RESEARCH LABORATORY TECHNICAL REPORT

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Defoliation on Shade Trees

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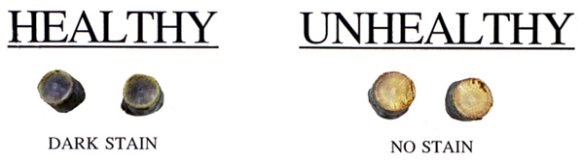
The plant leaf functions primarily to manufacture sugars and carbohydrates. These substances are the basic food, or energy source, for all metabolic processes in the plant including growth, root development, flower and seed production, disease resistance, etc. Leaves also provide many indirect benefits such as emitting oxygen, filtering out particulates and other air pollutants, intercepting precipitation to minimize erosion, and shading the ground to moderate surface temperatures.

Shade trees in the urban environment are subject to premature defoliation from a variety of factors including insects, diseases, and environmental/ cultural adversities.

Effects of defoliation on trees can range from a slight reduction in vigor to plant death. Defoliation harms plants by reducing their capability to produce food. The refoliation process, frequently occurring immediately following defoliation, also requires energy for budbreak and leaf expansion. This process causes further depletion of stored food reserves (Figure 1). The inability of the tree to manufacture food (energy) together with the depletion of stored food weakens the tree and results in reduced growth,

Figure 1: Plant food reserves are stored as starches (stained dark by iodine solution) in twigs and roots



stunted, pale-green new leaves, and possibly twig and branch dieback. Mortality of small feeder roots also frequently occurs.

Defoliation also causes physiological changes in the tree. The production of protective compounds that aid in disease resistance may be inhibited. Natural growth regulators also may be modified which may delay dormancy. These changes result in increased susceptibility to certain insects and diseases and reduced winter hardiness.

Factors Influencing the Impact of Defoliation

Complete tree recovery following defoliation may take as long as five years. In some cases, trees will not recover and death occurs either immediately or within several years following defoliation. The exact effect of defoliation on tree growth and survival is influenced by the interaction of many factors including the severity, timing, and frequency of defoliation, initial tree condition, and presence of secondary insect pest and disease organisms. These factors must be considered collectively when evaluating the fate of a defoliated tree.

Severity of Defoliation

Generally, the greater the amount of foliage removed the greater the adverse effects. However, healthy trees with a full crown can tolerate up to 50% loss in foliage without a significant reduction in vigor. Refoliation

usually occurs when more than 50% to 75% of the foliage is removed unless defoliation occurs late in the growing season when the tree is entering dormancy. Refoliation is particularly debilitating to the plant due to the additional depletion of stored reserves and the detrimental physiological effects associated with this process.

Timing of Defoliation

Defoliation early in the growing season when leaves have just reached full expansion is most detrimental. At this time, considerable energy has been expended for budbreak and leaf development, but food reserves cannot be replenished by photosynthesis due to the loss of the leaves. Refoliation usually occurs following heavy defoliation early in the season which will further weaken the tree. Late season defoliation is seldom injurious because leaves have already manufactured and stored most of the needed carbohydrates (Figure 2). However, if refoliation occurs in the late season, plant tissues might not harden off by winter and considerable injury could result.

Figure 2: Pinkstriped oakworm infestation may occur in June and again in August

Frequency of Defoliation

Most healthy trees can tolerate a single heavy defoliation event with only a reduction in vigor. Exceptions are evergreens which are usually killed by one complete defoliation. Two to three consecutive years of early season defoliation can kill even the healthiest trees.

Tree Condition

The relative vigor of a tree has a large influence on its ability to tolerate defoliation. Vigorous trees that have been cared for by periodic pruning, fertilization, watering, etc., are better able to withstand defoliation than trees weakened by drought, disease, new construction, mineral deficiencies, etc. Older trees are also more sensitive to defoliation than young trees.

Secondary Insects and Diseases

Secondary organisms are those that invade a tree after it has been weakened by a stress factor such as defoliation, drought, etc. The secondary nature of the organism refers to its sequence in time and does not refer to their importance in causing decline and death of the tree. Common secondary organisms invading defoliated trees include insect borers, bark beetles, root decay pathogens, and canker fungi. These are usually responsible for the ultimate death of the plant.

Preventative and Corrective Measures

Proper initial selection of tree species that are adapted to a site and resist insect and disease damage will reduce the risk of defoliation. Timely insect and disease management will also help prevent defoliation. Trees that have received periodic care including pruning, fertilizing, watering during dry periods, mulching, etc., will better tolerate and survive defoliation.

If a tree is defoliated, watering during dry periods is recommended to aid the refoliation process. Fertilization with a quick-release high nitrogen fertilizer will also help encourage rapid refoliation and help replenish nutrients lost due to defoliation. Quick release fertilizers are not recommended after mid-season (approximately July 15th) because this could encourage excessively late growth. Therefore, tree may not harden off in time for fall frosts. With defoliation in mid to late season, fall fertilization is recommended after the tree has gone dormant.