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Web Diagnostic Tool for Common Tree Diseases of British Columbia

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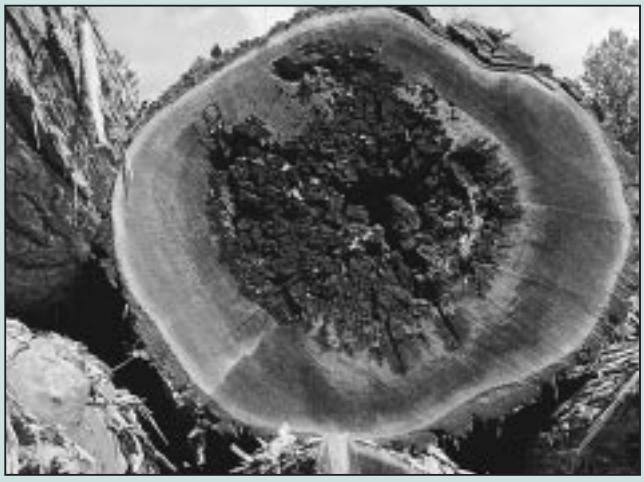
Strategic Importance and Management Implications

Tree diseases including root and heart rots, rust fungi, canker diseases, sap rots, needle blights, and mistletoes reduce growth, degrade timber and cause mortality. They may disrupt forest management plans, but they also have an essential role in forest ecological processes and biodiversity. Consequently, understanding forest disease-host relationships is fundamental to designing an Integrated Pest Management (IPM) approach which will minimize adverse impacts.

However, many constraints may override biological considerations used in IPM. For example, required information and predictive abilities may not be readily available to companies, associations or agencies. They are often unable to recognize and inventory common tree diseases, and this precludes the use of predictive models and cost-benefit analysis of management treatments.

To answer this need, the Canadian Forest Service has developed a knowledge base and diagnostic framework of common tree diseases, using expert systems to link diseases with host species and distinctive signs or symptoms. Accessibility and ease of use is dramatically increased by making the knowledge base and diagnoses available on the World Wide Web. Information on the Web is accessible to most common PCs and can be easily updated to broaden its scientific and practical applications. The Web Diagnostic Tool is available in both French and English. A CD-ROM of the English version is also available.

Enter the Disease Diagnosis Program through http://www.pfc.cfs.nrcan.gc.ca/health/td_web



Tree disease identification and understanding of host-species interactions are fundamental to integrated pest management.

The collection of information on tree diseases is the culmination of work begun in 1949 by J.E. Bier. The information has been extensively updated in recent years by E. Allen, D. Morrison and G. Wallis. Their 1996 book *Common Tree Diseases of British Columbia* is the basis for the diagnostic model.

Biological Significance

Infectious diseases are caused by living agents such as fungi, bacteria, viruses, and higher plants which attack trees to obtain nutrients essential to their development. Infectious forest diseases are classified as “native” or “introduced.” Native diseases do not usually threaten the existence of a tree species, but may cause severe losses in some stands. Introduced (extra-regional or foreign) diseases, such as white pine blister rust, may become epidemic and threaten the existence of a susceptible tree species throughout its entire range.

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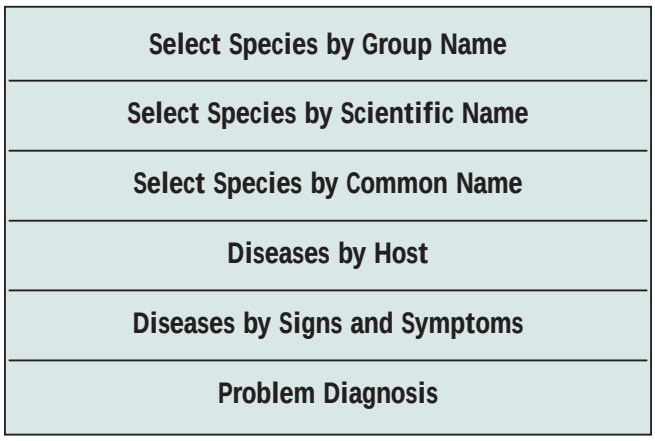

Figure 1. The Main Menu.

The most important infectious diseases occurring in British Columbia are caused by fungi and dwarf mistletoes. The magnitude of damage depends on the relative susceptibility of the tree (host), the virulence of the causal agent and its life history, as well as the environmental and other factors that influence the resistance of the host. Consequently, a disease may vary in importance among tree species in one region or in the same tree species in neighboring regions.

Information Retrieval

Extensive information can be obtained by browsing the Main Menu (Figure 1).

Information on specific pathogens can be obtained by three main routes:

1) The Scientific or Common Name Index lists diseases and pathogens by both common and Latin names;
2) The Host Index lists organisms that cause disease by host (commercial species); and,
3) The Symptom Index lists pathogens by distinctive signs or symptoms.

For example, Figure 2 illustrates a browse path through the Symptom Index. The user begins this search with the main menu and selects topic paths.

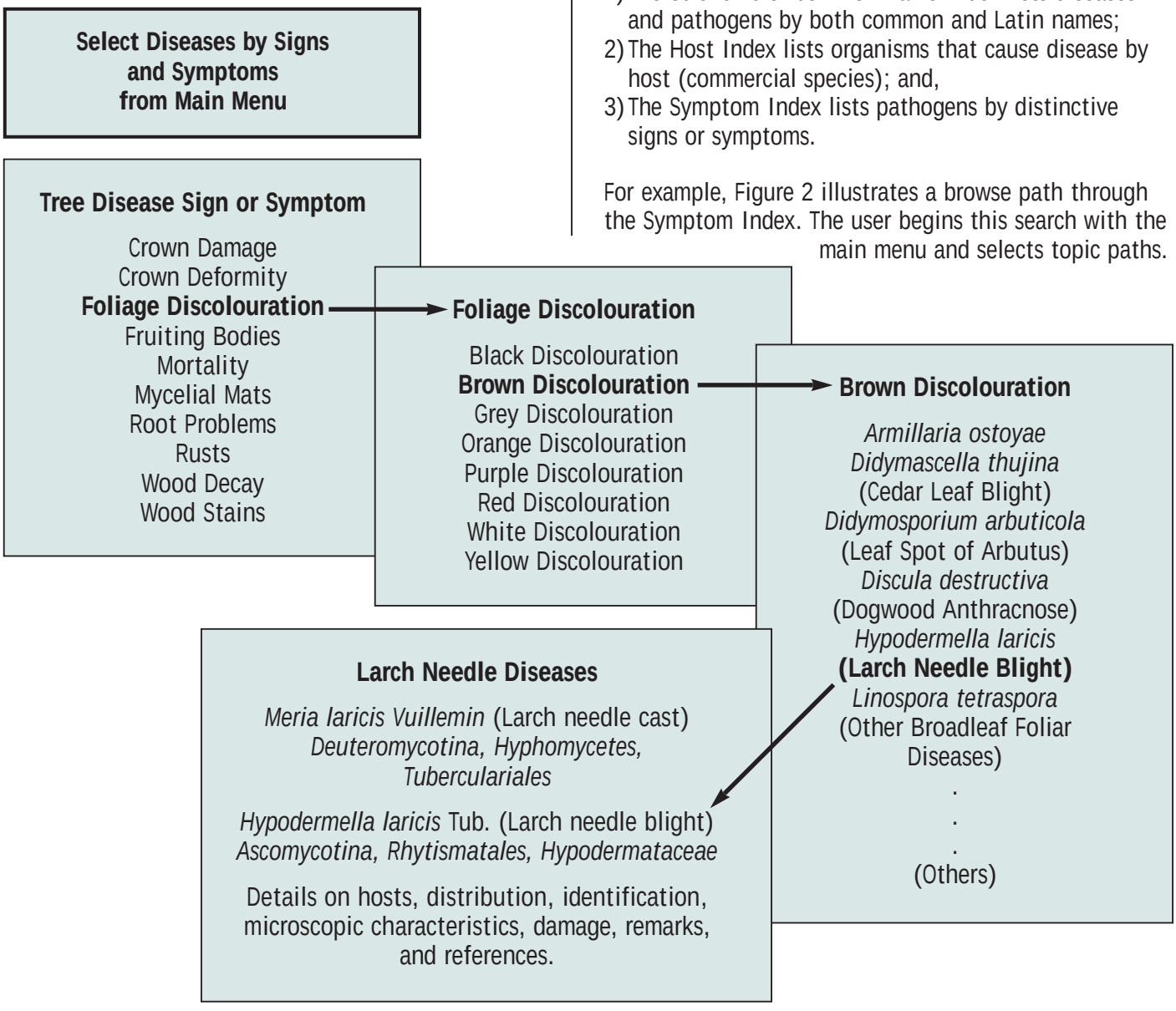

Figure 2. Example of a search through the Symptom Index.

Diagnosis

A diagnosis can be carried out by selecting host species and signs and symptoms on a form available through the "Problem Diagnosis" link on the opening page, and then selecting the "Submit Query" button at the bottom of the form.

As an example, fungal fruiting bodies were found on the ground around the base of a lodgepole pine. There were white mycelial fans (included in the mycelial mats category) on the inner bark. Some brown foliage discolouration was also noted. Figure 3 illustrates the query approach with these observations.

Diseases are ranked based on the number of signs or symptoms which exclude them as possible diagnoses. The number of exclusions on the table of results is itself a link that, when selected, shows a summary of the signs and symptoms that support or deny the species as a possible diagnosis. It is possible to determine both the most probable diagnosis and why a particular disease is not a possible diagnosis.

Select Tree Disease Diagnosis from main menu.

Query

HOST SPECIES:Lodgepole pine,
FOLIAGE DISCOLOURATION: brown,
MYCELIAL MATS:present,
FRUITING BODY LOCATION: ground.

Diagnosis Results

Species	Exclusions
Armillaria ostoyae (Armillaria Root Disease)	0
Armillaria sinapina (Armillaria Root Disease)	1
Armillaria cepistipes (Armillaria Root Disease)	2

Sample of information provided:

Armillaria ostoyae (Romagnesi) Herink (=*Armillaria obscura* Schaeff.:Fr.)

Hosts: In B.C., *Armillaria ostoyae* has been reported on amabilis, grand, and subalpine fir, European, Japanese, and western larch, Engelmann, Norway, Sitka, and white spruce, lodgepole... .

Identification: On conifers, *A. ostoyae* causes crown symptoms typical of root diseases; that is, reduced leader growth and foliage discolouration and thinning (Fig. 1c, 1d, 1e, 1f)... . Among resinous species, it is more obvious on moist sites than dry sites. White mycelial fans occur in the bark and in the cambial zone under bark showing resinosus... . Dead and diseased trees usually occur in "disease centers," which appear as openings in the canopy, and may be as large as 0.1 ha in mature stands... .

Damage: *Armillaria ostoyae* causes growth loss and small amounts of butt rot in diseased trees, however mortality is the greatest cause of loss. The fungus can kill conifers in plantations and natural stands throughout a rotation when roots of healthy trees grow into contact... .

Pictures and figures.

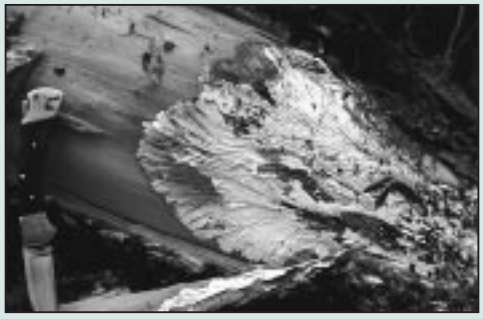

Figure 1d

Armillaria cepistipes - Armillaria Root Disease

Excluded	Not Excluded
Brown Discolouration	Mycelial Mats
Pinus contorta	Fruiting body: Ground

Figure 3. Example of a diagnostic query from the main menu.

The Web Diagnostic Tool was designed and tested with Netscape Navigator 3.0, and it makes use of Netscape's navigation abilities. For example, if you wish to change your query entry, press the back button of your browser to return to the diagnosis form, showing the last information entered.

Discussion

This tree disease diagnostic program draws from previous work on forest insect and disease diagnosis and management using expert system-guided hypermedia (see additional reading section). The combination of hypermedia and expert systems overcomes many of the limitations of using an expert system alone. This enables relevance checking, bias and accuracy evaluation, and organization and synthesis activities by the system user.

An earlier system (HFOREST) was delivered on CD-ROM and included approximately 350 high-quality color illustrations. As the World Wide Web is a form of hypermedia based on a Hypertext Markup Language (HTML), our experience with these earlier systems helped in the development of the present system, which, being Web-based, will provide flexibility and will be easy to update.

For Additional CFS Information

visit our web site at:
http://www.pfc.cfs.nrcan.gc.ca

Additional Reading

Allen, E.; Morrison, D.; Wallis, G. 1996. *Common Tree Diseases of British Columbia*. Canadian Forest Service, Pacific Forestry Centre, Victoria.

Thomson, A.J.; Sutherland, J.R.; Blache, M.; Dennis, J. 1992. Prototyping an expert system for diagnosis of forest seedling nursery problems using an expert system shell. AI Applications. 6: 21-31.

Thomson, A.J.; Sutherland, J.R.; Carpenter, C. 1993. Computer-assisted diagnosis using expert system-guided hypermedia. AI Applications 7 (1): 17-27 (with disk).

Thomson, A.J.; Van Sickle, A. 1996. Forest insect and disease diagnosis and management using expert system-guided hypermedia. AI Applications. 10(2): 23-32. (Includes CD order form)

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