JOURNAL OF
ARBORICULTURE
March 1982
Vol. 8, No. 3

THE WAYS WE KILL A PLANT[1]

by Robert E. Partyka

Green foliage, during the warm months of the year, generally signifies healthy, growing plants. To the casual observer this may be true in most cases, unless there has been widespread devastation that makes it obvious that something is wrong with the plant material. Extensive destruction of foliage or death of plant material in a short period of time often becomes noticed; mainly because it occurs, relatively speaking, in a short time span.

Gradual changes often go unnoticed because they occur slowly. Therefore, the day to day observations really do not signify any outstanding symptoms that the novice can detect until suddenly a very obvious problem exists. Logic dictates that the occurrence is sudden, but an understanding of plant physiology suggests otherwise.

As plantsmen, we should be attuned to the subtle changes that occur in plants under our jurisdiction. These changes signify a reaction of the plant with its environment. By observation and investigation we should be able to determine the nature of the change and whether a remedial measure is warranted. The nature of the remedial measure will vary depending on the particular problem.

Determining the nature of the problem is often most difficult because case histories are not usually kept on plants. Oftentimes "happenings" insignificant at the time are not reported or noted but can play an important role in the health of the plant because they often contribute to some other so called "minor incident." Each situation alone may be independent, and the plant will recover if given sufficient time. On the other hand, minor problems occurring in a short time span may have a synergistic effect and result in rapid decline of the plant.

What are some of the factors that may lead to plant decline? How are we encouraging plant decline in our modern day society? What should we be looking for, and making others aware of the final results, when something is done to a plant? We will try to cover some of these points in this discussion.

Plant production area. A logical place to start will be where the plants originate from. Plant production areas are regulated by each state to produce sound, healthy plants. However, as new introductions are brought into the trade, new problems often develop that were not present in the developmental stage. These problems are often difficult to trace back, and in the case of some diseases may be almost impossible because of other conditions that may encourage the organism at the final growing site. When growing conditions fail to stimulate the organism, no disease is apparent, and the plant looks healthy and normal.

Plant production practices in some cases may be aggravating the girdling root situation, with the advent of artificial media and container grown plants. If the time span is too long in the container, roots are distorted (Fig. 1) and are often put into the soil in that fashion. In time, distorted roots may lead to a girdling root problem at a level in the soil that is difficult to detect on an older plant. Specific handling instructions on these types of plants at the time of transplanting will often remedy the situation and prevent a problem from occurring in the future as the plant matures.

Landscape design. Landscape design for now or the future must be carefully thought out when selecting plant material. Too often plants are selected for an immediate visual impact, which

[1]Presented at the annual conference of the International Society of Arboriculture at Boyne Falls, Michigan in August 1981.

certainly cannot be neglected. But if the plant material is to remain permanent and develop into the future, soil, climate, size and area usage must be carefully thought out before planting. A life expectancy needs to be placed on the landscape and all environmental ramifications should be considered before plants are selected to avoid future problems.

Handling practices. Handling practices of plant materials in transit, storage and at the planting site are important considerations for survivability. Improper watering practices that fail to soak the root ball and provide water to the inner area may be a factor in plant losses. Burlap coverings often restrict water movement into the ball and plants can be suffering from a water shortage because of the barrier effect. The survivability of such plant material is often much lower due to physiological effects, even though visual appearance may not be altered.

The mechanical fracturing of the root ball and breaking roots by dropping is of concern with some plants. On the other hand, this type of handling may be more appropriate for pot bound or container grown plants to help break some of the roots for a better distribution pattern. Tightly bound roots need to be cut to reestablish a better root distribution pattern. This appears to be an increasing problem with containerized planting stock.

Standardized transplanting procedures for most plant material are well outlined in the literature. The major concern is whether the practices are followed properly and whether the transplant crews prior to the planting period have had a review of these proper procedures (Fig. 2). At times, there appears to be an information dissemination gap between the individuals doing the work and ones hiring them. Better training in this area or more onsite supervision will certainly help in reducing plant problems in future years.

Transplanting. Many new ideas and practices have been explored in the transplant area. Some have been very helpful while others have created problems. Old practices are being reexplored to see if they are valid and how they influence plant growth.

Transplanting procedures that can lead to future problems are many and each must be carefully considered at the time of planting.

Balled and burlapped plants are still used and should be handled carefully. One has to presume that all the roots are intact since it is not practical to tear the ball apart. How many plants fail because of a lack of roots (Fig. 3) due to a skewed root system or the ball is too small resulting in poor water and nutrient absorption. Standards have been developed for root ball sizes and should be adhered to when selecting plants.

Balling materials and twine must be of sufficient strength to keep the root ball intact, but once planted decompose to prevent root bound or girdling problems at a later date. Plastic and nylon have been the culprits in many situations when not removed (Fig. 4).

New mechanical equipment has given us the

Figure 1. Encircling roots as formed by a container will eventually result in a girdling root situation at a later date.

Figure 2. Declining Taxus plants planted too high for this location and watering regime.

Figure 3. A skewed root resulted in plant failure due to a limited root system for a balled and burlapped plant.

Figure 4. Trunk girdling associated with plastic, nylon twine or wire.

capability to move many plants into specific locations. The minimum soil and root disturbances, when done properly, should provide for better plant survivability. However, types of root systems on the plant, the transfer of a plant from one soil type to another, the improper placement depth of the plant, soil settling, and soil glazing have been factors in plant decline, often many months after the movement. Reserve carbohydrates in the plant often allow it to remain alive for an extended period of time, often lulling one into believing it is growing well only to find the plant eventually fails. Practices to improve establishment percentages need to be followed carefully.

Planting depth and soil oxygen as well as other gases are important factors for root growth and development. How often do you find plants too deep in tight soils. They often survive for a period of time until some other apparent minor problem develops and the added effect is disastrous to the plant. Settling of the plant ball as well as the original base soil are often associated with the plant being too deep. One can say that porosity of the original soil is the same, and this may be true if the area is not covered with something to change the air exchange capacity. However, roots established at one level in a soil type may not respond well when planted in a different gas exchange level of another soil type; therefore, roots may not expand out into the surrounding soil rapidly enough to take care of the top foliage needs.

Water and watering practices are part of transplanting procedures. Soils of low permeability will hold more water and affect gas exchange. Therefore, we see the need and often do establish plants at a higher level to provide a better area for root development if we cannot modify the soil water table. Of course, natural climatic factors of excess rainfall may come into play at times and aggravate the situation. Guarding against excessive soil moisture is an important consideration in poorly drained areas (Fig. 5).

Watering frequency after planting is important as it ties in with the soil site and root ball. Infrequent watering of a porous soil ball may result in water accumulating at the base of the root area, drowning lower roots but keeping the top roots too dry. This problem is often evident with the newer lightweight plant mixes. On the other hand, water applied rapidly to a tight root ball can result in water moving around the ball so the inner root system remains too dry. Proper development of the finished top soil area can direct the water to the best location. This soil must be structured before a mulch is placed on top.

Plant size. The proper plant size as compared to its survival capability needs to be considered in each location. What should one expect in future growth patterns? Large plant material improperly handled often results in a poor specimen that may take years to become fully established under the most ideal conditions (Fig. 6). Smaller plants with better recouperative capabilities may be a better choice in the long run.

Wire and twine needed to move the plant and establish it must be watched to prevent girdling and loss of the plant (Fig. 7). Thus, some time schedule should be established to look after the plants to insure that these materials do not become detrimental in the long run.

Soil disturbances. Mechanization and the capability of moving and molding the earth have resulted in many plant related problems. Unfortunately, many of these problems do not develop until long after the initial work has been done in the area (Fig. 8). Lack of records or people not familiar with the area makes it difficult to diagnose the problem. But construction stress as related to the specific plant and the particular site, coupled with other minor stresses, is common in most urban areas and can explain many decline problems.

Deep cuts and root pruning is often obvious in an area. A question always arises whether plant material in such an area should even be saved when subjected to installation of water and sewer lines under the surface, black top roads on the surface, a possible shift of the water table coupled with reflected heat and automobile exhaust fumes (Fig. 9). The cost of maintenance and removal of a dead plant could be used in establishing a new plant or plants to develop in the newly changed environment.

Fills, when done properly, often do less damage to the plant. The problem with a filled area is that oftentimes other subsurface soil disturbances may occur or water tables can change that eventually become the primary factor in plant decline (Fig. 10). Individual plant reactions to changing gaseous soil levels are important to the root system.

Mechanical damage. Mechanical damage to the trunk is often taken for granted and is considered a way of life with modern mechanization (Fig. 11). Too often a plant is put into the same class as an inanimate object that can be abused within reason and still perform. This is not the case, and if more people would consider someone kicking them in the shins or using a weedeater on their ankles at very regular intervals, possibly less damage would occur. Wounds pave the way for secondary organisms that can further weaken the plant and result in death or removal.

Proper pruning techniques have been well published but power equipment has in some cases resulted in poor pruning techniques that favor slow wound healing (Fig. 12). This, in turn, has given rise to internal rots and structurally weakened limbs of trees. Training aids of a visual

Figure 5. Initial planting at regular soil level failed due to excess soil moisture. Raised plants survived in this location.

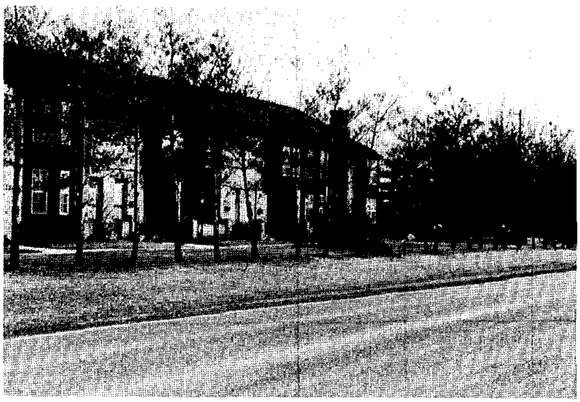

Figure 6. Large trees with too small of a root ball are slow in becoming established.

Figure 7. Guy wires need to be removed as soon as possible to prevent structural weakness in the trunk.

Figure 8. Die-back on white oak 10 years after L-shaped house built on property.

type, plus demonstrations, can certainly help in this area.

Mulches. Mulches have been used in recent years to control weeds, conserve moisture, prevent mechanical damage to plant material, and to provide for a more pleasing look in the landscape. Due to rising costs and availability in an area, various ways have been found to reduce costs and still provide weed control. Some of the new ideas and techniques have resulted in plant problems. Basically we need to be cognizant of downward movement of water and air, upward movement of water vapor and toxic gases, and the role of the mulching material on the root and lower stem microclimate. Plastic film barriers often redirect water to the root area resulting in excessive water, oxygen exclusion and dead roots (Fig. 13). This appears to be more of a problem in heavy clay soils and sloping areas where water moves to the lower level. Perforated plastic film or narrow strips placed in a manner to allow for better water penetration will help. However, gas exchange may still be a factor.

Deep, organic mulches, accumulating because of added layers used for esthetic purposes, can result in low evaporation rates and result in a water logged soil that favors low oxygen levels and root rot organisms. Deep mulches can also reduce stem tissue acclimatization in the fall in northern areas and favor low temperature damage of the lower stem tissue. Density or porosity of the mulching material used around the plants is important in such cases.

Soils and soil compaction. Soil compaction may be an important factor in many areas. The use of heavy equipment to move soils under less than ideal conditions destroys most soil structure. In addition, soils of the B and C horizon with a clay base tend to pack tightly and may create an artificial barrier. Top soil placed over this packed layer allows plant roots to establish in the upper soil layers. But if water permeability is restricted due the artificial hard pan, a high perched water table may become established and drown out the root system. Deep subsoiling may fracture the soil prior to planting and allow for water and gaseous movement. However, once settling reoccurs, permeability may be reduced and result in water accumulation around established roots.

Soil compaction from pedestrian traffic patterns under various weather conditions may be a factor around established trees. Moist soils in a pliable stage can be compacted more readily than dry soils. Thus, some foot traffic control may be needed in areas of extensive tree root systems.

Grade changes to move water away from

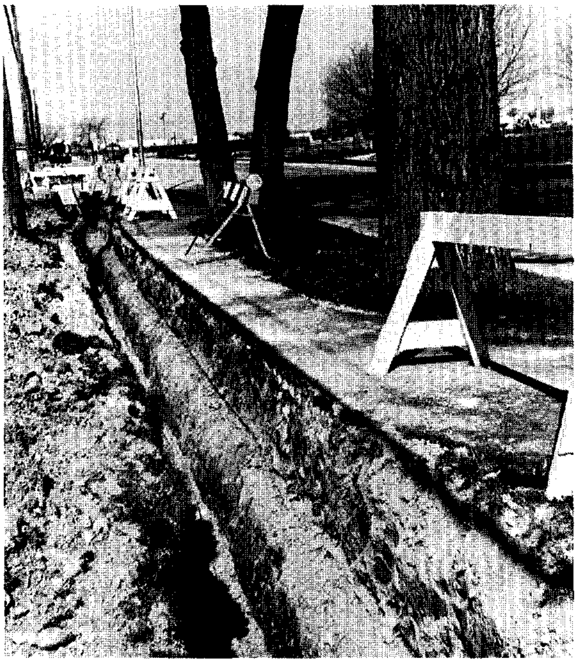

Figure 9. Construction injury near large trees often results in decline and/or death.

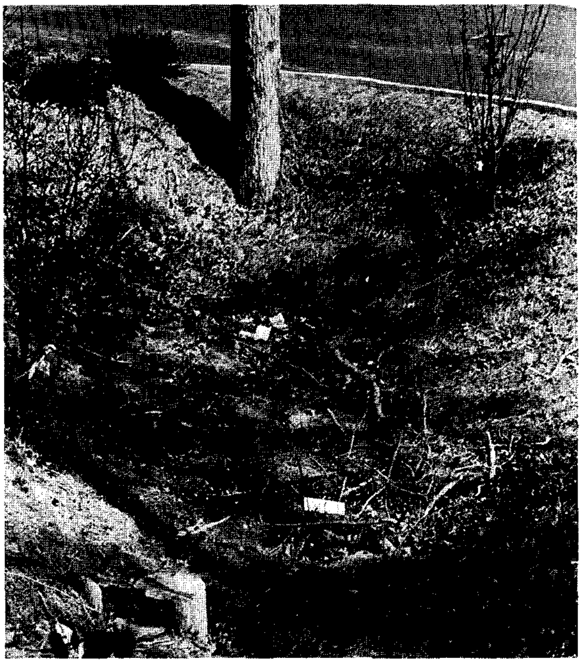

Figure 10. Deep fills without proper aeration to the roots always results in death of plant material. Standing tree has died since picture was taken.

buildings is necessary to reduce moisture problems in the building (Fig. 14). However, the rapid movement of surface water affects penetration and percolation, especially in turf areas that often become thatch bound. Plant material in these locations must be able to cope with low water requirements or else the area designed in a fashion to facilitate good water penetration into the soil.

Pesticides. Numerous chemicals have become important items in our ability to provide the needed feed, food and fiber to sustain man and provide him with opportunities to be more productive. Increased productivity has provided more leisure time. This leisure time has resulted in a greater demand for recreational development, a need for a pleasing and relaxing atmosphere and has created more opportunities and challenges for the "green industry."

Many of these same chemicals are used in the green industry to reduce man hour inputs and most have performed very well when properly used. As with any chemical, problems have occurred when directions are not followed, equipment is not calibrated or accidents occur. In some cases, all the ramifications of a material are not known and certain weather patterns may influence their behavior and performance.

Herbicides. Chemicals or compounds in the soil are at times very difficult to determine because of the many factors that influence them. The growth regulator materials so often used on turf generally are broken down readily by soil organisms and do not last for any appreciable time. However, some can move in soil water and may locate in lower soil levels where biological activity is lower; thus, they may remain for a longer period of time and exhibit typical leaf and parallel venation symptoms (Fig. 15) at some later date when the plant is subjected to a stress condition. In general, the growth regulator compounds often exhibit rapid symptoms on the plant because activity is so closely related to normal physiological processes in the plant. But, for the most part, healthy tolerant plants such as woody ornamentals are capable of overcoming these materials. Granted, continuous use at abnormal rates will weaken the plant and result in decline or death.

Non-mobile chlorophyll inhibitor chemicals used

Figure 11. Mechanical injury opens the way for secondary organisms.

Figure 12. Power equipment can make large cuts with ease but these callus slowly allowing secondary organisms to enter.

Figure 13. Directed water plus mulches has resulted in plant failure due to a water-logged soil.

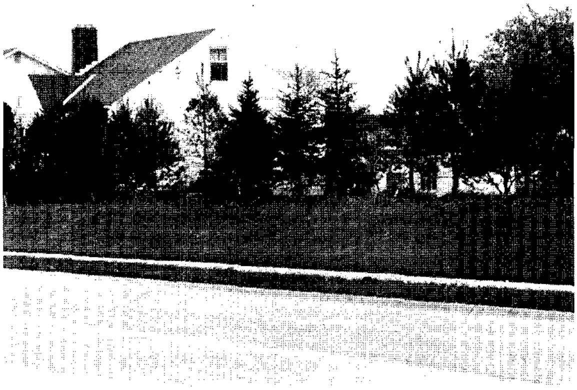

Figure 14. Steep grades favor water run-off. Minimum soil moisture can stress plants and result in poor growth or decline.

at proper rates have played an important role in weed and grass control. Excessive rates will result in definite yellowing of the foliage. The degree of damage and reduced carbohydrate accumulation often determines the survivability of the plant.

Mobile chemicals or persistent soil sterilants should never be used in the vicinity of woody ornamentals unless the purpose is to eliminate the plants (Fig. 16). Soil cracks, worm holes and frost action may result in the persistent material coming in contact with stem or root tissue and eventually damaging the plant.

Newer foliage-applied weed control compounds on the market that are soil deactivated must be used with caution because symptom patterns may

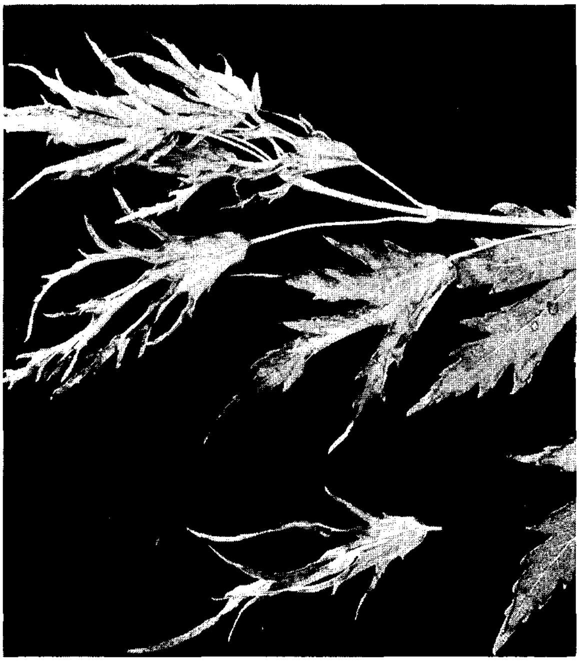

Figure 15. Distorted leaves on a maple due to fumigation with a growth regulator material.

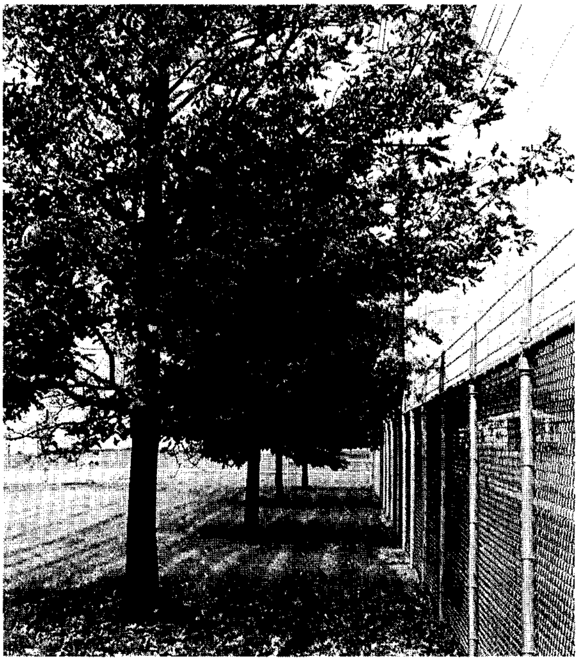

Figure 16. A soil sterilant used for grass control on the fence was absorbed by tree roots. Excess rates plus a sandy soil resulted in movement of material.

not appear until a year later. This appears when materials are misdirected to the woody tissue.

Oil or gasoline spills during construction resulting in a contaminated soil can explain some plant decline. Buried material is often difficult to detect and may require extensive digging and testing to determine the hydrocarbon culprit.

Soil gases. Soil gases are important to plant roots. The proper level of oxygen is necessary for root development. If the level becomes too low, root function ceases and top decline becomes evident. Leaks from gas and sewer lines are often present in areas, and if one has a keen nose one can often detect it in the area. Unfortunately, severe root damage has often taken place by the time the foliage responds and plant survivability may be questionable.

Soil gases associated with excess soil moisture in poorly drained areas is common in local areas. This often relates to watering practices and general water movement. One has to be aware of the grade and where water accumulates and also if irrigation is utilized in the area. Oftentimes water systems are designed for turf and not woody plants, resulting in saturated soils around trees. Two systems are often needed in these cases for best utilization of water and growth of the plant material.

Salts. Chemical salts in roadway use have been recognized by most folks living in northern climates when we look at our automobiles. With the price of vehicles now and longer retention time, the effects of salts are very evident. Aerial drift onto plants along roadways and soil accumulation is very evident in some parts of the country (Fig. 17). The selectivity of tolerant plants must be considered for the location if it is impossible to limit the use of salt in an area.

Insecticides/fungicides. Foliar applied pesticides for insect and disease control can result in plant damage when rates are too high, too many combinations are used, oil based compounds are utilized, temperatures are too high or too low, or plants are in a stressed condition (Fig. 18). Following label precautions, state recommendations, proper mixing procedures and keep-

Figure 17. Salt mist from roadway damaged one side of junipers.

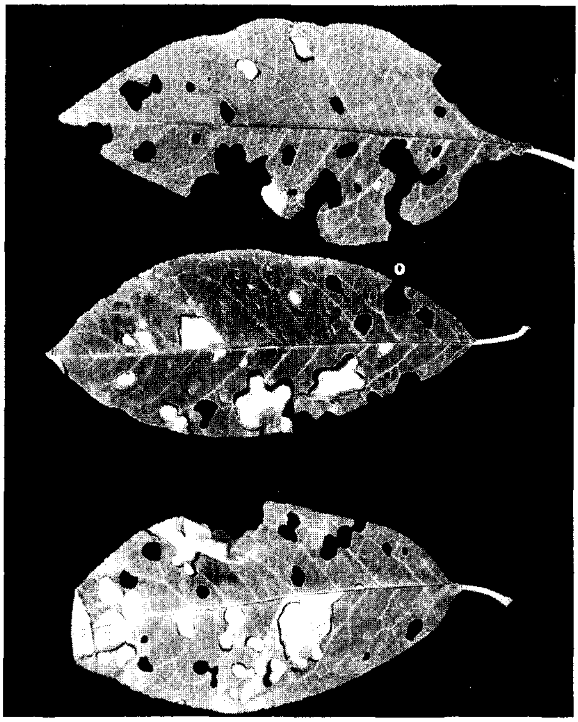

Figure 18. Prunus species reacting to a mixture of pesticides when applied in hot weather above 90°F.

ing good records is the best advice one can follow. There are many variables that come into play each year and possible damage may occur from time to time. One of the most fortunate things about foliage damage is that plant material will recover if it is in a healthy condition. A weak plant may be stressed to the point that it may fail to recover the following year. Another reason for good records.

Air pollution, as a factor of industrial progress, is part of man's doing. Some of the chemical pollutants are new but many have been around as long as the earth has been in existence. Man's development and concentration has allowed these materials to accumulate in certain areas and, thus, the problem on plants. Recognizing specific symptoms and looking at more tolerant plant species will be a factor for the future as industry copes with abatement devices.

We can't ignore man's introduction of certain insects and diseases into an area. This has been evident by the gypsy moth in the east, Dutch elm disease on our American elms, to the isolated plant with an insect problem in an area of the country where the pest is non-existent due to the nature of climatic conditions.

One more area of great importance needs to be considered and that is climatic changes that take place in varying cyclic patterns. Short cycle patterns are often easily recognized, but the 40-50 year cycles are difficult to remember unless accurate records are kept. But these long term patterns are extremely important in determining why certain plants fail after growing for so many years in one location. A long time to us is miniscule in the geological time span.

We talk in terms of an average life span of a plant. Do we really know how long that plant will survive when placed in an urban environment and subjected to man's constant manipulation? Essentially, the fate of urban plants is in our hands and what we do to them. We should follow all human precautions possible to insure the survival of the plant material. But, we must also recognize that based on past experience plants will not survive if certain practices are employed. Therefore, let us benefit from past experiences to determine the future and stop repeating the same mistakes. Accept plant material for the way we have treated it and recognize that it may have to be replaced because of our own mistakes.

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ABSTRACTS

HALLER, J.M. 1981. **Practical pruning.** Am. Forests 87(9): 11-14.

Pruning is an art as well as a science, and from a distance — since art's perfection lies in concealing itself — the properly pruned tree should show no evidence of the handiwork that made it what it is. Instead, it should present a graceful, symmetrical shape on all sides and a nearly unbroken surface of foliage. Many believe that a tree should be pruned only in the winter, when dormant. This belief is a carryover from the days when pruning was synonymous with severe topping or dehorning. In cases of dehorning, dormancy is indeed the indicated season. Since in the temperate zones growth occurs most rapidly in the first few weeks of spring and since healing is a form of growth, it follows that pruning cuts made just before spring will begin to heal over almost immediately. Conversely, cuts made in late summer will have to wait until the following spring before healing can begin. On most trees, however, a difference of a few months is not a serious matter, and in practice, pruning crews work all year around. Whether completed pruning cuts should be painted over or left exposed has long been a disputed issue. Personally, until the issue is settled (if it ever is), I continue to use tree seal on all the larger cuts (three inches or more in diameter) for looks if nothing else. A glaring white cut is objectionably conspicuous, but when covered over with tree seal, whose usual color is black, it goes unnoticed.

TATTAR, T.A. 1981. **Stress models for trees in the urban environment.** Arboric. Journal 5: 55-56.

Stress is common in the urban environment. In the forest ecosystem, trees have evolved means of successfully coping with stress through natural selection. Ability to survive injuries, insect and disease attack, and to compete successfully for limited water, nutrients and sunlight, has been a powerful selective force for ensuring that only the most healthy and vigorous trees would survive. As people began to build cities and towns and to plant trees in them, and environment emerged that was drastically different from the forest ecosystem. The suburban-urban ecosystem, spawned by the technological age, is so new in its evolution that trees have not had time to adapt. It is not surprising that trees are injured and often killed by extremes of soil, moisture, and temperature, by construction, by herbicide misuse, by road salt, and by a whole host of people-pressures.