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LIGHTNING PROTECTION FOR TREES AND RELATED PROPERTY[1]

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As members of the International Society of Arboriculture, I know you are all familiar with Joyce Kilmer's Poem, *TREES:*

I think that I shall never see a poem lovely as a tree . . .

My apologies to Kilmer, Longfellow and others as I, too, have written a poem:

Under a spreading forest tree
A dripping nimrod stands;
A raindrop dodging man was he
'Til lightning changed his plans!

In these two poems we have two extremes, the majestic beauty and irreplaceable loveliness of trees and a split second later, we are left with splinters, the smell of burning bark, destruction and even injury and death.

In the business of arboriculture, you are experts in how and where to plant trees, care for trees, lay out plantings, moving trees, pruning and bracing and, in general, beautification. I would like to tell you how to protect these trees from one of nature's worst destructive forces, lightning and lightning damage.

Lightning protection for trees is not new. Tree lightning protection has been available for over 50 years. There are codes, specifications and recommendations for proper equipment and installation procedures as set forth by the Underwriters' Laboratories, National Fire Protection Association, National Bureau of Standards, Lightning Protection Institute and, I believe, your own organization several years ago established minimum requirements for lightning protection of trees.

There are many reasons for protecting trees from the ravages of lightning and for you to provide this specialized service to your clientele.

1. You are the arboricultural professional. You are planting, moving, pruning, feeding, and bracing your customer's trees. Why not protect them from future lightning damage?

2. Your customer will have more respect for your advice and concern for his trees than that of a regular lightning protection installation firm.

3. The cost of lightning protection for important trees is small compared to the aesthetic value of the trees.

4. Many owners will not live to see new young trees grow to lofty beauty like the trees they now have. Lightning protection will save many fine trees for future generations.

5. In many cases of trees struck by lightning, it may cost more to remove the damaged tree than the cost of lightning protection.

6. The additional specialized service of lightning protection can be a door opener and sales closer for you and your sales representatives. Trees with a lightning protection system tend to reduce the hazard of injury or death to family, friends and neighbors near or under a tree during a thunder storm.

7. Extra profits. With your present organization, you can add thousands of dollars to your yearly sales volume and profit.

8. The investment is small in relation to your sales volume, you have the trucks, men and equipment. The cost of lightning protection, inventory and specialized tools is relatively small.

[1]Presented at the annual convention of the International Society of Arboriculture in Toronto, Ontario, Canada in August of 1978.

9. Many successful tree expert firms such as Duling, Lawrence, Brand, Davey and Bartlett have provided lightning protection tree service to their customers for many years.

In general, my remarks are related to home and large estate owners interested in protecting one or several trees surrounding their home. With Americans spending more weekends together in recreational areas, picnicking, playing golf, hiking, camping, and boating, we should also consider the need for lightning protection for trees in recreational areas.

Statistics compiled by the Lightning Protection Institute in 1976 show that one-third of the lightning deaths throughout the United States occurred under or near unprotected trees. Another large percentage of deaths occurred in open areas such as ball parks, under small shelters and in fishing areas. We are all too familiar with the lightning experience and near tragedy that could have occurred to Lee Trevino, Jerry Herd and Bobby Nichols at the Western Open two years ago.

A very real tragedy was narrowly averted last summer in a Missouri park when a young girl's screams brought a quick-thinking stranger to her mother's aid. The woman and her three children had sought shelter from a downpour under a tree when lightning struck, leaving the mother apparently dead. After emergency life saving measures, the woman was revived and sent to the hospital in shock.

The victim and her family were more fortunate than other people who sought shelter from storms under trees last year. A 24-year-old man and 22-year-old woman were killed last July when they cleaned up the remains of a family picnic in a park in New York.

A young couple in Georgia were struck, seriously injuring the boy, when they were unable to get back to the car and sought protection in an unprotected shelter. There were also several casualties from lightning on Cocoa Beach last summer causing authorities to devise a method of warning bathers when a storm was approaching.

How can protection be provided for families and individuals when engaged in recreation and other outdoor activities? First, let people know that a lightning hazard exists. This is the owner's responsibility. An article appeared in a recent *Park Maintenance* magazine entitled, "What You Need to Know About Lightning and Your Liability."

Second, install lightning protection in valuable and aesthetic and historical trees.

Third, protect recreational area facilities, *ie*, buildings in and around recreational camping areas.

Fourth, protect lone trees under which people are likely to seek shelter.

Fifth, protect lodges, cottages, rest rooms, cooking shelters, golf shelters.

Sixth, protect metal objects such as flag poles, lifts, towers, observation platforms, etc.

Seventh, post lightning safety rules in prominent areas.

Here are seven personal safety rules that should be posted:

In a building. If it does not have a lightning protection system, stay away from such metal objects as plumbing fixtures, the sink, appliances, screen doors and the fireplace. Avoid open windows and don't disconnect appliances after a thunder storm has started.

In the open. Race for the shelter of a protected building, a car, a large building though not protected, a cave or a lodge, in that order. If the storm overtakes you in a large open area, keep low. Lie in a ditch or depression during a severe thunder storm.

Under a tree. Don't be there! If you must seek shelter under a tree, pick a small one in a grove some distance from the taller trees.

In or on the water. Get out or off as soon as possible. If you are caught in an open boat, stay low.

In or beside a vehicle. Stay inside and roll up the windows. A vehicle is a larger target than you are alone. If riding a motorcycle or bicycle, dismount and seek proper shelter. The same is true for tractors and horses.

Outside a building. Get inside! And if the building is unprotected, stay in the middle of it away from metal.

In a camp or tent. Pitch tents in spots as low as you can and still avoid a flash flood or high water floor.

If Mother Nature had purposely set out to do so,

she could not have come up with a more unfortunate target for lightning than she did when she designed the tree. A Herodotus of Greece said 4,000 years ago, "God loves to truncate those things that rise too high." This is certainly true with trees. The taller, older, more stately and more valuable the tree, the more likely it is that lightning will either truncate it, strip off the bark or otherwise doom it to die.

Certain trees, of course, are more valuable than others. America is growing older and all over the country are an increasing number of publicly and privately owned trees which have grown in vulnerability to lightning as they have grown in historic and sentimental value. As a result, there is a new and larger need for lightning protection for these trees.

Examples are four valuable trees of history. One is the Dueling Oak in New Orleans. During the early Creole days, honor was easily injured. Many duels were fought under this tree. Some with little or no provocation. The Dueling Oak is still living and stands in New Orleans City Park. Another is called the Indian Trail tree. Indians often bent young trees over and tied their tips to the ground to mark a trail. It is found in a park near Evanston, Illinois. Another is the Sailor's Sycamore. It stands on the seashore near Santa Barbara, California. Sailing masters of the old days used this tree to locate their anchorage. The final example is the Mullan tree. Captain John Mullan carved his initials in the tree after completing a 624-mile military road past the tree, from Fort Benton, Montana to Walla Walla, Washington. The tree stands in the Coeur d'Alene National Forest in Idaho.

Among the four trees the Dueling Oak has the greatest chance of being struck by lightning according to commonly used statistics, because New Orleans is located in an area that has 80 thunder storm days per year. The tree that is second most likely to be struck by lightning is the Indian Trail tree near Evanston, Illinois, which has about 45 thunderstorm days per year. Third likeliest lightning target is the Mullan tree located in Idaho where there are about 25 thunderstorm days per year. And finally, the Sailor's Sycamore tree at Santa Barbara, Californis is in an area subject to lightning strikes about 10 thunderstorm days per year.

An area's thunderstorm days per year is not the sole determining factor in a tree's vulnerability to lightning. A thunderstorm day is a day during which thunder is heard within a particular area. But we all have seen periods when storms have stood stationary for days, with thunder heard each day for a number of days.

Trees are attractive lightning targets. Like a building, a tree provides a "ladder" for positive ground charges of electricity to climb and strain toward the negative charges in the storm cloud above. Certain trees are more likely lightning targets than others. Height, depth of roots, type of soil, elevation, and location are all factors. And so, it is believed, are the properties of the wood.

More oaks are struck than any other species. But this may be because there are more oaks in the heavier storm areas. Authorities believe that if all other factors were equal, a tulip tree in a grove of trees containing all species would be the likeliest target. A long-term study showed that the ten tree species most often struck by lightning run in this order: oak, elm, pine, tulip tree, poplar, ash, maple, sycamore, hemlock and spruce. Beech, birch and horse chestnut are the species struck least often.

Whatever the species, favorite lightning targets are a lone tree, the tallest tree in a group, and a tall tree at the end of a row or edge of a grove nearest the approaching storm. When two trees are of equal height, with one five feet from a house and one 15 feet away, the tree adjacent to the house might be the likeliest target because the house plumbing might give that tree a better ground.

A tree is not a great conductor of electricity and offers resistance to the travel of lightning current, but it gets struck because it is a better conductor than the air around it. Since it does offer resistance to passage of electric current, a tree is highly subject to damage. Lightning will punch through regardless of resistance, following a path on the outside or inside of the tree which happens to be the most moist and thus the most conductive.

Sometimes lightning uses the entire trunk of the tree as one large conductor. That is what happens when all the bark is stripped off the tree.

Very often lightning knocks the branches off a tree. This occurs without damage time and again in the forest, but it can be something of a bother when a tree is located near where a lady parks her car.

Lightning protection Codes require protection of any tree that is taller than a house and within 10-feet of that house. From thousands of lightning property loss reports over a two-year period, the Lightning Protection Institute picked 1,000 losses, large and small, in which the lightning bolt's point of entry into the house was known. In 112 of those cases, or 11.2 percent, the bolt first struck a tree, then flashed to the house in search of a better ground.

When lightning strikes an unprotected tree, it frequently follows down the trunk and then dissipates along the roots. More than half of the trees that are struck by lightning eventually die because of the traumatic damage. The ground potential within the drip area of the tree becomes very high when lightning current is being dissipated there. That is why so many people and animals are killed or injured under trees. Even if lightning does not physically kill the tree, a lightning struck tree is much more vulnerable to destruction by insects. When bark beetles attack a single lightning-damaged tree, they may then make a mass attack on surrounding trees. Alan Taylor, Research Forester of the U.S. Department of Agriculture, recently documented a case where lightning damage to the Ponderosa pine in Western Montana brought on a mass attack by pine engraver beetles. Lightning tore off a 65-foot spiral strip of bark from the bole of the struck tree and severed several lateral roots. Seventy-three trees within 80-feet of the struck tree were attacked by beetles, and 84percent of the attacks were successful.

There are a number of gruesome pictures of what happens to people and animals that are unfortunate enough to seek shelter under either a lone tree or the tallest tree in a grove during a lightning storm. One shows where 18 head of uninsured, valuable cattle were buried by a farmer after lightning struck a tree near where they were standing.

A study of 500 outdoor deaths and injuries from lightning bolts showed that in 63 of these cases the casualties occurred under trees struck by lightning. Golf courses lead as sites of outdoor lightning casualties, both under trees and in open shelters; therefore, more course owners are equipping trees, as well as shelter houses, with lightning protection. So are picnic ground owners, park boards or managers, and many homeowners.

One big and growing reason for an increase in tree protection at public places is owner liability. If a tree at a public site invites people to take shelter from rain and then those people are hurt or killed by lightning current, the owner stands a chance of being sued if he had not taken reasonable steps to prevent such an occurrence. Perhaps warning of the danger may be deemed a reasonable precaution or perhaps a protection system may be termed "prudent." In any case, the chances for legal liability are increasing.

Lightning protection for a tree will, if properly done, fully protect the tree from any likelihood of damage by a thunderbolt. It will also decrease the danger to people or animals of ground potential, because the grounds will lead the current deep into the moist soil where it will dissipate, or if a counterpoise ground, will carry the charge out beyond the drip area. We cannot say that lightning protection will completely eliminate danger to people or animals under or near the tree, but we can say that it greatly reduces the chance that they will be killed or injured.

From 80 to 90 percent of all accidental livestock deaths in the United States are caused by lightning bolts. Among cattle, one-third of such deaths occur under trees where the animals have sought shelter. Most of the remainder occur in barns that are struck. More lone pasture trees are being equipped with lightning protection because livestock and the trees themselves have increased in value. One fast-growing area of tree protection is on horse farms, and on county homesites where there is a horse or two. Horses, like cows, may stand under lone trees during thunderstorms.

Lightning protection equipment made especially for trees should be used, not material made for other purposes. A tree system contains four main parts: air terminal points (rods), conductor cables, copper fasteners and adequate grounding.

A main air terminal point is placed as high up as it can be securely fastened, and miniature terminal points are fastened on main branches. The main down-conductor, a 32-strand, 17-gauge copper cable, runs from the main terminal point to ground cables, and is joined by connectors to 14-strand, 17-gauge copper cable attached to the branch terminals. Grounds are generally half-inch to three-fourths inch rods driven to a depth of ten feet. Special soil conditions may require special grounding. Grounds are made away from the main root system. Trees with trunks more than three feet in diameter need two down-conductors, on opposite sides of the trunk. Only the major trees in a group or grove need to be protected. Thus, a sizeable grove of trees can be made safe without major cost.

If the grounding of a building is within 25 feet of a protected tree, the two systems can be interconnected. If there are several major trees in a row, there may be common grounding, so long as depth grounds are no more than 80 feet apart.

Special drive connectors are used to hold conductors away from the trunk. Attachments are spaced at three to four feet. Codes require that copper materials be used because aluminum cables may be damaged by moisture conditions from the sap of the tree. We recommend that the lightning protection installer be in good physical condition.

There are two Lightning Protection Institute programs that may be of interest to you. The first is the LPI code that is devoted to tree protection. The second is an LPI certification program for Installers, Master Installers and for lightning protection systems. Under the certification program, candidates are examined for knowledge and competency in four tests that require two days for the Master Installer designation, and one test beyond that for Designer certification. For LPI system certification, a Master Installer must supervise the installation, or the system can be installed by a journeyman and certified as correct by an LPI Certified Designer. The program is quite new, but is already being well accepted as a means of assuring quality and of discouraging owners from buying lightning protection that is low-priced because the materials and workmanship are deficient.

I will conclude with a quote from the article that appeared in *Park Maintenance* magazine:

What is the responsibility of the park's owner — county, village or municipality — if lightning should suddenly strike and cause casualties among the people gathered there?

This question has become far more critical in recent years since legal attitudes hardened in regard to lightning safety.

The role of legal thunder in the courts of America is signalling a new era of liability for public safety by property owners, particularly public bodies. A few years ago, no serious lightning casualty suits against cities and other government bodies had been heard of; today there are several.

A new legal trend toward greater public liability is evolving that could lead to blaming many recreational deaths and injuries from lightning or negligence. Lightning itself is still an unavoidable "Act of God" in law. If a casualty results from the failure of a park or campground owner to provide adequate and easily available lightning protection, however, the owner may now face greater likelihood of suit.

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