ARNOLD ARBORETUM
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TREE TROUBLES

NOT all trees keep in good healthy condition, and it is the purpose of this bulletin to mention some of the causes why we have "sick" trees, together with some recommendations for their "cure." The recommendations made are not primarily the results of any investigations at the Arboretum, but rather from various experiment stations throughout the eastern United States. Though suggestions are given on fertilizing it must be kept in mind that with wide variations in soils, in trees and in their root systems, any specific recommendation given to cover all conditions should be taken only at its face value. Efforts should be made by those interested to investigate thoroughly local conditions and try to suit any general recommendations to their particular needs.

Illuminating Gas in the Soil. Gas, leaking from mains, gets in the soil and may cause the death of trees. Even a very minute leak may, over a period of a few years, be sufficient to cause a nearby tree to die. An ingenious method has been devised at the Boyce Thompson Institute* to determine the presence of illuminating gas in the soil. Of course, if gas is known to be present by its odor, then there is no need for the test, but often the damage is done by an amount of gas in the soil, so small that it cannot be detected by its odor. The test includes placing a young tomato plant in a hole in the ground, leaving it covered for twenty-four hours and observing its reaction when uncovered. If gas is present, the leaves will show a very definite type of wilting.

*Toxic action in soil of illuminating gas containing hydrocyanic acid. By A.E.Hitchcock, William Cocker and P.W.Zimmerman. Boyce Thompson Inst. for Plant Research Contrib. 6: 1-30. 1934.

If illuminating gas is present in the soil, no trees should be planted until the leak has been definitely and positively stopped. When this is done, the soil should either be removed entirely or be washed thoroughly so that all the soluble poisons are taken out of the soil. If the drainage is poor, tile drains should be put in since this washing process should be a complete one. When this has been done satisfactorily, new trees may be planted.

Raising the Grade. Raising or lowering the grade around a tree may cause serious damage. The feeding roots of most trees are usually within the upper 18 to 24 inches of soil. At this depth there is a certain amount of oxygen in the soil air spaces, while at lower depths there is usually less oxygen, more carbon dioxide and possibly less water. Since roots need a certain amount of oxygen, and large amounts of carbon dioxide are injurious, when soil is piled on top of the existing level under a tree, conditions for root injury are augmented. A fill of a few inches of soil on top of tree roots is not harmful, but a fill of 18 inches or more may prove decidedly harmful, depending on the type of tree, type of soil, amount of rainfall, drainage and the like.

If a considerable fill is to be made the procedure is as follows: The surface of the old grade is loosened; several lines (at least four) of 4-inch agricultural tile radiating out from the trunk of the tree like the spokes of a wheel, are laid as far as the spread of the branches; a layer of coarse stone or large screened gravel is used to cover the tile and to raise the grade to within 15 inches of the final lawn surface. On top of this is placed a 2-inch layer of smaller stone or pebbles, and on top of this a layer of straw, or better a layer of manure, or some similar material, in order to keep the dirt from sifting down through the rock layer. The top soil is then added to the finished grade. This treatment should be made over the entire area of ground covered by the tree branches.

At the same time a "well" is built around the trunk of the tree to the top of the proposed soil level. This "well" is from 3 to 4 feet in diameter, or larger, depending on the size of the tree, and is made to allow air and water to enter the tile and the layer of crushed rock after the filling has been done. In this way, air and moisture can reach the tree roots no matter how deep the fill is. This treatment also makes it possible to water the tree very effectively during dry weather.

Gas in the Air. City conditions are hard on plant life largely because of the injurious gases and soot in the air. The soot and dust

fall on the leaves and clog the stomates, thus preventing the normal intake of carbon dioxide. Also the gases contained in the air of the city, especially sulphur dioxide, are injurious to plant life. Some trees, such as Ailanthus, Catalpa, poplars and willows are more resistant than others to these variable conditions. The conifers, as a rule, are the most susceptible to this injury. If these conditions are present, one should observe the trees doing best in the vicinity and plant them, rather than trying a long series of untried and often disappointing types.

Painting Wounds. Experiments have shown that wounds heal most quickly when the pruning is done between February 1 and May 1. While many small wounds may heal over quickly enough to prevent infection, still it is best to paint all wounds 2 inches or more in diameter with some good durable wound dressing. At the present time the best paint for wounds, listed in order of their merit, are asphaltum, orange shellac, white and red lead paint and bordeaux paste. One of these should be applied immediately, as soon as the cut has been smoothed off, except on trees like the maples and birches, which "bleed" profusely in the spring. Such trees should be pruned only in the late spring or summer when the wood remains dry enough to paint.

Asphaltum is probably the best type of paint to use on wounds, providing a thin covering can be obtained. Several commercial asphaltum paints are on the market, some of which are thin enough so they can be used in cold weather without heating. This is the type to use. Thick asphaltum paints are not recommended, for they easily "blister" and are very hard to use properly in cold weather. The large "blisters" caused by moisture collecting under the surface eventually break the covering and provide a source of infection by the large opening they leave in the covering itself.

Orange shellac is about the least harmful to the cambium tissue of any of the paint wounds. It can be appled in cold weather but is often objectionable on account of its brilliant orange color. It also tends to crack, particularly on large wounds and may have to be retouched once or twice a year.

White or red lead paints are objectionable in color and are slightly injurious to the cambium; but they are effective and are usually available. Wounds should be repainted, when necessary, once a year.

Bordeaux Paste is made by mixing dry commercial bordeaux mixture with enough linseed oil to form a thick paste. As a wound paint it has the desirable property of being slightly porous to moisture and

air, and at the same time is a fungicide. Blistering does not occur underneath this dressing. Its outstanding drawback is its color, which passes through changes of blue to green after it has been applied. Apparently little is accomplished by painting over it, since the multi-colored copper salts eventually appear on the surface.

Tree Repair. Tree repair is a study in itself. It is usually unwise, and often impossible, for the inexperienced person to attempt to fill cavities. In fact, some question the value of filling tree cavities at all, believing that trees are better off if the cavities are cleaned out, painted properly and left alone. This subject is too broad for discussion here. At least a cavity should have all the diseased wood cut out, the remainder smoothed over and then painted, preferably with a good fungicidal paint like bordeaux paste. A coat of asphaltum may be added over the bordeaux for permanence.

One other thing the amateur can do is to brace some of the bad crotches in the older trees. This is never accomplished by completely encircling the limb with a wire, but by putting an eye bolt through each limb and connecting these two bolts with an iron rod or heavy cable. Each eye bolt should have the washer and nut completely countersunk on the outside so that the bark may heal over quickly.

Fertilizers. Lack of sufficient nutrients in the soil is only one of many causes for "sick" trees. The addition of fertilizer to the soil about a tree is not a cure-all, and should only be attempted when one is certain that malnutrition is the cause of the poor condition. Experiments on a wide range of soils, over a long period of time, have shown that in the United States at least it is nitrogen which is most frequently deficient in the soil, and possibly phosphorous. Well rotted manure is always good as a fertilizer, not only because it has a high nitrogen content, but also because it contains much organic matter which aids the soil in retaining moisture. However, many trees can be aided materially by simply broadcasting on the surface of the soil under the tree ammonium sulphate or sodium nitrate (both of which contain a high proportion of nitrogen with no phosphorous or potash); or ammophos, a trade name for a material very similar to ammonium sulphate except that it contains phosphorous in addition to nitrogen.

Shade trees may be fertilized either in the fall or in the spring. Spring fertilizing is often preferred because then, if a readily available fertilizer is used, increased growth will result the same year. If the tree is not in a valued lawn, such a fertilizer may be broadcast underneath the branches and washed in with water, but it must be remembered that large amounts of commercial fertilizer spread indis-

criminately on the grass may seriously injure it. Tests at Cornell University have shown that amounts of ammonium sulphate as high as 30 pounds per 1000 square feet can be applied to a grass plot without injury to the grass, providing application is made before the grass begins to grow in the spring.

On the other hand, there are many fertilizers on the market for shade trees with nutrients which are not so readily available to the plant as ammonium sulphate or ammophos. If such a fertilizer is applied, or if there is any danger from injuring a highly prized lawn with too much fertilizer, then the crow-bar method of applying the fertilizer should be used, as follows.

Method of Applying Fertilizer. A circle is drawn on the ground under the outside limits of the branches of the tree, and another circle is drawn two-thirds of the way towards the trunk. The area between these two circles is the area to be fertilized. Holes about 15 inches deep are then dug with a crow bar, soil augur or automatic drill, and the fertilizer so divided so that a small amount is placed in each hole, and the soil replaced. The amount of fertilizer in each hole depends largely on the kind of fertilizer, if it has a high amount of readily available material in it, as does ammonium sulphate, then only a few ounces should be put in a hole. The holes themselves should not be more than 3 feet apart, preferably less, for the more evenly they are distributed, the better the results. In fact, some commercial concerns are now actually blowing the fertilizer into the soil in order to get better distribution.

However, trees should not be fertilized, in general, until at least one year after transplanting, since the first year the tree is much more dependent upon its new water relations, that is, the amount of water which can be taken in by the roots as compared with the amount given off by the tops. The first year then, water the tree well, mulch it if necessary to give it additional moisture around the roots, but do not give it the highly concentrated commercial fertilizers. Some well rotted manure is satisfactory for this aids materially in conserving the moisture in the soil, but it must be well rotted.

Amount of Fertilizer to Use. Most fertilizer recommendations are based on the size of the tree trunk, implying that the size of the trunk is an accurate criterion to the general size of the tree. Fertilizers vary considerably with the amount of readily available material in them, and that is why some are to be used at the rate of only 1 pound per inch in diameter of tree trunk, and some at 3 pounds.

Ammonium sulphate and other similar materials can be used at the

rate of ½ to 1 pound per diameter inch of tree trunk on mature trees and even more on very large trees. Such materials should be used with caution on evergreens and deciduous trees under 4 inches in diameter.

A 10-20-10 fertilizer (that is, containing 10 parts nitrogen, 20 parts phosphorous and 10 parts potash) can be recommended at the same rate, the larger amounts for the larger trees. There are many such mixtures on the market, varying considerably in the amount of readily available nitrogen. The larger the amount of readily available plant food in the fertilizer, the smaller the application should be.

Well rotted manure, forked in under the trees is always good, and in a place like the Arboretum is one of the best and cheapest fertilizers which can be used.

For Deciduous Shrubs and Evergreens. The best general recommendation for deciduous shrubs and evergreens is to regularly mulch them in the winter with well rotted manure, rotted leaves or other quickly decomposing organic matter. Particularly is this true of evergreens, at least until more is known about their reactions to commercial fertilizers. No commercial fertilizer should ever be placed in the hole at transplanting time. At maturity, most shrubs maintain a fairly definite height, and it is foolish to fertilize such plants in the hope of making them grow taller. Also, when excessive amounts of nitrogenous fertilizers are given to certain shrubs valued for their flowers and fruits, they make a greater vegetative growth at the expense of flowers and fruits. With some shrubs (Wisteria and flowering dogwood) it has been found that a phosphatic fertilizer such a superphosphate, mixed with the soil in a trench dug around the plant, may aid in producing more flowers the following seasons.

If commercial fertilizers are to be used on the shrub border, then a 5-10-5 might be applied at the rate of 1½ to 2 pounds per 100 square feet. A 10-20-10 might be used at half this rate. In growing nursery stock, stronger applications than these have been used.

In fertilizing woody plants it should always be kept in mind that there is a time during the summer when no fertilizers whatever should be applied. For, if application were made at this time, increased growth might result in the early fall which would not have sufficient time to mature before the killing frosts came. Consequently, fall fertilizing might best be done at any time after the first of September.

DONALD WYMAN