

dously in most urban areas over the last 20 years. Air pollution is often associated with the physiological decline of vegetation surrounding large metropolitan areas, and manifestations of this decline are characterized by early senescence, changes in plant-water relations and generally poor growth. Growth reduction depends on many factors, including the nature of the pollutant, its concentration, the duration of exposure and the species of plant(s) involved.

Among the most significant physiological effects ascribed to air pollution is the modification of CO₂ exchange. Most experiments indicate that photosynthesis is suppressed in trees with fumigated with gaseous pollutants. Photosynthetic decline may be caused by alterations in chlorophyll content, membrane permeability or stomatal opening. Important biochemical changes are also associated with atmospheric contamination, including changes in enzyme activity and alterations in the pattern of CO₂ fixation.

The various abiotic stress factors reviewed here represent some of the more important environmental constraints which influence the growth and development of trees in urban landscapes. As environmental conditions in most metropolitan areas continue to deteriorate, it becomes increasingly important for the professional arborist to understand the physiological response of urban trees to stress situations. Obviously, it will be much easier to select and maintain trees which can withstand the rigors of abiotic stress if the arborist has some understanding of the physiological basis for stress resistance.

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MUNICIPAL ARBORICULTURE IN CHARLOTTE, NORTH CAROLINA¹

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In growing cities like Charlotte, North Carolina there is constant need to maintain in the best manner possible the existing street trees, especially when little else other than answering complaints has been the rule for years. But more important to the future treescape of any such city is a vigorous planting program. Given municipal budgets these both need to be done at minimal cost. In Charlotte we are attempting to do both, and keep costs down, by first obtaining pertinent information on the existing street trees as well as suitable locations for future trees. With this background information and through the use of electronic data processing we then hope to develop a scientific, thorough street tree management program as well as an intelligent

tree planting plan and implementation. We are in the process of carrying out these procedures. This paper describes some of them.

Charlotte, North Carolina, like many other municipalities, has grown from a small crossroads to a thriving metropolis. In the process of this development Charlotte has undergone also a changing treescape. The future of any city's treescape, Charlotte's included, depends not only on a successful maintenance program of pruning, removal, pest control, etc. but also on what is planted now for the coming generations. Therefore, we would like to emphasize this aspect of our program.

The species that makes up the largest number of Charlotte's street trees is the willow oak

¹ Presented at the annual conference of The International Society of Arboriculture by the junior author in St. Louis, Mo. in August 1976.

(*Quercus phellos*). Although we have many other species along Charlotte's streets, only four species other than willow oak, make up any significant part of the street tree population. These are red maple (*Acer rubrum*), sugar maple (*acer saccharum*), dogwood (*Cornus florida*), and crape myrtle (*Lagerstroemia indica*). We are still planting these tried and true species, but we are attempting to be selective in where we plant them, i.e. to match the existing character of the street. This means, for example, that we will replace willow oaks on streets sides and medians with willow oaks when individual trees have been lost and space is available for the full development of that species.

However, we are deemphasizing the dependence on such a small number of species. With the Dutch elm disease experience in mind, we are trying new species, varieties, and cultivars. Besides "disaster proofing" our city against things equivalent to Dutch elm disease, this will also give more variety aesthetically and will allow more intelligent planting in such locations as under utility lines.

The new species, varieties, and cultivars that so far appear to be successful on the streets in this area are Kwanzan cherry (*Prunus serrulata* Kwanzan), bald cypress (*Taxodium distichum*), London plane (*Platanus acerifolia*), Scanlon red maple (*Acer rubrum* Scanlon), and Bradford pear (*Pyrus calleryana* Bradford). We are in process of adding others to this list.

As might be expected, experimenting with new types of trees in an area is going to lead to some failures. As examples: the cherry laurel (*Prunus laurocerasus*) at first seemed promising for downtown areas with its relatively small size and evergreen habit. Experience, however, has shown that it doesn't stand up well in such situations. It is also hard to obtain in suitable sizes. The flowering globe head locust (*Robinia hispida* x *macrophylla*) looks beautiful in bloom. The rest of the year, however, it has serious problems including its inability to stand on its own, poor graft unions, and, to some people, its grotesque form.

Both the Flame ash (*Fraxinus oxycarpa* Flame) and the Golden Desert ash (*Fraxinus oxycarpa*

aureaefolia) have had problems with borers in the Charlotte region.

One of the main goals of the Charlotte street tree planting program is to transform barren street sides into pleasing tree-lined communities. The Landscaping Division is approaching this goal in a number of ways. On major thoroughfares, when there are appropriated funds, the Division lets contracts for tree planting with private concerns. The trees planted are primarily B&B stock. This allows the planting to get off to a quick start. Monies for landscaping are now generally included with each road improvement contract. Again the B&B trees are planted by private contractors. Selection of suitable species, varieties, or cultivars for the particular situations and supervision of plantings are done by the City Arborist.

A third phase of the overall picture is the relatively new program of tree easements on private property. When many of the major roads in Charlotte are widened there is inadequate public right-of-way left for planting trees. To lessen the impact of increased traffic nearer to residences, we are planting trees on private property. These easements are for four years to allow for planting and establishment of the trees. After that period the trees revert to private ownership and maintenance. Landscaping Division personnel plant and maintain these trees for the time of the easement. So far results are promising but it is still too early to say how successful the program will be.

Another promising street tree program is one in which private citizens and the Landscaping Division actively cooperate. In consultation with the City Arborist, citizen groups, such as garden clubs, improvement associations, etc., select appropriate tree species, varieties or cultivars, for their streets. They determine what size tree will be planted. The cost of purchasing the trees is borne by the residents. Landscaping Division personnel locate the planting sites, order, plant, and maintain the trees. The contact groups collect funds for purchase of the trees from the neighborhoods and do much of the public relations work. If the trees are lost for any reason the City replaces them at no further expense to the

private citizen. Generally the trees planted under this program are bare root, although recently we had a case where large B&B stock was purchased by private individuals. This program is designed for residential streets where the trees will be primarily for the benefit of the local residents. The program multiplies the efforts of Division personnel and will make Charlotte a more beautiful city sooner than would otherwise be possible.

Next, we need to examine some of the tree problems in Charlotte and what the Landscaping Division is doing about them. Many of the willow oaks in Charlotte look great when just the tops of the trees are viewed. The bases tell a different story. Here we find conks of *Polyporus* sp. These indicate extensive root rot underground. Excavation of some of these root systems show that papery tissue is holding up 2-4 foot diameter trees. Some have already fallen on houses and cars during recent storms. Injury some time during the life of the tree allowed the decay fungus to enter the tree roots. We are attempting to remove these trees as fast as we find them.

Decay is not limited to the root systems. Basal rot may gain entrance into trees which have been injured by sidewalk, curb, or other types of construction, as well as those hit by cars. Apparently, rot in the Charlotte area proceeds faster than growth, which in itself is pretty rapid. We, therefore, have initiated a program of actively identifying and treating affected trees where possible. This program will save Charlotte's trees for a longer period than if nothing is done to slow down the decay.

Another decay and an aesthetic problem results from willow oaks and other large tree species growing under or too close to utility lines.

Decay is extensive in these "roundovers" and "side trims." We are working with the local utility companies to remove these eyesores and potentially hazardous trees. The utility companies are removing the branches near the wires and landscaping personnel are completing the removal. Landscaping then replaces them with species, varieties or cultivars compatible with the site.

The recently started, systematic pruning program should catch minor street tree problems before they become major. We do have crews handling complaints and crises, but hopefully these types of situations will lessen as the management program takes hold.

The basis of our management program is an accurate and up-to-date street tree census. Currently we are three-quarters through with the field work on the census and are progressing on the computer analysis of the data collected. Not only are we obtaining information on existing trees as to their species, size, and condition but we are also determining where we have locations to plant new trees and the limiting site factors, if any. Field information is being digitally entered on optical scanning forms for direct reading on to computer tape. The information gathered will not only be used to formulate a scientific management plan for Charlotte's street trees; along with ordered priorities and cost analyses of the operations involved, but will also allow the formulation of a master street tree program to make Charlotte, tree wise, one of the most beautiful cities in the United States.

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ABSTRACT

Long, M.E. **Chippers**. *Grounds Maintenance* 11(11): 32, 34.

Machines available for converting wood and brush into chips range all the way from huge, truck-mounted units powered by 300-horsepower engines, and capable of gobbling logs up to 5 ft. in diameter, to small 5-horsepower units that can be pushed on their wheels to the job site. In selecting from all the available machines the one which will best meet your needs, there are many factors to keep in mind. As with any mechanical device, your chipper unit is ultimately going to need repair parts and service.