INSECT-TREE RELATIONSHIPS IN AN URBAN ENVIRONMENT [1]

by David G. Nielsen

Urbanization following the mechanical and industrial revolutions created an environment hostile for growing many plants, including trees and shrubs. As the United States urbanized population became affluent enough to permit visits to forested areas and to plant trees in neighborhoods, people developed an increased appreciation for trees.

Today, most people agree that healthy trees are desirable for aesthetic value, temperature-moderating effects, noise abatement, and as organisms that simply help make life more pleasant. We would like woody plants to grow well in the artificial environment created by the urban community. Considerable efforts have been made to beautify our cities with trees but we have seldom considered how the urban environment stresses trees, making them more susceptible to attack and damage by pests.

Foresters spend much research effort identifying site characteristics best-suited to individual tree species. Landscape horticulturalists have learned some trees do better on well-drained or acidic soils or with full or partial shade. However, those who plant trees in cities seldom consider that certain tree species may not be well-suited to city living.

Trees have been planted in increasingly hostile locations, often drastically foreign to their genetic adaptations, without considering potential pest problems and associated tree maintenance. Little is known about how urban stress predisposes plants to insect attack. Understanding insect tree-host relationships in an urban community may lead to reasonable decisions about what kinds of trees should be used on urban sites and how existing trees can be managed to minimize losses from insect pests.

Stable host-parasite relationships are products of evolution. And through this process, a balance or state of equilibrium is reached where the parasite survives at some level low enough to enable both host and parasite to maintain a vigorous existence. A good example of this kind of relationship is the pine needle scale on conifers. This tiny scale insect is usually found in extremely low population density in the forest. However, in the nursery and in the landscape this insect often reaches pest status and can seriously reduce aesthetic quality of trees or even kill them. No one really knows why the parasite is benign in the forest and often destructive on landscape trees. Differences between the forest and man-made communities undoubtedly contribute to differences in how a scale population behaves on its host plant.

G.F. Edmunds, Jr., of the Department of Environmental Biology at the University of Utah has said outbreaks of black pineleaf scale occur following unusually high mortality of natural enemies caused by "sorptive dusts" or insecticides used for control of other pests. He has also reported "scale populations apparently become adapted to specific host individuals, and population density can become high only with genetic fitness of the scale population to the host species and individual." In his studies, scale nymphs had the best chance of survival on the parent tree, less chance on other trees of the same species, and little chance when transferred to another host species.

This explains why one species or a single tree supports a heavy insect infestation while similar, nearby trees may be uninfested or support only a light infestation. Perhaps the plant which demonstrates or expresses genetic fitness with an insect pest should simply be replaced by a plant which is less susceptible or more tolerant of the endemic insect pest.

Landscape managers, nurserymen, scientists and others frequently ask why one plant species or cultivar is a particularly good host for a pest.

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1. Reprinted from *Weeds Trees & Turf,* May 1976.

Does man sometimes play a significant role in the evolution of this sort of relationship? Many of the most destructive insects have been imported from abroad. The reasons for their pest status generally include availabilities of an abundant food supply, suitable climate, and absence of effective natural enemies. Gypsy moth, and black vine weevil are two examples of imported insects which create serious management problems on ornamental trees and shrubs.

Man has fostered another type of unstable host-parasite relationship by hybridizing and grafting woody plants. Lilac borer, a native insect, was a pest of common lilac for years without creating serious problems for nurserymen or landscape managers. However, when French hybrid lilacs were mass-produced by grafting lilac buds on privet and ash rootstocks, lilac borer became a serious pest, often precluding economical culture of lilac. Grafted lilacs are either more suitable host plants in which borers survive and multiply better, or they are incapable of withstanding or tolerating "normal" borer population density.

This example points out that man's endeavor to change characteristics of plants can create the same kinds of problems sometimes created when an insect is introduced into a foreign environment. In both cases, the host-parasite relationships that develop are often unstable, resulting in a serious pest problem. Similar problems sometimes occur when native forest trees are planted off-site in the nursery or in the landscape. White birch is a good example of what may happen when a native hardwood is planted in the urban environment. In the forest, bronze birch borer prefers over-mature trees or those in poor vigor. Severe damage occurs only on mature, decadent or disturbed stands.

Apparently, white birch has a poor water transport system and is adapted to northern areas where cold temperatures and rainfall prevail during much of the year. On more southern, drier, exposed sites, including nearly the entire state of Ohio, white birch seems to do quite well until bronze birch borer attacks. It appears that trees are healthy but are physiologically vulnerable to this destructive pest. Water stress is thought to play a primary role in the relationship. In this case, we are considering a native insect on a native tree in a foreign environment (the urban or suburban landscape).

Many of the most destructive urban insects are those which can be considered beneficial in the forest. Borers attack weakened trees, thereby expediting decline and decay of poor trees and making room for healthier trees. Whereas borers may be considered as secondary attackers or pests in the forests, clearwing moths seem to function as primary attackers or pests in the urban environment. Healthy looking ash trees in the landscape are often attacked by ash borers. These trees would probably survive if the borer were eliminated. On the other hand, ash growing under forest conditions are seldom attacked by this insect.

I believe principles learned in forest entomology concerning insect tree-host relationships and used in forest management seldom apply to the urban environment. Many insects which are secondary attackers in nature are primary attackers in the landscape because trees are not adapted to this environment. In the forest, insects are adapted to 1) a co-existence relationship with healthy trees, and 2) a destructive relationship with trees which are in a weakened condition.

T.T. Koslowski of the Department of Forestry at the University of Wisconsin, has stressed the fact that trees usually undergo some kind of physiological change before they are attacked by a damaging insect. And, the impact of an insect on a tree may or may not be drastic depending upon the physiological condition of the tree and subsequent environmental factors, including temperature, wind, rain, snowfall, etc. All these factors concern available soil moisture and evapotranspiration.

Most studies dealing with insect tree-host relationships indicate the importance of water stress in the severity of damage from insect attack. Bark beetles, borers, sucking insects and lepidopterous defoliators seem to be more damaging either during or immediately following droughts. Some sawflies, however, do better when succulent foliage is available. N.E. Johnson, presently with Weyerhauser Co., has reviewed the literature dealing with these kinds of relationships. He indicates that sweeping generalizations are difficult to make, but a tree can withstand more injury without sustaining damage if it is vigorous and growing on a good (natural) site. How many urban trees are really vigorous and planted on good sites?

Common practices, often unrelated to trees or tree management in the urban environment, contribute added problems. J.D. Carrow and co-workers at the Canada Department of Fisheries and Forestry in Victoria, British Columbia have learned that ammonium nitrate fertilizer adversely affects populations of balsam woody aphid, whereas urea and calcium nitrate are beneficial to the insect. Therefore, the kind or form of nitrogen fertilizer used on turf or landscape trees might promote or retard a sucking insect population. Defoliators and borers could be affected similarly.

As Kozlowski stated, insect pests influence their hosts by interfering with rates and balances among internal physiological processes, especially food, hormone, and water relations. How the urban environment stresses trees and affects these internal processes must be understood before we can identify urban conditions which affect stress to which an insect can respond. The complicated system of interaction of tree-host environment has undoubtedly contributed to the lack of studies considering insect tree-host relationships in the urban environment.

Most people who study trees and insects agree that many things are done unintentionally to encourage insect pest problems in the urban setting. The same is true for those who study plant pathogens. To change this trend we must begin to plan ahead. The landscape horticulturalist, plant pathologist, and entomologist can work with the landscape architect to design plantings which will be less susceptible to insect predation and require less maintenance.

If ornamental plants are a vital and necessary part of our urban environment, professional maintenance in the form of pest management is justified. Plant protection specialists who conduct surveys and serve as consultants to municipalities, industries, and homeowners could implement such programs. However, before this approach can be workable across the nation, we must rethink and possibly redefine the term "pest" and supply basic ecological information needed to make management decisions. Sampling methods, predictive models utilizing biotic and abiotic variables, and acceptable pesticides must be developed for our most common and destructive pests.

The research necessary to develop these tools is expensive and cannot be accomplished this century with the present commitment at state and federal levels. We must decide whether or not we will pursue pest management in the urban environment on the basis of sound biological and ecological information.

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ABSTRACT

Stroempl, George. 1976. **Peat wedges aid seedling establishment on shallow soil.** Forestry Chronicle (April) 47-51.

Tree planting experiments were established in southeastern Ontario on old pastures with shallow soil over limestone bedrock known to have frequent moisture deficits during the growing seasons. Wedge-shaped pieces of solid peat, saturated with water, were placed at the bottom of a planting hole to supply water to the roots during the early stages of growth and prevent dessiccation during severe drought conditions. The survival of trees planted with peat wedges was higher than those planted without, particularly in the year when soil moisture was most frequently within the wilting range. Additional experience is needed to realize the full potential of this method.