SHADE TREE MORTALITY STUDY TECHNIQUES[1]

by Robert S. Dewers

Abstract. Infrared overflight film was provided by the Texas Forest Service in September 1976 to aid in post oak mortality studies in the city of College Station, Texas. The film aided Texas A&M University urban forestry ground teams in locating trees under abnormal stress. Probable causes were determined on site. The gathered data indicated that construction related damage and not vascular diseases was the primary contributing factor to dieback and mortality. Recommendations were made to the city to reduce man-related stresses on this sensitive shade tree species. As a result a city forester position was established to design and promote tree policies. Incidental benefits of the tree survey included the adaptation of a grid sampling technique and a coordinate inventory system that can be used for street trees and off-street trees simultaneously.

For several years the post oaks (*Quercus stellata* Wangenh.) in the expanding Bryan-College Station, Texas area have been dying at an apparent abnormal rate. Causes of losses were unexplained and other species were planted to replace the native post oak. Recent observations by pathologists indicated the presence of a complex of vascular fungi which may be the terminal cause of host mortality (Van Arsdel and Halliwell, 1970). The prediction was made that within a few years virtually all the post oaks in the area would be eliminated by disease. Because College Station lies in a post oak savannah, this species represents the principal native shade tree in the environs. Thus, the citizenry became suddenly aware of the implication of this prediction, i.e., that they might lose their most valuable shade trees. Accordingly, the city fathers came to us for answers to sober questions: (1) would they lose essentially all the post oaks and (2) what could be done, if anything, to prevent further loss?

Procedure. Our first step in response was to make a ground survey of the post oaks in College Station during the summer of 1976. We were provided with infrared aerial photographs and ground maps. By studying the infrared frames and by making several ground truth surveys we were first able to identify post oaks with a satisfactory degree of accuracy from the frames. We then became more adept at observing the dark red color tone in post oaks indicating a vigorous canopy, the lighter pink indicating trees under stress, and yellow to green tone indicating trees with brown leaves (Van Arsdel and Bush, 1970). In almost every instance in our pilot study we noticed that trees under stress were in the area of recently constructed subdivisions. We then conducted a more thorough ground survey to confirm our growing suspicion that post oaks were dying where the sites were disturbed by man.

In the fall of 1976 we organized our urban forestry class into teams. Each team was given a ground map representing a segment of the city. Using infrared photographs to guide us we covered approximately 90 percent of the city and inspected virtually every post oak that was dead or in a state of decline. Vigorous trees were identified both by the infrared photographs and ground observation. To determine the total number of post oaks in the city we used a grid random sampling system on the aerial photos by plots as follows:

Ninety grid plots were sampled. Each grid represented 360,000 ft^2, 90 plots represented 32,400,000 ft^2. A total of 1082 post oaks 4" size or larger were counted in the 90 plots. This represented 743.8 acres or 1.45 post oaks per acre in the sample. With a total of 11,800 acres in the city the figure translated to 17,100 post oaks present in the city. A 90% survey converted to 15,390 post oaks actually in the survey.

Results. The results of the ground survey are summarized in Table no. 1.

Of an estimated 15,390 post oaks, 268 (1.74%) of the trees were in a state of decline or dieback and 153 (0.99%) were dead.

The conclusion was that construction was the probable primary contributing factor to dieback in post oak. Van Arsdel (1977) reported that cultures of post oaks exhibiting symptoms of dieback invariably show the presence of

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Cephalosporium diospyri, a specific vascular fungus which behaves similarly to oak wilt (*Ceratocystis fagacearum*). The same pathogen can also be found in vigorous post oaks. Therefore, it appears that an inverse relation exists between tree vigor and fungal activity resulting in host mortality. The apparent reaction of the tree to perturbation to the root system compounds the damage and might be considered the primary cause of decline and mortality. It is postulated that the roots of post oak are very sensitive to disturbance, particularly when growing in shallow sandy loam over a clay hardpan. Their lateral root systems become shallow and extensive as they attempt to penetrate the hardpan. A substantial portion of the root system is found near the soil surface where sufficient soil air is available for active uptake. Interference with normal root activity will inhibit water and nutrient uptake. Destruction of the root system itself is the more apparent cause of this inhibition. Exclusion of essential soil oxygen caused by compaction and fill is the more subtle cause (Yelonovsky, 1964). This places stress on normal tree metabolism which makes the host more vulnerable to insect and disease activity. The objective, therefore, is to reduce man-induced stress on this sensitive species and thereby keep pathogens endemic.

Table I. POST OAK DECLINE SURVEY
CITY OF COLLEGE STATION 1976

Probable Cause	Declining	Dead
Cut or fill - bulldozer	49	63
Vehicular compaction	11	1
Raising water table	18	14
Utility ditching	37	21
Erosion	6	1
Paving over roots	49	28
Lightning	11	3
Trunk damage	6	5
Weed killer	13	0
Other and undetermined	68	17
Total	268	153

Recommendations. The following recommendations formed a part of the report to the city council: (1) A seminar should be held for developers and builders in order to explain how trees grow and how to avoid unnecessary loss of post oak and other species. It is important that those responsible for ditching under ground lines, i.e., electric, gas, telephone, and cable television, be asked to attend such a seminar. It is recognized that some tree damage will occur despite care and understanding, but it is believed that damage could be materially reduced.

(2) A trained urban forester or municipal arborist, either as a member of the city staff or as a retained consultant, should be employed to work with the city planner and make a survey of proposed street and utility service prior to approval of

Fig. 1. Ditching for underground utilities was the apparent cause of loss of this group of post oaks which will not afford expected shade to this Texas home.

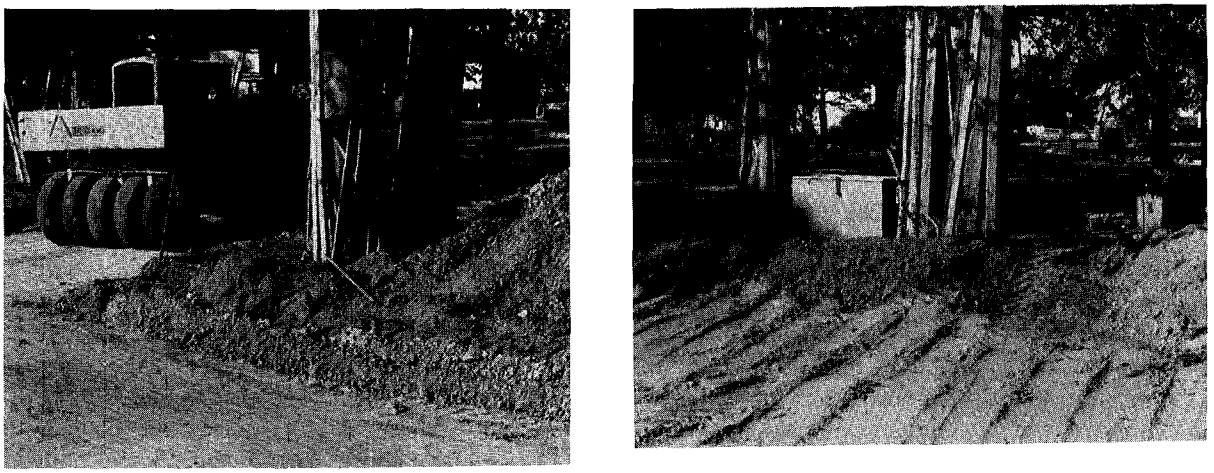

Fig. 2. Careful protection to the trunk of these oaks offers no protection to the root system as heavy equipment cuts away and compacts the root system.

same. Certain restrictions could then be placed on the developer relative to cut and fill procedures and ditching. Likewise, home builders should be made responsible for the stresses placed both on city-owned trees and trees on residential lots. This would provide more protection to the homeowners who have bought a home with trees, many of whom now find their wooded lots less wooded than they were when the property was acquired.

(3) The city should adopt a street tree policy which will assure future tree care and provide quality multi-species tree selection lists so that people will be less dependent on the construction-sensitive post oak.

As a result of the study a city forester position was established. Incidental benefits of the survey involved the adaptation of a grid sampling technique to city trees, and a coordinate inventory system that can be used for street trees and off-street trees simultaneously.

Literature Cited

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