REPLACING A PROBLEM PRONE STREET TREE SAVES MONEY; A CASE STUDY OF THE TULIPTREE IN BERKELEY, CALIFORNIA

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Municipal streets in America are lined with about 57,000,000 trees. Their value is conservatively estimated at 15 billion dollars (5). Trees greatly enhance the quality of our urban environment, but also have negative traits including the requirement for maintenance expenditures. Pest management is among the major costs of tree maintenance. Research on solutions to urban forest pests has generally lagged behind the investigation of pests of commercial forests or agriculture (3). Pest management and other maintenance costs can be particularly burdensome for species poorly suited for the local street tree environment. From an economic perspective, the best solution for particularly troublesome trees can be removal and replacement.

One problem street tree in the San Francisco Bay Area is the tuliptree, *Liriodendron tulipifera*. In the late 1960s, approximately 400 tuliptrees were planted along University Avenue in Berkeley, California. The tuliptree is native to the moist temperate zone hardwood forests of the eastern United States. Also known as the tulip-poplar or yellow-poplar, it is a commercially valuable hardwood species which grows to heights of over 100 feet. The tuliptree is adapted to deep, rich, well-drained soils and plenty of moisture during its season of growth (9). Tuliptrees are not well adapted for the summer drought of Berkeley's Mediterranean climate. The trees are sensitive to air pollution (6) and in Berkeley are stressed from being planted in poorly drained clay soils covered with pavement.

The most vexing problem of University Avenue's tuliptrees has been the summer rain of aphid honeydew. Aphids are considered the number one street tree pest problem in the western United States (5). The honeydew, and an associated black sooty mold, makes a sticky mess on parked cars and sidewalks. In the East, periodic summer rains cleanse the foliage and wash the honeydew into the soil where it is recycled through nitrogen-fixing bacteria. In Berkeley, aphid honeydew has been the city's primary source of street tree pest complaints.

Honeydew pest management costs along University Avenue have been a major consideration in the city's evaluation of improved tree maintenance vs. replacement. To assist in this decision-making, a study was undertaken to evaluate the long-term costs of tuliptree maintenance vs. tree replacement.

Methods

Direct costs (in 1984 dollars) to the City of Berkeley to maintain 400 tuliptrees along University Avenue over the next twenty years was estimated from a survey of five San Francisco area parks supervisors or city arborists who have at least several hundred tuliptrees within their jurisdiction. These long-term costs of tuliptree maintenance were compared to the current dollar costs of replacing and maintaining a different species better adapted for Berkeley's street tree environment.

Indirect costs, such as staff time associated with the city's pest management decision-making committee, are not included. Also excluded from consideration are external costs; those incurred by entities other than the city. External costs include the sooty mold and honeydew carpet cleaning bills of University Avenue merchants and the potential health and environmental hazards of broad spectrum pesticide applications.

Aesthetic costs/benefits are not included because they would vary substantially depending

on the time frame. Mature street trees have a significantly greater value than young trees (2) and tuliptree replacement would reduce the quality of the street temporarily. However, as they mature, a better adapted replacement tree would provide greater aesthetic benefits.

Results and Discussion

Trees require maintenance in order to function safely as desired along city streets. A 1975 study of 17 southern California cities found that the costs of maintaining park landscapes, including trees, ranged from $1,900 to $7,000 an acre per year. The initial costs of tree planting were equaled or exceeded by tree care costs after only three years (4). Some street tree costs, such as root damage to sidewalks and trimming, typically increased with age. The extent of sidewalk damage and pest management costs vary with tree species. Inappropriate species selection can result in a considerable increase in the demands on a city's street tree maintenance budget.

The twenty-year costs of maintaining University Avenue's 400 tuliptrees (excluding pest management and sidewalk repair) was estimated as $222,000 (Table 1). This includes two structural trimmings ($170,400), two clearance trimmings ($25,600), the removal and replacement of 1 in 100 trees assumed to die each year ($16,000) and sidewalk tree well modifications to accommodate trunk growth ($10,000). Annual maintenance costs per tuliptree along University Avenue are estimated as $28 (all values are 1984 dollars). This figure agrees well with Harris (4) who reported that the annual maintenance of public trees was about one third the cost of tree planting (planting was assumed in this report to cost $100/tree).

Pest management will add significantly to the cost of tree maintenance. Table 2 summarizes the twenty-year costs of annual aphid honeydew management for 400 tuliptrees. These costs range from $72,000 for tree injection to $307,200 for weekly sidewalk washing (June-September) by city employees. Berkeley currently responds to honeydew complaints by employing canopy sprays of insecticidal soap (Safer's Agro-Chem brand) and recommends that merchants regularly wash their sidewalks.

In addition to pest management, pavement damage by root growth from these moisture loving trees has been a particular problem in Palo Alto and San Jose, California. Those communities have tuliptrees averaging fifteen to twenty years older than Berkeley's. Experience there has shown that severe sidewalk displacement begins to appear when the trees are about twenty years old. The cost of root trimming and repairing damaged sidewalks is $300-500 per tree per repair. Once a tuliptree has begun to cause significant sidewalk displacement, this cost can be expected to be incurred again five to seven years after the first repair, and then again 2-3 years later assuming the pesky tree has not been removed.

Based on estimates from the cities of Palo Alto and San Jose, it is assumed that by the time University Avenue tuliptrees are 35-40 years old (20 years from now), 1/4th of them will require root displacement sidewalk repairs. Half of those trees will require a second repair (a total of 150 sidewalk repairs). At $400 per repair, this would amount to $60,000 during the next 20 years.

Root displaced sidewalks can also lead to accidents and liability claims. A single such claim in Palo Alto amounted to $50,000. Reduced liability is a primary goal of most tree maintenance programs. Recent "deep pockets" court rulings in California may require a city to pay 100% of any damage awards even though the city was at fault for only a small portion of the factors contributing to an accident. Berkeley's 20-year-old University Avenue tuliptrees have begun to displace sidewalks in at least one area. This problem can be expected to accelerate with age and eventually become of major concern along some of the most busy sidewalks in the city. The cities surveyed were reluctant or unable to quantify their liability costs from accidents caused by root damaged sidewalks, so potential liability costs are omitted from this analysis.

If sidewalk repair and annual pest management by the least expensive method (insecticide injection) are included, the 20-year cost of University Avenue tuliptree maintenance amounts to $354,000.

The replacement tree presumed for this analysis is the London plane, *Platanus acerifolia*. The plane tree is known for its "remarkable climatic adap-

Table 1. Maintenance vs. replacement, the twenty year costs of 400 University Avenue tuliptrees in Berkeley, California*

Maintenance Activity	*Activity cost per tree ($)*	*Frequency per tree*	*Total twenty year costs ($)*	
			Tuliptrees	*Replacements*
Trimming (structural)	213	2 times in 20 yrs. 1 time in 20 yrs.	170,400	85,200
Trimming (clearance)	32	2 times in 20 yrs. 3 times in 20 yrs.	25,600	38,400
Dead tree removal	100	1 tree in 100/yr.	8,000	8,000
Dead tree replacement	100	1 tree in 100/yr.	8,000	8,000
Watering (Jul-Sep)	0.60	Biweekly 1st 3 yrs.	none	3,600
Trunk growth allowance	25	Once in 20 yrs.	10,000	none
Tuliptree removal	100	Once in 20 yrs.	none	40,000
Tuliptree replacement	100	Once in 20 yrs.	none	40,000
SUBTOTAL			222,000	223,200
Sidewalk damage repair	400	3/8 of trees in 20 yrs.	60,000	none
Pest management	9		72,000	none
SUBTOTAL			132,000	none
TOTAL			354,000	223,200

*Values are in 1984 dollars.

Table 2. Twenty year costs for annual aphid honeydew management for 400 University Avenue tuliptrees in Berkeley, California.*

Method	*Annual cost per tree*	*Total 20 year cost for 400 tuliptrees*
Sidewalk washing (weekly Jun-Sep.)	$38.40	$307,200
Canopy soap sprays (3 times/yr.)	24.00	192,000
Injection (once/yr.)	9.00	72,000
Chemical sprays (2 times/yr.)	12.00	96,000

*Values are in 1984 dollars.

tability and easy culture" (7). Pirone (8) states that "The London plane tree is one of the most widely planted trees in cities . . . because it is more tolerant to air pollutants and other unfavorable growing conditions than most trees." The plane tree is planted along several main Berkeley thoroughfares and is considered to be relatively problem free. Beatty (1) developed a master street tree plan for Lafayette, California, which recommends other dominant and supplemental trees which would probably be suitable for University Avenue.

The current dollar costs of tuliptree removal, replacement, and maintenance over twenty years with the less problem prone plane trees is estimated as $223,200 (Table 1). This includes tuliptree removal ($40,000) and replacement ($40,000), summer watering of the new trees during their first three years ($3,600), one structural trimming ($85,000), three clearance trimmings ($38,400), and removal and replacement of the 1 in 100 plane trees expected to die each year. These expenses approximately equal the 20-year costs of tuliptree maintenance, excluding sidewalk repair and aphid control.

If the projected costs of sidewalk repair and annual tree injection are included, tuliptree maintenance would cost the city $130,000 more than removal, replacement, and new tree maintenance. The actual savings from tree replacement would be equal to any pest management and/or sidewalk repair costs which are avoided. A temporary loss in aesthetic value would occur from removing and replacing mature (but problem prone) street trees. However, the long-term benefits would be attractive and less bothersome street trees as well as a substantial savings in cost.

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