EMERGING TREE DISEASES IN URBAN ECOSYSTEMS[1]

by Charles L. Wilson

The title of this paper is somewhat misleading. We do not have many emerging tree diseases in urban situations. The diseases have been there for some time. We have an emerging awareness of the uniqueness of tree diseases when the trees are located near large human populations.

Tree diseases in urban areas are distinct from forest diseases in two major ways. (a) Original ecosystems near large human populations are so disrupted that they have to be considered as degraded. This has brought about the introduction of a number of new disease problems and modified the expression of "old diseases." (b) The economic and aesthetic value of trees in the proximity of human populations is different from that in the forest. This modifies the feasibility of certain control practices.

The urban ecosystem and tree diseases.

Trees have become adapted to ecological niches in various ecosystems. They did not evolve in an urban ecosystem. In fact, it is not possible for them to evolve because dispersal and establishment of new individuals is primarily through planting from existing populations, rather than seed. Therefore, urban trees are in a foreign ecosystem, to which they are not specifically adapted.

What are the unique factors in an urban ecosystem? An urban ecosystem is not a result of the long-term interaction of living organisms within their environment. Rather, it frequently develops through degradation of a previously evolved ecosystem or may be completely contrived (an "artificial ecosystem").

A balanced ecosystem depends on recycling of essential nutrients and energy. In an urban ecosystem recycling is drastically curtailed. Moisture is prevented from entering the soil due to buildings, pavement, and soil compaction. More rain is recycled into the atmosphere through rivers and oceans and less through the transpiration stream of plants. Leaves and plant parts are transported to dumps rather than allowed to decay in the soil. There is a continuous removal of energy and nutrients from the urban ecosystem with little compensation. Therefore, plants (particularly trees) are in a constant state of stress because of the deprivation of nutrients and energy.

In an ecosystem, one disruptive force can set into play a chain of successive changes. These changes can proceed to a point where certain species no longer can survive in that ecosystem. A number of disruptive forces are at play in urban ecosystems that can lead to environments unfit for the existing vegetation.

What Are Some of the Primary Disruptive Forces in Urban Ecosystem?

Terrain Changes

The urban terrain is radically changed by road and building construction and buildings. Accompanying profound changes in soil moisture and drainage patterns occur. A cut or fill some distance from a group of trees may critically change their moisture supply. Terrain changes through paving and soil compaction from vehicular and pedestrian traffic destroy soil structure affecting water percolation, storage, and soil aeration. These changes affect not only the physiology of tree roots but also the physiology of the microflora associated with roots (5).

For example, the decline of white oak in urban areas of the United States has been traced to a disruption in moisture levels as a result of construction. In some cases the water table is lowered making moisture conditions unfavorable for mycorrhizal development. Reduced colonization by mycorrhizae may then lead to oak decline.

[1] Special invitational paper for the Second FAO/IUFRO World Technical Consultation on Forest Diseases and Insects. Delhi, India. April 1975.

Mechanical Damage

Because urban trees are located in large population centers they are more subject to mechanical damage from man, his vehicles, and implements. Bulldozers at construction sites, lawnmowers, and tractors around dwellings cause considerable damage to trees. Also, trees in cities are subject to considerable vandalism which can be a major disruptive force. These wounds often set into motion invasion by a succession of microorganisms that can eventually render a tree useless (4).

Soil Pollution

A number of chemicals used in urban environments accumulate in soil and damage trees (6). Salt, herbicides, and natural gas are the most notable causal factors. In some northern climates salt used to de-ice highways accumulates in toxic quantities in adjacent drainage areas. Herbicides are being used more extensively to reduce weed populations of lawns and some have caused considerable damage to trees and other woody plants. A particular problem arises when fertilizers and herbicides are used in combination. The applicator often forgets that there is a herbicide in the mixture and applies the material solely as a fertilizer, or he may apply an overdose.

Air Pollution

Air pollution damage to trees is quite apparent in heavily industrialized areas or urban areas with heavy automobile traffic. The direct damage from various air pollutants has been clearly demonstrated. What is not clear is how air pollution affects and is affected by other disruptive forces in urban ecosystems. We are becoming aware of air pollutants that may have profound effects on disease and insect problems of urban trees (2). We need much more research in this area. Possibly the direct air pollutant damage to trees is small compared to the predisposing effects of these disruptive agents to other tree problems.

Disease Complexes

Koch's postulates have often trapped us into thinking that each disease has a single cause. This is not necessarily so. In urban ecosystems trees are often subjected to a number of disruptive forces and disease complexes. These complexes may result from cumulative impacts of different insults to the tree or from moderating influences of one insult on another.

As an example, a tree may display starvation symptoms that result from the cumulative effects of root rots, reduced mycorrhizal activity, reduced soil moisture, etc. Also, there is the possibility that air pollutants can actually reduce fungal damage to leaves by being fungicidal at levels that do not damage the tree. On the other hand the pollutant may reduce infection by foliar pathogens and be phytotoxic itself. There is an endless array of disease complexes that can be conceived for urban tree diseases.

Light Pollution

Intensive artificial lighting is being used increasingly in urban areas to combat crime. A number of adverse effects such as delayed dormancy have been observed (1). The interaction of intensive and prolonged lighting with diseases of trees is unknown. Definitive research is needed.

Artificial Ecosystems and Tree Diseases

Much of our urban vegetation is now being planted in completely artificial ecosystems. This is particularly true where trees are planted in shopping malls and within the lobbies of large buildings. There are advantages and disadvantages in tree disease control within artificial ecosystems.

Sanitation as a disease control practice can be carried out more efficiently in artificial ecosystems. It is possible to sterilize or pasteurize the soil. Plant material can be critically selected to be disease free. The major disadvantage of an artificial ecosystem is our inability to duplicate natural conditions for growth and development of trees. The result is that most trees in artificial ecosystems are growing under stress conditions.

Genetic Control of Urban Tree Diseases

Urban trees did not evolve in the degrading or artificial ecosystems that they occupy. They, therefore, are not well adapted genetically for survival. The stress factors that result from poor adaptation can cause disease themselves or modify other disease-causing agents. Until we attack these stress factors we will not be able to deal effectively with urban tree diseases.

Within tree populations there is varying resistance and tolerance to urban stress factors such as air pollution, reduced aeration, moisture, and others (3). Selection and breeding programs can be utilized to develop trees that can tolerate these stresses. A few such breeding programs are underway. Many more are needed around the world to ensure that man can live in harmony with trees.

Trees in artificial ecosystems require some cultural care. They may need watering, feeding, and pruning, depending on the site in which they are grown. A breeding and selection program to develop trees for artificial ecosystems needs to take cultural practices into account. Trees can be selected that are compatible with existing cultural practices or that reduce the cost of such practices. This is not a new approach. Considerations of this nature are made when we breed and select our food crops. Most food crops are also grown in completely artificial ecosystems.

The Economics of Tree Disease Control in Urban Ecosystems

Because of economic and aesthetic reasons, the individual urban tree is much more valuable than the individual forest tree. In urban ecosystems control practices can be designed for individual trees. Also, cultural practices can be performed on individual trees that reduce disease incidence. For these various reasons we may anticipate a number of innovative approaches toward the control of urban tree diseases.

Literature Cited

1. Cathey, H.M. and L.E. Campbell. 1975. *Security lighting and its impact on the landscape.* J. Arbor. 1(10): 181-187.
2. Heagle, A.S. 1973. *Interactions between air pollutants and plant parasites.* Ann. Rev. Phytopathol. 11: 365-388.
3. Santamour, F.S. 1969. *Breeding trees for tolerance to stress factors of the urban environment.* Second World Consultation on Forest Tree Breeding. FO-FTB-69-6/4. 8 pp.
4. Shigo, A.L. 1967. *Successions of organisms in discoloration and decay of wood.* Intern. Rev. of For. Research 2: 237-299.
5. Slankis, V. 1974. *Soil factors influencing formation of mycorrhizae.* Ann. Rev. Phytopathol. 12: 437-457.
6. Wilson, C.L. 1970. *Soil pollution and trees.* Trees Magazine 30: 6-7.

Research Plant Pathologist and Adjunct Professor
Agricultural Research Service
Ohio Agricultural Research and Development Center
Wooster, Ohio

ABSTRACT

Grant, G. and D. French. 1976. **Mating disruption of tussock moths by atmospheric permeation with synthetic sex pheromone.** Bi-Monthly Research Notes 32(5): 25-26.

Sex pheromones show promise as an environmentally acceptable means of suppressing insect populations. The most appealing technique appears to be the permeation of the local atmosphere of a pest with a level of sex pheromone sufficient to disrupt its mating ability. Presumably, the atmospheric pheromone habituates the males rendering them incapable of responding successfully to the small amount of perhomone released by the females with the net result that males are unable to located females and mate with them. The sex perhomone of the Douglas fir tussock moth has been identified and is commercially available. It sexually stimulates and attracts in the field both white-marked and rusty tussock moths. Laboratory experiments were conducted to determine whether the ketone has the potential to disrupt the mating ability of these two species which are currently pests in several localities in Canada.