fir sites in this area were currently occupied by brush, red alder and ferns. The consulting firm of Sanders, Larson, Cronk and Holmes were contracted to identify and map these sites with their final report due at the end of the year.

The use of remote sensing in land evaluation was also explored using Landsat satellite imagery. Douglas County, immediately east of Coos Bay, is the scene of this cooperative study. While the technique has not yet shown as much promise as hoped, it will, when completed next month, give us a handle on whether satellite imagery is worth pursuing further. Since this was written, we are now seeing that this is a reliable program.

It has long been recognized in almost every resource discipline that a lot of data is being collected by a lot of people. Much of these data is not readily accessible to those who might have a use for it. The firm of Moreland, Unruh and Smith, Eugene, Oregon, was commissioned to seek out all data sources and to compile the information in a usable catalogue. As a matter of interest, they located over thirty organizations collecting data and doing research on forestry-related tasks in Oregon alone. The 96 page catalogue has now been published and tells what information is available, in what form it is, when it was done and where it can be found. We think that this is a valuable contribution, especially to those working in scientific and technical fields.

By far, the most involved question to answer was the one related to current harvest, and projections for future timber supplies. Under the leadership of Dr. John Beuter, the Forest Research Lab at Oregon State University spent two years collecting information from all available sources and building a computer program to handle simulated management alternatives. The Beuter report was completed last January, and confirmed the fact that if current policies are continued there will indeed be a timber shortage in Oregon by the year 2000. This decline in harvest was projected to start in some areas within the next decade. Part of the decline rests with the facts that most of the mature age classes of timber are located on National forests, while the bulk of immature stands are on the private sector.

The report expressed the researchers belief that major increases can be made on federal lands during the next thirty years without violating the sustained-yield principle. Dr. Beuter feels that with increased harvests on federal lands and attention given to the small non-industrial forest land, harvests 10% higher than current levels could be sustained in Oregon. Small, non-industrial forest land owners total 36,000 and their combined acreage is in excess of 3½ million acres. It should be noted with emphasis that Dr. Beuter's projections do not provide for any major losses to Oregon forests in the future to fire, insects or disease. If we are to maintain harvest levels, we must have an Insect and Disease and Fire Program.

The Board of Forestry digested all the information obtained from the questions it had asked. They directed that the Land Management Services Committee, with help from the Department of Forestry Resource Study Team, develop the structure for a Forestry Plan for Oregon. Twelve specific forestry topic areas were identified and assigned to staff personnel for detailed objective and program definition. Some of these topic areas covered policy changes, intensive management with emphasis on the small ownerships, and a significant upgrading in the area of protection from insects and diseases.

The challenge is right here -- if we are to maintain our current levels of harvest from now on, Dr. Beuter has told us no more tussock moth outbreaks, no more large scale mistletoe infestations, etc. An assessment of the current situation in insect- and disease-caused losses showed a level approximately 60% of the annual cut in the state. While some of this percentage reflects past action of the tussock moth and part of the current 1 million acres of mountain pine beetle infestation, I would like to suggest quietly that this is an intolerable level. I might even go so far as to indicate a need for something to be done as early as yesterday.

I have before me a set of statistics derived from a U.S. Forest Service report dealing with annual losses from diseases in Region 6, which covers Oregon and Washington. The report doesn't state where or how they arrived at their data, so I must assume the writers are in the right ballpark. Provided the program chairman didn't set me in front of the wrong group, these statistics should be of concern to you pathologists and land managers and it should be my concern that you do something about them. These figures indicate that Oregon, based on 1973 stumpage prices, is losing about 87 million dollars a year to diseases. That is on non-federal land alone.

When federal lands are brought into the picture, the loss rises to an astronomical value of 170 million dollars. We won't even consider Regional values. The Beuter report showed that the average annual cut from all lands in Oregon is about 9 billion board feet and calculations show the disease-related loss to be about 22% of that cut. People who should know what they are talking about tell me the answer to the loss lies primarily in two areas: first, the establishment of an effective problem area detection system, and second, in the incorporation of control techniques into intensive management plans.

These two areas are well reflected in what we have said in the Forestry Plan for Oregon as being necessary in order to maintain or increase our forest resource. The Plan calls for more intensive management, particularly with small ownerships, and a significant upgrading in protection from insects and disease.

Generally speaking, contact between professional foresters and the small private owners has been minimal for a number of valid reasons. Some of these reasons which must be removed are: a lack of expressed desire on the part of the owner to become involved in forestry for profit, an existing initial financial burden only partly offset by external funds, and last but not least, the existence of a totally inadequate number of service-oriented foresters in state and federal organizations. Service foresters in the employ of forest industry contribute to the number of contacts, but their number is also inadequate. Small forest land managers could well increase their supply of timber through greater and more effective use of their service foresters.

If we search for the reasons behind these statistics, we find some gaping holes that are, in my estimation, the responsibility of all of us, pathologists and land managers alike, to fill. Research tells us that for the most part the depredation caused by dwarf mistletoes can be brought down to acceptable levels through silvicultural manipulation.

These manipulations must be part and parcel of the intensive management that is upon us. I noticed an interesting bit of information related to dwarf mistletoes the other day that you people from Colorado might have noted. This obscure journal reported that dwarf mistletoes form a significant part of the winter food for elk. Whether this is true in fact or not I don't know. However, while you and I know that most of the dwarf mistletoe lies above the reach of the average elk, the thought of the possibility of an environmental impact statement covering the effect of mistletoe control on elk herds is a bit disquieting. In that event, we would have entomologists, pathologists, foresters, DDT and elk all in the same boat. That is admittedly unlikely and at any rate, we know we can, with effort, substantially reduce the damage from mistletoes.

The same is not true for the heart rots. These are shown in the statistics as contributing almost a billion board feet to Oregon's annual loss. Even in this area I can see a ray of hope with intensive management. The memory of my exposure to diseases has gone the way of all flesh since I left OSU, but I do recall something about heart rots, how they attack the tree and the time they take to develop. Hopefully, the detection system will tell us what the disease or form of heart rot is and where it is, so that we can utilize one of the techniques like balloon or helicopter logging to minimize damage to the residual or surrounding stands.

As far as the root rots are concerned, I have been informed that major efforts are being expended on all fronts to combat this problem, particularly as it relates to laminated root rot. Until recently, most of us in management forestry have tended to ignore the problem. I don't know whether this was because of the scattered pattern of infection, lack of recognition of any pattern, lack of knowledge about the disease or whether we just hoped it would go away. I do know that throughout the Tillamook forest that now covers that famous burn there are dead and dying trees because of root rot. Also, I know that some effort on the part of forest land managers must be expended to improve root rot detection capability and, more importantly, pathologists must do something about successful control once diseased areas have been found.

It occurs to me that I have carried on long enough. Let me summarize my feelings for a moment. At the outset I made mention of pointing out to you pathologists and foresters the areas in which I feel you can make major contributions to forestry. Probably you have been aware of them all the time and if this is the case, my purpose has been served by insisting on early action. With my constant repetition of the development of the Forestry Plan for Oregon, I have run the risk of sounding as though the only reason for your meeting is to clear up Oregon's problems, as well as apparently assuming that what is good for Oregon is good for the country. Not having any statistics to back me up, I suspect that other states and western Canada are in situations much like ours in Oregon. Concepts are being prepared for the Plan, which if implemented, we believe will improve timber harvest capabilities. Hopefully, they will be of use at least in the planning stages elsewhere. We are vitally interested in the promotion of healthy forests and in the preservation of that part of the nation's economy that forestry benefits.

The need for an expanded and fully operational detection system that will trigger action for both insects and diseases is obvious and one that all of you can do something about. Disease survey systems must be developed that are consistent with current budget and manpower limitations that have been placed on all of us. In view of the probability that limitations may become even more stringent it would appear that we all will have to start to do two jobs instead of just one.

Once the systems have been developed, and you will note the assumption that they will be forthcoming, there remains the problem of making knowledgeable survey personnel out of field foresters, whether they work for public agencies, private industry or as consultants. This can only be done with everyone's cooperation, coordination and consistent application. This kind of intensification means that service and farm forestry is more important than ever.

It naturally follows that most of what I have just said will not make any dent in the losses unless techniques for control are available and action taken to employ them. Unfortunately for all of us, development and application of control techniques suffer the same limitations as the detection system. There is the added restriction that such systems show a positive benefit-cost ratio. We often don't enumerate all of the benefits -- both today and in the future when we start talking costs. Actually, benefits measured in today's materialistic dollars are only a small part of the benefits -- we should be looking at the intangibles and the future benefits of good management today.

Remember, one of the keys to maintaining our current level of timber harvest is to control and minimize our timber losses by insects and diseases. I would say the annual losses I quoted earlier from diseases alone indicate a need for control, and control can be found in intensive management through techniques that I know you are capable of coming up with.

It behooves all of us here to make known loud and clear what timber means to the economy, what diseases are doing to our resources and what needs to be done, and it needs to be made clear in a manner that will capture and hold the attention of those who control the pursestrings. We all have our work cut out for us and all I can add is "Good Luck".

PANEL - FIELD TRIP

HAZARD TREES IN PARKS AND CAMPGROUNDS

Peter Gaidula[1]
Moderator

INTRODUCTION

Today we are here at Umpqua Lighthouse State Park as the guests of Douglas B. Watson, from Salem, Oregon, who is representing the State of Oregon, Department of Transportation, which operates these parks. Doug will talk later about the park management and tree hazard problems he encounters in his work. He will be followed by Jim Hadfield who will tell us about his study of tree hazard problems with Sitka spruce and western hemlock.

DEFINITIONS

In analyzing the problems of hazards from trees, it is fair to ask ourselves whether it is the trees that are the problem; or is it the people and property intruding into the environment of the trees? In actuality, it is both the trees and the people with their property. A tree could not be considered a hazard unless there were something or somebody within reach for it to damage or injure. In brief, to have a hazardous situation we must have both a tree and a target. A precise definition of tree hazard is given by Dr. Lee A. Paine (1) as follows:

> "Expected accident loss resulting from mechanical failure of a tree during current inspection cycle if control is not undertaken."

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[1]Resource Protection Specialist, Resource Preservation and Interpretation Division, California Department of Parks and Recreation, Sacramento, California.

CONTROL PROGRAMS - THEIR IMPORTANCE

Public agencies and others operating recreation sites have found it essential and advantageous to carry out tree hazard control programs for a number of reasons:

1. Legal - Control programs help to ward off costly lawsuits in case of personal injury and/or property damage to recreationists. Our program in the California State Park System (2) has been set up in consultation with the Office of the State Attorney General to accomplish this purpose. We believe it has been successful. I will discuss this in more detail later.

   At the 21st WIFDWC held in 1973 at Estes Park, Colorado, Curtis Menefee, (3) Attorney Advisor, United States Department of the Interior, Office of the Soliciter, Denver, Colorado, gave us an excellent talk regarding legal implications of hazard from tree diseases in recreation areas. He pointed out that: "In the field of premises liability in which the problem of all hazards of visitors to public facilities falls, the trend to Tort Law in recent years has been away from the traditional view of classifying people who enter lands owned by them as trespassers, licensees or invitees. The modern trend is to make the owner or the occupant of the land responsible to exercise reasonable care under the circumstance to prevent harm to the person who might come on his land."

2. Moral Obligation - By the mere fact of providing recreation facilities for the public, the recreation site operator assumes a moral obligation for the safety of recreationists.

3. Environmental Considerations - Untimely tree failures, some of which might have been prevented by control actions, result in diminished environmental quality because of loss of shade, screening and aesthetic values.

4. Recreation Site Property Losses - Without a control program, the property damage to improvements such as restrooms, roads, camp tables, stoves, fences and other property can be substantial. Control programs can more than pay for themselves in preventing, or at least reducing such losses.

5. Public Relations - An agency's image is damaged by publicity about property losses and personal injuries from tree failures.

DAMAGES, LOSSES AND COSTS

Costs from tree failures and control programs can be incurred both in the pre-failure and post-failure period.

Pre-Failure Costs include: (1) site hazard inspection and evaluation; (2) costs of control and prevention incurred by tree pruning, topping and removal; and (3) relocation or removal of the recreation unit (rather than tree work).

Post-Failure Costs result from: (1) injury to persons; (2) damage to property (recreationist as well as site operator); (3) clean-up of fallen tree or its parts, or of debris from property damaged; and (4) damage to the site, both physical and environmental.

1. Losses on Western Recreation Sites - Studies by Paine (personal communication) showed the following accidents and losses from tree failures on western recreation sites (includes 11 continental western states including Alaska):

LOSSES FROM TREE FAILURE ACCIDENTS
ON WESTERN RECREATION SITES (1968-1973)

Species Group	Accidents			
	Injury	Fatality	Property Damage	Loss Totals
Softwoods	28	17	563	$ 1,212,964
Oaks	5	0	70	37,830
Other Hardwoods	3	2	148	123,324
Sahuaro	0	0	1	25
TOTALS	36	19	782	$ 1,374,143

Estimated property losses are usually somewhat convervative and data are sometimes missing according to Paine.

2. Failures, Losses and Costs in Selected Western National Parks - Paine's studies indicate the following combined summary of failures and consequences for several selected National Parks in the western United States for the period 1970 through August 1976. Figures given below include all failures, both catastrophic and non-catastrophic. Catastrophic failures are those occurring within a limited period of time on the same site and resulting from over-whelming environmental conditions such as snows and winds. Figures for tort claim settlements were not available and, therefore, are not included.

Park	Property Damage	Injury	Fatality	Total No. Accident Failures	Total Failures	Property Losses
X	68	9	2	71	173	$ 57,016
Y	71	8	3	71	169	53,440
TOTAL	139	17	5	142	242	$110,456

Approximate costs of tree hazard control for this period were:

Park X -	$ 139,400
Park Y -	926,000
TOTAL	$1,065,400

3. California State Park System Data - Data for the same six-year period furnished by Paine for the California State Park System show the following failures, losses and costs:

Property Damage	Injury	Fatality	Total No. Accident Failures	Total Failures	Property Losses
290	6	0	292	5,589	$ 45,336

Approximate control program costs (six-year period) - $420,000.

In summation, the foregoing data indicate, to some extent, the magnitude of the tree hazard problem on recreation sites; furthermore, these data show that considerable money is being expended for prevention and control of potential tree failures by the two agencies involved.

TRENDS IN COSTS AND LOSSES

According to Paine, there has been a decrease in the tree failure accident rate over the past ten years (personal communication) but losses per accident, based on reported property losses and standard values for injuries and fatalities, have been increasing steadily from $376 in 1968 to $3,437 in 1973. This does not include court awards or settlements out of court.

REFERENCES CITED

(1) Paine, L.A. 1971. Accident hazard evaluation and control decisions on forested recreation sites. USDA Forest Service Paper PSW-68.

(2) California Department of Parks and Recreation. 1969. Tree hazard control, policy and administration in the California State Park System.

(3) Menefee, C. 1973. The legal implications of hazards from tree disease and related factors in recreational areas. Proc. 21st Western Int. Forest Dis. Work Conf., Estes Park, Colorado. October 1-5, 1973.

OREGON STATE PARKS - THEIR DEVELOPMENT AND MANAGEMENT FOR PUBLIC ENJOYMENT AND SAFETY FROM TREE HAZARDS

Douglas B. Watson[1]

The original idea for the parks can be traced back to 1913 when the late Governor, Oswald West, gave his message to the Legislature saying "The ocean beach from the Columbia River on the north to the California State line on the south should be declared a public highway." Then, at the next Legislative assembly in 1915 he said, "The ocean has been reserved for the public for a highway." As we know, the beach was not used as a highway but has become a playground for the people of the State.

The original thought of most people when considering the parks in Oregon was to retain the natural environment along the highways and at the same time provide stopping places for the traveler. When the natural beauty was not to the desired degree, it was decided to plant the highway right-of-way with trees and shrubs suitable to the region.

Starting about 1919 the Highway Commission was making it known that they were aware of the needs of the public for the purposes of preserving the trees along the highways for a certain distance back from the right-of-way. Since this land was outside of the right-of-way, the Highway Commission requested legislation which would make it possible to appropriate private property for the purpose of beautifying or otherwise adding to the public highways.

In Governor Olcott's message to the Legislature on January 10, 1921, he said that many dollars were being spent urging the tourist to come to Oregon, and that we should have Oregon prepared for their enjoyment. He thought that the State Highway Commission should be the directing head in these endeavors in cooperation with the Forestry Department. As a result of the Governor's request, Legislation was provided for the Highway Commission to obtain land outside of the highway right-of-way either by purchase, donation or in eminent domain.

It is impossible to think of the beginning of Oregon State Parks without the inclusion of the beautification ideas as expressed and carried on by the Highway Commission in the period 1919 to 1930. The "Advisory Committee on Roadside Planning" was in existance during this time and its work outline included:

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[1]Forester, Oregon State Highway Department; Salem, Oregon.

1. Preservation and protection of present floral and scenic resources.

2. Roadside improvements.

3. Acquisition of desirable sites based upon proper investigation.

During the existance of this committee a number of inspections were made of our parks, and recommendations relative to soil conditions, topography, accessibility, plants and the growth of flowers and so forth were made on a number of parks. Interest in the parks system was growing rapidly and it was evident that Oregon was equipped to provide an adequate parks system for the citizens of Oregon.

The Highway Commission created the State Parks Commission at a meeting in August 1929, and placed Samual H. Boardman in charge of acquiring timbered areas. His title was Parks Engineer and he was to devote his entire time to park matters. This appointment was very beneficial to the State of Oregon because Mr. Boardman was very influential in persuading people of means to give property to the State for parks purposes. To further the personal interest in gifts, Mr. Boardman suggested, and the Highway Commission approved, giving donators of parks areas a certificate acknowledging the gifts.

Many of the improvements made on our parks were made in the 1930's. This era saw the CCC's, WPA and many other Federal and State agencies giving the recreation facilities a great boost.

The present parks organization saw its start in the 1950's. There now exists a State Parks Study Committee and Advisory Committee that advises the Department of Transportation and State Parks Superintendent on all matters of parks acquisition, management and maintenance. The present structure for the parks starts with an Assistant State Highway Engineer, then there is a State Parks Superintendent and one Deputy Parks Superintendent. There are three assistants, one responsible for recreation, one for operations and one for land acquisition.

Coming to my part in the system, I find that there is a policy on timber resources which states: "Oregon State parks include many miles of timbered waysides containing representative stands of the State's native trees, and in addition, most other parks have varying amounts of tree growth. It is the policy to preserve these timber resources to as great an extent as possible in conformity with good park management practices. Park improvements are made with careful regard to tree and shrub growth, and overuse of an area by the public, which would destroy these features, is continually guarded against. Park personnel are on the alert for timber trespass, and when such cannot be prevented, action is vigorously pursued against the offender to reimburse the State for the damages incurred."

It is park practice to sell dead and down timber if the removal does not impair park values to a greater extent than the benefits gained. This would include salvage of windthrown and other down material, as well as dead or dying standing trees in some cases. This practice may alleviate a fire hazard condition or prevent an insect or disease buildup that would threaten park timber nearby. Dangerous standing trees are removed if they are a threat to public safety. The Highway Division employs the services of a forester for timber appraisal work who also handles park timber salvage operations. Advice on forestry problems is sought from both federal and state forestry agencies as situations occur that require technical treatment. Adequate safeguards are taken to protect tree and shrub growth in park areas where it is necessary to grant easements of rights-of-way for utilities, etc. All requests for removal of shrubbery or flowers in State parks are denied, thus, preserving them for the enjoyment of the general public.

The forest practices on State park lands has been quite varied. We have been involved in reforestation, fertilizing and timber salvage. I foresee forest activities greatly increasing because of two factors. Hazard tree identification and removal is becoming more paramount as the public use of our parks increases. Increased forest activities are going to be needed to assure the public of safe and healthy trees for a longer period of time. We are at the threshold of a very exciting and intensive tree management program for the parks system.

JUDGING POTENTIAL FOR FAILURE IN WESTERN HEMLOCK AND SITKA SPRUCE

James S. Hadfield[1]

Hazard evaluation in forested recreation sites involves rating the probability of tree failure and the probability of target impact. I am going to address the first.

If you were directed to rate trees in this campground for hazard, what types of indicators should you look for? I would like to limit my remarks to western hemlock and Sitka spruce since these species may be unfamiliar to many of you.

In preparing for this assignment I asked Lee Paine of the Pacific Southwest Forest and Range Experiment Station for a printout of failures involving these species in Oregon and Washington. The following bits of information were extracted from the printouts.

Western hemlocks were involved in 113 failures. The classes of failures are shown in Table 1.

Table 1

CLASS OF FAILURE FOR 113 WESTERN HEMLOCKS IN OREGON AND WASHINGTON

Class of Failure	Percent of Failures
Upper bole	3.5
Lower bole	17.7
Limb	0.9
Butt	19.5
Root	58.4

These data clearly indicate that most of the failures of western hemlock have their origin in or close to the ground.

Table 2 lists the defects and faults associated with western hemlock failures.

[1]Pathology Group Leader, Region 6, U.S. Forest Service, Insect and Disease Management; Portland, Oregon.

Table 2

DEFECTS ASSOCIATED WITH 113 WESTERN HEMLOCK FAILURES IN OREGON AND WASHINGTON

Defect	Percent of Defects
Rot	44
Tree dead	11
Leaning	6
Mechanical wound	5
Cracks/splits	0.8
Widow-maker	0.8
Canker/mistletoe	0.8
Unknown	44

Factors contributing to the failures shown in Table 3.

Table 3

FACTORS CONTRIBUTING TO 113 WESTERN HEMLOCK FAILURES IN OREGON AND WASHINGTON

Contributing Factors	Percent of Factors
Wind	85
Snow	31
Shallow roots	15
Soil saturation	8
Tree striking tree	3
Stream bank erosion	4
Unknown	4

The printouts listed only 11 tree failures for Sitka spruce. Six of the failures were in the roots and butts. Rot was the most common defect and wind was the major contributing factor.

These data indicate that tree hazard inspectors should carefully examine the roots and butts of these two species for defects which may render them susceptible to failure.

Wood decays are the most important contributing factors to failure of western hemlock and Sitka spruce. These species have several characteristics which make them especially susceptible to bark penetrating wounds and subsequent infection by organisms causing decay. Their bark is thin, usually less than 1-inch thick, and is easily removed in the spring. Their roots are shallow. They typically develop pronounced butt swell and spreading root collar. The wood is nonresinous and poorly protected from infection by fungi. Both tree species grow best in mild climated with very abundant moisture; conditions ideal for growth of fungi which cause decay.

Scars are reliable indicators of defect for both species. Scars more than 3 years old and more than 1 square foot in surface area indicate decay. The amount of decay increases with scar size and age. The amount of decay associated with scars is also related to the position of the scars on the trees. Scars close to the ground have a high frequency of infection and more decay volume than scars higher up the boles.

Scar faces frequently become casehardened but the rinds may be only ¼- to ½-inch thick with advanced decay behind them. Scar faces should be struck sharply with an axe or sampled with a drill to detect advanced decay.

Just because trees may have decay does not mean they have a high probability of failure. In this Region we use the guidelines developed by Willis Wagener and published in the report "Judging hazard from native trees in California recreation areas: a guide for professional foresters", to determine if decayed trees have sufficient sound wood to support them. Increment borers or cordless electric drills can be used to measure the thickness of sound wood.

Conks are an obvious sign of decay and are indicators of potential tree failure. On western hemlock conks of the following decay may be found:

1. *Fomes annosus*
2. *Fomes pini*
3. *Stereum sanguinolentum*
4. *Fomes pinicola*

Fomes pinicola is the most frequently observed conk on Sitka spruce. It indicates advanced decay.

Black knots on western hemlock are not indicators of internal defect.

Dead tops on both species are highly prone to failure because the wood does not become impregnated with resin and decomposes rapidly. Dead branches also have a high potential for failure for the same reason. Most dead branches, however, break during winter months during storms when campsites are not likely to be occupied.

Multiple tops are not highly susceptible to failure if they are alive. Forks are also not especially prone to failure unless the members have grown especially long and heavy.

Leaning western hemlock and Sitka spruce have high potentials for failure, particularly if the lean is of recent origin. These are shallow-rooted species with limited anchorage. For the same reason root severence and soil saturation greatly increase potential for tree failure.

Dwarf mistletoe, *Arceuthobium tsugensis*, occurs commonly in western hemlock. Branch infections which result in witches'-brooms do not increase limb breakage unless the brooms become especially large.

Mistletoe trunk cankers do not render trees especially prone to failure if the bark remains intact. When the bark over a mistletoe stem infection dies and sloughs off the wood becomes infected by decay organisms and the failure potential increases.

Dead hemlock and spruce have very high potential for failure because of the rapid deterioration of the wood.

In conclusion, most of the failures in western hemlock and Sitka spruce occur near the ground with decay being the major defect. Tree hazard inspectors evaluating these species for hazard should carefully examine wounds for presence of extensive decay.

TREE HAZARD RATING DEMONSTRATION

Peter Gaidula

Today at Umpqua Lighthouse State Park we will demonstrate use of a tree hazard rating system. Each of you will be given a field guide, a tree hazard rating worksheet and a table of damage potential. We will make a step-by-step evaluation of hazard for a specific tree in this campsite.

The use of a tree hazard rating system has certain inherent advantages:

1. It provides a systematic, logical, step-by-step method of considering the main factors involved in tree failure and accident hazards.

2. It provides the examiner a numerical rating which enables the examiner to rank the hazardous trees in decreasing order of their seriousness. From this, he can set up control levels and priorities for expenditure of funds for control work.

3. It is an excellent tool for training personnel in tree hazard evaluation.

There are several hazard rating systems in use, but the one we will talk about today is one developed by Dr. Lee A. Paine, Principal Forest Pathologist of the Pacific Southwest Forest and Range Experiment Station. I have personally used this system for over four years in California State Parks and have found it very helpful. It is the official rating system for our Department.

Let us now proceed to rate the hazard of this tree, which is an 18-inch western hemlock standing over this campsite. It has a lean over the site. A dwarf mistletoe swelling on the bole, ten feet above ground, looks suspicious; however, on further consideration it was eliminated from consideration as a potentially hazardous situation. An old butt wound raised suspicion of heart rot; however, an increment boring helped to dispel this situation. Inasmuch as this tree did not prove to be a good example for rating, we must make certain assumptions for purposes of our demonstration:

1. A lower bole failure (Column 4 on rating sheet) is likely due to lean and advanced butt rot.

2. Probability of failure (Column 5), due to critical weather conditions (wind) which would cause failure, was judged to be 40%. See field guide for further explanation.

3. Probability of impact (Column 6) will be based on an assumed average annual occupancy of 50% for the camp units here.

Following the field guide (attached), and using the foregoing assumptions, we can complete Columns 4, 5 and 6 of the rating worksheet. By referring to the attached table 1, Recreationist Occupancy, we see that for an 18-inch softwood, the guide number is .09, which is entered in Column 7 of the worksheet. Under Column 8, we enter $4,000 for target value. The hazard rating can now be calculated by multiplying Columns 5, 6, 7 and 8. The rating turned out to be 72, which is entered in Column 9.

Having arrived at this rating, the question is what do we do now? Do we recommend control (Column 10) or not. My recommendation is to recommend control, and I shall explain the reasons. The approach involves setting of a control level on which to base control recommendations. Paine has outlined ways to arrive at control levels (see footnote). By experience and study of hazard ratings relative to the hazards found, the hazard examiner can select his numerical control level. This is what I have done in my work. Based on numerous evaluations made by using this rating system, I have determined that, under our conditions and species, we can achieve a satisfactory level of public safety and hazard control by recommending control work on all trees for which the rating is 50 or above. It should be emphasized that the hazard inspector, with sound reasons, can override the control level for trees rated below the control level and recommend control, if he feels that the rating in certain cases underestimates the potential for failure and accident.

TREE HAZARD RATING - A FIELD GUIDE

(Based on Dr. Lee A. Paine's Method)

RECREATIONIST OCCUPANCY

Rate only trees that have substantial susceptibility to failure and that pose an appreciable hazard to recreationists and their effects, or to property or both. Avoid rating minor hazards, especially those involving limbs.

Paine, L.A. 1971. Accident hazard evaluation and control decisions on forested recreation sites. USDA - Forest Service Research Paper PSW-8.

Dead Trees and Snags. Do not rate dead trees and snags. See criteria given earlier in this handbook. Dead trees and/or snags recommended for control must be given top priority. Complete Columns 1, 2 and 3. Enter "dead tree" (or snag if appropriate) in Column 4 and "top priority" in Column 10.

Use the Hazard Rating Worksheet. Make clear, legible entries and retain worksheet as part of legal records of the Tree Hazard Program. Make appropriate entries on DPR 311, Tree Hazard Report (or on DPR 211 when used).

Columns 1 and 2. Enter tree number, diameter, breast height and species.

Column 3. Enter type of occupancy (recreationist or fixed property).

Column 4 - Failure Class. Indicate part of tree that shows defect or fault (i.e. limb, upper bole, lower bole, butt, root). Avoid rating limbs unless they pose a substantial hazard.

Column 5 - Probability of Failure. (a) Estimate the type and intensity of the one critical weather condition (for the period until the next annual inspection) that will most likely cause tree failure due to the defect or fault found. For example, a 35 mph wind, or possibly a 50 mph wind, etc. (b) Determine the frequency of the selected critical weather condition year-long for the previous ten-year period. For example, if a 35 mph wind is estimated to have occurred four times in the past ten years at the recreation site being inspected, the probability of occurrence (probability of failure) for one year will be 4/10 = 40%. Enter .40 under Colume 5.

Column 6 - Probability of Impact. This step requires office work based on campsite occupancy and day use figures for the past three fiscal years. Calculate the average annual percent of occupancy for overnight and day use facilities in accordance with instructions give in this handbook. Enter percent of occupancy (probability of occupancy or of impact) after conversion to decimal (nearest hundredth) under Column 6.

A tree posing a hazard to a site having both recreationist and fixed property occupancy should be rated for both and the higher of the two ratings should be used.

Column 7 - Damage Potential. Refer to attached table for recreationist occupancy and enter appropriate guide number according to tree group, size and defect class.

Column 8 - Target Value. Enter $4,000 under Column 8.

Column 9 - Hazard Rating. Calculate rating by multiplying values in Columns 5, 6, 7 and 8. Enter rating in Column 9.

Column 10 - Control Recommended. If hazard rating equals or exceeds the departmental tree hazard control level, place a check mark in Column 10.

Finally, inspect adjacent trees for effects from control of hazardous trees that would require adjustments in rating of those trees.

HAZARD RATING WORKSHEET

Sheet 1 of 1

UNIT Umpqua Lighthouse State Park
DATE September 14, 1976
PARK FACILITY Campground
BY Peter Gaidula, WIFDWC

1	2		3	4	5	6	7	8	9	10
TREE NO.	SPECIES AND DIA. B.H.		OCCUPANCY TYPE	FAILURE CLASS	PROBABILITY OF FAILURE	PROBABILITY OF IMPACT	DAMAGE POTENTIAL	TARGET VALUE (Dollars)	HAZARD RATING	CONTROL RECOMMENDED
	DBH	SP	(a) recreationist (b) fixed property (describe)	(a) limb (b) upper bole (c) lower bole, butt, root	(a) defect (b) critical weather	Occupancy: (a) Human (b) Fixed property	(See tables) (a) Human occ. (b) Fixed property	Human occupancy use $4,000. Fixed property Estimate loss	Multiply column 5 x 6 x 7 x 8	Check trees falling within control level
1	18	WH	recreationist	lower bole	.40	.50	.09	4,000	72	X

Recreationist Occupancy

Table 1–*Guide numbers indicating relative potential of softwoods and hardwoods for damage to recreationists and their property, by tree size and defect class*[1]

Diameter breast height (inches)	Softwoods: Limb	Softwoods: Upper bole	Softwoods: Lower bole, butt, or root
10	–	0.055	0.055
12	–	.065	.065
14	–	.07	.07
16	–	.08	.08
18	–	.09	.09
20	–	.10	.10
22	–	.12	.12
24	–	.13	.14
26	–	.14	.16
28	–	.15	.19
30	0.12	.16	.23
32	.12	.17	.28
34	.12	.13	.33
36	.12	.13	.38
38	.12	.13	.44
40	.12	.13	.49
42	.12	.13	.55
44	.12	.13	.60
46	.12	–	.66
48	.12	–	.71
50	–	–	.76
52	–	–	.80
54	–	–	.84
56	–	–	.88
58	–	–	.91
60	–	–	.94

Diameter breast height (inches)	Oak[2]: Limb	Oak[2]: Lower bole, butt, or root	Other hardwoods[2]: Limb	Other hardwoods[2]: Lower bole, butt, or root
10	–	–	–	–
15	–	–	–	0.065
20	0.025	0.10	0.07	.07
25	.06	.10	.08	.10
30	.09	–	.08	.13
35	.12	–	–	.16
40	.16	–	–	.19
45	.21	–	–	.22
50	.27	–	–	–
55	.33	–	–	–

[1]Includes data for pine, fir, Douglas-fir, and the cedar family as well as oak and hardwoods other than oak.
[2]No upper bole recreationist losses reported for oak or other hardwoods. Figures for oak and other hardwoods based on limited data which reflect no injuries or fatalities.

Fixed Property

Table 2–*Guide numbers indicating relative potential of softwoods and hardwoods for damage to fixed property, by tree size and defect class*[1]

Diameter breast height (inches)	Softwoods: Limb	Softwoods: Upper bole	Softwoods: Lower bole, butt, or root
10	–	0.025	0.025
12	–	.03	.03
14	–	.03	.03
16	–	.04	.04
18	–	.05	.05
20	–	.07	.07
22	–	.08	.08
24	0.035	.09	.10
26	.035	.11	.12
28	.035	.12	.14
30	.035	.12	.16
32	.035	.13	.19
34	.035	.13	.22
36	.035	.13	.26
38	.035	.13	.31
40	.035	.14	.36
42	.035	.14	.42
44	.035	.14	.47
46	.035	.14	.53
48	.035	.14	.58
50	.035	–	.64
52	.035	–	.69
54	.035	–	.74
56	.035	–	.79
58	.035	–	.84
60	.035	–	.88
62	–	–	.91
64	–	–	.94
66	–	–	.97
68	–	–	.99
70	–	–	1.00

Diameter breast height (inches)	Oak[2]: Limb	Oak[2]: Lower bole, butt, or root	Other hardwoods: Limb	Other hardwoods: Lower bole, butt, or root
10	–	–	–	0.065
15	–	0.04	–	.065
20	0.018	.06	–	.065
25	.025	.08	–	.065
30	.05	.14	–	.065
35	.09	.20	–	.065
40	.12	.29	–	.065
45	.15	–	–	.065
50	.17	–	–	.065
55	.19	–	–	–

[1]Includes data for pine, fir, Douglas-fir, the cedar family, spruce, and hemlock, as well as oak and hardwoods other than oak.
[2]Insufficient data for upper bole. Suggest using limb values for oak upper bole.
[3]Insufficient data for limb and upper bole.

1/Tables from: "Accident Hazard Evaluation and Control Decisions on Forested Recreation Sites -PSW-68"
By Lee A. Paine, Pacific Southwest Forest and Range Experiment Station

PANEL - FIELD TRIP

DISEASES OF ROOT SYSTEMS I

PHYTOPHTHORA ROOT ROT OF PORT-ORFORD-CEDAR

Lewis F. Roth[1]
Moderator

Root rot of Port-Orford-cedar is caused by a water-loving, root-inhabiting, soil-borne species of *Phytophthora*, *P. lateralis*. The fungus is destructive only on *Chamaecyparis* and its place of origin is unknown. The fungus appears to have made its way from the urban residential areas of Seattle, Vancouver and Portland where the disease was first troublesome through the Willamette Valley, destroying the nursery industry based on ornamental *Chamaecyparis* as it went and ultimately in 1952, reaching the native range of *C. lawsoniana* on the southern Oregon coast. There it has killed landscape and hedge trees and has generally decimated the young-growth forests. These, for the most part are small woodlands and farm forests where, due to high population densities and accompanying intensive land use, the disease was actively spread about.

Periodic aerial photography showed disease spread to have occurred both narrowly along streams and waterways and broadly by construction, as well as in the rural areas by hoofs of cattle. The fungus produces no air borne spores (some aerial spread occurs very near the ocean) but on the gentle lowlands was physically carried almost everywhere.

Soon after its introduction into the native cedar range the disease appeared along the roads in the commercial timber of the mountains and spread quite extensively along the forest as the road network was extended.

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[1]Professor of Forest Pathology, Department of Botany and Plant Pathology, Oregon State University; Corvallis, Oregon.

However, it was ultimately realized that the much restricted land use and steep terrain of the commercial forest exercised some very real limitations on the ability of the fungus to spread widely. On the basis of topographic features in relation to water flow and on limited accessability as well, it appeared possible to identify sites that the fungus would be unlikely to reach. It further seemed that these could be maintained in cedar production by applying reasonable consideration in the execution of normal forest management and land use. This appeared true both on a large topographic scale where major ridge systems were involved and on a smaller scale within already established harvest units where stable disease distribution patterns were recognizable in the advanced regeneration or were predictable from minor topographic features visible in freshly cut units.

Therefore, the development of special management procedures for disease control applicable at the times of timber harvest, of thinning and of stand establishment, appeared available to the forester. Preliminary planning of these is discussed by John Shoburg and Bernie Altenbough, timber staff officers of the Powers Range District, Siskiyou National Forest.

POWERS RANGER DISTRICT

SISKIYOU NATIONAL FOREST

Robert Boston[1]

INTRODUCTION

The Powers District occupies 140,000 acres on the north edge of the Siskiyou National Forest in Coos and Curry Counties, Oregon. The district's main drainages are the South Form Coquille, Sixes and Elk Rivers. The district office is at Powers, Oregon. This district was called the Port-Orford in its early years.

The district lies generally on the western slopes of the coast range and north of the Siskiyou Mountains and extends to within two miles of the ocean. Topography on the district is generally mountainous, rough and steep. Elevation varies from near sea level on the Sixes River to 4319 foot Mt. Bolivar.

Climate is typical of southwestern Oregon with wet winters and dry summers. Yearly rainfall is 60 inches at Powers, 75 inches at Coquille River Falls, over 100 inches in the Sixes and 60 inches in the West Fork of Cow Creek. Rainfall between July 1 - September 30 is generally very light with most of yearly precipitation occurring between December 1 - March 1. Most high elevation precipitation is snow which may build to average depths of four feet. Temperatures rarely exceed 90 degrees in summer and seldom drop below freezing in winter in lower elevations.

Lumbering is the major industry in both Curry and Coos Counties and the timber resource of the district is important to their economy. Presently, most of the timber products from the district are processed in Coos County. The district's allowable cut is an important factor in stabilizing the timber industry of the area. The allowable cut of 40 MM board feet for the district has been reached and will be harvested each year. The major portion of the district has been made accessible by roads constructed in connection with timber harvesting.

The Powers district is the smallest district on the Siskiyou Forest. It occupies about 13% of the Siskiyou Forest land area but produces 21% of the total National Forest allowable cut.

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[1]Ranger, Powers District. Siskiyou National Forest

RESOURCES

Soil Resource. The soils of the Powers District originate from the Siskiyou Mountains and Coast Range. The soils of the Siskiyous are generally of low productivity because of their thin, rocky, easily erodable nature while those of the Coast range are quite productive deeper soils but still erodable.

Soils of both regions present a management problem because of their complex distribution. The intermingling of the basic soil types creates cleavage planes which cause soil disturbances during wet periods. This disturbance can be further aggravated by the improper location, construction and maintenance of roads and faulty logging practices. Much can be done to protect the soil resource through application of proper land management practices.

Water Resource. The streams are typical of the Oregon coast with heavy flows in winter and very light flow by the end of each summer. Three municipalities (Powers, Myrtle Point and Coquille) take most of their domestic water from the Coquille River system, which at this time is the largest use of water. The Coquille River system also supplies the lumbering industry for plant operation and log pond water and downstream water is pumped for irrigation.

Sport fishing is an important water use. The majority of the larger stream systems on the district support runs of salmon, steelhead and trout. Fishing for steelhead or salmon is permitted within the district boundaries and the streams provide valuable spawning grounds.

(Take note Scharpf and Parmeter! Ed.)

Recreation Resource. The demand on the recreation resources is increasing at a rapid rate. The district has seven developed campgrounds totaling 55 family units, which are inadequate to meet present demands.

The district has approximately 43 miles of major streams that provide good fishing. Hunting is a major recreation use with heaviest hunting pressure on blacktail deer and Roosevelt Elk herds. Grouse, black bear and pigeons are also well hunted. Miles of roads and trails entice the visitors.

There are several small lakes but only Squaw Lake with its developed campground is now accessible to the general public. The State Game Commission has planted trout in Squaw Lake annually since 1956.

Timber Resource. The commercial timber type is mostly old-growth Douglas-fir. Typical stand composition is 92% Douglas-fir, 3% Port-Orford-cedar and 5% other conifers including hemlock, sugar pine, true firs, western redcedar and western white pine. The timber stands of the district are generally continuous with small areas of brush and non-commercial land interspersed through the stand.

Port-Orford-cedar. The first timber sale on the Powers (Port-Orford) District was sold in 1916 to Coos Bay Lumber Company. This sale totaled 27 million board feet. Selling prices were Douglas-fir, $1.25/MBF; western redcedar, $1.00/MBF and Port-Orford-cedar, $2.00/MBF.

Port-Orford-cedar continued to be a significantly important wood species over the years. In 1921 it was selling at $5.00/MBF and in 1924 one sale was sold for $25.00/MBF. The current average bid prices in 1976 are well in excess of $1000/MBF.

One sale sold for over $1700/MBF. Port-Orford-cedar is extremely valuable and it's all going to Japan where it is a highly valued sacred wood. Every house in Japan has some Port-Orford-cedar in it. There is a built-in market.

Ed Note: It is interesting to speculate on the value of Port-Orford-cedar if it had only a domestic market. Its value would probably be less than Douglas-fir!

Forest income from this species alone is in excess of $10 million annually. Domestic use is relatively small and in the form of speciality products. Port-Orford-cedar snags are the mainstay of a small, but thriving, arrow-shaft industry. The cutting of "arrow-wood" provides a supplement to many winter unemployment checks in the surrounding local communities. In addition, the arrow-shaft manufacturing plant in Powers is the only self-contained industry in this small town of 800 people.

The cedar root rot. Phytophthora root rot (*Phytophthora lateralis*) was first discovered on the Siskiyou National Forest in 1952 in three separate locations. By 1954, it became evident that the disease was spreading along watercourses and roads.

Today, we have several thousand acres of infested timber to contend with. Areas that are easily accessible are salvage logged. Steep ground or inaccessible areas where mortality is high, must be worked into our total harvest plan for the district. In stands where uninfected Port-Orford-cedar is present, we are attempting to secure contract clauses that will minimize spread of the disease to these areas.

Reforestation. Regenerating cut-over areas is a major problem, and considerable effort will be needed to find better ways of assuring prompt reforestation. Adverse weather and big game combine to take heavy toll of the planted seedlings. Immediate restocking of logged areas where brush dominates and is suppressing reproduction is necessary to release the seedlings with herbicides.

Coquille River Falls Natural Area. This 500 acre natural area was established in 1943. The increased demand coupled with the rapidly growing shortage of Port-Orford-cedar indicated a need for action to preserve this comparatively rare species in its natural state. The area is 20 miles south of Powers along the Coquille River. No timber cutting, road building or structural improvements are permitted.

Port-Orford-cedar Natural Area. The Port-Orford-cedar Natural Area was established in 1937. This natural area of 1240 acres was created in connection with research projects being conducted on the Port-Orford-cedar Experimental Forest. It is located on the west side of the South Fork Coquille River 12 to 14 miles south of Powers. This area was reserved for use by the Forest Service in connection with research projects. The area will remain in its present state. Fire suppression will be the only activity permitted on the area by the Forest Service.

Range Resource. Domestic animal grazing is a very minor activity. (Ed. Note: A significant fact with regard to cedar root rot.)

REFORESTATION AND PRECOMMERCIAL THINNING OF PORT-ORFORD-CEDAR IN RELATION TO PHYTOPHTHORA LATERALIS

Bernard J. Altenbach[1]

For the past three decades the root rot has steadily progressed into the natural range of Port-Orford-cedar. More intensive management of our commercial forest land tends to accelerate the spread of the disease into uninfected areas. No economical or practical method has been found which can be utilized in our situation to stop the advance. The beast is here and we will have to live with it for the present and probably for decades to come. This doesn't necessarily mean the end of the Port-Orford-cedar or that it should be listed as a threatened or endangered species.

Port-Orford-cedar is a prolific seeder, and always naturally seeds into clearcuts where it normally occurs if a seed source is available. Our objective is to prevent *Phytophthora* from entering these young stands and control its spread if it becomes established, until such time as the disease can be eliminated.

Until 1959, Port-Orford-cedar was planted on selected sites. Some units were planted to solid cedar and others were planted in alternate rows. You can see the folly of this practice when you examine the methods by which the disease spreads. Future plantings should be directed at inhibiting the spread within the plantation. Guidelines for control must of necessity be experimental in nature until more is learned about the longevity of the disease spores.

What can be done? We must be able to grow disease-free seedlings. Since at present all nurseries now producing bare root stock are infected with *Phytophthora* or are assumed to be infected, we must look to new methods of producing seedlings for outplanting. This can be accomplished by producing seedlings in containers. The potting medium will have to be sterilized and tested for *Phytophthora* before it is used. At present, this method of tree production is more than twice as expensive per thousand seedlings as bare root stock.

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[1]Planning and Other Resource Assistant. Powers Ranger District. Siskiyou National Forest.

Entry of equipment into cedar production areas during the wet season must be avoided. Since this is the time of year that most reforestation work is accomplished, certain precautions will have to be taken. Planting crews will have to walk to the units or be transported on sanitized equipment which can be trailered in. Helicopter transportation of seedlings and crews is another alternative but one which would be severely limited because of weather conditions and cost. Containerized seedlins show great promise in extending the planting season into the dryer months of summer. If survival percentages for planting during this dry period are acceptable, this technique would eliminate the problem of entering the cedar production areas during the wet season.

The majority of our outplanting areas are either totally below a road or the road passes through the unit near the top. Since the disease spores travel downhill in the ground water, we proposed to leave a 200 foot cedar free strip below the roads. A 100 foot slope distance strip extending from the bottom of any draw and along stream courses will also be left cedar free.

These strips will have to be maintained free of cedar either by chemical or mechanical means. Planting in the remainder of the unit should be regulated so that no more than 20% to 25% of the planting is Port-Orford-cedar. They should not be planted in rows but intermixed with other species so that they occur no closer than 50 feet from each other throughout the planting area.

Another option we have in plnating would be to increase minimum cedar spacing to 100 feet and plant two or three cedars 10-15 feet apart. This would increase the number of cedars that could be planted in the unit.

Procedures for precommercial thinning are similar to those for planting. Recent stand improvement work has made no effort to save the cedar as crop trees. In most instances, the cedar was discriminated against because of root rot. Cedars were left for crop trees only when Douglas-fir, true fir or mistletoe-free hemlock was not available. Recent thinking leads us to believe that this is a poor and wasteful practice, especially on good cedar sites.

Control of disease spread should be accomplished with the same cedar free strips along the roads, draws and streams as in reforetation. In addition, a 200 foot cedar free buffer strip should be created around any infection center found within the thinning unit. These buffer strips will also need to be maintained in a cedar free state.

Within the remainder of the project area cedar should be left at wider than normal spacing. This wider spacing is calculated by multiplying the normal spacing specified in the contract times four. The distances between cedars would vary between 40 and 60 feet. Other species would fill the spaces between.

Another alternative would be to pre-mark the Port-Orford-cedar to be left, cut all other cedar and thin the other species at required spacing disregarding the marked cedar for spacing purposes.

In summary, grow cedar on the ridges and keep it out of the draws. Encourage cedar on convex slopes and keep it away from concave slopes where potential water borne spores from infection sources above could contact cedar roots.

After examination of these proposals, we find we have written off substantial areas of productive cedar growing sites. Parts of these areas may be reinstated for cedar management provided certain questions can be answered.

1. How long can the *Phytophthora* spores live without coming in contact with the roots of a live cedar?

2. How far can these spores travel in ground water and still be able to infect a live cedar?

3. Are the spores dormant during any part of the year or over a period of years? If so, what causes this dormancy and what combination of conditions causes these spores to become active? Can the spores be killed more easily during the dormant period than during the active period?

4. Is there any method of sanitizing a cutting unit prior to planting?

5. Is there a safe, economical and feasible method of sanitizing road surfaces to kill spores present in the road and also those that come in contact with the road surface within a certain period of time (one year or more)?

6. Is there any possibility of creating a genetically resistant Port-Orford-cedar? If yes, how long will it take?

7. How big an area is encompassed by the root system of a 100 year old Port-Orford-cedar?

8. When the rot finally kills the tree, does it continue to move through the root system on the other side of the tree from which it enters? If so, how fast does it move? Is it able to move uphill in this manner?

MANAGEMENT OF PORT-ORFORD-CEDAR AND CEDAR ROOT ROT

John Shouberg[1]

INTRODUCTION

Dr. Lew Roth has adequately filled us in on the biological characteristics of the fungus *Phytophthora lateralis*. The method by which it travels to its host is primarily by water. Once present on a site, the spread of *Phytophthora* infection is aided by root grafting in the characteristically shallow-rooted Port-Orford-cedar.

How does this fungus become introduced to an area to start with? As has been indicated, man with his machines has been the main contributor, carrying the fungus on trucks, tractors, graders, pickups, cars and logging equipment from areas infected with the fungus into the spore-free areas during wet weather.

Past management of Port-Orford-cedar has been limited and geared toward individual effort within the range of this species. A major contribution to the widespread introduction of *Phytophthora* occurred in the late 50's and early 60's. This was a period when development of our transportation system was greatly accelerated. Major drainages were roaded rapidly during this period to provide access so the timber could be harvested. Little thought was given to the protection of Port-Orford-cedar from *Phytophthora* as the fungus was not present.

It became known early that the disease was a deadly killer and that there was absolutely no known contorl. This latter led individuals to "write off" the Port-Orford-cedar in the newly established plantations. The decline of Port-Orford-cedar and lack of concern for it management, even with its high value, has failed to create a public furor and this can probably be blamed on the fact that there are no home grown industries dependent on the species for domestic manufacture.

Today we will have stands with a significant component of Port-Orford-cedar on the Siskiyou National Forest which are free from infection by *Phytophthora*. There areas are not overly abundant and several are planned for entry within the next five years. Through the life-long work and persistance of Dr. Roth in this field, management within the Forest Service has recognized a need to manage Port-Orford-cedar,

[1]Timber Management. Powers District. Siskiyou National Forest.

wherever practical, as an integral part of these last remaining stands on a sustained yield basis.

I prefer to identify these areas which are capable of being managed without the introduction of *Phytophthora* as cedar production sites, coined from Dr. Roth's Disease Management Guidelines for Commercial Coniferous Forests Infected by Phytophthora. A definite terminology is needed in order that management activities can be rigidly monitored and recorded on these acres.

These potential cedar production sites are characterized by stands comprised of 30-90% Port-Orford-cedar. Generally speaking on this District, the soils in these areas are comprised of a high percentage of serpentine. The higher the percentage of serpentine, the more dominant the Port-Orford-cedar becomes within the stand. Roaded access into these areas needs to be predominantly on the ridgetops, due to the slumpiness and high erodability of the soils on the lower slopes.

DISEASE MANAGEMENT

As land managers we have developed four major alternatives on how to manage these remaining *Phytophthora*-free stands which have the potential to become cedar production sites.

1. The first alternative would be to access these stands and manage them as we have in the past. This would guarantee that *Phytophthora* would soon be prevalent within each area entered. Several thousand acres, where Port-Orford-cedar is the dominant species, would have to be taken out of the commercial harvest land base as proper reforestation would not be successful. On those acres where reforestation can be ensured, Douglas-fir and hemlock would have to fill the Port-Orford-cedar void. This is not an acceptable alternative.

2. Another alternative would be to avoid entering these stands at all. This would prevent the introduction of *Phytophthora*, but would have a grave affect on the commercial harvest base and the availability of the valuable Port-Orford-cedar on tomorrow's market. This would not be acceptable unless both alternatives 3 and 4 or some combination of these cannot be used.

3. A third method which has been used to a limited extent is to avoid road building by using helicopter logging. Presently, helicopters are authorized to log those areas which are uneconomical, or impossible, to road. Most potential cedar production sites can be roaded very easily. Helicopter logging, besides being expensive, increases the cost and difficulty of doing post-sale and cultural work due to lack of access. This method would be acceptable for managing fungus-free areas if our proposed alternative is not approved and the authority to use the helicopter is extended to cedar production sites.

4. Our forth alternative, which we feel is most advantageous, and will be expanded upon, is to provide minimal access into the cedar production sites. This alternative would allow the use of cable systems on the majority of the ground. Two criteria are necessary in order to ensure this method prevents the introduction of *Phytophthora*: (1) more stringent contract language and (2) proper administration of the activities which take place upon this land once it has been designated a cedar production site.

Contract restrictions. The requirements within our timber sale contracts are general in that they are based on a national and regional basis, not on a specific parcel of land nor for one particular disease.

We have a contract committee to which proposed clauses for specific reasons can be submitted. Development of these clauses is often difficult if one is not sure of the proper operating techniques that will meet the objective. Dr. Roth's Disease Management Guidelines for Port-Orford-cedar has taken the technical language of research and placed it in a context so the land manager can better define the objectives he must strive for. Use of the objectives helps develop contractual constraints which must be placed on sale design, road construction, logging and post-sale activities such as slash disposal and cultural techniques which will best perpetuate Port-Orford-cedar and eliminate the introduction of *Phytophthora*.

For example, in our most recent timber sale we submitted several proposed contract clauses to the contract committee. These clauses restrict operations on the sale area to dry weather periods with low soil moisture. They allow road construction only when soil moisture is below a given minimum and require the road to be substantially completed one full season prior to removing any trees. Logging operations will be restricted by additional contract language to similar dry periods.

Additional management requirements for these stands which can be controlled by present contract language include the following. Roads will be gated to limit travel during the wet season. Where the road needs to be constructed through wet areas, it will be turnpiked. Material for the turnpiked section will be brought in from areas identified as being *Phytophthora*-free. Dust soil will be required on the road to eliminate hauling water for dust abatement. No tractor yarding will be allowed within cedar production sites. Cut and fill slopes on the newly constructed roads will be heavily seeded with grass and fertilized. This will aide in intercepting water from the road surface and prevent accumulations of Port-Orford-cedar seedlings from becoming established along the roadside near the primary point of *Phytophthora* introduction.

The design of the road and units to be harvested is again geared toward meeting the objectives outlines in Dr. Roth's guidelines. Roads will be designed to minimal standards (excavation, fills, etc.) which will allow access for the equipment needed to operate the sale. Units are designed from the ridgetops to the creek bottom. These units will then be broadcast burned, killing all live vegetation. This latter will benefit the reforestation, especially if introduced spores are short-lived without their primary host present.

An active information and education program will be necessary before, during and after major operations have taken place in the designated cedar production sites. This will be aimed at industry, the local public, Forest Service employees and visitors to the Forest. Its purpose is to prevent "slip-ups" or animosity toward this management program by providing a good understanding of why we are gating these roads and restricting operations to particular seasons.

CONCLUSION

In conclusion, it has become quite evident that in order to perpetuate Port-Orford-cedar, disease management measures are needed on those lands where the introduction of *Phytophthora* can be prevented. Our objective is to identify and manage, through a minimal transportation system, potential cedar production areas which have the opportunity for protectability as outlined in Dr. Roth's Disease Management Guidelines for Commercial Coniferous Forests Infected by Phytophthora.

REFERENCES

Roth, L.F. Disease Management Guidelines for Commercial Coniferous Forests Infected by *Phytophthora*, A Case Involving *Phytophthora lateralis* on Port-Orford-cedar.

PANEL - FIELD TRIP

DWARF MISTLETOE AND WHITE PINE BLISTER RUST

Robert F. Scharpf[1]
Moderator

INTRODUCTION

A field trip took us into the mountains of the Siskiyou National Forest in the area of Powers, Oregon. Conference members were exposed not only to the chilly wind of the upper elevations of the Siskiyou but also to the hemlock dwarf mistletoe (*Arceuthobium tsugense*) on both western white pine and mountain hemlock. Severe infection by blister rust (*Cronartium ribicola*) was also present.

Stimulating presentations were made by the various panelists, but in the interest of time discussion was, unfortunately, held to a minimum.

The general impressions received from both the panelists and participants were that research and control are underway on both blister rust and dwarf mistletoe in the West, but that we do not have all the answers or the final solutions to either of these problems. Research needs to continue to provide information where it is lacking about these problems and more importantly, forest managers need to work with researchers and pest control people to test and apply the information now available for control. Efforts all along the way need to be better coordinated and applied if control is to be our ultimate goal.

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[1]Pathologist. Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

MANAGEMENT OF CONIFER STANDS INFECTED WITH DWARF MISTLETOE IN SOUTHWEST OREGON

Duane Kingsley[1]

The Umpqua, Rogue River and Siskiyou National Forests in southwest Oregon contain predominantly conifer forests of a large variety of mixed species. Most of the timbered areas are managed for sustained yield of softwood sawlogs and related products, plus other multiple uses.

Within this area are seven forms, or species, of dwarf mistletoe that belong to the genus *Arceuthobium*. These are white fir, red fir, sugar pine, lodgepole pine, ponderosa pine, Douglas-fir and hemlock dwarf mistletoes. By far the most virulent are the Douglas-fir and hemlock dwarf mistletoes. White fir and red fir dwarf mistletoes are very common in parts of the area, but although damage certainly occurs, the damage is generally tolerable. The damage caused by lodgepole pine, sugar pine and ponderosa pine dwarf mistletoe in southwestern Oregon is generally insignificant.

On the Rogue River National Forest, which I represent, it is not uncommon for three species of dwarf mistletoe to occur on the same acre. Each dwarf mistletoe species reacts differently in terms of virulence and amount of damage caused. Single dwarf mistletoe species react differently in different drainages, different slopes, different timber types and different tree sizes. The vigor of dwarf mistletoe may be tied to tree vigor, rather than light or nutrients alone. But this is very confusing, since dry sites seem to have more dwarf mistletoe than moist sites. Some infections stay light, no matter how much the stand is opened up; others run rampant. Crossovers seem to be more common than the literature indicates. Dwarf mistletoe seeds seem sterile some years, which might cause infection by wave years. *A. tsugense* seems to have at least two subspecies, if not three.

No wonder many confusing statements are head in the woods these days about dwarf mistletoe. They are heard in conference rooms, in financial planning meetings and on timber sale areas.

They go like this:

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[1]Forest Silviculturist. Rogue River National Forest.

1. "Dwarf mistletoe has always been around, yet we have big stands of timber. I don't see what the big fuss is about."

2. "We're not going to get rid of dwarf mistletoe anyway, so wouldn't it be better to spend the money for something urgent?"

3. "Dwarf mistletoe is the most damaging agent in this area. We know how to get rid of it, and we will make every effort to do so whenever a new stand is regenerated. Our goal is to allow no new stands to become infected."

4. "No dwarf mistletoe suppression should be undertaken unless it can be proven that the benefits outweigh the cost."

5. "We should not be cutting down so many dwarf mistletoe whips in plantations. It wastes too much wood that should be utilized."

6. "No dwarf mistletoe suppression projects should be done unless approved by a forest pathologist."

The point of my mentioning these things is that the dwarf mistletoe business is very complex. We will never know all of the things we might want to know about dwarf mistletoe.

But meanwhile, we have to go on what we've got. The three National Forests in southwestern Oregon (Umpqua, Siskiyou and Rogue River) are regenerating by clearcut or shelterwood some 16,000 acres per year; commercial thinning 2,000 acres; and precommercial thinning about 10,000 acres per year, for a total of 28,000 acres per year. Add to this all the work of the Bureau of Land Management, State of Oregon, the Counties and private industry and it is clear to see we are talking about a huge operation, just here in southwestern Oregon.

Now, I can't speak for everyone in southwestern Oregon, but it is clear to me that the quality of timber management to minimize the effects of dwarf mistletoe varies from zero to very good, depending on where you look. Some people do not even know they have a dwarf mistletoe problem. Others are hoping their problem will go away, so they won't have to spend any money on treatments.

So, here is a classic example of the problem all researchers are well aware of: How to get research findings into common field practice. You would think that if the scientist developed a better mousetrap, everyone would stampede to use it. But such is not the case. Maybe our salesmanship is none too good.

I believe you will find the progress is more a crawl than a stampede. And it will remain so, until we can answer the following questions:

1. Where should I do something, and what is it that needs to be done? Why should it be done? What can I expect to happen if it doesn't get done?

2. Where should I do nothing? Why?

My report here today is not a plea for a set of cookbook recipes for dwarf mistletoe treatments, because the variety of conditions is too complex to cover in this way. There seem to be no statements, rules, or guidelines in the dwarf mistletoe business that are always true, or always false. There is no statement we could make that does not have an exception. Each stand and each situation must be analyzed on its own unique merits.

The managing forester needs to know the basic facts and how to design his own treatment prescription for each stand.

With a few exceptions, I believe there is sufficient technical data on dwarf mistletoe for anyone who wants to dig it out. But there is a decided lack of state-of-the-art, practical guidelines on what to do about the problem. Salesmanship! Where is the pamphlet that I can hand to the district ranger that tells him how to size up the problem, how to solve it and what will happen if he doesn't?

Where is the group training package, the slide tape program, or self training aide designed for a group or a new forester to bring their skill level up to standard? If I don't have time to write it, and you don't have time to write it, then who will?

Where is the top-level direction that demands that the land manager take appropriate action to solve his dwarf mistletoe problem? And along this vein, where is the reinforcement for the land manager who decides to do something, but can't get the money without writing justification statements, environmental analysis reports, economic analyses, etc. for each project.

It is possible to grow a tremendous amount of wood in this area, if we decide we really want to do it.

Its time we decided what the job is that needs to get done, and get with it.

As a case in point, consider reforestation. Top management has, in most forestry organizations, made the decision - "we are going to get the reforestation job done". Training sessions were set up. People check on progress. Numerous "how to" publications are available. More training sessions, accomplishment reports, inspections, etc.

We do not need a proliferation of justification statements, economic analyses, etc. We simply plan the job, ask for the money, get it (usually) and go out and get the job done. Those who fail will quickly hear about it. There are even State laws on the subject.

This has not happened with dwarf mistletoe control. We know approximately what to do and how to do it, but there is some lingering doubt whether we should do it, considering the cost. And nothing happens if we don't get the job done. No one says anything. We just go along from year to year.

Effective control will continue to languish until research can convince management that the job must be done. Until then, progress will be sporadic and frustrating.

You may think it is not your job to convince management that dwarf mistletoe prevention is important. But I say it is your job. And if you don't get the job done through your writings, personal contacts and memoranda, then who will? Everyone is waiting for research to make up their mind as to what should be done; for what we lack is an overall, coordinated campaign. We are fighting a war against dwarf mistletoe, but most people don't know it. Too many fight a little skirmish here, a little there and ignore the rest of the problem.

In conclusion, I believe it is well within our knowledge and resources to meet a goal that states: "We will minimize the effects of dwarf mistletoe in stands already infected, and prevent dwarf mistletoe from infecting the crop tree species in any future plantation or regeneration area." I believe that such a goal is reasonable and prudent, and that the Nation would not expect us to prescribe anything less.

THE DORENA TREE IMPROVEMENT CENTER AND PROGRAMMING IN WHITE PINE BLISTER RUST RESISTANCE IN THE PACIFIC NORTHWEST REGION

Jerry Barnes[1]

The Dorena Tree Improvement Center is a U.S. Forest Service installation designed to provide leadership and services in operational phases of tree improvement programming in the Pacific Northwest Region. These services extend to the Bureau of Land Management through cooperative agreement. We are located near Cottage Grove, Oregon, a few miles south of Eugene on Interstate 5. Administrative services and guidance are provided by the adjacent Umpqua National Forest.

Programming is geared to activities in tree improvement requiring extensive testing facilities and highly trained specialists that would be prohibitive in cost if duplicated on a forest-by-forest basis in the Region. Disease resistance development is currently the Center's major. Tree improvement, seed extraction, testing and storage for the Region is also centralized at the site. Training in tree climbing safety and breeding procedures is provided to Region Six units by Dorena personnel.

The Center has a permanent staff of ten, with supervisory positions established in tree breeding, genetic appraisals, nursery management, seed orchard development and seedcone processing, under the supervision of a Center Manager. Total manpower use ranges to 30 employees at peak load periods.

Technical direction is provided by the Timber Management Division of the Region Six office. Advisory channels from the Insect and Disease Control Office at the Regional level and Research Stations at Idaho, California and Oregon are established and active.

The Rust Resistant White Pine Program

Two disease resistance programs are currently included in the Dorena assignment. Resistance in lodgepole pine to western gall rust (*Peridermium harknessii*) is in the pilot programming. Resistance programming in sugar pine and western white pine to white pine blister

[1]Manager, Dorena Tree Improvement Center; Cottage Grove, Oregon.

rust (*Cronartium ribicola*) is the prime assignment at Dorena and is now in its twentieth year of development in the Region.

White pine resistance programming, involving over 1,500,000 acres of forest land, has been highly successful in the Pacific Northwest in both the sugar pine and western white pine species. Initial resistance programming in white pine in the West and Inland Empire was reviewed in 1969 at a NATO-IUFRO Conference: Advanced Study Institute on the Biology of Rust Resistance in Forest Trees. This conference formed the base from which rapid development of resistance was accomplished in all involved programs.

The Pacific Northwest Program entered the production phase in 1971 when 112 western white pine and 76 sugar pine trees were certified for collection and use of open-pollinated seed for reforestation purposes. Significant levels of seed were also produced in the western white pine seed orchard at Dorena the same year. Tree certification and seed production have increased each year since with a current total of 421 trees certified for open-pollinated cone collection, representing 190 natural tree stands in 29 breeding zones.

Production levels, currently set at 480 progeny lots/year tested at Dorena, will be expanded by 120 lots/year starting in FY 1978 to 960 lots/year in 1981 and subsequent years. A total of 2648 trees have been located to date. Several hundred additional trees are located each year by the field units.

A resistance development program for Region Six designed to provide durable resistance with a broad genetic base has been established. This program was established using the general guidelines of developmental research in white pine rust resistance provided by the research team at the Intermountain Forest and Range Experiment Station, Moscow, Idaho. Emphasis is on horizontal traits in combination with multiline vertical resistance factors. A horizontal resistance factor resulting in marked reduction of frequency in needle lesions of all types (the N-gene factor) is the prime selection criteria in the Region Six program. The N-gene expresses in the artificial inoculation program at Dorena in the form of significantly reduced numbers of needle lesions in involved trees.

In the woods, outplantings verify that the factor provides high levels of blister rust resistance. The N-gene factor is under major gene control and can be treated as a single dominant gene in practical programming. Because of this, parent trees with the N-gene can be certified for open-pollinated cone collection for reforestation purposes with expectations of no less than 50% resistance in resultant plantations. The N-gene is required in all parent trees certified as elite for blister rust resistance in the Region Six program.

Seed orchard parent stock must possess the N-gene as well as one or more other expressed resistance traits such as: (1) the lack of needle lesions of certain colors or shapes, (2) the shedding of infected needles or fascicles, (3) violent reaction at the bark level which isolates the obligate blister rust fungus in dead tissue or (4) the tolerance of the disease by stem tissues.

A "wind screen" program is the major effort in our on-going program. Cone samples from hemotypically resistant and dominate trees representing various zones and tree groups in the Region are sent to Dorena by the field units. A typical "tree group: consists of five adjacent trees in a uniform environment selected on the basis of freedom from blister rust infection with superior growth and form. Select trees may have minor levels of blister rust infection when relatively free of the disease as compared to adjacent trees. Trees with the N-gene are identified through the Dorena progeny testing program and certified as elite.

A parallel tree breeding program managed by the Dorena crew, consisting of diallel mating groups involving various resistance expressions, provides an on-going resistance identity and improvement program to back up the wind screen projecting. This approach has been effective and productive. Eighteen breeding blocks are delineated in Region Six, each incorporating one to several elevational breeding zones. The fourteen largest breeding zones are earmarked for centralized seed orchard production of seed at Dorena and the BLM-managed Sprague Seed Orchard in southern Oregon.

In-woods seed orchards will be developed in the remaining zones, as well as the fourteen major zones. Two hundred families per zone, each representing a single tree group somewhere in the involved area, is the goal in the major zone seed orchards. Thirty families (tree groups) per zone is the goal for in-woods seed orchards. A seed orchard "family" will consist of five trees, either sibling, clonal or both that will be used but one time in any seed orchard field, totally preventing the possibility of inbreeding depression.

The Champion Strain

Geneticists predicted that the impressive but typically vertical resistance expressions identified in the early phases of white pine resistance programming would fall prey to mutated or rare strains of the blister rust pathogen. This has been dramatically demonstrated in the Champion Mine western white pine tree group and in the Dorena progeny beds in recent years.

The Champion group near Cottage Grove, Oregon has been under observation for forty years as a highly resistant group of trees in an extreme infection hazard area. A portion of the white pine stand was infected and killed in the initial spread of the blister rust disease through the West. A significant number of trees remained healthy, however, until recent years. Progeny testing of the Champion trees at Dorena over a period of fifteen years revealed that most carried an unusually large number of resistance genes of various types. Most progeny families could not be infected beyond the 20 or 30% level, compared to total wipe out of most progeny families from elsewhere in the Region.

In the late 1960's and early 1970's an increasing number of cankers on previously disease-free Champion trees were noted. By 1975 the infection rate was at an epidemic level with hundreds of separate infections on many trees. Inoculum had been collected from the Champion Mine area over the same period of time as one source for the artificial inoculation program at Dorena. In the last few years, infection symptoms changed drastically in the western white pine progeny beds and mortality from blister rust infection greatly increased. Resistance factors identified in previous years were and are being largely overridden. An important exception is that sugar pine seems little affected by the new pathogen strain.

Had the Region Six program not been built on horizontal and multiple resistance factors, the Champion Strain would have been a disasterous development. As it is, the strain is a predictable and controllable factor that strengthens rather than weakens the program. The presence of the strain permits screening of trees against its probably occurrence in other areas in the future. It also provides a measure of the validity of resistance factors identified as horizontal in nature. The N-gene does express in spite of the Champion Strain. And there is a reduced but significant level of healthy trees in the progeny beds exposed to the strain.

Finally, the strain supports the importance of broad-based inoculum sources in resistance programming to ensure the involvement of "local strains" of the pathogen that apparently can be quite isolated in the Champion Mine area with no spread to nearby stands of western white pine.

Growth Improvement of White Pine

Resistant progeny siblings in the Dorena beds are measured for height and stem volume after resistance screening and roguing is completed. Within the resistance base, the fastest growing siblings within each family are selected for seed orchard use. Families falling significantly below the growth rate mean for the involved breeding zone are rejected for seed orchard use regardless of resistance expression levels. This parallel program should provide additional genetic gain in resultant white pine plantations.

IMPLICATIONS AND LESSONS FROM AN OUTBREAK OF WHITE PINE BLISTER RUST IN JAPAN

Ed F. Wicker[1]

I was asked by the planning committee to say a few words about "mass selection" for blister rust resistant white pines. I agreed to do so providing I could also relate my work on blister rust in Japan.

There is nothing new or mystic about "mass selection". The principles and concept are older than forestry, older than agriculture; yes, even older than man. They are being applied to forestry, to agriculture and to man; they are nature's way of selecting the best fit for a given environment. This selection occurs in all living systems, with or without assistance from man. The term "mass selection" has been suggested and applied in those cases where man has attempted to speed up this natural selection process in plants for the benefit of mankind.

The white pines of North America have evolved during the recent Quartenary Period in the absence of *Cronartium ribicola*. They have not had to adapt to this fungus as an environmental factor. Suddenly, after thousands or perhaps millions of years, their populations are exposed to the fungus and *C. ribicola* becomes another force in natural selection. Fortunately, man is on the scene and has recorded some of the reactions and interactions of this event. As these white pine populations adapt to the presence of *C. ribicola* in the environment, man is observing and recording (at least temporarily) changes in them. Such changes may be beneficial or detrimental to the desires of man with respect to direction and time. Thus, man's response is to attempt to gain control of the variables and he has devised numerous schemes to do so. "Mass selection" is just one scheme, but a very promising scheme providing man has the patience and judgement to utilize it.

Anyone who has observed stands of western white pine exposed to *C. ribicola* for three or four generations has observed nature's demonstration of such selection. Such observations should further emphasize the importance of careful selection of seed trees during regeneration cuttings. White pines heavily infected with blister rust should not be considered good seed trees if others in the stand have less rust.

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[1]Plant Pathologist. Forestry Science Lab. Intermountain Forest and Range Experiment Station. Moscow, Idaho.

Thus, in regeneration cuttings designed to achieve natural regeneration, those white pines with the least amount of rust are selected for seed trees. Geneticists call this "mass selection".

We are certain that nature's method of selection will provide populations more attuned to nature's laws and more conditioned for the battle of survival. Critical seed tree selection has considerable merit and is well worth the extra time required for selection in any regeneration cutting system.

So much for "mass selection". I would like to spend the remainder of the allotted time relating my work on white pine blister rust in Japan to the overall problem of blister rust control.

I traveled to Japan in 1974 to work with Japanese scientists on a rust problem of *Pinus strobus* in eastern Hokkaido. This rust was first described by Jorstad (1936) from collections of V.L. Komarov and others on the Kamchatka Peninsula, U.S.S.R. He examined the uredial and telial stages of the rust on *Castilleja pallida*, *Pedicularis resupinata* and *P. chamissonis*. He gave it the "provisional name" *Cronartium kamtschaticum*.

Jorstad could not identify the rust he examined on a pine host but concluded that the rust could not exist and complete its life cycle solely on the alternate hosts. He reasoned that there had to be an aecial host, a pine. The only pine that grows in Kamchatka is *Pinus pumila*, a five-needle pine that has a growth form similar to *Pinus muga* and grows as a dwarfed trailing shrub of many stems in high elevation. At lower elevations a single stem, small tree growth form is normal. Jorstad surmised that *P. pumila* must be the pine host and that *Peridermium kurilense* Diet., described on *P. pumila* from the Kurile Islands might represent the haploid stage of *C. kamtschaticum*.

This rust received little attention from mycologists or pathologists because of several reasons, not the least of which was the fact that *P. pumila* was of no economic importance at that time. However, following World War II, the Japanese embarked on a reforestation program using *Pinus strobus* as planting stock in several areas of Hokkaido. In 1972, they noticed an outbreak of rust on *P. strobus* in eastern Hokkaido near Nakashibetsu which in two years caused 53 percent mortality in the planted pine. Mortality has since increased to 93 percent. I was able to work for about 7 months there making collections and actively participating in artificial inoculations.

This particular rust will go to *Castilleja*, *Pedicularis* and *Ribes* species. I was asked to identify the rust and I called it an ecotype *Cronartium ribicola*. Mycologists refer to these as physiological races, forma specialis, biotypes or biological forms. There are several names that have been applied; I call rust forms such as these ecotypes. They have been selected for a particular environment over a long period of time with gradual adaptation.

Plant Disease Reporter (March 1976) contains an article by Dr. Y. Hiratsuka, Edmondton, who successfully inoculated *Castilleja miniata* with aeciospores of *Cronartium ribicola* from two locations in Canada. This plant is a native Scrophylariaceae which grows from northern Canada to the central Rockies in the United States. Most Scrophulariaceae are root parasites and are difficult to grow from seed.

When these plants are collected and potted, there is a real problem of knowing whether they are infected or not. A few researchers believe and have some evidence that rust infections can be systemic. Systemic infection could be a problem while working with rust inoculations on potted plants from the field. Dr. Hiratsuka could not grow *Castilleja* from seed for inoculation tests, which meant he had to use field dug plants. He grew the plants for one year under frequent observation and after the aerial plant parts died back at the end of the growing season he had observed no rust development.

The next year when the new shoots came up he inoculated the plants with aeciospores of *Cronartium ribicola* obtained from two locations in Canada. One collection came from *Pinus albicaulis* and the other from *Pinus monticola*. He obtained successful rust infections on the Indian paintbrush in both cases.

At the same time he also inoculated two species of *Pedicularis* native to the Canadian Rockies. These plants had been obtained from the forest the previous fall and it was the first year they had aerial shoots. Hiratsuka obtained successful rust inoculation on the *Pedicularis* plants also. Since they were not grown for a year in a rust free environment, the same confidence in successful inoculation could not be expected as was found in the *Castilleja* which had been grown away from exposure to rust spores for one season.

The major difference in these inoculation tests on members of the Scrophylariaceae was that the uredial stage was missing. The cycle went right from aecial to telial stage. This is not uncommon. In certain species of *Ribes* in the Intermountain area, we have good uredia produced with little or no telia. Other *Ribes* species have just the reverse while still others have good uredia and telia production. This is normal variation within the various rust hosts.

It appears that *Cronartium ribicola* is not a simple rust species fitting a specific genetic entity as scientists once thought. The rust has considerable variation which poses new problems to our own rust resistance breeding programs. We weren't successful in keeping the European races of *C. ribicola* out of the United States, and I do not believe we will be any more successful at keeping the eastern Asia races out. In fact, there is evidence that some of them are already here. This new knowledge should be incorporated into our rust resistant white pine breeding programs.

PANEL - FIELD TRIP

DISEASES OF ROOT SYSTEMS II

ORIGIN IN THE NURSERY
AND
SURVIVAL AS OUTPLANTINGS

Everett M. Hansen[1]
Moderator

INTRODUCTION

By way of introducing today's panel, allow me to challenge you with the same question Ed Schroeder posed in his keynote address at the beginning of this conference. What happens if we get a fungus that would do to Douglas-fir what *Phytophthora lateralis* is doing to Port-Orford-cedar? Why hasn't it happened? Are we in danger of having it happen?

This morning we are going to play this "what if" game. I hope we won't stop there but go on to more important considerations of how to prevent something like this from happening.

If the "what if" is going to come to pass in the immediate future, it's going to happen on this unit or on one of the hundreds of other clear-cuts planted the last few years with diseased stock from Oregon and Washington nurseries. We are into a situation where we must wait and observe those planted trees.

Protection against disease is part of the still larger problem of ensuring quality planting stock for the forest manager. It is critical that we have successful regeneration in order to support our sustained yield harvests, for without regeneration there would be no sustained harvest.

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[1]Forest Pathologist. Department of Botany and Plant Pathology, Oregon State University; Corvallis, Oregon.

FOREST TREE DISEASES RELATED TO REGENERATION
A FOREST LAND MANAGER'S VIEW

Jack Barringer[1]

If you will allow me to borrow a page from Charles Dickens, I would like to briefly discuss "forests past, forests present and forests to come", as they relate to the often ghost-like presence of forest tree disease problems. Some references to Scrooge-like attempts at solutions are inevitable.

I have been asked what a forest land manager does. One answer is that we specialize in generalities. So, when the going gets tough, we call in the experts. In my opinion, there is no aspect of forest land management in greater need of expertise than the diagnosis and prognosis of forest tree diseases. The problems are, by their very nature, far beyond casual detection and solution. This expertise needs to be communicated for man's use if it is to justify its existence.

"Forests past" (old growth) require a custodial effort, primarily. Usually the presence of diseases takes the form of some percent defect found in the gross to net recovery and is accepted by the land manager as a natural consequence to logging over-mature timber. Fortunately, recent efforts have been directed toward a better understanding of the carry-over effect of some forest tree diseases from the old growth clearcuts to the regeneration effort. We accept old growth disease losses just as we accept the gain from the existence of the stands established by nature some 400 to 500 years ago and managed by her with the unhuman objective of maintaining a successful, biological community. Enter man, taxes and dollar return to the landowner.

"Forest present" (which I define for my own purpose as being 10 to 100 years old) are receiving a great deal of the forest land manager's attention as we intensify our management programs. More specifically, and in somewhat chronological order, genetics, planting and/or seeding, brush spraying, precommercial thinning, fertilization, weed tree removal, commercial thinning and partial-cut salvage are useful tools in the manager's bag. However, every entry by man into the natural sequence of events established by nature in her forests carries with it not only the opportunity for human gain through enlightened practices but also the opportunity for failure for man and nature through ignorance. Can we really afford not to know?

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[1]Forester. Timber Services Company. Sweet Home, Oregon.

"Forests to come" I define as being approximately 10 years of age or younger, or non-existing. They began with the first planting of trees from improved seed. They will incorporate all of the management skills that can be brought to bear. They will be exposed to extremely intensive, but not necessarily informed, management.

Planting trees to establish forests, since biblical times, is a matter of record. But only as late as July 1, 1972, with the beginning of the Oregon Forest Practices Act have results from regeneration efforts been required by law in this State. Consequently, many companies in the forest industry suddenly were faced with the legal need for more than a token effort toward reforestation of cut-over lands. This, coupled with increasing silvicultural and economic evidence that tree planting was, in fact, superior to natural or artificial seeding, resulted in a rather sudden, extreme demand for seedlings. The response from forest tree nurseries around the State has been nothing short of heroic. Despite shortages in suitable nursery property, trained labor and physical plant facilities, not to mention capital, the orders for seedlings are being filled in bare root nurseries.

Fortunately, the arrival on the scene of containerized seedlings could not have had better timing. They are helping fill the seedling production gap with their relatively short growth cycle. The very nature of the containerized nursery lends itself to effective disease control. The demand for forest tree seedlings continues to grow, but industry is tooling up to meet that demand.

The effect of a root rot such as *Phytophthora* rearing it's ugly head and perhaps becoming wide spread in Douglas-fir nurseries, as well as outplantings, amidst the current surge in regeneration effort, could leave the average forest land manager paled and panic stricken.

It just so happens that there are no average forest land managers. We are all good guys with white hats, ready to jump into the nearest phone booth, change into hard hats and caulked boots, stride out into our forests and face the problems.

Perhaps a little more to the point, I see a major forest tree disease control effort in a vigorous young forest brought about through planning for the following:

1. Seed collected from proper drainage and elevation at least, breeding for disease resistance at best.

2. Careful cleaning and sizing to give the nurseryman the very best possible seed for planting.

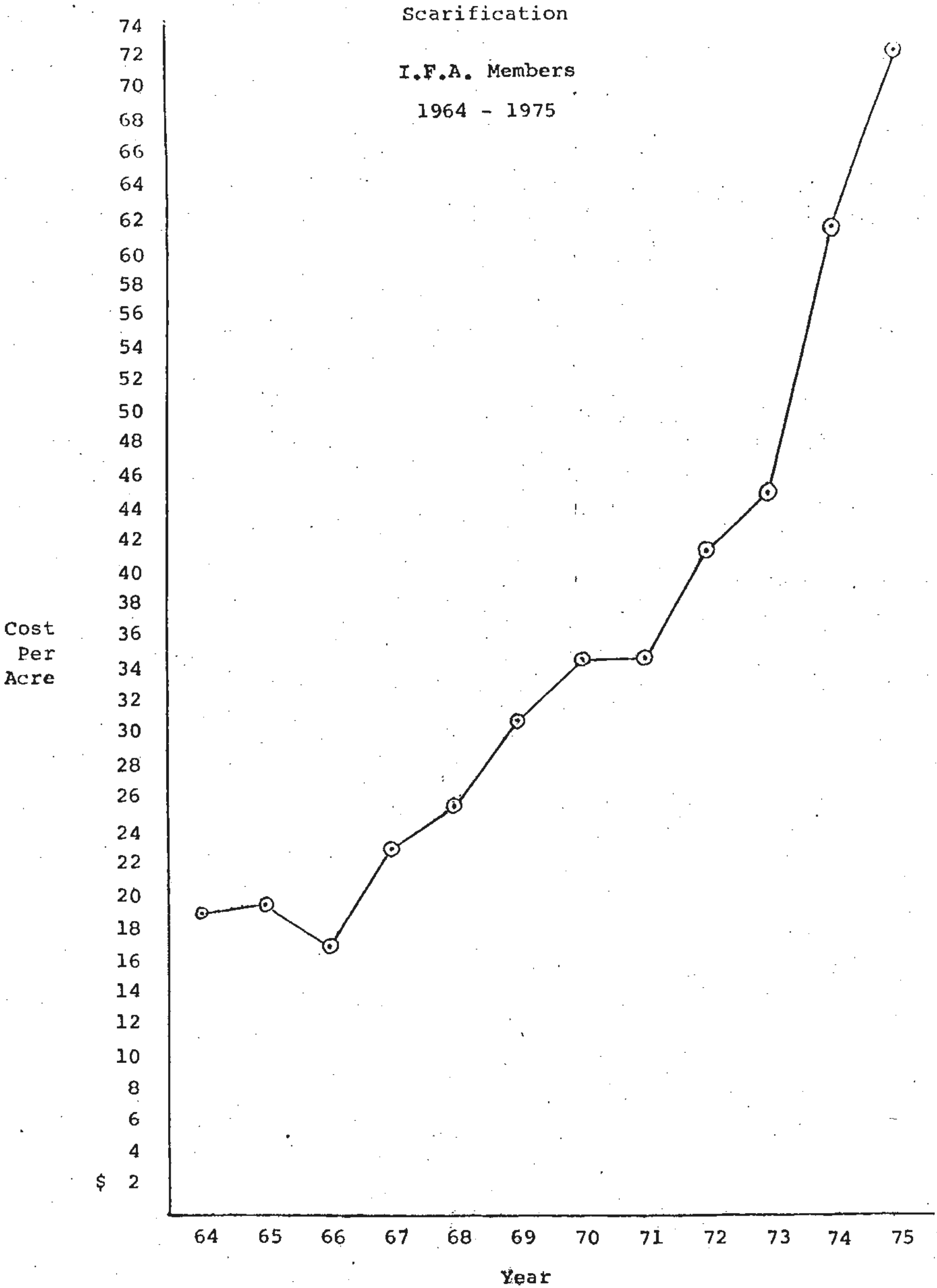
3. Proper storage, stratification and sowing rate to put the correct number of seeds in the right place in the nursery beds or containers, in their best physiological condition for germination and growth to a size and condition prescribed by field foresters for the outplanting sites intended.

4. Care in lifting and packing conditions, storage and transportation to the planting site.

5. Insistance on proper planting techniques with appropriate planting tools and the acceptance of the fact that it is not the initial cost of planting but the cost of live seedlings that is important.

Nothing is more wasteful than a good plan poorly executed. Close communication with those doing the work to insure attention to the many small but important details, is a must.

In summary, I would point out that the researcher, the nurseryman and the forest land manager have a heavy responsibility to the earth's people, present and future, to insure a sufficient supply of one of the world's most important and only renewable resource.


Scarification
I.F.A. Members
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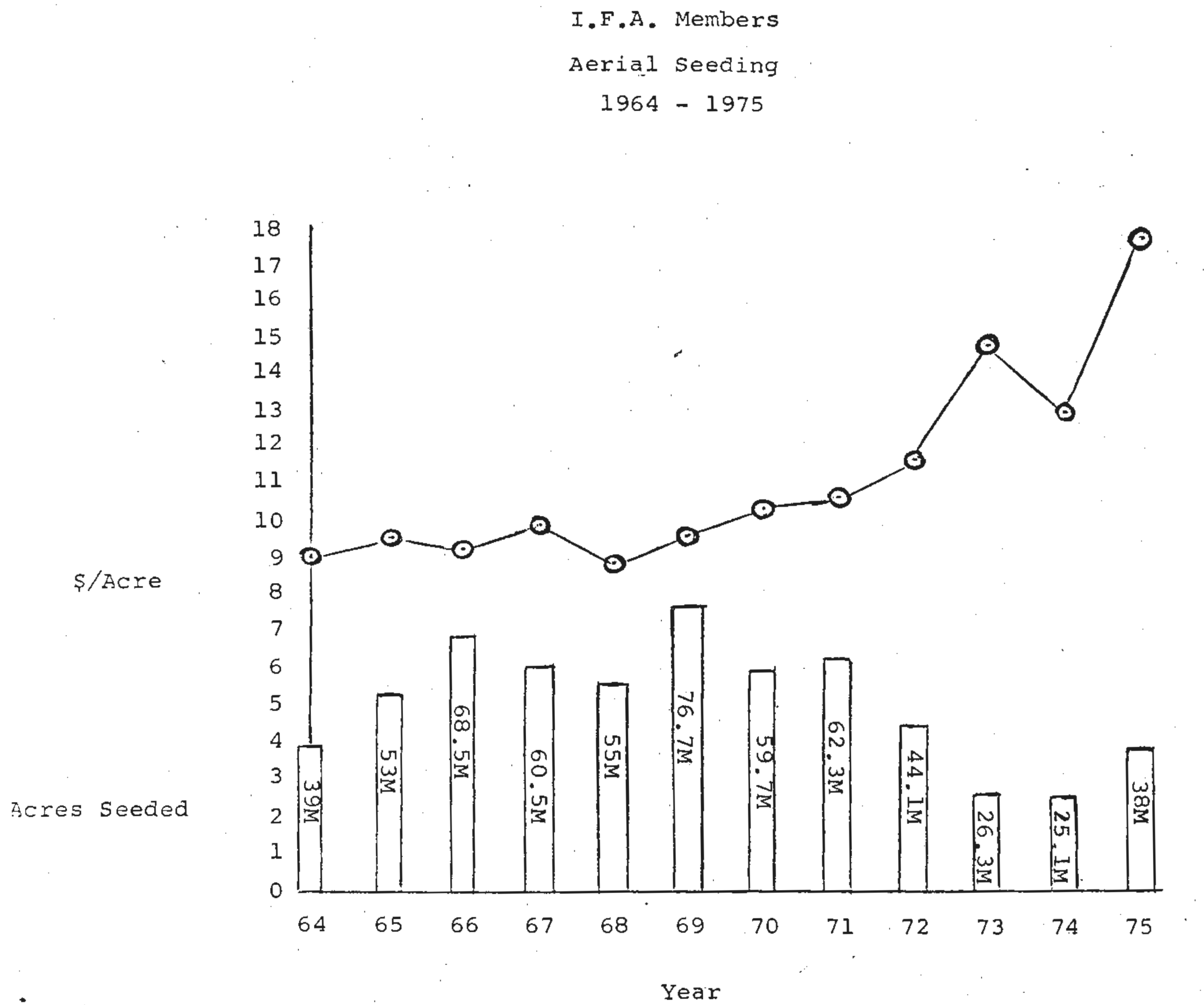
Year


I.F.A. Members
Aerial Seeding
1964 - 1975
$/Acre
Acres Seeded
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17
16
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14
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12
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39M
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68.5M
60.5M
55M
76.7M
59.7M
62.3M
44.1M
26.3M
25.1M
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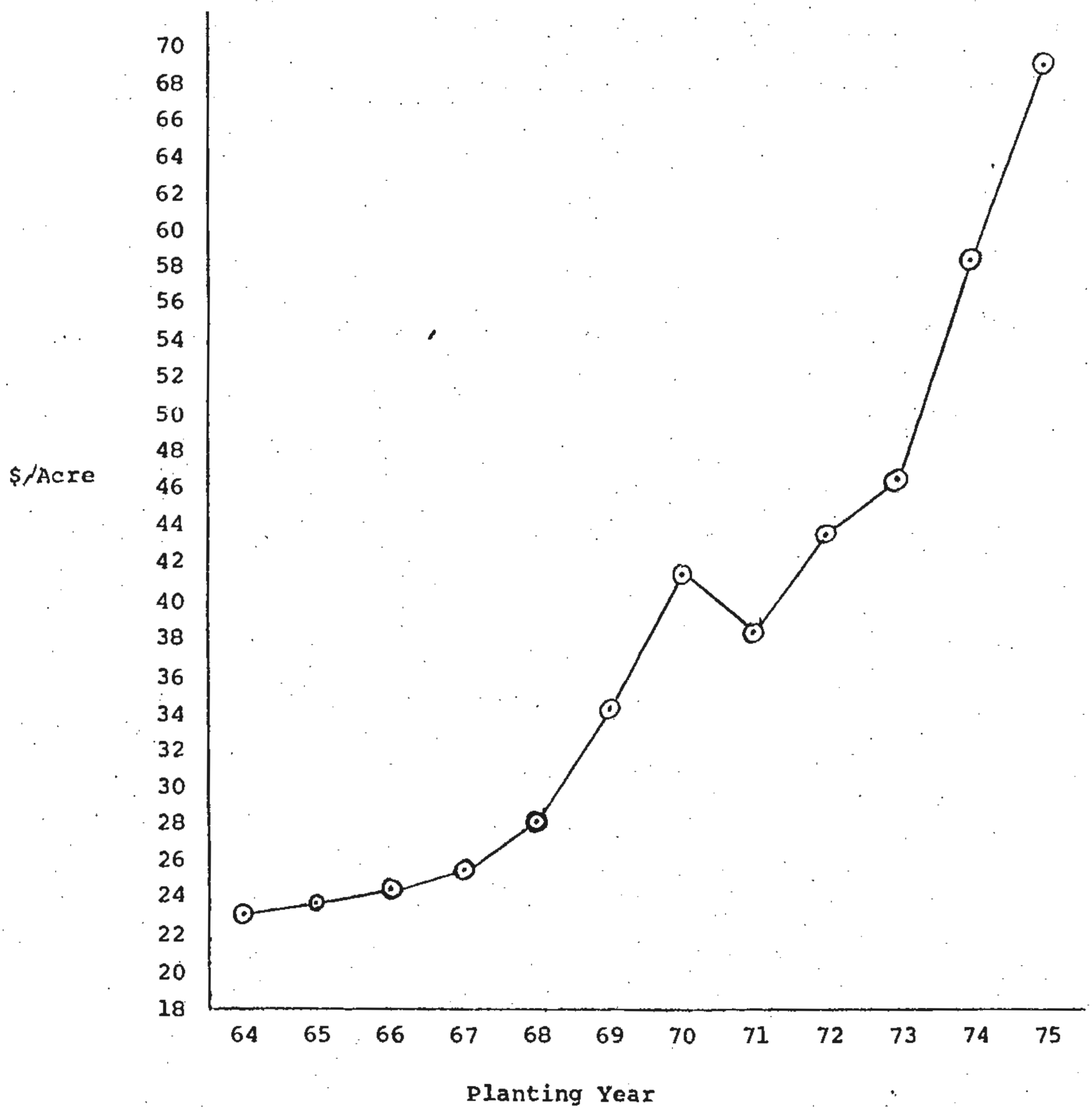
Year

Tree Planting Costs

I.F.A. Members
1964 - 1975



MINIMIZING SOIL BORNE DISEASES THROUGH EFFECTIVE NURSERY SOIL MANAGEMENT

John Blake[1]

I wish to emphasize that Everett Hansen has just given a synopsis of what we in the Industrial Forestry Association wish to do to prevent the development and spread of root diseases, particularly *Phytophthora*.

We operate three bare root nurseries, one in Oregon (Canby) and two in Washington (Olympia and Toledo). The Canby Nursery began operation in 1961, Olympia in 1970 and Toledo in 1976.

We had not been specifically concerned with *Phytophthoras* until the recent detection of these fungi at Weyerhaeuser's Jefferson Nursery. We decided to look at our own nurseries by doing a specific bioassay for *Phytophthoras* and found them in the Olympia nursery.

Another reason we began checking for *Phytophthoras* was that one of our companies had a great deal of mortality in an outplanting and several affected seedlings appeared to have root rot. Everett has stressed that trees suspected of root rot should never be outplanted; however, these seedlings were not stunted or chlorotic when pulled from nursery beds. They appeared to be normal looking 2-0 seedlings when planted. The problem we had was that even though visual appearance was good, a razor blade autopsy after several months in the plantation revealed apparent root disease development.

Root rots, whether *Phytophthoras* or not, cannot be effectively eliminated at the culling table unless they are extremely obvious. In the past this has been our best means of removing poor quality stock from production. A dependence on traditional cull standards would be ineffective in eliminating root rots such as *Phytophthoras*. It becomes obvious that in order to prevent the transfer of the disease from the nursery to the field, the disease must be controlled at the nursery bed prior to the time trees are established rather than at the culling table.

Our philosophy has been to use as much information as is presently known about these *Phytophthoras* for practical control measures. Our

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[1]Tree Quality Technologist. Industrial Forestry Association; Toledo, Washington.

present approach is to use soil management practices that improve our surface and internal drainage rather than chemical control.

We do a number of things we think would have a pretty direct effect on water movement on our nursery blocks. We identify low spots where water may collect by constructing large scale topography maps of the blocks. We practice reduced tillage to minimize compaction, construct dry wells, install drain tile, subsoil when necessary and chisel our tractor paths during winter. We eliminate permanent wet areas from production. During the summer we cut irrigation frequency.

We have been using these principles over the past 15 years before we ever knew we had *Phytophthoras*. We feel that these basic soil management practices should be done whether disease is present or not. Most species, especially Douglas-fir and others, just do not grow well under near saturated conditions.

Certain root rots like *Phytophthoras* may be enhanced by poor soil management practices. Good soil management must be done not just to enhance the plants that grow in it but also to adversely affect soil borne diseases. We have tried to practice this principle right from the start at our three IFA nurseries.

KEEPING NURSERY STOCK AND THE "WOODS" DISEASE FREE

Kenelm Russell[1]

Nursery seedlings suffer from all kinds of adversities. It is often amazing that we get good quality seedlings when one considers all the problems affecting their number and quality.

It seems they always receive either too much or too little water and too much or too little nutrients, which may encourage disease when the soil is warm and semi-dry (*Fusarium*) or when the soil is coolish and wet (*Phytophthoras*).

Seedling problems often begin from adverse environment of some kind which may then allow a pathogen to develop. Trees exhibit symptoms and by then it is too late. The trees may be either unusable or dead. Experts and nonexperts alike, including the boss, then converge on the poor nurseryman.

Immediate answers are expected! Think of the planning chaos!

What do we do about nursery disease surveillance? How do we avoid the above panic situation? Some states have a nursery inspection system, others don't. Oregon has inspectors where nursery beds are actually walked and observed for disease. Washington does not have official forest nursery inspectors who walk the beds looking for disease. Other states, including Washington and British Columbia, have disease surveillance and quality control built into an overall tree performance and evaluation system.

How do we approach a newly developing pest problem?

The *Phytophthora* problem we are now involved with in Oregon and Washington began with accidental observation of diseased seedlings in an Oregon nursery. This observation eventually came to the Northwest Forest Pest Action Council, which is the pest guidance organization for the forest industry. The Council recommended a special task force be formed to provide direction for solutions to the *Phytophthora* problem.

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[1]Forest Pathologist. Washington State Department of Natural Resources. Olympia, Washington.

Nursery managers and their employees have sharp eyes and usually report unusual signs of disease or other maladies to a pathologist. On occasion, this method of disease detection is too late. Production is jeopardized.

There are better ways to avoid the "too late" detection of disease. One of these is to develop a soil assay system specific for soil borne diseases that is conducted before trees are ever planted.

In 1966, I first tried such a soil disease assay when we began having tree quality problems in one of our Webster Nursery blocks (Washington D.N.R.'s nursery near Olympia).

Here is how we developed the process at Webster Nursery.

Soil samples were first sent to Georgia where Campbell and Hendrix found unusually high populations of Pythiums from diseased tree areas (1).

Based on this original data, a systematic sampling technique was developed using existing special *Pythium* selective media. Each nursery block that is bare of trees is systematically sampled during the summer. Soil dilutions in water agar are made from the soil samples and incubated for 72 hours on special *Pythium* media plates. *Pythium* colonies are counted, reduced to propagules per gram of field moist soil and plotted on maps of the block where they were sampled. Isolines drawn around similar concentrations indicate high and low disease hazard zones (Figure 1).

At first, my tendency was to have too many disease rating categoies. Originally, I used disease ratings shown in the table below left.

1966 *Pythium* Ratings

General rating	Pythium propagule counts/gm of field moist soil
Nil	0 - 0.9
Very low	1.0 - 1.9
Low	2.0 - 4.9
Moderate	5.0 - 24.9
High	25+

1976 *Pythium* Ratings

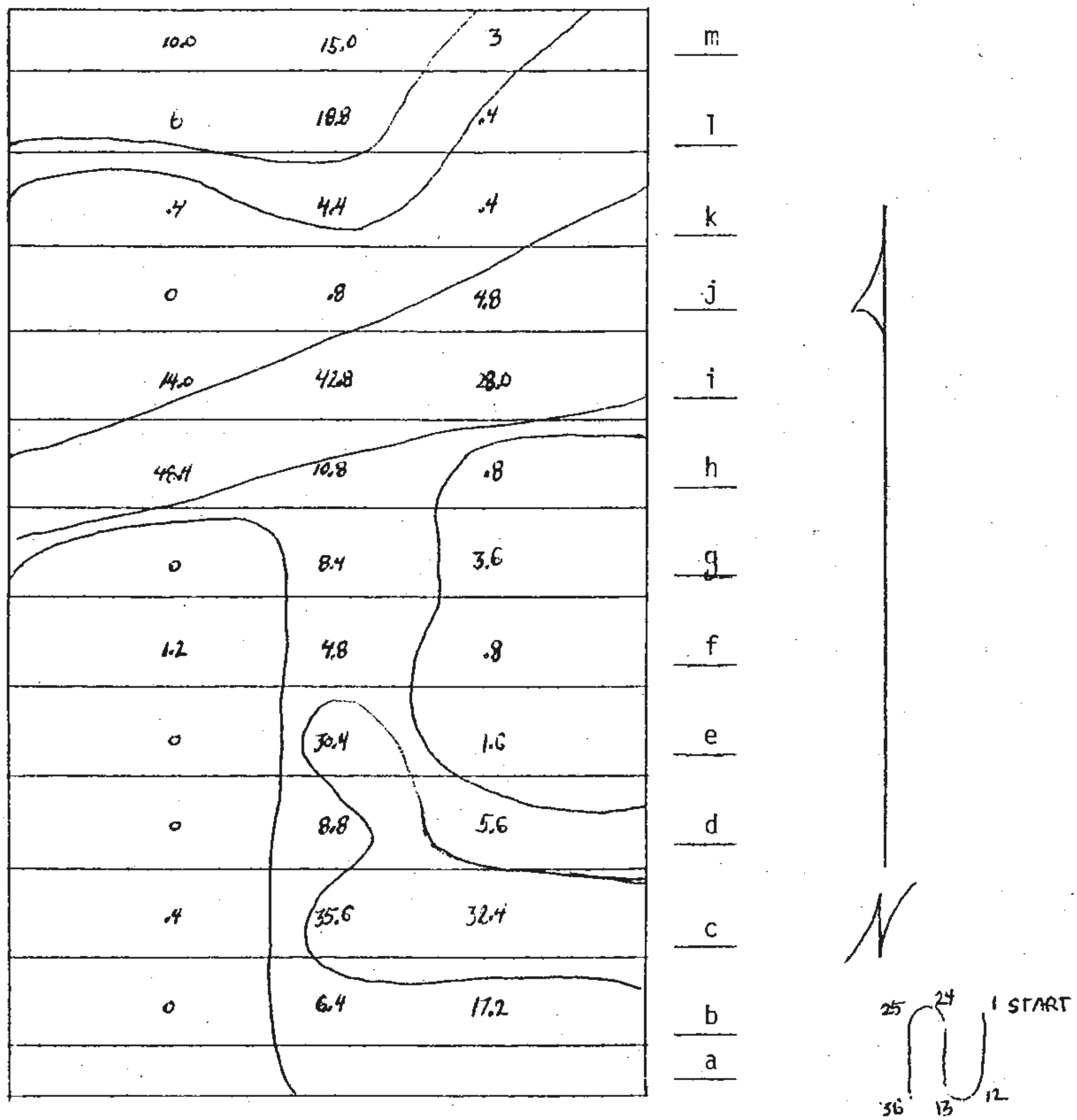
General rating	Pythium propagule counts/gm of field moist soil
Low	0 - 4.9
Moderate	5.0 - 25
High	25+

Today these breaks have been reduced (table - right). The nurseryman does not need precise counts because when he fumigates based on a high infection area he will streamline his tractor pattern for efficiency.

Over a period of years and a number of disease assays on the same nursery blocks, an informative disease pattern begins to emerge. This is the best way to keep on top of disease epidemics and to avoid the situation described in the first paragraphs. The nurseryman begins to

Figure One: NURSERY BLOCK SURVEY MAP

Nursery Webster   Block one
Type of Survey Pythium
Personnel cj
Remarks
Date 6/28/76



Isolines are drawn around different levels of Pythium concentration. The numbers show Pythium propagules per gram.

get a feel for disease potential in each block. Disease levels will vary from crop to crop and when they begin to reach threshold levels he knows he must either control the fungus or suffer seedling quality reduction. This is real management. He knows that his blocks are clean before he has trees, not after. *Pythiums* are ubiquitous -- they are everywhere and they have the potential of rebounding quickly under the right conditions.

Unfortunately, we do not have disease assays that conveniently pick up a number of soil borne organisms in the same incubation operation. Each disease must be assayed and incubated separately. The same soil samples will serve for several assays. At present, we can look for *Fusarium*, *Pythium* and with some effort, *Phytophthoras* by using a soil assay system.

Pests thought to be dangerous to the forest or other nurseries can be contained at least temporarily by declaring quarantine zones. An example of this was the European pine shoot moth. Such a quarantine in the Pacific Northwest might begin with discussions conducted through the Northwest Forest Pest Action Council. Affected states would be advised of the Council's findings and the quarantines would be placed in effect through state government. Trees could be banned or be shipped outside quarantine zones only following inspection, fumigation or other specified control of the pest.

There are possibilities where uninformed nursery inspectors could cause havoc by closing a nursery that had a soil disease that although lethal to nursery seedlings was not even significant to out planted or natural seedlings.

An example was a Michigan industrial forest nursery infested with *Cylindrocladium scoparium*, a virulent root rot of white and black spruce. The company knew through much testing that infected trees could be culled at the sorting table and the green trees could be planted with confidence they would not die of root rot.

The inspector came along, saw the root rot (identity unknown to him) and immediately condemned the nursery. Pandemonium!

Fortunately, the company knew the fungus well and quickly taught the Michigan Agriculture Department how to isolate it and showed them that the fungus would not carry the woods. After a tense month with ornery foresters snapping at the heels of the nursery management, the shipping ban was lifted and trees went out nearly on schedule.

A fungus that does carry to the field from infected nursery stock is not a root rot but a foliage disease. *Lophodermium pinastri* can spread throughout a nursery bed of Scotch or shore pine and be transferred to the field after planting. Infected Christmas trees are worthless. Cooperative work between the Christmas tree industry, Washington DNR and John Staley at the Rocky Mountain Station produced a control for this disease in two years. Scotch pine seedlings are now routinely sprayed with maneb in the nursery to control the disease.

Pathologists often know how to control soil borne diseases before they fully understand the disease or even know its identity. *Cylindrocladium* could be controlled in midwest nurseries at least two years before its identity was known. The present *Phytophthora* problem can be minimized by following the guidelines published by the Northwest Forest Pest Action Council. These guidelines advise nurserymen to stay out of wet clayey soils and grow trees in sandier well drained sites. "Stay out of the mud, fellas!"

I found from experience in working in various nurseries that one of the best ways of keeping tabs on total nursery activity and overall performance of trees was to keep a daily diary. Each day the nursery foreman would write what he actually accomplished that day. He might state that they weeded block 2, fumigated block 3 (had a little trouble in the first three beds getting the equipment calibrated), disked block 7, etc.

He recorded general weather conditions such as "0.2 inches rain" or "wind blowing a lot of sand" or "clear and hot, 88°". Experience shows that this sort of record provided clues in diagnosing some "after the fact" noticed problem. The use of a daily diary is not a common practice in nurseries but it is one of the best methods of keeping tabs on overall activity.

In my opinion, the approach for nursery surviellance we have in Washinton works fairly well. We do not need at this time a cadre of pest inspectors for the forest nursery industry. I would encourage nurserymen to conduct their own disease surveys to ensure that they always grow seedlings in clean soil. This relatively small expense more than justifies their existance.

Every time I think the soil disease assay approach is too time consuming and too expensive, I am bolstered by the assurance and confidence in clean soil they provide ...

Example.

DNR's Webster Nursery desired to grow seedlings in what had been a transplant bed for years. A *Pythium* assay showed propagule counts right off the scale. From past experience we knew excessive seedling failure would occur if we did not fumigate. We fumigated based on that assay and were rewarded with high quality seedlings from the new seedling block.

The estimated cost of the annual disease evaluation at Webster Nursery is about $1000 which includes labor, agar and antibiotics for the selective media.

Example.

Weyerhaeuser Company began a new nursery near Rochester, Washington in 1967. The land had previously been cropped in corn, beans and other vegetable crops. *Pythium* assays showed counts too high to be safe for trees. Fumigation was recommended. Nearly all trees in a narrow unfumigated control strip failed. Our assay paid us back well!

EVALUATING VIGOR IN SEEDLINGS

Joe B. Zaerr[1]

Foresters have demanded good vigor in planting stock for years; nurserymen have been claiming to produce vigorous seedlings for years. But until recently, few foresters or nurserymen have been willing to go to the effort necessary to evaluate the vigor of seedlings. The problem is that physiological vigor cannot be judged by morphological characteristics. To put it more simply, "You can't tell by looking."

How then can physiological vigor be judged? The most simple method is to plant the stock in the field and see how it grows. This procedure has the disadvantage of being subject to whims of the weather, unreproducible planting sites and changing conditions of planting. One improvement would be to plant all seedlings to be evaluated on the same site. A further improvement would be to plant seedlings on one site and control competing vegetation. An estimate of vigor can then be obtained by measuring shoot growth, date of bud burst and survival. We have evaluated the vigor of planting stock at OSU in this manner for several years, and the results are generally satisfactory.

In another experiment we out-planted seedlings from a seedbed known to be infected in places with *Phytophthora*. Seedling survival was 93.6% for all seedlings as of September 1, and no differences could be discerned between seedlings from diseased areas and "disease-free" areas of the seedbeds. There was also no effect of treatment with Benolate. In this particular case, the disease seemed to have had little or no effect on the vigor of surviving seedlings.

A more rapid answer to the vigor question can be obtained by using a growth room rather than field plantings. Root growth after 30 days and number of days to bud burst can give an indication of physiological vigor in a relatively short time in a growth room. Additional information can be gained by subjecting some seedlings to stress such as drought. This procedure tends to identify weakened seedlings which might otherwise survive in the growth room.

One technique which I do NOT recommend for evaluating vigor is the square wave generator and oscilloscope. Although claims have recently

[1]Forest Scientist. School of Forestry, Oregon State University; Corvallis, Oregon.

been made that such equipment can detect dormant seedlings, so far nobody has demonstrated that what one sees on the oscilloscope is related to the dormancy condition of a plant. Electronic methods for assessing vigor may be available in the future, but right now we have no basis for using electronic equipment to evaluate dormancy condition or vigor.

In summary, the best way to judge physiological vigor is to plant the seedlings in a field environment and/or growth room and measure the date of bud burst (days to budburst in a growth room), shoot growth and survival. Shortcuts are not likely to be available in the near future.

HISTORICAL REVIEW OF THE PHYTOPHTHORA OUTBREAK IN OREGON AND WASHINGTON NURSERIES

Everett Hansen

Ed. Note: This discussion took place on a foggy clearcut near Reedsport; one of the experimental outplanting sites of *Phytophthora* infected seedlings.

Background

Two years ago, Bob Pratt (OSU post doc. *Phytophthora* specialist) and I were invited to an industrial forest tree nursery to counsel on an apparent disease problem in a newly established seed orchard. We found several dead and dying trees in low areas of the field, and later recovered *Phytophthora cinnamomi* from affected trees. This was interesting, and of legitimate concern to the seed orchard manager, but just the tip of the *Phytophthora* iceberg at the nursery.

Bob and I took a quick tour of the bare-root nursery on our way out. Most pathologists know the mixed feeling of exhilaration and despair that follows discovery of a spectacular disease situation, so can imagine our reaction when we saw bare areas, some several acres in size, surrounded by dead and dying trees in a large field of 2-1 transplants. Root rot symptoms were striking on tops and roots, and subsequent isolations yielded several *Phytophthora* species.

The story might well have ended with a brief report of a new nursery disease and recommendations for its control, but when Bob and I returned for more seedlings to confirm our identification, trees from half of the affected areas had been lifted for outplanting. Our nursery problem had become a reforestation problem with unknown potential danger to Douglas-fir forestry.

Coincidentally, we received in this same month two reports from regeneration foresters concerned with bad-looking planting stock and outplanting failures. Both proved to be *Phytophthora* related problems, originating from different nurseries. As the word spread, we were literally swamped with reports of planting failures and bundles of bad trees. Some were *Phytophthora*, others were not. Most hadn't been handled in a manner to allow diagnosis. Field foresters forced to decide whether to go ahead and plant suspect stock or look for scarce replacement trees needed more information. State Forester Ed Schroeder asked the key question in yesterday's opening remarks. "What if we spread a fungus that can do to Douglas-fir what *Phytophthora lateralis* has done to Port-Orford-cedar?" In the winter of 1974 we knew we had *Phytophthoras* pathogenic to Douglas-fir, and knew that infected trees had been outplanted. More information was needed quickly, but funds were not there to go get it.

MECHANICS OF THE PHYTOPHTHORA RESEARCH PROGRAM

Al Larsen[1]

It is a normal course of action for problems similar to the *Phytophthora* one to be referred to the Northwest Forest Pest Action Council. The Council consists of Federal, State and forestry industry personnel and has permanent committees concerned with forest diseases and insects in Washington and Oregon. Through those committees, ongoing business and continuity are provided over the years. The Council has previously served as catalyst and sounding board for several region-wide pest problems, new research programs, or coordinated efffforts to solve these problems.

Soon after the *Phytophthoras* had been discovered in several nurseries, nursery managers throughout the region wanted to know their potential threat. At that time, there was no ongoing information source for *Phytophthora* or research capability for these new species. We recognized that Lew Roth at Oregon State University, Corvallis, and his group has long association with other *Phytophthoras* and this was the logical place to go for answers. Lew said the school wished to tackle the problem but lacked funds. The Pest Action Council then formed a special task force consisting of people from involved nurseries, forest industry and other agencies including O.S.U. The Task Force evaluated the problem and asked for a research proposal, including costs, from O.S.U.

The Council and its Task Force functions on a strictly cooperative basis without funding or other structure. Through several meetings, the original research proposal asked of O.S.U. by the Task Force was modified and improved to a point of mutual agreement. The formal contract stipulated that O.S.U. will do the research and the Task Force will serve as the evaluation, review and information dissemination body.

The Task Force invoices cooperating nurseries and other agencies for money for the project. Then, because the Pest Action Council has no corporate officers, the funds are collected and dispersed to O.S.U. through the Industrial Forestry Association, which headquarters in Portland.

We now have a lot of involvement with many people in getting this work done. We set up an ambitious 18 month, $50,000 program and during that

[1]Oregon State Board of Forestry; Salem, Oregon.

time the efforts of Lew Roth, Everett Hansen and collegues may answer the basic concern of the forest: "What is the threat of these newly found *Phytophthoras* to the forest nurseries and the Douglas-fir forests of the region?"

POTENTIAL OF PHYTOPHTHORA ON CONIFEROUS NURSERY STOCK FOR SURVIVAL AND DAMAGE IN THE FOREST

Everett Hansen

In this section, I will outline the objectives and early results of the research program that the *Phytophthora* Task Force is supporting. But first a word of appreciation to the individuals and organizations that support the Task Force. We now have field foresters and nursery managers recognizing and working together to alleviate a shared problem. We see a new emphasis on quality planting stock that will go a long way towards protecting our forests from future introductions of potentially damaging pathogens. And the cooperative funding of needed research by user organizations may serve as a model for the solution of future problems.

As we began analyzing the *Phytophthora* problem two things became evident. First, we can minimize losses in nurseries using available information. Second, we have no information about the damage potential of these organisms in the field. Species of *Phytophthora*, including some we have found on Douglas-fir, are common agricultural pathogens. Soil management practices for disease control that work on other crops should be adaptable to nursery situations. A vigorous extention program is needed to get the information into practice. On the other hand, we have no basis for predicting the ability of these agricultural pests to survive and spread in the forest environment. *Phytophthora lateralis* always looms as a dark example of what might happen.

When we were asked by the Pest Action Council to submit a research proposal the objectives reflected this understanding of the problem. Our objectives are:

1. To assess the survival and spread capabilities of these fungi on outplanted stock. Have we threatened the native Douglas-fir forest by introducing these fungi to field planting? Sixty percent of our effort is going into this question.

2. To study the biology of the organisms as it affects spread and survival. Twenty percent of our effort will go here.

3. Identify the problem in the nursery and develop improved nursery management proposals.

We began by trying to assess the magnitude of the problem and locate nurseries we could use as suppliers of diseased stock for our other experimental purposes. Our initial examinations identified six nurseries in Oregon and Washington where *Phytophthora* is present. *Phytophthora* is not a serious problem in most of those nurseries, but their infected stock is going to the field. These fungi have not yet caused serious volume losses in the region's nurseries. Our major concern is on the outplanting sites.

Initially, we identified three species of *Phytophthora*: *Phytophthora cryptogea*, *P. drechsleri* and a third that appears to be new. Upon closer study and after we lost Bob Pratt (our first post doc) it appeared we had not three, but between four and eight species. Phil Hamm, my technician, and I (neither of us a *Phytophthora* expert) found what appeared to us a bewildering array of organisms. We solved this partially by dealing with the disease complex rather than with individual *Phytophthora* species. We selected three nurseries to focus our attention on, a Forest Service nursery (West Fir, near Oakridge), a private nursery (Reforestation Management Inc., Brownsville) and a State nursery (Phipps, Elkton, Oregon). These nurseries do not necessarily have the most serious disease conditions, but they have been very cooperative.

Each of these nurseries has a different complex of *Phytophthora* organisms. As we gain expertise we will begin to separate the species.

<u>Symptoms</u>

When we see top symptoms we know there is something wrong below ground but it is often too late for positive diagnosis, and it is nearly impossible to assign cause once a tree is dead.

When infected trees are pulled up, they have a noticeable lack of live roots (Ed. Note: See Everett's picture in front showing affected tree.). Typically stunting, short needles and chlorosis are evident, really nothing above ground specific to *Phytophthora*, but collectively they are indicative of a root problem. A cut made into the cambium at and below the root crown with a pocket knife will show the reddish stained cambial area tissue. This is a good characteristic of the disease, especially where a margin between healthy and diseased tissue can be found.

Why hasn't the disease appeared before? It could be new. Maybe these are new organisms. We talked to nursery people for more background. They had known about "wet feet" in low areas of the nurseries that didn't give them very good production. They historically blamed it simply on the saturated soil. At one nursery we found this condition being described as a genetic problem. They had been aware of the short and stubby needles for some time. A number of researchers working with reforestation also did not recognize the problem. The disease has apparently been present in some nurseries for at least four years, but more specific information on origins is not available. These fungi have not been isolated from undistrubed forest sites. It appears most likely that we are dealing with common agricultural pests on a new host. The problem appears new because location of nurseries on old farm land, often with drainage problems, and summer irrigation are fairly recent practices. The frequent movement of stock from one nursery to another has undoubtedly spread the disease.

We worked with the three nurseries and tried to get a better feel for the *Phytophthora* species involved and their distribution within the nursery. To our consternation, even after much practice we were never able to obtain successful isolation greater than about one tree in five. We have had samples where we knew every tree in the bag was infected with *Phytophthora*, but we still recovered from one tree in five. At first we were upset about this and tried all sorts of things to improve success. As we talked with other *Phytophthora* workers, however, we found they had the same problems. This seems to be about the normal success rate with *Phytophthora*.

These water fungi are tough organisms to work with. They are very ephemeral and slow growing. We use selective media, but *Pythium* spp. in great numbers tend to overgrow any *Phytophthora*. The *Pythiums* are not affected by the selective media.

Investigators who work on *Phytophthora* on citrus and other fruit trees often plate 100 root pieces from a single tree, and only two or three may show *Phytophthora*. When you have decimated root systems like our typically infected Douglas-fir, there is not enough root tissue to cut 100 root pieces. Now we are proud of our 20% isolation success.

From our examinations in the nurseries, we have come to a better understanding of the disease situation. We have the two known species, *P. drechsleri* and *P. cryptogea* and a host of unknown species. Some people are defining those as a single species. In California they are at least culturally very distinct. We now have Dr. Jay Julis working with us who has been involved with *Phytophthora* on apples. We hope Jay can sort out this "zoo" we are faced with.

We have run preliminary pathogenicity tests on the various *Phytophthora* spp. and we find quite a range of pathogenicity symptoms. A few species just nibble the fine roots while others go right into the root crown tissue. We find a variety of behavior exhibited by the fungi. Our most critical concern is can any of these fungi survive here in this outplanting, or in some other forest environment?

About fifteen years ago we went through this same sequence with *Phytophthora cinnamomi*. Concern was expressed about *P. cinnamomi* and its potential harm to the Douglas-fir forests of the Northwest. A *Phytophthora* task force was formed and a research program developed with similar objectives to what we now have. The conclusion at that time was that *P. cinnamomi* would not pose a threat to the Douglas-fir forest primarily because of its optimum growth temperature range. The strains of *P. cinnamomi* that they are working with then and other strains that have been isolated since, are warm temperature organisms. Our summer soil temperatures are warm enough, but too dry. In winter, when moisture is available, soil temperatures are too cold for *P. cinnamomi* to survive.

On the other hand, we also have *Phytophthora lateralis* in Oregon that survives in cooler temperatures. Its optimum growth temperature range allows it to do well in fall and spring temperatures when there is adequate moisture, with disasterous consequences to cedar.

The nursery *Phytophthoras* we are dealing with today have a temperature range that overlaps that of *Phytophthora lateralis*. Optimum temperature ranges for all of the nursery isolated *Phytophthoras* are below 20° C. All of the *P. cinnamomi* isolates that Zentmeyer checked are above 20° C.

We do not yet know what the critical temperatures are for sporulation and infection. They appear to have a temperature growth range at least in culture, that will allow growth on some field sites during the growing season.

Our major effort to date has centered on providing the basics needed for field survival tests. The plot we are visiting today represents one of twelve outplanting sites. The field sites are divided up with stock from three contributing nurseries. We have not put stock from an infected nursery on a site that has not already been planted with stock from that same nursery. This is understandably a concern of land managers. We have had excellent cooperation with forest managers, industry and State and Federal agencies in establishing our field studies. With some normal wet Oregon weather, and a year's time, we should be able to answer the question, "Can these fungi survive and spread in field environments?"

A LAND MANAGER'S CONCERNS ABOUT ROOT ROT

John Nesbitt[1]

I speak to you as a Silviculturist and a Land Manager. A Land Manager, as you are aware, must integrate many disciplines to achieve his forest land objectives. In my particular case, the objectives I strive to achieve are those of the Siuslaw National Forest. In so doing, the multiple-use-sustained yield concept has to be used as a guiding force, and national forest policies, land use plans and management plans must be considered as parameters for the prescription applied to the forest.

I am sure you are all aware there are no simple answers to reaching these objectives. All pertinent disciplines and inputs must be considered and integrated into the prescription. These could include, but are not necessarily limited to: pathology, physiology, genetics, geology, soils, economics, engineering, logging systems, wildlife biology, landscape architecture, sociology, psychology, hydrology, biometrics, entomology, soil nutrition, ecology, fire management and probably some theology.

As you are aware from incidences in your own life, you are probably remembered for some mistakes you made rather than all the right things you did. Or, as Shakespeare said in Julius Caesar -- "The evil that men do lives after them - the good is oft' interred with their bones." Because of this and because of the challenge it presents, we often look at and concentrate our efforts on the problems or tough areas of our job rather than the successful things that we are doing. It seems to me that this is the charge of research -- to go after the problem areas.

In my field, the major problem on the Mapleton Ranger District of the Siuslaw National Forest is root rot. As much as I am able to get a handle on it, the largest part of our root rot problem is *Phellinus weirii*, although there are traces of *Verticicladiella* and *Armillaria*. The two over-riding considerations in dealing with this problem are economics and the weight of production. I will deal first and briefly with this latter problem just to explain it.

[1]Silviculturist. Mapleton District, Siuslaw National Forest; Mapleton, Oregon.

The sheer weight of the workload to be silviculturally treated a year or any other given time frame dictates that a prescriptive technique be as broad as the problem and simple to apply. Disregarding the economics of it, we are not able to manage on an acre-by-acre intensity at this time; therefore, what works in the laboratory or in quarter-acre plots may not be applicable to ten thousand acres. On the Mapleton District, we regenerate from 2,200 to 2,500 acres a year. This means burning and planting that many acres and precommercial thinning about 1,500 acres.

In recent years, we have adopted a survey technique to determine the extent of our root rot problem. I'll just briefly describe the technique.

Starting about November each year, we do a windshield survey of plantations more than eight years old, looking for yellowed crowns. We would double sample or verify the reason for discoloration by physically inspecting the dying tree to determine the cause. During the survey, we would note the location of the plantation on the map and record it by our TRI system, which is an in-place mapping inventory. We went out in November because we noted that yellowing would appear about that time of year. The color would go progressively from yellow to red in about June and the needles would shed on the stressed trees from July to August. Then the cycle would repeat itself again in November. So actually, the survey could have been any time between November and early summer.

Using this technique, we have determined there are about 14,000 acres of plantations that have some root rot in them. The crews that lay out timber sales in mature timber are also on the lookout for root rot pockets. However, as in many other jobs, we get the most data and the most information from a single purpose trip. This 14,000 acres represents approximately 23% of our plantations and does not account for those plantations under eight or older than 20 years old or sites that have not been harvested.

Once one has discovered an impact of this magnitude, the next logical question is what does this mean in timber production? There have been investigations to determine rates of spread of root rot centers, total population of root rot in stands, etc.; however, I am not aware of a methodology a land manager can apply to determine his fiber loss by root rot on any given land base. I have attempted to determine what this fiber loss would be by utilizing information from Weyerhaeuser Research Paper No. 14 by Kenneth Wiley and Marshall Murray. They showed that in the stands they examined throughout the Northwest, an average of 1½ trees per acre died per year between the ages of 10 and 35 years. They estimated that 40% of this mortality was due to root rot. This gives 0.6 of a tree per acre per year throughout the Northwest that dies due to root rot in those age classes.

Assuming this is a linear relationship to rotation age, I entered the managed yield tables that we will be using on the Siuslaw National Forest and reduced the intermediate and final harvest volumes by that number of trees. I assumed that none of the dead trees would be salvageable, yet the intermediate entry leave stand would not be reduced below the recommended level, therefore, the reduction in stems would be taken out of the harvest -- not out of the growing stock. I also reduced the final harvest by the same mortality figure method. When I added all this volume and compared it to the full yield available I calculated an 18% reduction in total yield through a rotation of 85 years.

As an example, if a stand was precommercially thinned to 400 stems-per-acre at 10 years and then commercially thinned at age 25, there would be a reduction of 0.6 of a tree per acre per year for 15 years, which would mean nine fewer harvestable trees at the entry. I simply multiplied the nine trees by the average volume per tree to come up with the volume loss. I feel that if this 18% reduction in yield is anywhere near correct, then we do have a significant problem with root rot.

Carrying this impact one step further, I don't know if the root rot on the site -- and here I speak specifically of *Phellinus* and *Verticicladiella* -- is increasing with our more intensive management, is decreasing or holding its own. As these pathogens are diseases of the site, one would assume that the magnitude of the problem in the standing mature timber would be similar to that found in the plantations. As the District is primarily a 100 year old, fire created, even-aged Douglas-fir type, one would expect to see large holes in this standing timber created by root rot. There are many brush pockets throughout the District, but we have yet to determine how many were created by mortality of conifers by root rot and subsequent invasion by the deciduous species; or if that is just the way the stands regenerated after the fire.

So, wrapping this all up, one needs to know what the fiber loss, whether measured in cubic feet, board feet, stems or acres, is, and in the direction in loss that the problem is taking, before you can prescribe sanitation prescriptions to the stands. We need to know the fiber loss to assess the economics of living with the problem or growing a resistant hardwood that only produce one half of the fiber per rotation.

For instance, the work that has shown that red alder may suppress *Phellinus weirii* suggests that we may want to grow mixed stands of alder and Douglas-fir. Even if such a practice were a proven control, attempting to deliberately grow a mixed stand is extremely difficult silviculturally because the tendency is for the alder to take over the site, suppress the Douglas-fir, and eventually become a pure alder stand. By intensive management, the alder could be maintained on the site without seriously competing. This is where the magnitude of the job comes in. Attempting to do this yearly on 23% of 2,500 acres is unrealistic on our District at this time.

Another possibility is to grow a mixed stand of alder and a tolerant conifer (shall we say western hemlock). Earl Nelson and Everett Hanson are looking at this possibility now, and they do have plots on the

Mapleton District. A third possibility would be to grow as a crop a resistant species that will produce the amount of fiber that Douglas-fir will. We do not know what that resistant species might be, but again, Earl Nelson has plots on the District and elsewhere to study this possibility.

Fourth, the work that has been done in British Columbia and elsewhere on grubbing out the infected roots and stumps on a site will not work in our area because our terrain averages about 60% sideslope. So the economics, technology and erosion potential presently rule out this technique in our area. The last alternative that I foresee, and possibly the most viable, is to forego conifer production on a diseased site, and grow two rotations of a pure hardwood. This last possibility poses three questions:

1. Will this sanitize the site?

2. What would be the total fiber production difference in using this prescriptive technique as opposed to living with the problem and continuing to grow rotations of Douglas-fir?

3. What species of hardwood should be grown on crop rotation to sanitize the site, and should it be a pure stand or should it be a mixed stand? If it is a mixed stand, perhaps it could be a non-competitive brush species rather than a competitive low-value hardwood species.

Now, where I feel research can assist me in making the proper prescription to deal with this problem is:

1. Help me to determine the fiber loss potential from root rot on a given stand.

2. Determine to what extent hardwood rotation(s) will sanitize the site.

3. Determine if there are other vegetative techniques that will allow me to continue to grow Douglas-fir and simultaneously sanitize the site.

4. What is the relative impact of *Verticicladiella* and *Phellinus*.

When I have the answers to these questions, I can make a strong case for initially reducing fiber production for a long term gain. Without these answers, I am presently charged with producing the maximum fiber per time frame. That means the state of the art as it is now -- continuous crops of Douglas-fir and/or western hemlock and ignoring the root rot problem.

BLACK STAIN ROOT DISEASE

Summarized by Don Goheen

Contributors to this section: Fields Cobb, Everett Hansen, Dave Johnson, John Nesbitt, Mike Srago, Bill Stambaugh, Ed Wicker

The Disease

Verticicladiella wagenerii Kendrick causes a vascular wilt-type disease of conifers. The fungus invades host tracheids, interfering with water uptake and causing rapid tree decline. A dark brown to black stain in the sapwood is diagnostic of infection, hence the common name of the disease - black stain root disease. Symptoms caused by black stain are similar to those associated with other root diseases of conifers, including growth loss, thinning of crowns, needle chlorosis and fairly rapid tree death. Trees weakened by black stain are frequently infested by bark beetles.

Occurrence of the Disease

Black stain root disease was first discovered in 1938 affecting ponderosa pine at Black Mountain, Lassen County, California. It has since been reported from scattered localities throughout the west. In the 1940's it was found affecting pinon and single-leaf pinon pine in southern California, Arizona and Colorado. In the 1960's the disease was discovered to be extensive in some central Sierra Nevada ponderosa pine stands where it was associated with heavy bark beetle activity. The disease was also found in California affecting Douglas-fir, first at Boggs Mountain and subsequently at Jackson State Forest. The disease is now being observed with increasing frequency in California Douglas-fir stands, most commonly in the Coast Ranges but also in the Sierra Nevada.

Black stain root disease was reported affecting eastern white pine and lodgepole pine in a local infection center in Montana as early as 1960. The disease is now occurring over a wider area in the Northern Region where it seems to be becoming more common and damaging in some stressed plantations of non-local trees.

Surveys in Colorado indicate that black stain is currently widespread in pinon pine on the westside of the Rocky Mountain crest, though it apparently does not occur on the eastside. Black stain was first reported in the Pacific Northwest in the early 1970's. Current evidence suggests that the disease is fairly common in 10-30 year old Douglas-fir plantations in Oregon and Washington, especially on the westside of the Cascades. The disease has also been found affecting ponderosa pine and mountain hemlock in Oregon.

A disease similar to that caused by *V. wagenerii* has been observed on eastern white pine in several eastern states. It is caused by a closely related fungus, *V. procera*.

Significance

Black stain root disease has an extremely scattered distribution and is probably not at present an inordinately important forest tree disease when considered on a west-wide basis. However, it is quite damaging in some local situations and now seems to be spreading and appearing in new localities. On the Georgetwon Divide in the central Sierra Nevada where studies on the impact of the disease in second growth ponderosa pine have been conducted, over 800 infection centers have been detected on a 26,000 acre area. Some centers are as large as 90 acres. Loss in the stands surveyed approaches 20% of the volume. Ninety-two percent of the *V. wagenerii* caused mortality was associated with bark beetle infestation. Rates of spread of from 6 to 30 feet per year have been documented in this area.

Disease Spread

V. wagenerii spreads from tree to tree in established infection centers across root grafts and contacts. In the central Sierra Nevada there is also considerable evidence of the fungus entering new hosts through small rootlets that are not in contact with, though they are close to, other infected roots. This suggests that the fungus may be able to grow short distances through the soil or that it is carried short distances by soil, animals or water.

Long distance spread and establishment of new infection centers is thought to involve insect vectors. Considerable circumstantial evidence has been found to support this hypothesis, including discovery of a *Ceratocystis* perfect stage of the fungus in insect galleries. Suspected vectors are root feeding curculionids and scolytids, especially *Pseudohylesinus* spp., *Hylastes* spp. and *Dryocetes* spp. The fungus has been isolated from *Pseudohylesinus grandis* in California.

Site Factors Favoring the Disease

Black stain root disease is most common in heavily stocked, pure or nearly pure stands of host tree species. Past site disturbance is often associated with infection centers. High soil moisture content (soil moisture at or near field capacity in spring and early summer) appears to favor the disease, and many infection centers in dry locals occur in low lying areas and creek drainages. Studies of soil characteristics in California infection centers suggest that high organic matter content, a high redox potential and high levels of soil manganese are associated with pathogen activity. In the Sierra Nevada the disease is found predominantly at elevations between 4500 and 6000 feet.

Disease Control Tests

Host tree free barriers up to 15 feet wide were constructed in an attempt to halt the spread. This barrier proved inadequate and fungus stopped only when it encountered a mixed conifer type. A wider barrier may prove more successful. Other control tests are continuing.

VERTICICLADIELLA ON DOUGLAS-FIR IN OREGON

Everett M. Hansen

Is black stain root disease, caused by *Verticicladiella wagnerii*, a serious problem on Douglas-fir in Oregon and Washington? This is the big question that covers many others, far more questions than answers. Our current concern with the disease in the Northwest stems from a plantation disease survey conducted by Insect and Disease Control personnel, Region 6, in 1969-1971. They found *Verticicladiella* infrequently but throughout the region.

My efforts at OSU date from 1972, when I first realized that all the dead trees in Douglas-fir plantations hadn't been killed by *Phellinus weirii*. The diagnosis method used then is still valid. First scrape away the duff at the root crown looking for surface mycelium of *P. weirii*. Frustration will rapidly mount because there isn't any mycelium. As the falling rain and fir needles creep down your neck and the blackberries work through your knees there comes a time to strike back. A quick blow of the axe makes me feel better, and will also expose the characteristic brown-black stain, if *Verticicladiella* is the cause.

The two diseases can be distinguished from crown symptoms with a modest degree of accuracy. Laminated root rot in 10-20 year old trees typically reduced leader growth for one or two years before death, accompanied by a gradual change of crown color from green to yellow to red. Black stain in trees this age often causes a similar growth loss before death, but crown color seems to fade rather than go through distinct color changes, and trees take on a "ratty" appearance as needles fall prematurely.

Permanent plots were established in 1974 and 1975 in six young stands to monitor spread of *Verticicladiella*. These infection centers involve from 3 to 52 dead trees and cover areas up to about 1 ha. The plots have been stem mapped with maps generated by computer. No new mortality has occurred in the two smallest plots, but the larger ones remain active. The plot visited on the WIFDWC field trip is one of the larger and more active centers that we are aware of. The stand is 22 years old. Twenty five trees have been killed since 1972, but no earlier mortality was found. Another 20 trees are showing crown symptoms.

Don Goheen and Fields Cobb discussed the evidence for insect vectors of this fungus. If there is an insect vector, we might predict that new infection centers would start around weakened trees, which are attractive to beetles. This possibility, together with a known proclivity of forest pathologists for windshield surveys, could result in an overestimate of the occurance of *Verticicladiella*. To test this possibility I compared disease incidence adjacent to two road systems in Oregon with its incidence away from the roads.

The sampling scheme used paired 0.1 ha strips, one adjacent to the road and the other 25 m or more away. Each strip was 10 m wide by 100 m long, divided into 0.01 ha blocks (10 m x 10 m). A total of 82 strips were examined along 23 miles of road. Two areas were sampled. Highway 20, through the Oregon Cascades, was sampled along Tombstone Pass. Roadside strips were started every 1.0 mile, by car odometer. Forty-eight strips were examined. The other sampling area was along Forest Road 16007 on the Mapleton District, Siuslaw National Forest (the site of the WIFDWC field trip). Thirty-four strips were located 0.2 miles apart along 2.4 miles of this road through 10-20 year old Douglas-fir plantations.

All dead and symptomatic trees were examined for causal agent and marked on a sketch map of the strip by 0.01 ha blocks. The results are summarized in the accompanying table. *Phellinus weirii* was most frequently the cause of death (109 trees), followed by *Verticicladiella* (83 trees). Two trees were found killed by *Armillaria*. Several points should be emphasized. *Verticicladiella* does indeed appear to be more frequent and more damaging next to the road than away from it. It is less frequent and less damaging at this time than *P. weirii*, even along these two roads, which were selected because of known *Verticicladiella*.

The behavior of the two organisms makes comparisons a little risky, however. *Verticicladiella* was found almost exclusively in young plantations. *Phellinus weirii* is just beginning to express itself in stands this age. This was illustrated by the samples taken along the first 12 miles of Highway 20. These strips were all in a 150-year old Douglas-fir stand of fire origin. Two trees were found killed by *Verticicladiella*, but about 12% of the land area was not growing Douglas-fir due to *P. weirii*. At higher elevations *P. weirii* was found less frequently, but these stands were much less uniform, ranging between 10-20 year old plantations and old growth. *Verticicladiella* occurred more frequently and in larger centers than did *P. weirii* in these strips between about 2000 feet and 4000 feet elevation.

This survey was not designed to measure the incidence or importance of *Verticicladiella* or *P. weirii*. It did show *Verticicladiella* to occur more frequently next to the road than away from it, and this must be considered in attempts to determine disease importance. *Phellinus weirii*, on the other hand, shows no association with roads, a result predictable from our understanding of its biology.

Most *Verticicladiella* infection centers are small and have not caused a significant loss in the well-stocked young plantations where they occur. The future importance of this pathogen to Douglas-fir forestry depends on how fast it spreads, and for how long.

Comparison of the Occurrence of *Verticicladiella* and *Phellinus weirii* in 0.1 ha strips and 0.01 ha blocks adjacent to and away from roads in Oregon.

	Roadside	Away
Verticicladiella		
strips	23%	14%
blocks	6%	3%
trees	66%	17%
P. weirii		
strips	44%	44%
blocks	10%	12%
Lower Hwy 20		
strips	67%	67%
blocks	22%	24%
area	9.2%	15%

SPECIAL REPORT: APPLICATION OF SOIL FUMIGANTS TO ERADICATE ARMILLARIA MELLEA FROM STUMPS OF YOUNG-GROWTH PONDEROSA PINE KILLED BY ROOT ROT

Gregory M. Filip[1]

Introduction

Armillariella (*Armillaria*) *mellea* frequently kills young-growth timber, creating roughly circular unproductive openings in the ponderosa pine forest. The fungus persists in the roots of dead stubs and snags and prevents forest regeneration by communicating the disease to roots of the seedlings and surrounding trees which contact the infected stubs and snags.

As a possibility for control, fumigants were applied to the main tap root of infected and killed trees in disease centers. The literature revealed some standard soil fumigants that showed promise for eradicating *A. mellea* from infected stumps. Among these were chloropicrin, carbon disulfide, methyl bromide, Vapam and Vorlex.

Materials and Methods

Fumigation studies were located in south central Washington state, Klickitat County, southeast of Mt. Adams (see WIDFWC Proc. 1973, p. 90-95). Ponderosa pine is the principle tree species in the study area in mixture with Douglas-fir, grand fir and Oregon white oak. The forest has been under a selection-cut type of management for 25 years by the St. Regis Paper Company.

Stubs and snags of ponderosa pine killed by *A. mellea* to be fumigated were managed as follows. In July, 1974, eighteen 37 sq. m plots were located within typical *A. mellea* disease centers in the study area. All infected stubs and snags on the plot were measured for diameter, cut as close to the ground as possible, and the cut surface of each stump was rated as to extent of decay.

[1]Forest Insect and Disease Management, U.S. Forest Service, P.O. Box 3623; Portland, Oregon.

One of five fumigants (chloropicrin, methyl bromide, carbon disulfide, Vorlex and Vapam) was applied to each of three plots. Fumigants were either: (a) poured into soil holes around each stump, (b) poured into holes drilled in the top of each stump, or (c) a combination of the above. Application rates (Table 1) were estimated from previous reports with moderate rate increases to insure adequate diffusion into the fairly resinous pine wood. Control stumps were treated with water according to the three methods of fumigant application. The stumps of all treatments (including controls) were covered with polyethylene tarps and left in place for four days.

Results

In July, 1975, one year after treatment, 132 treated stumps were excavated with a backhoe. Each stump was scrubbed with water and split longitudinally. The strong odor of fumigant, especially chloropicrin and Vorlex, was persistent in many of the dissected stumps. Isolations were made on selective media from typical yellow decay in the center of each tap root and from mycelial fans of *A. mellea* beneath the bark. A total of 3,300 isolations (550 per treatment) were made from 132 excavated stumps.

Of 550 isolations from 22 controls stumps, 104 (19%) were positive for *A. mellea* (Figure 1). Methyl bromide, Vorlex, chloropicrin, carbon disulfide and Vapam significantly ($P = 0.01$) reduced *A. mellea* in treated stumps when compared to the control. *Trichoderma* was apparently unaffected by all fumigants except methyl bromide and Vorlex. In these treatments, *Trichoderma* was more abundant than in the controls, significantly so ($P = 0.05$) in the case of methyl bromide as determined by isolation.

Differences in the effectiveness of fumigation method (whether into the soil, the wood or both) could not be determined at the concentrations tested since *A. mellea* was practically eliminated with all fumigants. The same is true for the effect of stump size and degree of decay on fumigant response, although a preliminary study indicated that the more decayed stumps may have contained less viable *A. mellea* prior to fumigation.

Discussion

At the rate used in these studies, methyl bromide, chloropicrin, Vorlex, Vapam and carbon disulfide eradicated *A. mellea* from naturally infected pine stumps. It appeared also that some of the treatments increased *Trichoderma* populations as is commonly reported in the literature. These *Trichoderma* increases, except possibly for methyl bromide, appeared not to be of a magnitude sufficient to influence *A. mellea* through antibiotic action. Many of the stumps upon dissection contained a noticeable odor of fumigant one year after treatment. Fumigant persistence may have limited growth of larger *Trichoderma* populations. It appears, therefore, that the decrease in *A. mellea* was largely due to chemical toxicity rather than to antagonistic fungal action.

Application methods used in this study were more specialized than would be economically desirable for commercial use. However, the toxicity results showed that soil application alone was effective at the rates of fumigant applied. Adequate application, therefore, probably could be accomplished with conventional fumigant injectors at great savings in time by eliminating the need to fell, drill and perhaps tarp infected stumps (Table 2). Reduction in application rates could also decrease treatment costs (adapted procedure). Where infection is scattered, expected per hectare treatment cost would be considerably less than those reported. Further testing is needed to ascertain the limits of both treatment simplification and dosage reductions in the forest.

While the fumigants tested were highly effective in eradicating *A. mellea* from treated stumps, it cannot be safely assumed that the fungus was completely eradicated from the site. Numerous buried infected smaller roots were undoubtedly present and probably not treated. Most of this material, however, is in an advanced state of decay and will decompose rapidly. These smaller infected roots, lacking both mass and longevity, appear to be inadequate to supply the inoculum potential required to maintain a disease epidemic as characterized by the disease center. These infected roots should cause only limited and isolated infection in scattered small trees and later in mostly weakened or suppressed trees of larger diameter. Fumigation of infected pine stubs and snags within *A. mellea* disease centers should enable further pine production in reasonable safety.

Table 1. Rates of *in situ* application of fumigants to *A. mellea* infected stumps of ponderosa pine

Diameter Class (cm)	Stumps Treated: Number		Application Rate (per stump)			
			Methyl bromide	All other fumigants		
	Methyl bromide	All other fumigants	All Treatments (g)	Soil Treatment (ml)	Wood Treatment (ml)	Combined Treatment (ml)
10-18	9	46	650	400	100	500
20-28	10	37	1300	500	250	750
30-38	2	28	1950	500	500	1000

Table 2. Comparative costs of fumigating pine sites where young-growth timber has been killed by *Armillariella mellea*.

Fumigation Treatment	Cost per hectare (2285 stubs/snags)		
	Materials and Labor	Chemicals	Total
	(dollars)		
Experimental methods[1]	5560	1975[4]	7535
Conventional injection[2]	740	1975	2715
Adapted procedure[3]	740	990	1730

[1] Two stubs/snags per hour (includes felling, drilling, pouring, and tarping)

[2] Twelve stubs/snags per hour (soil injection only)

[3] Applied by soil injection at ½ of the rate used in the study

[4] Estimated per hectare cost of chloropicrin. Carbon disulfide is $1235 and methyl bromide, $8650.

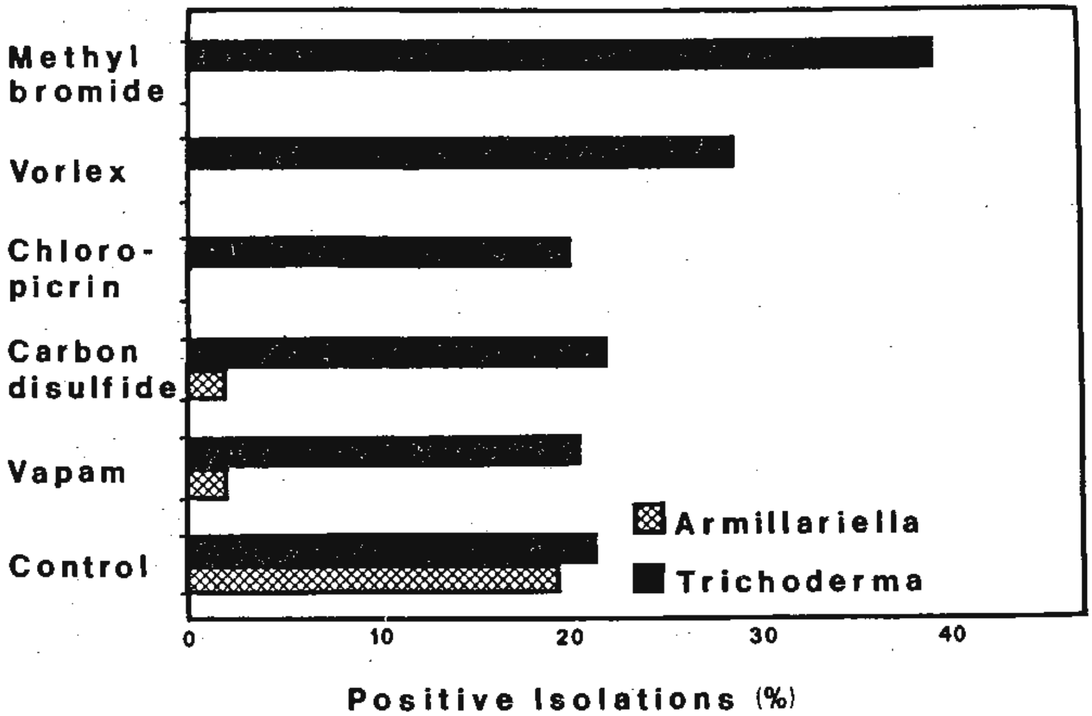


Figure 1. Frequency of successful isolation of *Armillariella mellea* and *Trichoderma* from naturally infected ponderosa pine stumps that had been treated *in situ* with five fumigants.

NEW AND MODIFIED TECHNIQUES

"Pointer" Research

A specially grown pointer was presented to chairman Lew Roth. Taper factor has been restored but straightness has proved difficult. Species used is Corkscrew willows. (A.H. McCain)

Marking Plots

Heavy aluminum tags nailed to cedar posts hold up well after 10 years. The lettered or numbered tags are made on a Roovers printer on 0.018" x 0.75" aluminum tape. The machines are expensive, but worth it. They are abailable through Dymo Systems, Inc., Atlanta, Georgia.

The small Dymo tape writers are not adequate as the tape is too thin. Electrolysis claims the aluminum very early.

Tags should also be nailed with aluminum nails, not stapled, to avoid electrolysis (Laurent stressed that aluminum does not work on aspen or birch. It leaves a bad stain).

Pencil marking on cedar posts holds up extremely well. Marking should be done with a carpenters pencil or soft artist's sketch pencil. Ten years exposure is nothing. I've seen a penciled inscription on a cedar tree (debarked area) in Wisconsin from December 25, 1848. E.G. Kingsford wrote "This country is hell." in pencil and it still was legible 115 years later! (K.W. Russell)

Observing Mycorrhizae

It is often difficult for a layman to see mycorrhizae. A sample of roots from seedlings thought to be mycorrhizal can be placed in a wetted Kraft lunch sack with most of the top cut off. I remove the seedling tops, wash the roots thoroughly, and wet everything down. A wet paper towel over the top of the sack makes a nice moist chamber overnight.

Next day's observation often shows a nice white fungal bloom on mycorrhizal roots. Caution is advised that if roots are unhealthy one could be looking at *Pythium*. (K.W. Russell)

Health Analysis

Instead of "hazard reduction" we should call our tree inspection programs in recreation areas a "health analysis". This positive approach is better for those using the site to understand. (E.M. Sharon)

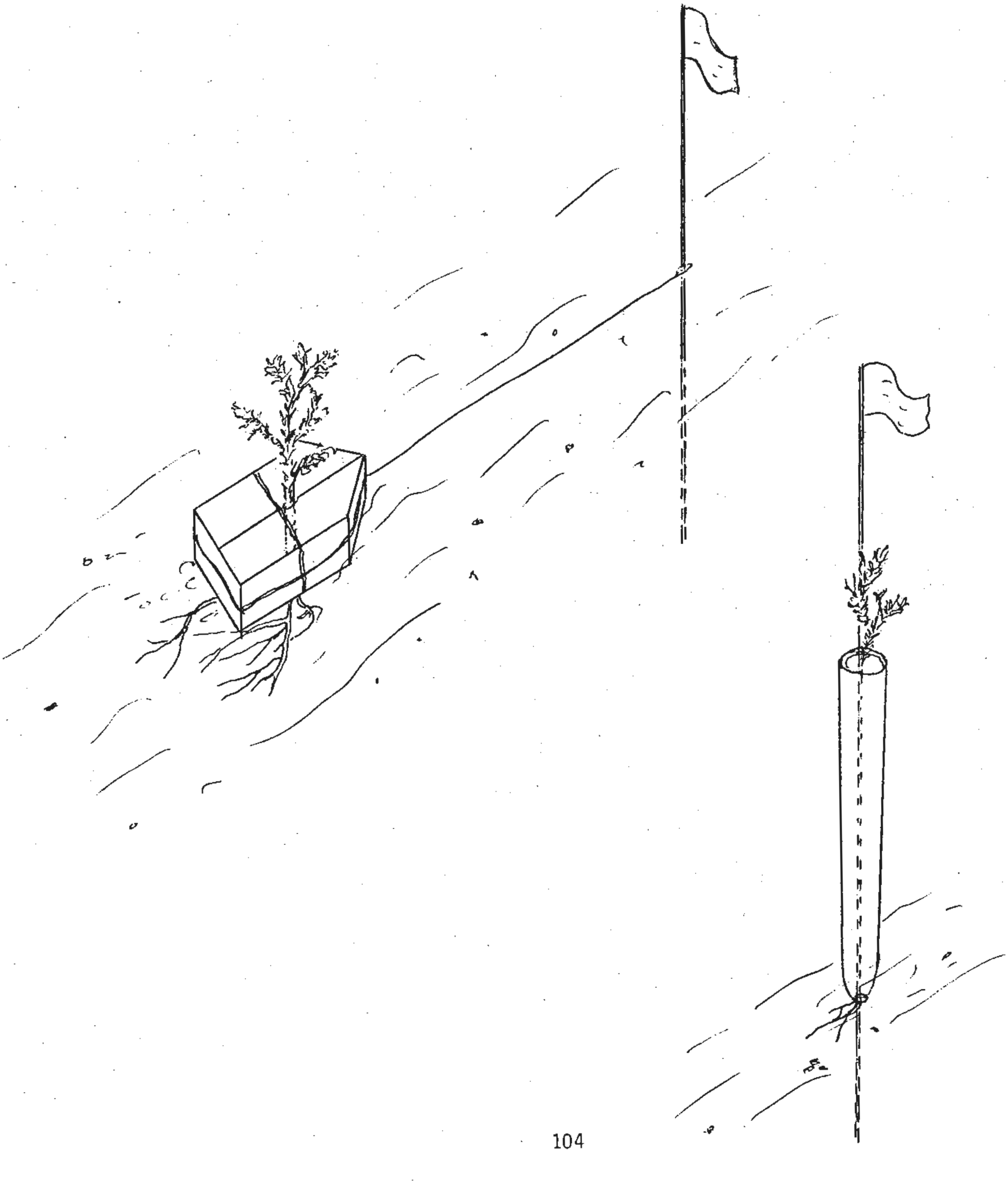
Assay for *Phytophthora lateralis* Employing Living Seedlings

Though they are aggressive and sometimes abundant pathogens, soil inhabiting species of *Phytophthora* often are isolatable from the soil only with great difficulty and consequent limited reliability. Sufficient consistency of detection to allow monitoring of the presence of the fungus or of its abundance, as influenced by management practices, could be extremely useful in disease control strategy. Such appears to be the case with *Phytophthora lateralis*, which is spread almost exclusively by water, by clinging soil or mud or by more extensive earth movement. The fungus apparently does not grow free in the mineral soil away from particulate organic matter, is not isolatable by laboratory culture methods and is poorly recoverable by tissue baiting procedures.

In order to achieve a monitoring capability we have used living seedlings in two procedures. The first of these is suited to small streams of the forest habitat, which with the onset of fall rains may vary widely in flow level. Monitoring the streams provides such information as an index to the onset of zoospore production and indirectly knowledge concerning the presence of active *Phytophthora* within the watershed. The second method allows more detailed study. It is suitable to quite small rivulets, and during the rainy season to surface water and wet soils. Both procedures expose the intact, actively developing roots of Chamaecyparis seedlings to the ambient under test.

The first method employs seedlings or wildings 3 to 10 inches tall. Such trees can be carefully shaken from a friable planting soil at any season, exposed in the stream for up to 10 days and replanted in wet peat moss without serious transplant loss. Exposure is accomplished by floating the seedling upright in a small, styrofoam boat so that the roots extend below the boat bottom into the water. The boat, pointed at the bow, of 1½" styrofoam 6" long and 4" wide is split vertically down the midline. The seedling is clamped in place amidships by joining the two halves of the boat the rubber bands. The boat is moored in the test site by a wire attached to a "stake wire flag" (see sketch).

In the second method young greenhouse-grown cedar seedlings in small (3/4" id. x 4 1/2") planting cells - employed in production of containerized seedlings - are used. These seedlings are produced by placing the racks of seeded cells in trays of shallow water so that after a few months of growth roots of the young seedlings grow out through the perforated cell bottoms into the water. They are then ready for test exposure. Exposure is accomplished simply by setting the cell upright in the monitoring site and holding it erect by passing the wire of a "stake wire flag" into the planting medium at the top of the cell, down past the seedling, out the bottom of the cell and deep into the bottom of the rivulet. Roots of cells monitoring wet soil surfaces are covered lightly with wet peat moss to reduce drying. After exposure the cells are placed in foil-darkened test tubes (held vertically in racks) to keep the exposed roots moist during incubation. Positive readings result in seedling mortality. The seedlings are never transplanted. See sketch. (L.F. Roth)



NEW AND MODIFIED PROJECTS

USDA Forest Service

Region 2

1. A survey of root diseases in managed conifer stands of Region 2. Stands with precommercial or commercial thinning at least 5 years ago were inspected and *Armillaria mellea* was the only fungus identified in root disease infected centers. It affected several commercial stands of ponderosa and lodgepole pine and white fir and was found occasionally also on limber and pinyon pine, Rocky Mtn. juniper (a new US record), Douglas-fir, subalpine fir and Engelmann spruce. In several locations the *A. mellea* appeared to be creating openings in the stands that will result in less than desirable stocking. Plots will be established next year to determine impact.

2. Indigenous mycorrhizal fungi of Colorado forests as related to successful forest reproduction. Mycorrhizal fungi native to R-2 are being identified and cultured on artificial media with the objective of inoculating seedlings in containers and nursery beds in which the soil has been sterilized. Fungi for which a suitable inoculum base can be produced will be tested to determine which are the most successful in aiding regeneration.

   Suillus granulatus has been the most vigorous in culture and is being tested on ponderosa pine in containers this year.

3. Inventory of conifer seed and seedling losses at the Mt. Sopris Nursery. Preliminary results indicate that damping-off fungi (*Pythium* and *Fusarium*) were responsible for up to 80% loss in all conifer species. Bird damage to seed and seedlings varied from only 2% for Engelmann spruce to over 50% for ponderosa pine.

4. Survey for *Fomes fraxinophilus* stem rot of green ash in Nebraska-Praire States Forestry Project Windbreaks (USFS-R2: RMFRES). Initial survey indicated that this fungus is very common and disease incidence could be as high as 50%.

5. Mycorrhizal inoculation of containerized ponderosa pine with three fungal symbionts. Container-grown ponderosa pine were inoculated with vegetative mycelium of three different ectomycorrhizal fungi: *Pisolithus tinctorius*, *Cenococcum graniforme* and *Suillus granulatus*. Two different inoculation treatments were tried. The first treatment involved mixing the inoculum into the potting mix and the second treatment consisted of applying the fungal inoculum as a top dressing.

6. A significant trend for the mountain pine beetle to infest dwarf mistletoe infected trees of the higher DMR (dwarf mistletoe

ranking - Hawksworth's 0-6 classification) was noted in one area. Survey data also indicated that the mountain pine beetle attacked the larger diameter trees in the stand.

Additional work is planned to more precisely determine the extent of this relationship and to compare brood production in dwarf mistletoe infected and non-infected trees.

Region 6

1. Evaluation of blue stain penetration and checking in recently killed lodgepole pine in northeastern Oregon.

   The purpose is to determine how quickly blue stain penetrates to the heartwood-sapwood interface of lodgepole pines attacked by mountain pine beetles. Also, to determine how quickly checks on cracks develop in killed trees. Duration of evaluation - 1 year. (R. Harvey, J. Hadfield)

2. Evaluation of the rate of spread of black stain root disease, *Verticicladiella wagnerii*, in plantations.

   The purpose is to measure the rate of spread of the disease, as evidenced by recently killed trees and to measure the amount of damage. Twenty-three spread plots have been established, all but one are in Douglas-fir stands. One is in mountain hemlock. (D. Goheen)

3. Evaluation of tree species susceptibility to laminated root rot in eastern Oregon and Washington.

   The objective is to rate the susceptibility to laminated root rot infected mixed species stands. (G. Filip)

4. Evaluation of Truban and Banrot for disease control at the Westfir Nursery. (D. Goheen)

5. Evaluation of the growth impact of *Rhabdocline pseudotsugae* on sapling Douglas-firs in western Oregon. (D. Goheen)

6. Evaluation of the growth impact of *Lophodermella concolor* on sapling lodgepole pines in central Oregon. (R. Harvey)

The following item was reported last year but did not appear in the 23rd proceedings.

   Evaluation of the rate of deterioration of mountain pine beetle killed lodgepole pine in northeastern Oregon. (R. Harvey, J. Hadfield)

Pacific Northwest Forest & Range Experiment Station

1. Effects of pathogen control on performance of container-grown Douglas-fir seedlings. (Thies, Owston)

2. Fertilization and root disruption to control laminated root rot of Douglas-fir. (Thies, Nelson)

3. Effect of surface-applied and incorporated chipped slash, with and without supplemental nitrogen, on soil microflora and survival of *Phellinus* (*Poria*) *weirii* in buried wood cubes. (Nelson)

4. Effect of N, P and K on survival of *Phellinus weirii* in buried wood. (Nelson)

5. Incidence, extent and rate of decay associated with grand fir tops killed by the Douglas-fir tussock moth. (Aho, Wickman)

Rocky Mountain Forest & Range Experiment Station

Stem diseases, malformations, etc.

74-F. Biology and epidemiology of dwarf mistletoes of Arizona white pines. (R. Mathiasen, F. Hawksworth, R. Gilbertson)

75-F. Quantification of rates of spread and intensification of dwarf mistletoe in ponderosa pine stands. (G. Dixon, F. Hawksworth)

76-F. Importance of flavonols as chemotaxonomic indicators in *Arceuthobium* and *Phoradendron*. (D. Crawford, F. Hawksworth)

76-F. Inoculation studies to determine the host ranges of *Arceuthobium campylopodum* and *A. occidentale* in California. (W. Mark, R. Scharpf, F. Hawksworth)

76-F. Biology and epidemiology of a *Peridermium* associated with lodgepole pine dwarf mistletoe. (F. Hawksworth)

Stem diseases, rusts and cankers

76-H. The imperfect stage of *Cenangium singulare* on aspen cankers. (T. Hinds)

Miscellaneous

76-K. Etiology and importance of a new twig disorder of aspen. (C. Livingston, T. Hinds)

Canadian Forestry Service

Pacific Forest Research Centre

PC-14-246 Diseases of seeds and cones. (J. Sutherland)

PC-40-157 Simulation of forest nursery diseases. (W. Bloomberg)

PC-40-275 Developing guidelines for silvicultural control in immature western hemlock stands. (W. Bloomberg, R. Smith, A. Thomson)

PC-40-276 Simulation of root rot impact in second-growth coastal Douglas-fir stands. (W. Bloomberg, G. Wallis)

States

Idaho - Department of Lands

John Schwandt has been appointed forest pathologist for the State of Idaho. His responsibilities include aiding State personnel in establishing tree disease priorities and to become involved in the following projects:

1. Establishing mistletoe free stands of Douglas-fir in areas where overstory has varying amounts of Douglas-fir and lodgepole pine, both of which are heavily mistletoe infected. (Three study plots established this year in the Island Park area.)

2. Training crews for mistletoe control thinnings and cull removal following normal timber sales.

3. Training timber inventory crews to recognize major disease problems.

North Dakota

The State of North Dakota has a new extension plant pathologist, Robert Stack. Part of his duties will be in shelterbelt diseases. Specific studies to be developed later. Major problems probably will be herbicides and *Fomes fraxinopolis*.

Washington - Department of Natural Resources

A special color infra-red flight will be flown over *Armillaria* infection centers near Mt. Adams in southcentral Washington. The unique part of the flight is that specifications call for a high cloud cover. The resulting shadowless photography gives better resolution of ground surface and reduces shadows which conceal root rot killed trees. (K. Russell)

Initial observations have been completed on a suspected needle disease (unk) of grand fir which concerns Christmas tree growers. During the summer, 1977, several fungicides will be applied to test for control. (K. Russell)

Universities

Oregon State University

1. An evaluation of *Verticicladiella* in Oregon. (E. Hansen)

2. Potential of several species of *Phytophthora* for damage to coniferous forests and forest nurseries. (E. Hansen, L. Roth)

University of California, Berkeley

72-J-1 Effect of pathological conditions on properties and utilization of California woods. (W.W. Wilcox)

76-J-1 Microdistribution and efficacy of preservatives in treated wood and their effects on microorganisms. (W.W. Wilcox)

TERMINATED PROJECTS

USDA Forest Service

Region 2

1. Oak wilt in Kansas and Nebraska.

2. *Verticicladiella* root disease survey in West Slope pinyon pine stands of Colorado.

3. Herbicide testing at Mt. Sopris Tree Nursery.

Region 6

73-A-3 *Rhizina undulata* survey on National Forests of western Oregon and Washington. (W. Thies and J.S. Hadfield)

71-C-2 Monitoring populations of *Fusarium* and *Pythium* spp. at the Wind River and Bend Nurseries. (D. Johnson and W. Thies)

66-F-1 Field tests on cultural control of dwarf mistletoe by understory destruction and by species manipulation. (J. Hadfield)

Rocky Mountain Forest & Range Experiment Station

B. Non-infectious Diseases
68-B-4

D. Root and Soil Diseases
71-D-2
71-D-5
71-D-6
72-D-2

E. Foliage Diseases
66-E-1
69-E-1

F. Stem Diseases, Malformation, etc.
62-F-9
62-F-13
68-F-2
72-F-3

G. Stem Diseases, Stains and Decays
72-G-1

H. Stem Diseases, Rusts and Cankers
   62-H-1
   62-H-2
   63-H-5
   64-H-2
   65-H-3
   65-H-4
   67-H-2
   68-H-1
   69-H-8

K. Miscellaneous
   71-K-1

Universities

Oregon State University

1. Chemical control of *Rhabdocline pseudotsugae* in plantations. (G. Harvey)

Defolitan, Maneb, Benomyl, Chlorothalonil and Thiabendazole were ineffective foliage protectants on any of the spray schedules tested. Statistical treatment of data showed no significant differences from control trees, but some treatments warrant further tests based on observation.

University of California, Berkeley

65-J-1 Incense cedar pocket rot: effects of infection and biology of the causal fungus. DELETE - no longer active

66-J-3 Microbiology and pathology of wetwood in California firs. DELETE - no longer active

71-J-1 Defects and decays of forest products. DELETE - I've never had a project with this title; I think someone picked up the subject heading somewhere along the line.

DWARF MISTLETOE COMMITTEE
REPORT ON HIGHLIGHTS OF 1976 RESEARCH

John G. Laut

I. Taxonomy, Hosts and Distribution

a. The white fir dwarf mistletoe, *Arceuthobium abietinum*, has been found in the Chiricahua Mountains in southeastern Arizona. This discovery is of interest as it represents an extension of the known range of the parasite of more than 300 miles (from the Grand Canyon, Arizona). (R. Mathiasen, University of Arizona)

b. The dwarf mistletoe population on bristlecone pine on the San Francisco Peaks, near Flagstaff, Arizona, has been found to be *Arceuthobium microcarpum*, and not *A. cyanocarpum* as suggested in a recent dwarf mistletoe monograph. Principal hosts of the mistletoe on this mountain are *Pinus aristata* and *Picea engelmannii*; rare hosts are *Pinus strobiformis* and *Abies lasiocarpa* var. *arizonica*. The parasite is most serious in bristlecone pine. (R. Mathiasen, University of Arizona and F. Hawksworth, USFS, Fort Collins)

c. Studies are continuing on the comparative taxonomy and epidemiology of *Arceuthobium blumeri* and *A. apachecum*, both of which parasitize *Pinus strobiformis* in Arizona. *A. apachecum* occurs in the Santa Catalina Mountains and northward; *A. blumeri* in the Huachuca Mountains and southward. Preliminary results suggest that populations from the Santa Rita Mountains, which are between the Santa Catalina and Huachuca Mountains, are intermediate in several characteristics. Cross pollination studies between *A. blumeri* and *A. appachecum* have been started. (R. Mathiasen, University of Arizona and F. Hawksworth, USFS, Fort Collins)

d. An inoculation study is planned in California to determine the taxonomic status and host ranges of the hard pine dwarf mistletoes (*Arceuthobium campylopodum* and *A. occidentale*). Seeds will be collected of each taxon on all available hosts and planted in pines in plots in various geographic areas of the state. (W. Mark, Cal. Poly, San Luis Obispo; R. Scharpf, PSW Station, Berkeley and F. Hawksworth, RM Station, Fort Collins)

e. A study of the flavanols in *Arceuthobium* shoots and the chemo-taxonomic implications of this group of compounds is underway. We plan to analyze all North American dwarf mistletoes, as well as make a preliminary analysis of available species of *Phoradendron*. (D. Crawford, University of Wyoming, Laramie and F. Hawksworth, RM Station, Fort Collins)

II. Physiology and Anatomy

a. A Ph.D thesis, "Water Relations of Dwarf Mistletoe on Pine", by James T. Fisher has been completed at Colorado State University. The results are being prepared for publication. For summaries of the findings which deal with water stress and transpiration, see last year's (Missoula) proceedings.

b. Cation concentration in tree tissues as related to dwarf mistletoes. (E. McDowell, Syracuse and D. Knutson, PNW)

III. Life Cycle Studies

a. Work continues on construction of a specific mathematical model of hemlock dwarf mistletoe spread to provide guidelines for estimation of effort and cost in silvicultural control by sanitation cuttings. Efforts have been mainly devoted to quantifying the magnitude and pattern of seed dispersal from discrete sources, the effect of plant age and position in tree on fruit production, the amount of source tree interception, the proportion of seed intercepted by target trees, germination and infection rates on regeneration and subsequent within- and between-tree intensification. Considerable amount of the basic information is coming from re-analysis of "mothballed" data collected at Cowichan Lake. Other data will have to come from specially devised experiments (see 1975 report).

In addition, a more basic model is being developed starting with a characterization of seed dispersal and interception mechanisms, e.g., evaluating the importance of the angle of discharge in determining seed trajectories. (W. Bloomberg, R. Smith and A. Thompson -- biological systems analysis -- PFRC, Victoria)

b. Of 156 birds trapped during seed dispersal of *A. vaginatum* subsp. *crytopodum* in 1976, only one seed was found on one gray-headed junco. I have concluded that birds do disseminate dwarf mistletoe seeds, but such dissemination is infrequent and haphazard. Viable seeds are not passed by birds. Additional satellite infection centers have been found in the study area; one was ca. 450 meters from the nearest possible inoculum source. Alleviation of bird dissemination of *A. vaginatum* subsp. *crytopodum* through habitat management is neither feasible nor desirable. The potential for bird-mediated reintroduction of this dwarf mistletoe to sanitized areas is low and need not be a source of concern to the forest manager. (G. Hudler, Colorado State University, Fort Collins, CO)

IV. Host-Parasite Relations

a. Analyses to mathematically quantify the rates of spread and intensification of *Arceuthobium vaginatum* in various kinds of ponderosa pine stands were continued. A combination of long-term Arizona, Colorado and New Mexico permanent plot and temporary plot data is being used. Computer-generated maps showing the progression of the parasite through stands have been prepared and will be shown at the Coos Bay meeting. Preliminary resluts suggest that stand factors (e.g., density, tree size, etc.) are more closely related to spread than to intensification. (G. Dixon and F. Hawksworth, USFS, RM Station, Fort Collins)

b. The infection process of ponderosa pine by *A. campylopodum*. (Calvin, Portland State University and D. Knutson, PNW)

c. A manuscript on "population buildup and vertical spread of dwarf mistleote on red and white firs in California" is in press. In brief, we found that population buildup of the parasite in young firs was slow after 12-15 years and that vigorous trees were able to outgrow (in height) the vertical spread of dwarf mistletoe by at least 4 to 1. (R. Scharpt, PSW and J. Parmeter, U.C., Berkeley)

V. Effects on Hosts

a. A yield simulation program (SWYLD-2) for even-aged and two-storied stands of southwestern ponderosa pine has been published (For. Serv. Research Paper RM-163, 1976). Also, a user's guide has been issued (For. Serv. General Technical Report RM-23, 1976). This program is a revised and expanded version of the original SWYLD program published in 1972. Modifications include application to two-storied stands, and to a broader range of stand densities. In addition, several mistletoe-related equations have been modified and improved. The LPMIST program for even-aged lodgepole pine stands has also been updated. No publication on the new version is planned but the new program is available to anyone interested. (F. Hawksworth and C. Edminster, RM Station, Fort Collins)

b. Our analysis of tree mortality and infection on Douglas-fir on the Okanogan National Forest is still lodged at the programmer's office in Portland. (Knutson, PNW)

c. We're continuing measurements of tree and mistletoe performance in thinned (18 x 18') stands of Douglas-fir (5 x 15" d.b.h.) on the Malheur and Okanogan National Forests. (Knutson, PNW)

d. Recording intensification of *A. tsugense* on planted (1963) hemlock at Cowichan Lake has been reduced to measurements of upward spread. At last count (end of 1975) some 2,576 infections were tagged. A maximum of 311 infections occurred on one tree. Of 49 trees with at least one infection before removal of the infected residual tree in 1969, 22 have experienced no upward advance of dwarf mistletoe. The average annual upward advance in the remaining 27 trees for 1969-74 was 12.9 cm (5.8 cm for all 49 trees). During this time, annual height growth of the trees averaged 31.2 cm. Currently, then, the proportion of healthy crown is increasing -- 43.5% in 1969 and 64.5% in 1974. These data are subject to revision as more 1974 "advances" will likely be found in our 1977 spring examination. (R. Smith, PFRC, Victoria)

VI. Ecology

a. By bagging plants with maturing fruit (see 1971-73 and 1975 reports on field inoculations), it has been determined that *A. tsugense* established on western hemlock in inland British Columbia can disperse seeds normally and that a high percentage of these seeds germinate. Similarly, *A. americanum* established on shore pine on the coast (Vancouver Island) produced mature fruit which discharged their seeds normally. A high proportion of these seeds also germinated. Other than some *A. douglasii* inoculations which are experiencing a longer life cycle (6 years min.) than *A. tsugense* (4 years min.) or *A. americanum* (5 years min.), the trials will be terminated in the spring of 1977. (R. Smith, PFRC, Victoria)

b. Field examinations this summer found that a dramatic ecological change occurred on one of our long term pine dwarf mistletoe impact and population dynamics study plots. The Kiburz burn on the Eldorado NF in 1974 completely wiped out several hundred study trees that were due for a 10-year reading this summer. The dwarf mistletoe problem, by the way, was completely controlled. (R. Scharpf, PSW)

c. Studies on distribution of *A. vaginatum* in relation to climatic factors were continued. The dwarf mistletoe does not occur throughout the entire range of interior ponderosa pine. Distinct northern, upper altitude, and lower altitude limits exist. Temperature, precipitation, and relative humidity data were collected from 93 ponderosa pine sites, 51 U.S. Weather Bureau weather stations and 42 U.S. Forest Service fire-weather stations in Arizona, Colorado, Nebraska, New Mexico, South Dakota, Texas, Utah and Wyoming. The presence or absence of dwarf mistletoe can be predicted fairly accurately from thermal correlation diagrams which relate January and July mean temperatures. Stations with dwarf mistletoe generally have a greater differential between these two means. Temperatures and relative humidities during certain periods of the year are also useful in delineating distribution. The northern and upper altitudinal limits appear to be cold-temperature related. No dwarf mistletoe was found in stations with a January mean temperature below 6° C. (W. Mark, Cal. Poly., San Luis Obispo and F. Hawksworth, RM Station)

VII. Control - Chemical

a. Studies are continuing in testing chemicals for use in controlling dwarf mistletoe (*Arceuthobium vaginatum*) in ornamental ponderosa pines in Colorado. More than 30 chemicals have been tested (including several herbicides, gibberelic acid, antitranspirants and asphalt) as sprays and injections. Some chemicals, particularly Kuron (Dow), Weed-B-Gon (Chevron), Ethephon (AmChem) and Sencor (Chemagro) look promising in preliminary (2-year) results, as they cause high mistletoe-shoot mortality but relatively little host damage. Tests are continuing with applications planned at different seasons. (A. Moinat, Greeley, Colo. and F. Hawksworth, USFS, RM Station, Fort Collins)

VIII. Control - Biological

a. A summary paper on the hosts and geographic distribution of the fungi parasitic in dwarf mistletoe shoots in North America (south of Canada) is in press as a RM station research paper. Eight fungi are discussed: The "Big Three" - *Colletotrichum gloeosporioides*, *Cylindrocarpon gillii* and *Wallrothiella arceuthobii* - are widespread, and distribution maps for them are given. *Wallrothiella* is found to have a disjunct distribution - the southwestern populations (Colo.-Ariz.-N Mex.) are separated from the northwestern ones (Wash.-Ore.-Idaho-Mont.) by nearly 700 miles. *Pestalotia heterocornis* is reported for the first time as a dwarf mistletoe parasite (on *Arceuthobium bicarinatum* in the Dominican Republic). An undescribed *Cylindrocarpon* occurs on at least 2 dwarf mistletoes in southern Mexico. The remaining 3 fungi (*Pestalotia maculiformans*, *Metaspheria wheeleri* and *Alternaria alternata*) are rare and local as dwarf mistletoe shoot parasites. (F. Hawksworth, RM Station, Fort Collins; E. Wicker, Int. Station, Moscow and R. Scharpf, PSW Station, Berkeley)

b. Our paper on *Wallrothiella* on Douglas-fir dwarf mistletoe is in final manuscript form. (Knutson, PNW)

c. We are also studying *Cylindrocarpon* as a bio-control agent on the mistletoes of ponderosa pine, western hemlock and true fir. (Knutson, PNW)

d. Data from field tests, isolation of fungi and histological examinations of natural and induced resin-disease of *A. americanum* and *A. vaginatum* infections are being analyzed. The natural occurrence of resin-disease was extremely high during the test period which confused our field results; but, with the help of a test in a greenhouse, resin-disease symptoms can be induced by spraying a suspension of inoculum of *Pullularia pullulans*, *Alternaria alternata* and *Epicoccum nigrum* on to *A. americanum* infections of *Pinus contorta*. Aerial shoots begin to die within 4 weeks, resin flow follows, but the response periderm in the host cortex does not form until after the aerial shoots die. (J. Laut, CSFS and F. Hawksworth, RM Station)

IX. Control - Silvicultural

a. In 1965 a cooperative study between the Rocky Mountain Station and the Rocky Mountain Region was begun to determine the effectiveness of sanitation in young mistletoe-infected lodgepole pine stands. About half the plots were sanitized in 1965 and 1970, and then thinned to regional standards in 1970. Other plots were left untreated as a check. The plots were examined in 1975. A comparison of the 10-year change for stands in the treated (and thinned) plots (now 30 to 40 years old) vs. those untreated is:

	Treated Plots	Untreated Plots
Percent of trees infected	- 9%	+ 76%
Average dwarf mistletoe rating	- 7%	+ 56%
Average d.b.h.	+ 85%	+ 37%
Basal area per acre	- 74%	+ 96%

The results from the 10-year examinations of these plots are being written up as a RM Station Research Note. Preliminary analyses suggest that thinning was too drastic (leaving on the average only 340 trees per acre) and the growing stock was seriously reduced. However, since the leave trees in the treated areas show more than twice the diameter growth of those in the untreated stands and have significantly less mistletoe, yields in the treated stands are expected to surpass those in the untreated stands. The differences should become more marked when mistletoe-caused mortality begins to take its toll in the next few years. Periodic examinations of the plots are planned. (F. Hawksworth and T. Hinds, RM Station, Fort Collins and D. Johnson and T. Landis, RM Region, Denver)

b. Studies are planned to determine the effects of thinning to various growing stock levels in stands of different intensities of dwarf mistletoe infection. Studies of *Arceuthobium vaginatum* in ponderosa pine will be at the Fort Valley Experiment Forest, Arizona and those of *A. americanum* in lodgepole pine at the Fraser Experimental Forest in Colorado. (F. Hawksworth, RM Station, Fort Collins)

c. A sanitation study in five 22- to 39-year old lodgepole pine stands initiated by Joe Baranyay in 1967-1968 is to be completed. Following a second and third treatment at 3-year intervals, a final examination of three stands in Alberta occurred in 1967 and the B.C. plots will be done in 1977. The average percent of living trees infected increased slightly

(42% to 48%) on the check plots in the 7-year interval, while decreasing from 41% to 27% with pruning and thinnings, and from 47% to 15% with eradications. Only eradication also reduced the stand infection index. (G. Van Sickle, PFRC, Victoria)

d. A 110-year old western hemlock stand with 65% of the trees moderately or severely infected has just been logged because of dwarf mistletoe. Although waste and breakage was not abnormal, the operator experienced higher yarding and loading costs, and greater sinkage during booming and transport. (G. Van Sickle, PFRC, Victoria)

e. An unspecified number of dwarf mistletoe control demonstration plots are being established throughout Oregon and Washington. The purpose of the plots is to demonstrate the most up-to-date methods of dwarf mistletoe control. (Hadfield, R-6)

X. Surveys

a. Field data collected during and subsequent to a roadside survey (cf. p. 91 WIFDWC proceedings, 1972) are being evaluated. Based on stand cruises, roadside surveys may be adequate for classifying mistletoe infection over large districts, but they were only accurate about half the time for individual stands. The roadside survey was comparable in percentage of trees infected for 12 stands; it underestimated the infection for 8 stands, and overestimated in four stands. Height-diameter curves from the cruise (473 tenth acre plots in 24 stands) showed a decrease in height, and consequently volume, with moderate or severe infection. Based on 300 semi-mature lodgepole pine trees which were rated using the six point scale then felled and again rated, experienced observers were usually accurate 70% to 90% of the time. Ten percent of the healthy trees were mistakenly called infected when standing because of simulation brooming, or heavy moss resembling mistletoe aerial shoots. Of the lightly infected trees, 92% were initially considered uninfected indicating the difficulty of detecting few, small infections in standing trees. (G. Van Sickle, PFRC, Victoria)

XI. Miscellaneous

a. The FAMULUS retrieval system of the world mistletoe literature is operational in Berkeley (PSW station) and Fort Collins (RM Station and USDA, Computer Center). The system now contains nearly 7,000 references, including over 2,100 on *Arceuthobium*. We processed 22 requests for printouts in 1975 and so far we have had 42 requests in 1976. The long-promised "user's guide" for the system is in press and will appear this fall as a RM Station General Technical Report. Requests for runs are welcome. (R. Scharpf, PSW Station, Berkeley and F. Hawksworth, RM Station, Fort Collins)

b. A forest insect and disease (pest) leaflet on the *Phoradendrons* in conifers is being prepared. Six taxa parasitizing junipers, cypress, incense cedar and white fir will be included. (F. Hawksworth, RM Station, Fort Collins and R. Scharpf, PSW Station, Berkeley)

c. The 1964 forest insect and disease (pest) leaflet on lodgepole pine dwarf mistletoe is being revised and any suggestions would be welcome. (F. Hawksworth, RM Station, Fort Collins and O. Dooling, Northern Region, Missoula)

d. Three two-day dwarf mistletoe training sessions were conducted in Oregon and Washington this year. The sessions covered all aspects of mistletoe from basic biology to control strategies. More than 120 foresters attended the sessions. This training will be continued. (Hadfield, R-6)

e. The mystery of how European mistletoe (*Viscum album*) became established on trees over about a 12 square mile area in northern California has finally been solved. Luther Burbank, the renowned horticulturist of yesteryear, was the culprit. For details of the exciting true life story read the article in the September, 1976 edition of Plant Disease Reporter "Luther Burbank introduced European mistletoe into California". (Holmes and Watson, Detectives-at-Large)

f. Dr. Tinnin's (Portland State) and my paper, "Ten Statements for Dwarf Mistletoe Management" is in final form and should be published within the year. (Knutson, PNW)

DISEASE CONTROL COMMITTEE

HIGHLIGHTS OF 1976 CONTROL INVESTIGATIONS

I. SEEDLING DISEASES

A. Phytophthora root rot of nursery seedlings
Host: Douglas-fir
Causal Organisms: *Phytophthora* spp.
Control: Chemical
Development Stage: Field trials

A nursery test of various soil drench treatments has been installed by Jad Lemhouse. (Reforestation Management Inc. and OSU; E.M. Hansen)

B. Nursery diseases and insects
Hosts: All spp.
Causal Organisms: Numerous soil borne and foliage pests
Control: Chemical
Development Stage: Field trial

Field testing phytotoxicity of AWK #1, AWK #1 special, Benlate, Dexon, Neutro Cop 53, diazinon, Dylox, malathion and Sevin to five germinant stages of Douglas-fir, Sitka spruce, white spruce and lodgepole pine. (Pacific Forest Research Centre; J. Sutherland)

C. Container seedling diseases
Hosts: Douglas-fir, Sitka spruce and western hemlock
Causal Organisms: *Botrytis cinerea*
Control: Chemical
Development Stage: Flat or bench trials

We suspect *Botrytis* sp. may be capable of infecting roots. Captan with surfactants has been our best deterrent so far. The results look very good. (DNR Olympia; K. Russell)

D. Container seedling moss control
Hosts: Douglas-fir, Sitka spruce and western hemlock
Causal Organisms: Mosses
Development Stage: Flat or bench trials

Combinations of X77 surfactant (Chevron) and high doses of Captan are very effective against moss. We are now working on the timing. We expect to release data in fall 77. (DNR Olympia; K. Russell)

E. <u>Mycorrhizal inoculation of seedlings</u>
Host: Douglas-fir
Causal Organism: *Lycoperdon* sp (puffballs)
Control: Biological and growth stimulant
Development Stage: Greenhouse and field.

Intriguing results. There is definite response of seedlings. We are continuing to investigate. Mycorrhizae may or may not be main stimulus. (UW; A. Greco & K. Russell)

II. FOLIAGE DISEASES

A. <u>Needle diseases of true pine (Christmas trees)</u>
Host: Grand fir
Causal Organisms: *Phaeocryptopus* sp. and others
Control: Chemical
Development Stage: Field trial

Originally attributed to drought injury but now quite sure we have a fungus. Tried summer control tests using Dithane and Benlate. (DNR Olympia; K. Russell)

III. STEM DISEASES

A. <u>White pine blister rust</u>
Host: *Pinus monticola*
Causal Organism: *Cronartium ribicola*
Control: Chemical
Development Stage: Field trial

No startling control using the following: Bravo, Benlate, Benodonil, Caprate, Fundalin, Plantvax, Cela, Topsin, Cerobin or Vitavax. (Pacific Forest Research Centre; R. Hunt)

B. <u>Dutch elm disease</u>
Host: *Ulmus*
Causal Organism: *Ceratocystis ulmi*
Control: Chemical
Development Stage:

No progress. Initiated summer 1976 to determine efficacy of Lignasan BLP as preventive and as therapeutic treatment for Dutch elm disease in Colorado. In spite of full EPA registration, Colorado has only provisional approval pending better evidence. Colorado Dept. of Ag. has asked CSFS to conduct more tests. (Colorado State F.S.; J. Laut)

C. <u>Dutch elm disease</u>
Control: Biological
Development Stage: Field trial

Plot design for the second year of Multilure trapping program in Fort Collins has been modified based on last year's catch of 1.5 million beetles. A cooperative project with USFS, Fort Collins, Greely and Loveland. (CSFS; M. Schomaker)

IV. ROOT ROTS

A. Black stain root rot
Host: Ponderosa pine
Causal Organism: *Verticicladiella wagnerii*
Control: Silvicultural in natural stands

The cutting treatment which removes all ponderosa pines from the infection centers plus a 75 foot buffer zone (conversion to mixed conifers) has been completed. Evaluation to continue over three years. (U.C., Berkeley; F. Cobb & Parmeter)

B. Laminated root rot
Host: western conifers
Causal Organism: *Phellinus (Poria) weirii*
Control: Biological
Development Stage: In Vitro

Monogliceride containing 60% lauric acid completely suppressed growth of *P. weirii* at 5 ppm. Soil under mixed alder-conifer stand contained significantly higher level of lauric acid than either the soil of conifer or red alder. (USFS, Corvallis; C.Y. Li)

REPORT OF COMMITTEE ON FOREST DISEASE RECREATION HAZARDS

Peter Gaidula

Due to scheduling difficulties, as well as conflicts with other committee meetings, the Forest Disease Recreation Hazards Committee did not hold a meeting at the Coos Bay meeting.

Several committee projects are nearing completion. These include an outline for training field personnel in tree hazard recognition and evaluation; a second project involves the preparation of a selected list on forest disease recreation hazard problems.

Dr. Lee Paine is continuing his collection of tree failure data, but with more emphasis on data from urban areas. He is also preparing a paper on trends in accident rates and losses from tree breakage on recreation sites.

BUSINESS MEETING MINUTES

September 17, 1976

OLD BUSINESS

Chairman Lew Roth opened the meeting. The Missoula minutes and financial status were accepted.

Air pollution committee. Fields Cobb moved that the air pollution committee be dropped, but died for lack of second. Bob Scharpf wrote to Paul Miller asking his recommendations since he was last chairman. Paul has recommended the committee be dropped now and reinstated when the need arises.

History. Frank Hawksworth reported that the status of printing the Buchanan manuscript on the history of forest pathology in the West was still in limbo. Gerald Anderson was working on it.

Reid Miller reported that Benidict was writing a history of the blister rust control program.

A complete treasurer's report will appear separately.

NEW BUSINESS

New and terminated proejcts. Tom Laurent and Dave Graham suggested that the New and Terminated Projects section needs more emphasis than at this meeting. They questioned how projects should be reported. Could they just be sent to the secretary or discussed at the meeting?

Trust fund. Ed Wicker moved and John Palmer seconded, members passed to send $50 to Nagy Ochima's trust fund.

Root rot committee. Bill Bloomberg brought up the subject of a new committee on root rots. It was moved, seconded and passed that an official committee be formed by interested persons at the next meeting.

Social functions. John Laut moved, Scharpf seconded, members passed that the executive be authorized to spend money for a formal social hour at the beginning of the session to kick the Conference off.

Dick Parmeter commented on poor performances for Social Achievement Award of late. Several alternatives were discussed: (1) No change; (2) Abandon award; (3) Divorce the competition from the banquet. Move event to a second night (earlier), then present award at the banquet. (Note: this item was recommended by a committee)

Tom Laurent stressed that the original intent of WIFDWC is to be informal. Laurent moved and McCain seconded that no change be made in current award system. Motion failed. John Laut amended as item 3 above. His amendment was seconded and passed resoundingly.

Fields Cobb moved and Don Graham seconded that the Achievement Award Committee be instructed to make their selection before midnight of the night before the banquet. Passed resoundingly!

Discussion came up about commercial sponsorship of social events during Conference. (See item 7 page 77 of 22nd Monterey Conference minutes). Ed Wicker moved and several seconded that no commercial involvement be allowed. Passed unanimous.

Executive appointments. Larry Weir and committee studied whether to have the executive appointed 1 year in advance. He recommended this not be done. It was moved, seconded and members passed that we continue current executive election system.

Outstanding contributions. Jim Hadfield headed a committee to study merits of giving an outstanding contribution award. They found little justification and felt that it would make the Conference too formal. Ed Wicker moved that the committee and idea be dropped. Passed unanimously.

Proceedings byline. The Proceedings must have the formal statement on the cover. The membership also wished to reaffirm the 1957 statement regarding proceedings. Laurent moved, Wicker seconded, members passed that this be done. Here it is as worded in the business notes of the 1957 Conference:

Conference Proceeding Recommendations

"Issuance of Proceedings of WIFDWC meeting contributions are according to rules formulated during the third meeting. Distribution of proceedings should be made to all persons known to be qualified for membership and who have an active interest in WIFDWC.

The committee formulating the rules was agreed that printed transcripts of our meetings served a vital purpose in the conduct of Conference affairs.

It was of the opinion that a conscious effort be made to alleviate the extraordinary volume of work that has fallen to the few members made responsible for services each year."

AMEN!!!

Meeting place. Allen Van Sickle invited the 25th Conference to Victoria for the 1977 meeting to be held after October 1. Moved, seconded and passed.

Don Graham invited WIFDWC to the Tuscon area near Phytopath time (back to back) in late October or November with WIFDWC at the end of Phytopath. Wicker moved, Laurent seconded, passed unanimous.

Honorary life members. George Harvey, Bratislav Zak, Alex Molnar and Phil Thomas were added with unanimous vote initiated by John Palmer.

Thank yous. Thanks to the crew that arranged and guided the meeting: Larry Weir, Kathleen Weir, Lyn Roth, Lew Roth, Jim Hadfield, Ken Russell. Thanks also to all those on panels and those giving special talks, including the field trips.

Meeting time. Dave Graham stressed that a high proportion of Federal employees would have budget problems and asked that meeting time be changed to put meeting at beginning of fiscal year instead of end. Federal year begins October 1.

Phytopath participation. Bob Scharpf reminded that Bob Bega is the Phytopath chairman for the western area and asked that more members participate.

Interim program chairman report. Fields Cobb has a list of program subjects that are listed separately. He stressed three points:

1. Half of all sessions should be reserved for discussion.

2. Build flexibility into program.

3. Strengthen new and terminated projects. Limit to 3 minutes total.

New executive. Don Graham was elected for next year's chairman and John Laut, secretary by the usual quick democratic process.

Adjourn!

WESTERN INTERNATIONAL FOREST DISEASE WORK CONFERENCE

TREASURER'S REPORT

Balance on hand following twenty-third meeting	$ 241.13
Total interest paid November 24, 1975 to June 30, 1976	$ 8.03
Total	$ 249.16

Receipts Twenty-fourth WIFDWC Meeting

Registration (83 persons) .... Includes banquet, bus, lunches, salmon barbecue, coffee, registration and other miscellaneous costs.	$ 2182.65
Jack Barringer pd. back expenses June 15, 1977 ..	$ 25.00
Total ...	$ 2207.65

Expenses Twenty-fourth WIFDWC Meeting

Greyhound bus rental	....	$ 549.50
OSU van rental	....	$ 167.00
Lunches	....	$ 249.50
Sunset Bay picnic	....	$ 504.00
Coffee and conference room	....	$ 93.00
Banquet	....	$ 483.00
Banquet speaker	....	$ 60.00
Local arrangements	Hadfield	$ 27.00
	Roth	$ 23.00
	Weir	$ 6.00
Jack Barringer travel expense	....	$ 25.00
	Total ...	$ 2187.00

Balance from Twenty-fourth WIFDWC meeting (2207.65-2187.00) .	$ 20.65
Balance on hand following Twenty-fourth meeting	$ 269.81
Interest paid July 1, 1976 to June 30, 1977	$ 12.71
Total ...	$ 282.52
Expense - Nagy Oshima trust fund (Sept. 20, 1976)	$ 50.00
Balance June 30, 1977 — TOTAL ...	$ 232.52

Deposit held: Washington State Employees Credit Union
P.O. Box WSECU
Olympia, WA 98507
Account No. 936258

INTERIM PROGRAM CHAIRMAN'S REPORT

Fields W. Cobb, Jr.

Suggested Topics:

1. Update on the M.A.G. at Davis, California.
2. New developments in Impact Evaluations and Survey.
3. *Fomes annosus*: new information from the East and West.
4. Heart rots: their potentials in second growth.
5. New developments in Dutch Elm disease.
6. Canker diseases: impact, biology and control.
7. Update in products pathology.
8. Insect vectors of forest pathogens.
9. Public relations in forest pathology -- Why are we so underfunded if losses are so high?
10. What do we need to know to alleviate the impact of our major diseases -- Who should do what?
11. Foliage diseases. A review of control techniques and schedules.

Program Suggestions:

General Conduct. Stress the informal.

1. At least half of each session is to be reserved for discussion.
2. No schedule pressures -- i.e., we shouldn't be rushing around without time for relaxed discussion, showers, naps, etc.
3. Strengthen sessions on new projects and terminated projects (or current status).
4. A chairman's suite to serve as a rallying point.
5. There should be no evening committee meeting. Rather, set aside at least a couple of hours of daylight to have meetings.
6. We should have special interest discussion sessions for at least half of a day -- 3 or 4 to be run concurrently (sessions on such things as fir decays, *P. weirii*, etc.).
7. On field trips, allow enough time for some close up inspections, photos, etc.
8. Schedule a first evening get-together to renew acquaintances.

NEW PUBLICATIONS

AHO, PAUL E. AND JAMES HADFIELD. 1975. How to estimate defect in white fir in southcentral Oregon. USDA, Forest Service, PNW Station Informational Brochure, 10 p., illus. Pacific Northwest Forest & Range Experiment Station; Portland, Oregon.

AHO, PAUL E. 1976. Fungal and bacterial associations in heart rots of *Abies concolor* (Gord. and Glend.) Lindl. and techniques for estimating damage in southwestern Oregon. (Abstract) In Dissertation Abstracts International 36(7):3145-B

AHO, P.E., K. CROMACK, C.Y. LI AND A. HUTCHINS. 1976. Concentrations of selected nutrients and oxalic acid in sound and decayed *Abies concolor* wood. (Abstract) In Program and Abstracts of the 49th Annual Meeting Northwest Scientific Association. Pub. by Wash. State Univ. Press.

ALEXANDER, M.E. AND F.G. HAWKSWORTH. 1976. Fire and dwarf mistletoes in North American coniferous forests. J. For. 74:446-449.

BEGA, ROBERT V. 1974. *Phytophthora cinnamomi*: Its distribution and possible role in ohia decline on the island of Hawaii. Plant Disease Reporter 58:1069-1073.

BEGA, ROBERT V. 1975. An epidemic outbreak of *Phomopsis* on Douglas-fir in a California forest nursery. Proceedings 23rd Western International Forest Disease Work Conference, Oct. 1975.

BEGA, ROBERT V. 1976. Tree diseases -- an approach to integrated pest management. McGraw-Hill Yearbook of Science and Technology.

BLOOMBERG, W.J. 1976. Simulation of Douglas-fir seedling root growth, damping-off and root rot. Can. For. Serv. Rep. BC-X-127.

BLOOMBERG, W.J. 1976. Distribution and pathogenicity of *Fusarium oxysporum* in a forest nursery soil. Phytopathology 66:1090-92.

BLOOMBERG, W.J., D. HUNT AND G.W. WALLIS. 1976. A data bank system for forest tree disease and growth plots in British Columbia. Can. For. Serv. Rep. BC-X-143.

COBB, F.W., JR., R.L. JAMES, N.L. BRUHN ET AL. 1976. Effects on epidemiology of forest tree pathogens. In Photochemical Air Pollutant Effects on mixed conifer ecosystems, a progress report. R.N. Kickert et al. EPA, Corvallis, Oregon. p. 147-159.

COBB, F.W., JR. AND J.R. PARMETER, JR. 1976. Modeling of plant pathogen populations in the forest ecosystem. In Modeling for pest management: Concepts, techniques and applications. Eds.

R.L. Rummala, D.L. Haynes and B.A. Craft. Mich. State Univ. pp. 165-167.

EDMINSTER, CARLETON B. AND FRANK G. HAWKSWORTH. 1976. User's guide to SWYLD2: Yield tables for even-aged and two-storied stands of southwestern ponderosa pine, including effects of dwarf mistletoe. USDA For. Serv. Gen. Tech. Rep. RM-23. p. 8.

FUNK, A. 1976. *Parkerella*, a new genus of Coronophorales. Can. J. Botany 54:868-871.

FUNK, A. 1975. New microfungi on coastal Douglas-fir. Can. J. Botany 53:2297-2302.

GOHEEN, D.J. AND F.W. COBB, JR. 1976. Attack of *Pinus ponderosa* by bark beetles subsequent to infection by *Verticicladiella wagnerii*. Proc. Am. Phyto. Soc. 2:113 (Abstract).

HANSEN, E.M. AND R.F. PATTON. 1975. Types of germination and differentiation of vesicles by basidiospore, of *Cronartium ribicola*. Phytopathology 65:1061-1071.

HANSEN, E.M. 1975. *Phellinus* (*Poria*) root rot in Douglas-fir/alder stands 10-17 years old. USDA Forest Service Res. Note PNW-250.

HANSEN, E.M. 1976. Twenty year survival of *Phellinus* (*Poria*) *weirii* in Douglas-fir stumps. Can. J. For. Res. 6:123-128.

HARVEY, GEORGE M. AND LARRY R. CARPENTER. 1975. Fungi on stored Douglas-fir cones -- a problem? Tree Planters' Notes 26(4):16-17.

HAWKSWORTH, FRANK G. AND MELVYN J. WEISS. 1975. *Arceuthobium gillii* in New Mexico. Southwest. Nat. 20(3):418.

HAWKSWORTH, FRANK G. AND D. WIENS. 1976. *Arceuthobium oxycedri* and its segregates *A. juniperi-procerae* and *A. azoricum* (Viscaceae). Kew Bulletin 31(1):71-80.

HEIDMANN, L.J. 1975. Predicting frost heaving susceptibility of Arizona soils. USDA For. Serv. Red. Note RM-295, p. 7.

HINDS, THOMAS E. 1976. Aspen mortality in Rocky Mountain campgrounds. USDA For. Serv. Res. Pap. RM-164, p. 20.

HINDS, T.E. AND R.G. KREBILL. 1975. Wounds and canker diseases on western aspen. USDA For. Pest Leafl. 152, p. 9.

HIRATSUKA, Y. AND A. FUNK. 1976. Additional records of *Gremmeniella abietina* in western Canada. Plant Disease Reporter 60:631.

HOPKINS, J.C. 1975. A review of moulding of forest nursery seedlings in cold storage. Can. For. Serv. Rep. BC-X-128.

HOYER, G.E. AND K.W. RUSSELL. 1975. Attaining intensive management goals by stems-per-acre control in plantations. DNR Note No. 12, p. 6. Wash. State Dept. Natural Resources; Olympia, WA.

HUNT, R.S. 1976. Eriophyid mite associated with damaged yellow cypress cones. Bi-Mon. Res. Notes 32(3):15-16.

HUNT, R.S., F.W. COBB, JR. AND J.R. PARMETER, JR. 1976. *Fomes annosus* stump colonization and fungus development in the California mixed-conifer type. Can. J. For. Res. 6(2):159-165.

HUNT, R.S. AND A. FUNK. 1976. Common pests of arbutus in British Columbia. Can. For. Serv. Forest Pest Leaflet No. 63, p. 7.

JAMES, R.L., F.W. COBB, JR., P.R. MILLER AND J.R. PARMETER. 1976. Effects of ozone on infection and colonization of ponderosa and jeffrey pine seedlings by *Fomes annosus*. Proc. Am. Phyto. Soc. 2:115 (Abstract).

JAMES, R.L., F.W. COBB, JR. AND J.R. PARMETER, JR. 1976. Effect of photochemical air pollution injury on the susceptibility of ponderosa and jeffrey pine roots to *Fomes annosus*. Proc. Am. Phyto. Soc. 3: (In press).

JAMES, R.L., F.W. COBB, JR. AND J.R. PARMETER, JR. 1976. Influence of photochemical air pollution injury on the susceptibility of freshly cut pine stumps to *Fomes annosus*. Proc. Am. Phyto. Soc. 3: (In press).

JOHNSON, D.W. 1976. Incidence of diseases in National Forest Plantations in the Pacific Northwest. PDR 60 (10).

JOHNSON, D.W. AND B. ZAK. 19__. Effects of soil treatments on fungal populations and ponderosa pine seedling survival in an Oregon nursery. PDR. (In press).

JOHNSON, D.W. AND J.E. KNUTZ. 1976. Sporulation from Eutypella-cankered maples reduced by felling infected trees. PDR 60(5): 448-451.

JOHNSON, D.W., L.C. YARGER, C.D. MINNEMEYER AND V.E. PACE. 1976. Dwarf mistletoe as a predisposing factor for mountain pine beetle attack of ponderosa pine in the Colorado Front Range. U.S. Forest Service, Rocky Mountain Region Technical Report R2-4. August, 1976. p. 7.

JOHNSON, D.W., T.D. LANDIS AND L.S. GILLMAN. 19__. Rocky Mountain juniper, a new host of *Armillaria mellea* in Colorado. PDR. (In press).

LANDIS, T.D. 1976. Foliage nutrient levels for three Rocky Mountain tree species. Tree Planters' Notes 27(2):4-5.

LANDIS, T.D. 1976. Nitrogen fertilizer injures pine seedlings in Rocky Mountain Nursery. Tree Planters' Notes 27(4).

LANDIS, T.D. AND D.W. JOHNSON. 1976. Tree Hazards: recognition and reduction in recreation sites. U.S. Forest Service Rocky Mountain Region. Technical Report R2-1. February, 1976. p. 9.

LANDIS, T.D. AND L.B. HELBURG. 1976. Black stain root disease of pinyon pine in Colorado. Plant Disease Reporter 60.

LANDIS, T.D. AND L.S. GILLMAN. 1976. Mycorrhizal inoculation of container grown ponderosa pine seedlings. U.S. Forest Service, Rocky Mtn. Region Tech. Rep. R2-3. p. 10.

LANDIS, T.D., R.S. FIFER AND C.A. TAYLOR. 1976. Soil and water quality in relation to lodgepole pine culture at Mt. Sopris Nursery. U.S. Forest Service, Rocky Mtn. Region Tech. Rep. R2-2. p. 6.

LANDIS, T.D. Oak wilt detected in 5 new counties in Kansas and Nebraska. Tree Planters' Notes. (Manuscript submitted).

MORRISON, D.J. 1976. Vertical distribution of *Armillaria mellea* rhizomorphs in soil. Trans. Br. Mycol. Soc. 66:393-399.

MORRISON, D.J. 1976. Armillaria root rot. Forest Pest Leaflet 35 (rev. July 1976). Can. Forest. Service., Pac. For. Res. Cen., Victoria, B.C.

MYERS, CLIFFORD, A., CARLETON B. EDMINSTER AND FRANK G. HAWKSWORTH. 1976. SWYLD2: Yield tables for even-aged and two-storied stands of southwestern ponderosa pine, including effects of dwarf mistletoe. USDA For. Serv. Res. Pap. RM-163, p. 25.

NELSON, E.E. AND T. HARTMAN. 1975. Estimating spread of *Poria weirii* in a high elevation, mixed conifer stand. Journal of Forestry 73:141-142.

NELSON, E.E. 1975. Survival of *Poria weirii* in wood buried in urea-amended forest soil. Phytopathology 65:501-502.

NELSON, E.E. 1976. Effect of urea on *Poria weirii* and soil microbes in an artificial system. Soil Biology and Biochemistry 8:51-53.

PARMETER, J.R., JR. AND B. UHRENHOLDT. 1975. Some effects of pine-needle or grass smoke on fungi. Phytopathology 65:28-31.

PARMETER, J.R., JR. AND B. UHRENHOLDT. 1976. Effects of smoke on pathogens and other fungi. Proc. Tall Timbers Fire Ecology Conf., Missoula, Mont. 1974. p. 299-304.

PETERSON, GLENN W. 1976. Disease of Russian-olive caused by *Botryodiplodia theobromae*. Plant Disease Reporter 60(6):490-494.

PETERSON, GLENN W. AND C.S. HODGES, JR. 1975. Phomopsis blight on junipers. USDA Forest Pest Leaflet 154, p. 6.

PETERSON, GLENN W. AND JERRY W. RIFFLE. 1976. Protection of windbreaks from diseases. p. 172-180. In Shelterbelts on the Great Plains. Proc. Symp. (Denver, Colo., Apr. 1976) Great Plains Agric. Counc. Publ. 78, p. 218.

PRATT, R.G., L.F. ROTH, E.M. HANSEN AND W.D. OSTROFSKY. 1976. Identity and pathogenicity of species of *Phytophthora* causing root rot of Douglas-fir in the Pacific Northwest. Phytopathology 66:710-714.

RIFFLE, JERRY W. 1975. Two *Aphelenchoides* species suppress formation of *Suillus granulatus* ectomycorrhizae with *Pinus ponderosa* seedlings.

RUSSELL, K.W. AND H.W. ANDERSON. 1975. Composting red alder bark for forest nursery organic supplement. Abstract, Northwest Scientific Association. Ellensburg, WA.

RUSSELL, K.W., B. HOWARD, E.E. NELSON, L.C. WEIR AND D.W. JOHNSON. 1975. Forest disease priorities in the Pacific Northwest. Miscellaneous Bulletin, pp. 15. Northwest Forest Pest Action Council. 1500 Yeon Bldg. Portland, OR.

RUSSELL, K.W. 1975. Growing container Sitka spruce under high pressure sodium vapor lights. DNR Note No. 9, p. 6. Washington State Dept. of Natural Resources. Olympia, WA.

RUSSELL, K.W. 1976. Mycorrhizal inoculation of container grown Douglas-fir seedlings. Northwest Scientific Association. Cheney, WA. (Abstract).

RUSSELL, K.W. 1976. Operational aspects of disease control: Dwarf mistletoe (western hemlock). In Proceedings: Hemlock Symposium, University of Washington College of Forest Resources; Seattle, WA.

RUSSELL, K.W. 1976. Planting levels to meet stand management density objectives. In Proceedings: Western Forestry and Conservation Association. Portland, OR.

SAFRANYIK, L., D.M. SHRIMPTON AND H.S. WHITNEY. 1976. Mountain pine beetle workshops, planning and execution. Can. Forest. Ser., Victoria, BC-P-15.

SCHARPF, ROBERT F. 1976. Know your forest diseases -- cytospora canker of true firs. Forest pest conditions in California -- 1975. A publication of the California Forest Pest Control Action Council. p. 13-16.

SCHARPF, ROBERT F. AND J.R. PARMETER, JR. 1976. Population buildup and vertical spread of dwarf mistletoe on young red and white firs in California. American Phytopathological Soc. Meeting, Kansas City, Mo. (Abstract).

SCHARPF, ROBERT F. AND FRANK G. HAWKSWORTH. 1976. Luther Burbank introduced European mistletoe into California. Plant Dis. Reptr. 60:740-742.

SCHARPF, ROBERT F., FRANK G. HAWKSWORTH AND BERNARD J. ERICKSON. 1976. Mistletoe literature of the world: A user's guide to a FAMULUS retrevial system. USDA Gen. Tech. Rept. RM-30, p. 5. Rocky Mt. Forest and Range Expt. Station; Fort Collins, Colo. 80521.

SMITH, R.B. AND E.F. WASS. 1976. Field evaluation of ecological differentiation of dwarf mistletoe on shore pine and western hemlock. Can. J. For. Res. 6(2):225-228.

STALEY, J.M. 1975. The development on and penetration into *Pinus sylvestris* foliage, of a pathogenic Lophodermium. p. 43-45. In Lophodermium in pines. Proc. 5th Eur. Colloq. For. Pathol. (Schmalenbeck, Apr. 1975).

STALEY, J.M. 1975. The taxonomy of Lophodermia on pines, with special reference to problems in North American Christmas tree plantations. p. 79-85. In Lophodermium in pines. Proc. 5th Eur. Colloq. For. Pathol. (Schmalenbeck, Apr. 1975).

SUTHERLAND, J.R. AND D.G.W. EDWARDS. 1976. Pigments for use on conifer seeds sown in forest nurseries. Pac. For. Res. Centre, Can. For. Serv., Victoria, B.C. Infor. Res. BC-X-146. p. 12. 3 Tables.

SUTHERLAND, J.R. 1976. Control of nematode-caused seedling diseases, especially corky root of Douglas-fir. Joint Proc. West. For. Nursery Council and Intmtn. Nurserymen's Assoc., Vancouver, B.C., Aug. 10-12, 1976. p. 5.

VAN SICKLE, G.A. AND T.E. STERNER. 1976. Sanitation: a practical protection against Dutch elm disease in Frederiction, N.B. Plant Disease Reptr. 60:336-338.

WALLIS, G.W. 1976. *Phellinus* (*Poria*) *weirii* root rot. Detection and management proposals in Douglas-fir stands. Environ. Canada. Forestry Tech. Rep. 12.

WALLIS, G.W. 1976. Synopsis of establishment data for Douglas-fir growth and yield, and root rot installations. Canadian Forestry Service Rep. BC-X-144.

WALLIS, G.W. 1976. Growth characteristics of *Phellinus* (*Poria*) *weirii* in soil and on root and other surfaces. Can. J. For. Res. 6: 229-232.

WALLIS, G.W. AND G. REYNOLDS. 1975. Mass inoculation of Douglas-fir seedling roots with *Phellinus* (*Poria*) *weirii* (Murr.) Gilbertson. Can. J. Forest Res. 5:741-742.

WASS, E.F. 1976. Ecology of shore pine stands infested with dwarf mistletoe on southeastern Vancouver Island. Can. For. Serv., Pacific For. Res. Centre, BC-X-142. p. 33.

WHITNEY, H.S., J. REID AND K.A. PIROZYNSKI. 1975. Some new fungi associated with needle blight on conifers. Can. J. Bot. 53: 3051-3063.

WILCOX, W. WAYNE. 1975. Micro-bioassay of pentachlorophenol within wood cell walls. For. Prod. J. 25(12):37-43.

WILCOX, W. WAYNE AND NELLY C. REM. 1976. Aid to rapid differntiation between California white fir and hemlock woods. For. Prod. J. 26(1): 47-48.

WILLIAMS, STEPHEN E. AND EARL F. ALDON. 1976. Endomycorrhizal (vesicular arbuscular) associations of some arid zone shrubs. Southwest. Nat. 20(4):437-444.

WYSONG, DAVID A. AND JERRY W. RIFFLE. 1975. Cytospora canker of poplars and willows. NebGuide G75=257, B-2. p. 4. Nebr. Univ., Lincoln.