What Do You Do for Your Tree after It Has Been Defoliated by Gypsy Moths?

by FRANCIS W. HOLMES[1]

Defoliation by the gypsy moth is simply another source of stress to be added to any others a tree has undergone previously or may undergo later. Other causes of tree stress include prolonged drought, unsuitable soil (e.g., clay or sand), change in the water table or grade, disease of or injury to the root system, soil compaction, construction of a paved surface over the roots, improper (too deep) transplanting, earth fill, injury from salt or weedkiller, flooding of the soil with water or gas, and leaf damage due to prolonged exposure to warm, dry winds, infection with foliar disease organisms, chewing by other leaf-feeding insects, and sucking by mites and aphids.

Since many aspects of civilization cause stress in trees, trees in ornamental, yard, park, and street environments are often under greater stress — and thus in poorer health — than those in forests and woodlots. Trees of the same species and with similar outward appearances may be in quite different health conditions because of the unique combinations and degrees of these numerous stresses, and because of differences in where they are growing. Some can endure much more stress than others.

Sometimes symptoms of this stress are very conspicuous. They include excessive seed set, early autumn coloration of the foliage,

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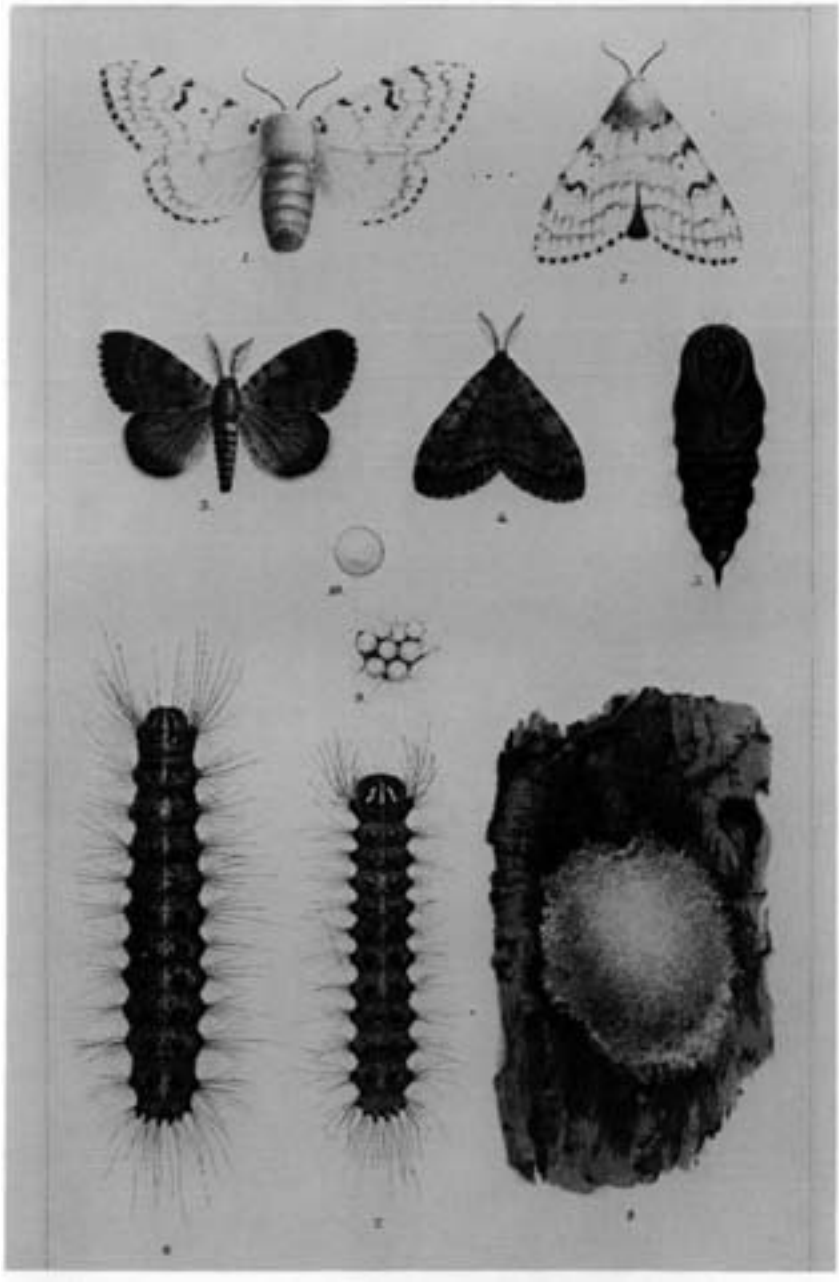

The gypsy moth a female with wings spread (1) and wings folded (2); a male with wings spread (3) and wings folded (4), a pupa (5); caterpillars (6, 7); a cluster of eggs on bark (8), several eggs, enlarged (9), and a single egg, greatly enlarged (10). From E. H. Forbush and C. H. Fernald, **The Gypsy Moth** *(Boston, 1896), Plate 1.*

Trees in Arlington, Massachusetts, defoliated by gypsy moth caterpillars Photograph taken July 9, 1891. From E. H. Forbush and C. H Fernald, The Gypsy Moth *(Boston, 1896), Plate 10*

early leaf fall (abscission), and fewer, smaller leaves in the spring. Other related symptoms include the presence of dead areas at the tips of evergreen needles, or "scorch" — dead areas at the outer margins and between the veins of broader leaves, leaving green only in stripes along the veins. Further stress leads to dieback of the top branches (called "stag-heading") and, eventually, to the death of the tree.

Stress increases a tree's susceptibility to attack by certain weaker (secondary) diseases and pests, like the shoe-string rootrot disease, the *Cytospora* canker disease, the two-lined chestnut borer, and various bark beetles. Most of these agents, and the organisms they may bring with them (especially the blue-stain fungi, brought to conifers by the bark beetles *Ips* and *Dendroctonus*), can ultimately kill a tree. Tree deaths ascribed to a secondary organism may have been triggered by a primary stress such as the gypsy moth.

When the gypsy moth defoliates a tree that is already under considerable stress from other causes, the tree may die relatively promptly. However, when the gypsy moth attacks an otherwise vigorous tree, the tree may or may not then be attacked by secondary organisms before it has a chance to recover its vigor during the following several growing seasons. Much depends upon whether the secondary pathogens or pests are in the vicinity at the right time. This uncertainty accounts for much of the variation in tree mortality that has confused some observers.

One effect of defoliation is a substantial decrease in the amount of food reserves stored in the tree. These reserves — ordinarily stored as starch in the roots of broad-leaved deciduous trees and to a certain extent in those of evergreen conifers as well — maintain the tree's life processes during winter dormancy and times of defoliation, when little or no food is produced. They also provide the energy and substance necessary when a new set of leaves is being put out, whether in early spring or at a less usual time.

In conifers considerable additional food reserves are stored in the older foliage, so defoliation not only deprives a conifer of its current food source but also removes significant amounts of its food reserves. In addition, conifers rarely refoliate in response to a complete defoliation. A single defoliation often proves fatal for a conifer, while hardwoods frequently live on after a first or even a second defoliation.

The fact that a hardwood tree clothes itself in a second set of foliage late in the growing season after gypsy moth defoliation ought not be a cause for rejoicing, however. Dr. Philip Wargo, of the U.S. Forest Service's Northeastern Forest Experiment Station in Hamden, Connecticut, has found data that confirm earlier suspicions: a tree commonly uses more of its food reserves to build a second set of leaves than it replaces through photosynthesis during the late summer and early fall.

The following spring such trees have even smaller leaves, and because the twig growth pushed out in the previous late summer did not harden off, it has often been killed by the winter cold. It would have been far better if enough leaf surface — no matter how ragged in

Men inspecting the Dexter elm in **Malden**, *Massachusetts, for gypsy moth eggs After intensive efforts to clear this tree of eggs and caterpillars in 1891 and 1892, it was free from them in 1893. From E. H. Forbush and C. H. Fernald,* The Gypsy Moth *(Boston, 1896), Plate 36*

appearance — had remained to prevent triggering the trees into putting forth the extra leaves.

What should you do, then, with a tree that has been weakened by defoliation from the gypsy moth? Do nothing different than you would do to help a tree weakened by anything else.

First, remove all present causes of stress. If the defoliation continued last year without any action on your part, that *cause* of stress is now gone — the gypsy moths left the tree last summer, when they had either completely removed the leaves from the tree or reached the end of their larval growth period and changed into adults. The *stress*, of course, continued after the insect-feeding injury had been completed.

You then need to protect the tree from all stress for several years. The most obvious stress to prevent in 1982 is another defoliation by the gypsy moth. Even if the 1982 defoliation occurs in a smaller total area than that of 1981, the effects will be more severe — many of the trees will be weaker due to last year's defoliation.

Trees that were defoliated last year should receive high priority for protection and should be treated like sick trees. You will need to decide which trees to treat for control of these caterpillars and which ones not to treat. You must also decide how important it is for the treated trees to survive — this will determine the material to use in the treatment.

In the case of broad-leaved deciduous trees that were not defoliated last year, are not under any severe stress from other causes, *and* are not of any historical or personal significance, partial defoliation can be accepted — provided that enough leaves remain to prevent the tree from squandering its remaining food reserves in a second set of 1982 leaves. Even if these trees lose all their leaves and refoliate, chances are that they will survive one such defoliation.

A description of the gypsy moth and its life history, together with a list of the insecticides — both chemical and biological — used against this insect and a discussion of other measures taken in its control, are in the circular *Gypsy Moth.*[2]

The second step is feeding. Don't feed the tree immediately after defoliation! Feeding from approximately mid-June through September may force a flush of new growth that will be killed by the first frosts because it has not had time to go dormant and harden off. Fertilizer applications are ordinarily made to trees either in late fall or in spring after the ground thaws (i.e., from mid-October through May).

While compost and well-rotted manure are good fertilizers, commercial dry fertilizers are usually more readily obtainable and can be used under most circumstances. Those relatively high in nitrogen, such as are used for lawns, are considered best for most trees, although an ordinary garden fertilizer will do as a substitute. The important point is to use a complete mix that includes nitrogen, phosphorus,

[2] All publications mentioned in this paper are available from Massachusetts County Extension offices or from the Shade Tree Laboratories. They have also been sent to every public and high school library in Massachusetts and to every municipal Tree Warden in the state.

Injection of fertilizer into the ground Photograph courtesy of Frost and Higgins

and potassium. With members of the rose family — for example, apple, pear, crabapple, and mountain ash — avoid high-nitrogen fertilizers because they make the tree more susceptible to the fireblight disease. Water-soluble or liquid fertilizers generally come in higher concentrations and can be applied with an injector attached to the garden hose. The beneficial effects of liquid fertilizers (dark green foliage) appear sooner, but those of dry fertilizers last longer.

To determine the amount of fertilizer to use, measure the diameter of the tree trunk four feet above the ground. Per diameter inch, use two to four pounds of fertilizer for trees with trunks six inches or more in diameter, and one to two pounds for smaller trees; for needle-type evergreens use the lower number of pounds. With water-soluble or liquid fertilizers follow the directions on the package.

Application is made through one-inch (or slightly larger) holes punched or drilled in the soil over the root system. A crowbar or a hollow tube may be used to make the holes, which should be 12 to 18 inches deep and about two feet apart, arranged in concentric circles starting one foot or more from the trunk and extending out at least as far as the spread of the branches. With larger trees, start farther from the trunk to avoid wounding the large roots.

Distribute the fertilizer equally among the holes, using a funnel (or a small can with the top edge bent to form a pouring spout) to prevent spilling fertilizer on the lawn and burning the grass. After you have put the fertilizer in, you may either fill the holes with topsoil or leave them open. Open holes will help air and water reach the roots; this effect is especially needed if the soil is hardened or packed down. Rain and soil moisture will distribute the fertilizer among the feeding roots.

You can use water-soluble or liquid fertilizers by inserting the injector at regular intervals as stated above and applying the fertilizer by water pressure. This method is easier than using dry fertilizer, if you have the necessary equipment. The water used to carry the fertilizer

Apple trees in Swampscott, Massachusetts. The above photograph was taken August 15, 1891, after the trees had been defoliated by gypsy moth caterpillars The photograph on the opposite page shows the same trees in July, 1892, after the moths had been cleared from the area by agents from the Board of Agriculture From E. H. Forbush and C. H. Fernald, **The Gypsy Moth** *(Boston, 1896), Plates* **37** *and* **38.**

into the soil will help distribute the fertilizer and make it readily available to the plant.

How often you should fertilize a tree depends on the type of tree and how it responds to treatment. Generally it is safe to fertilize every two

or three years. Fertilizer should not be used at the time of transplanting; instead, plantings should be made in a good-quality topsoil containing plenty of organic matter. After the tree has grown in this soil for two or three years, it may be included in the program of fertilizer

applications described above. Consult the publication entitled *Fertilizing Trees and Shrubs* for further details.

The third step in helping a tree to regain vigor after defoliation by the gypsy moth is watering. Natural rainfall may be quite adequate, depending on the season. When it is not sufficient, a mere sprinkling is of no value: enough water must be placed in the soil surface to penetrate down to the roots in the upper foot of soil. If trees receive only a little water too often, they tend to develop their roots too near the soil surface. Such roots are more likely to be injured during a drought. If the foliage is sprinkled during the watering process, leaf diseases may develop and may further reduce the tree's vigor (a drawback to the frequent use of lawn sprinklers to water trees). On the other hand, unnecessary watering during a wet season can itself be a cause of weakening and stress, since the roots may drown. Roots need oxygen, which filters down to them through the interstices between the soil particles, and they need to get rid of carbon dioxide, which diffuses up to the ambient air.

You should therefore water about once a week, and only during dry periods. To be soaked to a depth of two feet, a fine sandy loam soil dry enough to cause plants to wilt requires one gallon of water per square foot of surface over the roots. The roots usually extend beyond the limits of branch spread and may pervade the entire lawn. (In areas with heavy clay or poor drainage, be careful not to drown the roots by waterlogging the soil.)

It is likely that no one has the patience to stand on the lawn with hose in hand long enough to put down as much as one gallon of water per square foot. This amount is equivalent to a layer of water more than one and a half inches deep over the entire area. The way to soak the soil, then, is to lay the hose on the ground, with the water running slowly enough not to run away over the surface of the soil. Two soaker hoses, joined with a siamese coupling, will provide for slower seepage and therefore less puddling. Move the hoses from time to time.

Unfortunately, the time when trees need water most is also the time when such use of water may be locally banned because of shortages. In that case, the only way to provide artificial watering may be to haul or pump water from a pond or stream where you have water rights; this is practical only for small trees. Consult the publication entitled *Watering Shade Trees* for more information.

Emphasis should be given to the fact that feeding and watering help to increase the vigor of a tree, but they do not protect it against future feeding by gypsy moth caterpillars. Defoliation, or spraying to protect from defoliation, during one season gives no protection for another year. So far as pest control is concerned, the 1982 season is "a new ball game" — the tree is protected only to the extent that you take action *this year* to protect it.