LESSON 4 Wilt, Foliage, Bark and Seedling Diseases

LESSON OVERVIEW

CONTENT

This lesson is divided into four self-contained sections, each dealing with a particular group of diseases, as indicated by the title of the lesson. Each section has its own reading assignment, and is followed by a set of self-testing/review questions.

The content of this lesson is discussed under the following section topics:

- Wilts: Diseases of the vascular system
- Foliage diseases
- Cankers
- Seed and seedling diseases

OBJECTIVES

When you have completed this lesson, you will be able:

1. to recognize typical signs and symptoms of each of the four groups of diseases;
2. to describe their life cycles and infection pathways;
3. to identify some of the common diseases in each of the groups;
4. to assess the impact of these diseases on management goals and how to take preventive or remedial action to limit damage.

READING

Specific reading assignments are suggested in each section.

LESSON STUDY INSTRUCTIONS AND ASSIGNMENT

Study each section in turn, answering the self-testing/review questions before proceeding to the next section.

After you have studied all the sections, complete Assignment #2 (in Appendix A) and submit it for marking. This assignment covers content in Lessons 3 and 4.

COMMENTARY

SECTION 1

WILTS: DISEASES OF THE VASCULAR SYSTEM

reading

Start by reading Chapter 13 of Manion (1991), then study the material that follows in this manual. To test your understanding of the material in this section, answer the self-testing/review questions before proceeding to the next section.

Wilt diseases are diseases of the vascular system of hardwoods. The pathogen lives in the most recently formed xylem and interferes with normal water translocation. In most cases, the causal agents belong to the Ascomycotina, but the perfect or sexual stage is often rare or unimportant in the life cycle. Infection usually requires insect (e.g., bark beetle) vectors but it may also occur via root grafting to adjacent infected trees, or occasionally via wounds (e.g., through the use of unsterilized pruning tools). The pathogen commonly produces small spores which are carried passively from the point of penetration up and down the xylem. The typical symptom is sudden wilting early in the season, at a time when the transpiration stream runs mostly through the large spring wood vessels. These large, diseased vessels are often stained.

CAUSES OF WILT

Possible causes of wilting are:

1. formation of tyloses that block vessels, in an attempt by the host to limit the spread of the pathogen;
2. blockage of vessels by fungal hyphae and spores;
3. breakdown and solubilization of cell wall material resulting in increased viscosity and hence slower flow rates;
4. introduction of air bubbles into the vessels through disruption of the cell wall;
5. production of toxins by the pathogen.

Of these, the last is probably the major mechanism. The toxin(s) may disrupt normal stomatal function, leading to excessive transpiration. While the other mechanisms may contribute, they cannot by themselves explain the sudden wilting of all the foliage on major branches or the whole crown.

DUTCH ELM DISEASE

In North America, the best known example of wilt is Dutch elm disease (DED) caused by *Ophiostoma ulmi* (formerly known as *Ceratocystis ulmi*). Symptoms include sudden wilting of large sections of crowns in mature elms and a ring of brown stain in the outer vessels of branches in the affected crown parts. This pathogen was introduced into Quebec from Europe during the second world war, probably on elm lumber cut from unbarked logs which carried live bark beetles. There may have been an earlier introduction in U.S.A. It has since spread west to the Rockies

and will no doubt arrive in Vancouver and Seattle in the next decade or so. Transmission is by insects, mainly the European elm bark beetle (*Scolytus multistriatus*) and, to a lesser extent, the American elm bark beetle (*Hylurgopines rufipes*). When these bark beetles emerge from infected trees, they carry spores of the pathogen on their bodies and in their mycangia. They feed in branch crotches and leaf axils of nearby trees, occasionally transmitting the disease, and then mate and bore a gallery, infecting the brood tree. In the major springwood vessels the fungus produces small asexual conidia which are carried passively through the vascular system. The fungus also fruits in the beetle galleries, producing abundant coremia (another asexual spore stage) and occasionally perithecia.

MANAGEMENT TECHNIQUES

The American elm is extremely susceptible. It is also an important shade and landscape tree, and hence there has been much concern about this disease. Initial control was by the use of DDT to kill the bark beetles. This was fairly effective but required large and repeated applications.

Massive DDT applications to control DED on the Michigan University campus triggered the publication of a book by Rachel Carson, *Silent Spring*, in the early 1960s. This book is considered germinal to the current popularity of the North American environmental awareness movement.

Current management techniques are aimed at protecting large, valuable elms in urban settings from the disease. Some are directed at the vector, and for these a good understanding of the local vector life cycle is required. Others are aimed at the pathogen. The main methods include:

1. Sanitation — if all trees showing symptoms are immediately removed and burned, infected beetles will not emerge. Sanitation does not work if there is a large population of untreated elms in the vicinity (e.g., a forest). Some towns in New England which have good sanitation programs have retained more than 70% of their elms, compared to 100% mortality elsewhere. Speed, and access to all elms on public and private property are essential for a successful sanitation program. Costs are not really a factor, since elm trees must be removed after they die anyway.

2. In elms planted closely together in rows, the pathogen can spread from tree to tree via root contact. In such cases taking out alternate trees can usually stop further spread.

3. Disease development in infected trees can sometimes be retarded or stopped by injection with systemic fungicides such as Benomyl. This is an expensive treatment that must be repeated every time the tree is reinfected, and hence is suitable only as a stop-gap measure for very valuable trees.

4. Insect trapping using pheromones can reduce insect populations and infection.

5. Breeding of resistant trees is in progress, and current releases show some promise, although there is concern about the stability of such resistance. Apparently, the pathogen exists in several forms of variable aggressiveness; circumstantial evidence suggests that new aggressive strains have arisen from time to time.

Other Wilt Diseases

Other major wilt diseases include oak wilt caused by *Ceratocystis fagacearum* in certain parts of the eastern hardwood forests, and *Verticillium* wilt of eastern maples and elms caused by *Verticillium dahliae* or *V. albo-atrum.* In the case of *Verticillium* wilt, the pathogen survives in soil as dormant sclerotia, and infection takes place through small root wounds. Also, the development of symptoms is much slower. Black stain root disease, described in the lesson dealing with root diseases, also has many characteristics of a wilt disease. However, since it occurs in conifers, it is not normally included with wilt diseases.

SECTION ASSIGNMENT

SELF-TESTING/REVIEW QUESTIONS

Test your understanding of the material in this section by attempting to answer these questions. Do not proceed to the next section until you are satisfied with your proficiency in this section.
Do *not* send your answers to the tutor for marking. If you continue to have difficulty with a question after you review the relevant material, you may wish to discuss it with your tutor.

1. What are the mechanisms that account for the symptoms of wilt diseases?
2. Which control measures against Dutch elm disease are aimed at the vector insect? Which deal with the pathogen directly?
3. If you were concerned about the expected arrival of Dutch elm disease in Vancouver, what measures would you take now to prepare for the arrival of the disease?