

**ROOT DISEASE SURVEY METHODS
PHASE I
CRITICAL REVIEW AND ASSESSMENT**

by

**T.M. Thomson & Associates Ltd.
1006 Government Street
Victoria, British Columbia**

**British Columbia Ministry of Forests
Victoria, British Columbia
Forest Service Internal Report**

PM-PB-63

Submitted January 1986

Not for Publication

March 1991

(The contents of this report may not be cited in whole or part without the written approval of the Director, Protection Branch, Ministry of Forests, 31 Bastion Square, Victoria, British Columbia V8W 3E7)

FOREWORD

This report is one of a series of internal reports distributed by Forest Protection Branch, B.C. Ministry of Forests, to record accomplishments and interim or provisional results for the information of staff, colleagues, and others.

In the Canada-British Columbia Forest Resources Development Agreement (FRDA) 1985 to 1990, over 100 pest control projects were directly funded by the province and administered by protection staff. To facilitate application of the results, and development of improved forest health management strategies, the contractors reports have been edited and distributed as internal reports. Accordingly, any opinions and recommendations expressed are those of the contractor, and not necessarily those of the ministry or the FRDA management committee.

For details or more information about the report or project, please contact forest health staff at Protection Branch or at the forest region offices.

J. Muir, RPF
Acting Manager
Forest Health
Forest Protection Branch

The guidelines for internal reports outlined in the Protection Manual were adhered to as closely as possible. All manuscripts were altered to comply with a common format, but entire reports were not rewritten to conform to a standardized outline.

Most Executive Summaries were the work of Graham Hawkins of MoF Inventory Branch (formerly with Pacific Coast Forest Biology). All word processing was accomplished by Catriona Kaufman of Top Kat Services. Will Gordon of R. White Woods inc. prepared all maps and figures.

R. White, editor
R. White Woods inc.



T.M. Thomson & Associates Ltd.
Consulting Engineers and Foresters

Head Office

1006 Government Street, Victoria, British Columbia, Canada V8W 1X7 Tel. (604) 385-4468 Telex 049-7345

January 24, 1986

File: 1609

Dr. J. Muir, Pathologist
B.C. Ministry of Forests
Protection Branch
1450 Government Street
Victoria, B.C.
V8W 3E7

Dear Sir:

Re: Phase I of Our Proposal to Review
Root Disease Survey Methods

Attached is our report, "Root Disease Survey Methods, Phase I, Critical Review and Assessment".

We have examined pertinent literature and interviewed key personnel from major agencies who have experience in root disease survey operations.

T. M. Thomson & Associates Ltd.'s (THOMSON's) findings are summarised in the following report. We are proceeding with Phase II of our proposal, "Recommendations on Improvement and Development of Technology Associated with Root Disease Surveys".

Dr. G. Wallis, Forest Pathologist, and Mr. E. G. Vaughan, R.P.F., compiled this report. Mr. B. T. Wallis, R.P.F., was responsible for editing and general overview.

Yours very truly,

T. M. THOMSON & ASSOCIATES LTD.

Per: *B.T. Wallis*

B. T. Wallis, R.P.F.
Senior Forester, Silviculture

BTW:db

Enc.

Victoria Office: 1006 Government St., Victoria, B.C. V8W 1X7 Tel. (604) 385-4468 Telex 049-7345

Vancouver Office: 400-540 Burrard St., Vancouver, B.C. V6C 2K1 Tel. (604) 687-3346

North West Regional Office: Suite 1, 214 3rd Ave. West, Prince Rupert, B.C. V8J 1L1 Tel. (604) 624-6058

North Interior Regional Office: 111-1717 3rd Ave., Prince George, B.C. V2L 3G7 Tel. (604) 562-7725

EXECUTIVE SUMMARY

Interested agencies were consulted and pertinent literature examined to appraise root disease survey practices and results achieved. Currently, all agencies are using the methodology developed by the Canadian Forestry Service or minor modifications thereof. Surveys, for the most part, have been undertaken in coastal stands; the results have been generally satisfactory, and no major changes in technology were recommended.

A review of inventory and silviculture measurement forms currently in use by the agencies indicated that they would provide little information on root disease distribution and losses.

Current survey methodology is applicable primarily to coastal stands and young interior stands where the disease occurs in discrete centres. New or modified methodology will be required for interior stands.

Current root disease survey methodology, being confined to ground sampling, is not, by itself, suitable for sampling large areas of timber such as a Timber Supply Area (TSA). Multistage sampling techniques are being examined relative to these large areas.

TABLE OF CONTENTS

	Page
COVER LETTER	ii
EXECUTIVE SUMMARY	iii
1 INTRODUCTION	1
2 OBJECTIVE	2
3 METHODS	3
4 RESULTS	4
4.1 <u>B.C. Ministry of Forests</u>	4
4.1.1 Inventory Branch	4
4.1.2 Silviculture Branch, Vancouver Region	5
4.1.3 Vancouver Forest Region	5
4.1.4 Duncan and Sechelt Forest Districts	6
4.2 <u>Canadian Forestry Service</u>	6
4.3 <u>Canadian Pacific Forest Products Ltd.</u>	7
4.4 <u>MacMillan Bloedel Ltd.</u>	7
5 DISCUSSION AND EVALUATION	8
5.1 <u>Disease Recognition</u>	8
5.2 <u>Survey Methodology</u>	8
6 REFERENCES	10

1 INTRODUCTION

Root disease, caused by native fungal pathogens, is known to cause significant losses in softwood stands throughout southern and central British Columbia (Morrison 1981; Wallis 1976). Damage is known to increase with certain management practices; losses, frequently starting early in the life of a stand, continue to increase throughout the rotation; and the fungus persists in infected residue from one rotation to the next.

Root disease has been noted throughout commercial softwood regions; however, no maps are available that designate areas or stands requiring special prescriptions for disease management. Also, although losses have been recorded for a few specific units in some regions, no figures are available for calculating current and predictable losses in large management units such as Timber Supply Areas (TSAs).

Root disease survey technology has been developed by the Canadian Forestry Service, Pacific Forestry Centre (Bloomberg 1983; Bloomberg *et al.* 1980) for appraising losses in definitive stands. A number of agencies have subsequently utilized this method or minor modifications thereof in coastal stands. A summary of their opinions of the system and its application to large timber blocks is included in this report. No extensive use of the system has been attempted in interior B.C. stands.

2 OBJECTIVE

The objective of the survey was to review current root disease, inventory and silviculture survey practices undertaken by the B.C. MoF, industrial companies, the Canadian Forestry Service and other agencies, relative to effectiveness in evaluating root disease distribution and losses in:

1. specific management units;
2. large timber blocks, such as TSAs, on the coast and in the interior.

3 METHODS

The procedures outlined to conduct the survey were to:

1. examine pertinent literature;
2. confer with agencies and personnel conversant with root disease damage and survey methodology;
3. evaluate findings relative to the foregoing objective and prepare a report.

4 RESULTS

Literature examined is listed in the references section of this report. Agencies and personnel contacted were:

- B.C. Ministry of Forests (MoF)
 - Inventory Branch
 - Mr. B. Hall
 - Mr. J. McLellan
 - Silviculture Branch
 - Mr. P. Diggle
 - Vancouver Region
 - Mr. J. Beale
 - Mr. G. Kennah
 - Duncan District
 - Mr. R. Clevette
 - Sechelt District
 - Mr. G. Hemphill
- Canadian Forestry Service (CFS)
 - Pacific Forestry Centre
 - Dr. W. Bloomberg
 - Dr. D. Morrison
- Canadian Pacific Forest Products Ltd.
 - Mr. V. Korelus
- MacMillan Bloedel Ltd.
 - Ms. J. Kummi

Agency interview provided the following information.

4.1 B.C. Ministry of Forests

Discussions were held with MoF individuals of the Inventory and Silviculture Branches, the Vancouver Forest Region, and the Duncan and Sechelt Forest Districts.

4.1.1 Inventory Branch (B.M. Hall, J.F. McLellan)

In cooperation with the CFS, this Branch was involved in root disease survey projects on an experimental basis from 1981 to 1983. Technology was based on the use of low-level photography, principally 70mm, with both color and infrared film utilized.

Results were satisfactory in areas where root disease openings were discrete and easy to identify, e.g., *Phellinus* damage, but unsatisfactory where openings were not well defined, e.g., *Armillaria* damage in the interior.

B.M. Hall concluded that the use of low-level 70mm photography would be a valuable aid in root disease survey technology over restricted areas, but too costly and not effective for extensive surveys over large TSAs unless used to supplement other techniques. Also, color photography was preferred over infrared as the results were as good, or better, and the handling costs for infrared were much higher.

It has been determined through discussions with J.F. McLellan that the standard Inventory Branch field forms for sampling and classification do not include any discrete sections for the notation and measurement of root disease damage when encountered in inventory field work. Only the "Remarks" section on these forms is available for general comments.

4.1.2 Silviculture Branch, Vancouver Region (G.L. Kennah)

Silviculture operations in young stands are not conducted before an assessment of root disease damage is completed. If reconnaissance surveys determine the incidence of root disease to be less than 10% of the area, then treatments are likely to proceed as planned. If the incidence ranges from 10-20%, then a detailed root disease survey using the Length Intersection Method (Beale and Wood 1985) is completed, and planned silvicultural treatments adjusted accordingly. If the occurrence of root disease is greater than 20%, then planners will adjust operations significantly. For example, spacing will not be performed, but a root disease survey may still be made if detailed loss estimates are required.

4.1.3. Vancouver Forest Region (J.D. Beale)

The Vancouver Region became involved in root disease surveys in 1982. The Intersection Length Method - Mapping Option developed by Bloomberg *et al.* (1980) was utilized.

The major objectives of Beale's work were to modify this method by simplifying it and making it easier to apply in the field, and, also, to convert it from a random to a systematic system.

Work was confined to young Douglas-fir stands and results were good where infection damage was characterized by discrete centres or openings.

Beale concluded that the system could be used with good results in large TSAs, provided that forest types were stratified and only those known to contain significant amounts of root disease were surveyed.

He also concluded that the system presented no major personnel training difficulties. Individuals soon learned to identify diseases in the same manner they identified tree species.

Compilation and analysis of results has been undertaken primarily at CFS using the RRSAMP program.

4.1.4 Duncan and Sechelt Forest Districts (Greg Hemphill)

Greg Hemphill has been transferred to the Sechelt Forest District from the Duncan District. While employed at Duncan, he was involved in root disease survey work using the Vancouver Region's Intersection Length Method designed by J.D. Beale and P.M. Wood (1985). The work was restricted to young Douglas-fir stands and was designed specifically to cover site-specific situations for silvicultural treatment operations.

Reconnaissance traverses were first conducted across areas suspected of having, or known to contain, root disease damage. Where the incidence of disease was found to be over 10%, a 100% survey was made with strip intervals of 30m or less.

Hemphill commented that although no serious problems occurred, effective training and supervision of personnel was a very necessary part of the program. He remarked also that the Intersection Length Method designed by Bloomberg *et al.* (1980), and since modified by Beale and Wood (1985), is onerous and not feasible for direct application to extensive TSA areas.

4.2 Canadian Forestry Service

Most agencies surveying for root diseases in British Columbia use the method developed by Bloomberg *et al.* (1980). The method, developed primarily to measure losses in specific management units, provides for five levels of survey intensity. The program is currently mounted only on the CFS computer in British Columbia; all agencies are submitting their data to this agency.

The method is satisfactory only in stands where the disease is present as discrete openings or centres. This has not presented a problem in most coastal stands. In many stands in the interior, because of the advanced condition of disease development (many centres merging), openings are not discrete and the survey method has not proven satisfactory.

The methodology of the root disease survey could be readily modified if an agency wished to combine it with other types of cruises, e.g., inventory.

The survey method, by itself, would be prohibitive, both cost- and time-wise, if applied to large units of timber, such as a TSA.

A combination of sampling procedures (e.g., type maps, aerial photographs, ground truthing) would probably provide a satisfactory solution.

Development of sampling technology for stands in the interior has not, as yet, been approached.

4.3 Canadian Pacific Forest Products Ltd.

This company has good type maps for most of its areas. Susceptible stands designated for management have been recorded as to present or absence of root disease.

Stands with significant (arbitrary assessment) levels of root disease are being surveyed using the method developed by the CFS. Crews are well-trained in disease recognition and survey methodology. The technician (who has recently left the company) responsible for crew training and follow-up spent considerable time with knowledgeable people at the CFS.

Because of the good initial training and regular checks by the responsible technician, the crews undertook the surveys with no undue difficulties, and the results were sufficiently accurate for development of management policies.

No specific recommendations were forthcoming for a change in their survey procedure for root disease. Use of the system for surveys of very large units would be prohibitive unless combined with other levels of examination to prioritize stands.

4.4 MacMillan Bloedel Ltd.

Root disease surveys have been confined to specific stands known to be infected. Two types of crews have been used: well-trained MoF crews and new crews trained by company and CFS people. No survey problems were encountered when the former crews were employed, and the results provided the information necessary for stand management. When the latter crews were employed, little difficulty was experienced with survey methodology, but because of a lack of frequent field checks, considerable error arose because of misidentification of disease symptoms.

There is an immediate need for a "disease hazard rating system," if the survey is to be used in rating losses in large timber units.

5 DISCUSSION AND EVALUATION

All agencies used the root disease survey methodology developed by the Canadian Forestry Service, Pacific Forestry Centre (Bloomberg *et al.*, 1980) or minor variations thereof.

Appraisal of root disease losses requires a knowledge by the survey crews in two general areas: disease recognition and survey methodology.

5.1 Disease Recognition

All agencies were in agreement that recognition of the signs and symptoms of the diseases and definition of disease centre margins were a major concern in accuracy of survey crews. Crews employed for short periods required frequent checks to update disease recognition, if major errors were to be avoided. CFS technicians have been utilized in this area of training and proved beneficial. As more root disease fungi are included in the system, the problems of disease recognition will increase.

5.2 Survey Methodology

All agencies were in agreement that, provided adequate training was provided, little difficulty should be encountered in obtaining satisfactory results using the root disease survey methodology developed by the CFS. Currently in B.C., the program is mounted only on the CFS computer. Although this will undoubtedly change in the near future, no major problems have been encountered to date. Forms used for inventory and cruise assessment provide only general information on root disease occurrence under "Remarks" or "Notes" columns. Silviculture performance assessment forms for stands up to five years of age require a detailed accounting of disease and recommendations for control. Silviculture pre-stand tending forms require only a general note on disease in the "Remarks" column.

No agency contacted had applied the current methodology to large blocks of timber; consequently, no results were available. However, in discussions, most were of the opinion that large-block sampling would require a stratified approach. This would require good type maps, large-scale aerial photographs and good stand information available on demand from computers.

Current root disease survey methodology is applicable only in stands where the disease occurs in discrete centres. Surveys on the coast of B.C. are only conducted on a stand basis with no projection to the management unit as a whole. In a large percentage of stands in the interior, because of advanced age and advanced stage of root development, disease occurrence is generally scattered rather than in discrete openings. Modification of existing survey technology or a new approach will be required to accurately assess the damage in these stands. Currently, no concerted effort is being undertaken

on this problem, nor is it feasible, from an operationally practical standpoint, to use the line intersect method to survey an entire TSA. A new approach must be developed in order to estimate root disease-related losses on a management unit basis.

6 REFERENCES

- Baumgartner, D.M. and R. Mitchell (Eds.). 1984. Silviculture management strategies for pests of the interior Douglas-fir and grand fir forest types. Univ. of Washington.
- Beale, J.D. and P.M. Wood. 1985. A description of the intersection length method of surveying for root diseases. B.C. Ministry of Forests. Forest Service Internal Rep. PM-V-3.
- Bloomberg, W.J. 1983. A ground survey method for estimating loss caused by *Phellinus weirii* root rot IV. Multiple-disease recording and stratification by infection intensity. Can. For. Service Rep. BC-R-8.
- Bloomberg, W.J., P.M. Cumberbirch and G.W. Wallis. 1980. A ground survey method for estimating loss caused by *Phellinus weirii* root rot II. Survey procedures and data analysis. Can. For. Service Rep. BC-R-4.
- Filip, G.M. 1984. Estimating damage caused by root diseases in forested areas. U.S.D.A., Forest Service, Portland (rough draft).
- Morrison, D.J. 1981. Armillaria root disease. A guide to disease diagnosis, development and management in British Columbia. Can. For. Service Rep. BC-X-203.
- Wallis, G.W. 1976. *Phellinus (Poria) weirii* root rot. Detection and management proposals in Douglas-fir stands. Envir. Canada, For. Tech. Rep. 12.
- Wallis, G.W. and Y.J. Lee. 1984. Detection of root disease in coastal Douglas-fir stands using large scale 70-mm aerial photography. Can. J. For. Res. 14:523-527.