BETTER WAYS OF SELECTING TREES FOR URBAN PLANTINGS[1]

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Abstract. How to choose the best species and cultivars for particular planting sites is a challenging problem even for experienced arborists. Many types of information are available to guide decisions, but more specific and precise urban performance data are needed. A threefold strategy is suggested for urban tree managers: 1) exploit current knowledge more fully; 2) participate in tree testing to obtain more extensive, objective data; and 3) consider special analyses of existing plantings to fill the gap until test results became available.

How can arborists do a better job of choosing trees for urban plantings? Undoubtedly, this has been one of the most challenging questions since the profession of arboriculture began, and still is today. Practices such as assembling lists of species that are recommended or prohibited, or preparing master planting plans, indicate the importance of this question. These may be useful approaches if they draw upon the best expertise available. But they are limited by the validity of the information used to select desirable species and cultivars, and the wisdom used in assigning them to particular locations.

It is time-consuming to make a wise decision about which tree is best for a particular site. Experienced arborists know that there is no easy shortcut. Complex biological, architectural, managerial, and social considerations are involved (Gerhold and Steiner 1976). Even with the most careful analysis, one cannot be entirely sure that the best choice has been made.

The main reason for uncertainty in deciding which species or cultivar to plant is due to the difficulty of predicting performance under urban conditions. In particular, information for comparing survival, growth rate, risk of disease and insect injuries, maintenance costs, and longevity of trees growing on specific urban sites is generally not available. The lack of objective data on urban tree performance is understandable, as relationships with site variables are especially complicated in cities. When a tree is unhealthy it is usually difficult to determine to what extent it is inherently inferior or has been exposed to adverse urban site conditions. In a recent national survey (Ottman and Kielbaso 1976), municipal tree managers were asked to rank the importance of information they needed most. "Tolerance of different tree species to adverse conditions" was ranked first in a list of 62 items, and "species selection for the manager's own area" was ranked fifth. Because published information for guiding planting choices is grossly inadequate, arborists have had to rely mainly on their own experience.

Improper choices of species can result in serious losses, both financial and aesthetic. In northeastern states alone, over one million landscape trees are sold annually by nurseries, representing a landscape investment of at least $50 million dollars (Gerhold *et al.* 1975, 1979). About 40 percent of these are planted and managed by municipalities and highway departments (Long *et al.* 1973, Ottman and Kielbaso 1976). Too many trees die prematurely or receive avoidable injuries, resulting in eyesores and excessive costs of removal and replacement. If urban tree managers in the Northeast could improve their selection methods, collectively they could save $200,000 per year for each one percent improvement in survival. An even greater amount could be saved in reduced maintenance costs if trees were better adapted to urban conditions.

The purpose of this paper is to compare several ways of obtaining better information to guide planting choices. Recent progress in this subject is reviewed, and a strategy is suggested for ar-

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borists to improve their selection methods.

Currently Available Information

Most of our present-day knowledge about selecting urban trees concerns their appearance and the diseases or insects that may injure them. Appearance traits generally are under strong genetic control. Therefore, repeatable observations of trees growing in different environments support reliable conclusions about the more obvious differences among species and cultivars. For example, red maple cv. 'Armstrong' is fastigiate, while cv. 'Bowhall' has a narrow pyramidal shape; cv. 'Autumn Flame' turns scarlet early in the fall, while cv. 'October Glory' is brilliant orange to red and retains leaves later (Dirr 1977). Our knowledge of diseases and insects is generally based on sound research which makes it possible to recognize species differences in susceptibility, but in many cases it is not sufficient to predict the impact on tree management programs. Books by experts such as Pirone (1978), Tattar (1978), and Wyman (1965, 1969) contain a wealth of information. But little of it is quantified in a form that would be most useful to urban tree managers for making planting choices.

By digging through the scientific literature, one may also find more specialized information, such as variation in tolerance to air pollutants. For example, red maple as a species has been classified as resistant to ozone and intermediate in susceptibility to sulfur dioxide (Davis and Gerhold 1976). In a later study, red maple cv. 'Bowhall' was resistant to sulfur dioxide, intermediate in sensitivity to ozone, and sensitive when exposed to a mixture of the two gases (Karnosky 1981). It remains to be seen how these contradictory results from fumigation chambers will be related to reactions of street trees exposed to different mixtures of gases under varying environmental conditions. Comparisons of field tests with chamber fumigations (Karnosky 1981) indicate that revisions will be needed in sensitivity lists. Such inconsistencies and uncertainties must be frustrating to arborists who try to keep up with research findings.

How much easier it is to rely mainly on nursery catalogs. To sell trees they emphasize the desirable features of trees with beautiful pictures; it is of course not advantageous to mention any flaws that some trees may have. Most catalogs do contain reliable information about traits such as cold-hardiness and crown shape. Some deal with potential problems in a constructive way by listing trees that can tolerate drought, shade, smoky cities, and other difficult planting sites.

Organization of Information

Several formats have been employed to simplify comparisons among species and cultivars, especially those most useful to urban tree managers. A "Manual of Woody Landscape Plants" by Dirr (1977) uses standard headings to summarize the usual information about species, and also contains comments on landscape value and cultivars. A similar format is used in "Native Trees for Urban and Rural America" by Hightshoe (1978), a book which in addition contains many lists, tables, maps, and graphic symbols. Articles by Shurtleff (1979) and by Koller and Dirr (1979) provide information about more restricted lists of trees which they considered especially suited to city environments. Another approach is to tabulate information about trees recommended for limited regions, such as "Trees for New Jersey Streets" (N.J. Fed. Shade Tree Comm. 1974) or "Street Trees" for Pennsylvania (Daniels 1975). "Selecting and Growing Better Landscape Trees for Northeastern United States" (Gerhold *et al.* 1979) contains tabulated characteristics of 86 species and cultivars based on a survey of municipal arborists, exemplifying the present state-of-the-art. Respondents evaluated appearance and adaptive traits, and overall performance on five types of urban sites.

These various sources and types of current knowledge all contain information that is useful, but far from ideal for making planting choices. If a novice were to make full use of current knowledge, he should be able to avoid the most serious blunders, and to make a reasonably good choice in many cases. But even the most experienced arborists could benefit from more specific and precise information. Currently available information about many species and traits has moderate to severe deficiencies in three respects. It is —

1) not detailed enough for defining adaptation to specific geographic regions and kinds of

urban sites.

2) not standardized in methods and format for comparing performance.
3) not precise enough for discriminating some important differences among species and cultivars.

Urban Performance Tests

How can better information be obtained for making planting choices? Scientifically designed tests of trees growing under urban conditions at many locations would provide the most satisfactory data. Methods and data forms for performance testing have been developed (Bartoe and Gerhold 1979, Sacksteder and Gerhold 1979), with the hope that financial support for large scale testing might be obtained through federal agencies. When this did not materialize, the concept was revised to enable interested state and municipal agencies to begin on their own. Data on survival and recovery from transplanting can be collected within a few years, so that species best adapted to particular sites can be selected and the need for replacements can be reduced. But it will take longer to evaluate most other traits, including growth rate, susceptibility to injuries, and maintenance needs. That is all the more reason to start performance testing as soon as possible.

Recognizing this imperative, the Metropolitan Tree Improvement Alliance (METRIA) in June, 1980, decided to start a Cultivar Testing Project. Its purpose is to stimulate the testing and evaluation of cultivars which are commercially available for urban planting. The procedures are simple and practical. Cooperators will incur no added costs for purchasing and planting trees, as trees designated for testing will be among regular urban plantings and obtained through the usual channels. METRIA proposes to serve as a catalyst, assisting those municipal arborists and state agencies that wish to participate. Regional committees composed of participants will adopt standardized testing methods, inform participants about technical services and publications that are available, monitor progress, and disseminate results. It is anticipated that testing of some species can begin in 1982.

The concept of obtaining performance data from urban plantings is not new. Small-scale studies of street trees have been conducted successfully in Ohio by Reisch and co-workers (1971) and in New York by Mower (1973). The shade tree evaluation project in Ohio also includes a much larger number of species and cultivars, but in a non-urban environment (Chapin and Kozel 1975). Similar evaluations have been made in Oregon by Ticknor (1971). The Cultivar Testing Project of METRIA differs in that many more trees, locations, and people will be involved. Results will apply specifically to the cities where testing is conducted. Furthermore, through a unified approach and standardized methods, data from extensive geographic regions may be compiled and compared. The results will show the geographic region and kinds of urban sites to which each cultivar is well adapted, and the traits in which it is superior or inferior compared to other cultivars. The cities that become engaged in testing will receive the greatest benefits, but others will find the results useful, too. All who are able to participate will be encouraged to do so (contact METRIA, Forest Resources Laboratory, University Park, PA 16802). For as the number of participants increases, more cultivars can be tested, and the quantitative and geographic precision of results will improve. The most important incentive, however, is that results will apply most directly to those cities where performance data were obtained.

As performance testing continues and expands over the years, the knowledge available to aid in selection will become progressively better. Improvements in survival can be realized after one-to three-year data have been analyzed. Information on health and maintenance needs will become increasingly more useful as data accumulate over a 10 to 30 year period. However, it should be recognized that several years will elapse after performance testing gets started before any practical results will become available; and many years will go by before optimum effectiveness will be realized.

Analyses of Existing Plantings

Because of the inevitable delay before new plantings can be evaluated, the possibility of filling the gap with studies of existing street plantings should be considered. One source of such data is tree inventory files, which can be utilized conveniently if the most important variables defining tree and site conditions have been recorded, particularly in computer-readable form. Another possibility is a specially designed survey of existing plantings which samples species or cultivars and ages that are of greatest interest. Cities where a new inventory will be conducted can avail themselves of features which evaluate species performance in some of the more advanced inventory and management information systems (Sacksteder and Gerhold 1979).

We have conducted two projects for evaluating species and cultivars in existing urban plantings. The first was a research study in which extensive tree inventory data from several cities in the Northeast were analyzed. The second was a contract for collecting and analyzing performance data by randomly sampling species and cultivars of known ages planted in a large urban region of Maryland.

Inventory Data

The analyses of existing tree inventory data were made possible by a grant from the I.S.A. Memorial Research Trust. Data from several cities in Massachusetts, New York, and Pennsylvania were collected by different observers using the Tree Records System for Municipalities (TRESYSTM) (Gerhold and Sacksteder 1979). Forms and data processing were provided by Urban Tree Systems, Inc., a consulting firm through which TRESYSTM services are made available to communities. After sorting out records for species with less than 50 trees in a city or without foliage ratings, we were left with about 13,000 trees in 14 different species at four locations. Because these extensive data sets were already collected and stored on magnetic tape, it was convenient to extract subsets for comparing the health of species and for correlation analyses.

Some rather large differences were found in the composite health ratings of the various species at the four locations (Table 1), ranging from 3.3 to 4.8. Ratings above 4.0 indicate good health, 3.0-3.9 fair health, and below 3.0 poor health. The city average of Winchester was lower than the others, indicating either that the observer there was more critical of tree health, or else that more of the trees were in poor condition. Some species such as honeylocust and pin oak had high ratings at all locations, while others such as silver

Table 1. Size and health of street trees in Lynnfield (L), MA, Winchester (W), MA, Babylon (B), NY, and State College (S), PA.

	Number of Trees				*Av. diameter inches*				*Av. health[2] rating*			
Species	*L*	*W[1]*	*B[1]*	*S*	*L*	*W*	*B*	*S*	*L*	*W*	*B*	*S*
Norway maple	311	1373	2150	508	10	12	9	20	4.7	3.8	4.2	4.4
Red maple	145	93	468	372	16	16	9	7	4.1	3.6	4.2	4.4
Silver maple	13	106	1025	62	15	21	16	24	4.8	3.6	4.2	4.5
Sugar maple	373	678	32	2116	16	15	11	9	4.0	3.6	—	4.4
White ash	207	214	—	—	18	18	—	—	4.1	3.7	—	—
Honeylocust	14	54	37	107	8	7	3	9	4.8	4.3	4.6	4.4
Crabapple	17	12	17	136	5	4	3	4	4.4	3.7	4.7	4.2
London plane	4	—	81	144	6	—	2	23	4.2	—	3.7	4.3
White pine	107	29	6	—	16	11	6	—	3.7	4.1	4.5	—
White oak	63	24	101	20	18	22	12	21	3.9	3.6	4.0	4.6
Pin oak	14	45	203	201	11	10	5	15	4.6	4.3	4.3	4.6
Red oak	—	47	146	426	—	19	16	7	—	3.9	4.0	4.3
Black oak	198	67	—	—	20	21	—	—	4.0	3.8	—	—
American elm	80	55	—	256	19	23	—	25	3.4	3.3	—	4.7
City Total	1546	2797	4446	4348								
City Average									4.2	3.8	4.2	4.4

[1] In these two cities all calculations were based on the number of trees indicated, except health of foliage was recorded on a smaller number in most species.

[2] Average health was calculated from separate ratings of trunks, branches, and foliage on a scale of 1=poor to 5=excellent; e.g., a foliage rating of 4 indicates 4/5 (80%) of the foliage was completely healthy.

maple, white oak, and American elm had high ratings in some locations and much lower ratings elsewhere. Thus the composite health rankings of species within cities varied greatly.

The separate health ratings of trunks, branches, and foliage exhibited even more extensive variation (Table 2), ranging from 2.6 to 5.0. Health ratings of trunks were highest in Lynnfield, branches in State College, and foliage in Babylon. Within cities there was fairly close correspondence of health ratings given to foliage and branches of many species. Trunk health ratings were not as closely correlated with foliage or branches. Red maple in particular had low values for health of trunks, possibly because of its thin bark. Honeylocust and pin oak where the only species in which all average health ratings were 4.0 or better. American elm had very low ratings in two cities, but high ratings in State College which has a very effective program for controlling Dutch elm disease. This illustrates the extent to which health ratings can be influenced by managerial practices.

Effects of site conditions were analyzed in State College and Lynnfield, the only places where sufficient data were available (Tables 3 and 4). Only significant correlations are shown in the tables, and most were for foliage or composite health ratings. Quite a large number were found, especially for species that had a large number of observations. However, most significant correlations only accounted for a small proportion of variation (which is the correlation coefficient squared). Most correlation coefficients were between 0.10 and 0.33, which correspond to 1 percent and 10 percent of the variation, respectively. Correlations of health with diameter generally were the largest, but negative values in Lynnfield indicated smaller trees were healthier, while larger trees in State College were healthier than smaller ones. Many other comparisons point to contradictory results at the two locations, i.e., opposite signs, low vs. high coefficients, or significant vs. insignificant correlations.

The bewildering results indicate that various causes of variation in tree health were confounded in the two data sets. Only speculations are possible about most causes. Did observers apply health rating scales differently? Probably not enough to explain the results. Were various seed sources within species differentially adapted? Quite possibly, but no information on this question was available. The same answer can be given to questions about differential damage possibly caused by insects or diseases, or about differences in tree care practices such as planting, pruning, or removals. It is known that average diameters differed greatly in some species (Table 1), and these must reflect age differences. It is likely that the distribution of different sized trees

Table 2. Health of trunk, branches, and foliage of street trees in Linnfield (L), MA, Winchester (W), MA, Babylon (B), NY, and State College (S), PA.

	Trunk Health[1]				*Branch Health*[1]				*Foliage Health*[1]			
Species	*L*	*W*	*B*	*S*	*L*	*W*	*B*	*S*	*L*	*W*	*B*	*S*
Norway maple	4.7	3.9	4.0	4.3	4.6	3.5	4.1	4.5	4.6	3.8	4.6	4.5
Red maple	4.2	3.6	3.9	4.1	4.0	3.4	4.0	4.8	4.0	3.9	4.6	4.2
Silver maple	5.0	3.9	3.9	4.5	4.8	3.6	4.1	4.5	4.8	3.4	4.5	4.5
Sugar maple	4.3	3.7	4.0	4.2	3.9	3.3	3.6	4.8	3.8	3.8	—	4.3
White ash	4.6	3.8	—	—	3.8	3.3	—	—	3.8	3.9	—	—
Honeylocust	4.8	4.5	4.3	4.4	4.9	4.0	4.3	4.6	4.9	4.4	4.9	4.1
Crabapple	4.4	4.1	4.4	4.0	4.4	4.0	4.4	4.7	4.6	—	4.7	3.9
London plane	4.5	4.0	3.9	4.2	4.0	4.0	3.3	4.8	4.0	—	4.0	4.0
White pine	4.7	4.4	4.2	—	3.1	3.8	4.3	—	3.3	3.9	5.0	—
White oak	4.7	4.1	4.1	4.4	3.4	3.3	3.8	4.9	3.6	3.3	4.3	4.6
Pin oak	4.9	4.5	4.0	4.6	4.3	4.2	4.3	4.8	4.4	4.3	4.4	4.4
Red oak	—	4.2	4.0	4.3	—	3.7	3.9	4.5	—	3.8	4.3	4.1
Black oak	4.7	4.2	—	—	3.6	3.6	—	—	3.8	3.6	—	—
American elm	4.4	3.9	—	4.6	3.3	2.9	—	4.7	2.6	3.3	—	4.8
City Average	4.6	4.1	4.1	4.3	4.0	3.6	4.0	4.7	4.0	3.8	4.5	4.3

[1]Calculated from observations on the numbers of trees listed in Table 1. Standard deviations ranged from 0.3 to 1.2.

among the several site conditions could explain some of the variability. But it must be concluded that many of the correlations that were found (Tables 3, 4) could be accidental.

Accordingly, many of the inconsistencies in species health ratings (Tables 1, 2) probably are due to some unknown degree to the site conditions where they happen to be growing, also changes associated with size and age, and partly to genetic differences among and within species. Results of surveys or analyses of inventory data in which effects of variables are not adequately controlled or corrected are likely to be misleading.

Special Surveys

In the Maryland Project, three local governments (the city of Baltimore, and Montgomery County, and Prince George's County) contracted Urban Tree Systems and the Environmental Services Division of Davey Tree Expert Company to evaluate existing plantings of various species and cultivars during 1980. Old planting records were assembled by the tree departments, and plantings of ages 3 to 20 were randomly sampled. Minor problems were encountered due to high mortality in some plantings, and some records that were inaccurate as to species or age of planting. Nevertheless some very useful information was obtained about tree performance in that region, and some important insights applicable to using this technique elsewhere were gained. In this specially designed survey and analysis, there was much

Table 3. Health of trees in Lynnfield, MA, correlated with site variables and trunk diameter. Larger values show stronger correlations[1]; blanks indicate significance. B or T indicates where a significant correlation with health of branches or trunk was stronger than with foliage (F) or the composite (C) of foliage, branches, and trunk.

		Planting Space						*Curb*		*Traffic*		*Site*		*Trunk*	
	No.	*Total*		*Width*		*Length*		*dist.*		*class[2]*		*class[3]*		*diameter*	
Species	*trees*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*
All species	1495	.14	.11			.09	.07 T	.19	.15 BT	.10 B	.07 B			−.41 B	−.37 B
Norway maple	302	.23	.19	.20 T	.15 T	.13	.15	.26	.25					−.27 B	−.23 B
Red maple	141							.28	BT	T	T			−.42	−.32 BT
Silver maple	13														
Sugar maple	362	.25	.22 BT	.16 B	.12 BT			.32	.27 B	T	T			−.41 B	−.34 B
White ash	198							.16 B	.16 B	.18 B	B				
Honeylocust	14							.15	.51 T					−.61	−.53 T
Crabapple	17							BT	BT	B	B		−.58 B		
London plane	4														
White oak	59									.36 B	.33 B				
Pin oak	14						.55								
Red oak	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Black oak	191					.16 T	T	T	T					−.17 B	B
American elm	76	−27 B	−.23 B	−.26 B	B										

[1]Spearman correlation coefficients, significance level 0.05.

[2]Traffic class light = 1, moderate = 2, heavy = 3.

[3]Site classes light residntial = 1, dense residential = 2, business = 3

better control over some sources of variation. A single tree expert measured and evaluated all species and cultivars, checked their identities, and recorded site variables. Relationships of tree characteristics with age and site variables were calculated, so these would not confound comparisons.

The results provide a much sounder basis for making planting choices, as performance comparisons apply directly to the environments and managerial practices that were sampled. Nineteen species and 16 cultivars of Norway maple, red maple, sugar maple, Callery pear, and little-leaf linden were compared. Superiority in one or more characteristics was exhibited by 'Olmsted' and 'Cavalier' Norway maples and 'Rancho' Callery pear, while 'Bowhall' was inferior to other cultivars of red maple in Maryland. No relationships with site variables were uncovered. Extensive statistical analyses supplemented by observations on the condition of each species and cultivar gave practical results which can guide planting choices in the future. These will be reported in detail in a separate publication. The techniques employed in Maryland will be useful and available also to other cities that wish to have existing plantings analyzed.

A Strategy for Tree Managers

Returning now to the question posed initially,

Table 4. Health of trees in State College, PA, correlated with site variables and trunk diameter. Larger values show stronger correlations[1]; blanks indicate significance. B or T indicates where a significant correlation with health of branches or trunk was stronger than with foliage (F) or the composite (C) of foliage, branches, and trunk.

		Planting Space						Curb		Traffic		Site		Trunk	
	No.	Total		Width		Length		dist.		class[2]		class[3]		diameter	
Species	*trees*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*	*C*	*F*
All species	4333	−.06	−.13	−.05	−.11			−.07	−.10	−.14	−.12	.08		.31	.31
						B	B					B	BT		
Norway maple	506	.17	.14	.16	.14	.11	.11	.12	.16		−.09	.17	.18		
		T	T	T	T									B	B
Red maple	367												.17	.22	.19
				B	B							B	B		T
Silver maple	60						27								
						B									
Sugar maple	2112	−.06	−.13	−.05	−.12			−.06	−.11	−.18	−.17	.09	.06	.34	.28
						B	B					T	T	T	T
White ash	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Honeylocust	107										−.32	−.23			
												T	T		
Crabapple	136			.18				.29	.33			−.27	−.35		
														B	B
London plane	144	.16		.17											
			T		T										
White oak	20														
Pin oak	201									−.26	−.14		.16	.19	.31
		BT	BT	BT	BT	T	T	T	T						
Red oak	424	−.26	−.19	−.27	−.20			−.22	−.14	−.33	−.21	.11		.59	.42
			T	T	T				T		BT		B		T
Black oak	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
American elm	256														.21
		T	T	T	T										

[1] Spearman correlation coefficients, significance level 0.05.

[2] Traffic class light = 1, moderate = 2, heavy = 3.

[3] Site classes light residntial = 1, dense residential = 2, business = 3

"How can arborists do a better job of choosing trees for urban plantings?", we recommend a three-fold strategy. Its objective is to improve the process for selecting species and cultivars by exploiting existing knowledge more fully and by obtaining more extensive information that applies to the specific geographic locations and types of sites where trees are to be planted.

First, currently available information should be exploited more effectively, including published articles and personal experience. The main idea is to reduce generalized information to its specific application and value in the local tree management program. One useful format for organizing such information is a table in which characteristics of species and cultivars are quantified and organized so that the relative desirability of each is expressed for different categories of planting sites. An example of this type of format is found in Appendix 2 of "Selecting and Growing Better Landscape Trees for Northeastern United States" (Gerhold *et al.* 1979). However, planting site categories should be modified so that they are the ones used in each tree manager's decision-making process. When the table has been completed, the several species and cultivars that are most suitable for each type of planting site can be readily identified. These are then ranked in order of desirability as a guide for making the final choice for a particular site.

The second part of the strategy is to join in a cooperative program for obtaining better information for selection. The Cultivar Testing Project of METRIA is a long-term effort which provides an opportunity to meet this need. It will fulfill its potential only if large numbers of arborists participate over a period of several decades. But the need for this undertaking is so great, and the degree of improvement that can be achieved is so valuable, that it is expected to receive strong support.

The third element in the strategy is to consider special analyses of existing plantings or inventory data, to provide immediate information. This approach is likely to be worthwhile especially for larger cities or groups of cities that have large planting programs. However, useful interpretations seem possible only where there is reliable information about the ages and genetic identities of trees.

The three-fold strategy should be highly cost-effective. Parts one and two will require only about 2 to 5 days of an arborist's time per year; thus no increase in the budget will be required, though it may take a special effort to set aside the necessary time. However, the return on this investment should be substantial, especially after several years. Special studies of existing plantings may cost several thousand dollars, the exact amount depending mainly on the number of trees to be evaluated. Therefore, only cities with large planting programs can affort special studies, as potential savings will be proportional to improvements in survival and quality in the absolute numbers of trees planted. Analysis of existing or new inventory data may be a more reasonable alternative if reliable data on ages and genetic identities are available.

Urban tree managers always have had to rely mainly on their own knowledge and resourcefulness in making planting decisions. The proposed strategy for selecting trees does not relieve them of this responsibility. But their planting choices can be improved if they will join with others in obtaining better basic information and devising ways to use it more effectively.

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ABSTRACTS

RIEDEL, R.M. 1981. **Pinewood nematode discovered in several Ohio pine species.** Ohio Report 66(3): 43-44.

A new and potentially serious pathogen of important species of pine trees has been identified in Ohio. The pinewood nematode, *Bursaphelenchus lignicolus,* was first found in the state in March 1980, in Hamilton County, in response to a call from a Cincinnati arborist about declining 30-year-old red pines. A brief survey in the summer of 1980 found the nematode in red, white, Scotch, pitch, and Japanese red pine in nine Ohio counties. It has been collected from landscape, nursery, and forest plantings.

HALLER, J.M. 1981. **Improving the arborist-customer relationship.** Am. Forests 87(5): 11-14.

As in any other professional-client relationship, difficulties sometimes arise between the arborist and the person employing him. The customer (in most cases a homeowner of modest means) often does not know what he wants or needs, has generally only the haziest idea of prevailing prices, and is unable to distinguish between genuinely good work and the most blatant charlatanism. The arborist, for his part, frequently neglects to explain exactly what needs to be done and how he proposes to go about it, and too often fails to give a realistic estimate of cost — generally because he is afraid of driving the customer into the arms of his competitors. Perhaps the best way to avoid unpleasant misunderstandings is to make out a written agreement in which everything to be done, together with the amount and conditions of payment, is stated specifically and unambiguously. This agreement should be made in duplicate; each party should sign, and each should keep a copy. Both customer and arborist should politely but firmly insist that the other comply.