SELECTING AND TESTING STREET TREE CULTIVARS

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ABSTRACT – – To improve street trees through better selection of species 1 and cultivars is an important goal of the Municipal Tree Restoration Program . Communities have been assisted by publishing "Street Tree Factsheets", through workshops on "Selecting Street Trees', and by research on performance testing of cultivars. Factsheets on 35 species or genera and 87 cultivars were based on published information and observations of arboricultural experts. The factsheets provide practical descriptions of appearance, advantages, limitations, and culture. The workshops introduced laymen and professionals to the factsheets and how to use them in municipal settings. More precise information is being obtained through performance tests of cultivars, which have been established at 20 locations so far and include 23 cultivars. Tests have been organized by service foresters of state forestry agencies jointly with community representatives, utility foresters, and Penn State University. These 50-tree plantings, supported financially by utility companies, serve also as incentives for community participation and as demonstrations of how conflicts of trees with wires can be resolved. The cooperative Municipal Tree Restoration Program has developed successful methods that integrate education, research, and service to communities, methods which have excellent potential for improving urban trees and tree care practices.

INTRODUCTION

"What's the best tree to plant along this street?" appears to be a simple question. But few people would give a simple answer. A novice might

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thoughtlessly recommend a favorite tree, not recognizing the complexities of such a decision. A local arboricultural expert could quickly arrive at a simple recommendation, by sorting through his extensive knowledge of trees according to constraints of the site and the community. But many of us would take longer, and perhaps would give a less definitive reply. A thorough analysis would take into account the desired landscape design, several important site variables, some managerial and safety concerns, and the many tree characteristics of a large number of species or cultivars that deserve consideration.

Most people who select street trees are neither novices nor experts. They commonly are aware of the importance of selecting appropriate trees, but they can also be somewhat bewildered by complications of the selection process. This was recognized when the Municipal Tree Restoration Program was started in Pennsylvania in 1987, and has been addressed in three ways:

1) Practical information that can be used in selecting trees has been compiled from many sources into a publication, "Street Tree Factsheets".
2) Educational workshops have been held on "Selecting Street Trees".
3) Better information needed for selection is being obtained through a series of performance tests planted in municipalities.

I shall describe each of these and explain how they fit into the more comprehensive purposes of the Municipal Tree Restoration Program.

STREET TREE FACTSHEETS

There is a wealth of information that is useful for selecting landscape tree species adapted to temperate zones of North America. But much less has been published on cultivars, and it is more scattered and based on fewer observations, especially for newer cultivars. The purpose of "Street Tree Factsheets" (Gerhold et al. 1989) was to compile such written and observational information with particular reference to cultivars that are suitable as street trees. A standardized format was adopted to enable users to quickly find the facts they seek. Concise information was assembled on mature size (color coded for easy sorting), hardiness, limitations, and cultural advice. Color photos were included because they impart information about appearance and branching structure that cannot be readily conveyed by words or numbers.

Published information about species and cultivars was compiled from seventy publications. These included scientific and technical papers, popular articles, books, extension bulletins, and various other reports. Another very important source was a draft of the "Handbook of Landscape Tree Cultivars", which has since been published (Wandell 1989). This reference contained much data gathered from members of the nursery industry in a systematic manner. It also identified cultivars which were being

produced annually by primary growers in quantities of 2,000 and more.

In choosing cultivars to be included, several criteria were employed. Cultivars should be well adapted to urban sites in the 20 northeastern states represented by the U.S. Forest Service region which provided financial support for the publication. Many of these cultivars are grown also in more western and southern states. Another criterion was ability to withstand stressful site conditions such as compacted soils, drought, or pollution. Low maintenance requirements also were desirable, so branching structure, disease resistance, and insect resistance were considered. The best cultivars were chosen for species in which many were available; summary information was provided for these in species factsheets. Several species in which no cultivars are available or commonly used were also selected. A few factsheets were included to caution against misuse or overuse of certain species or cultivars, such as silver maple and 'Bradford' Caller-y pear. Altogether, there are 35 factsheets on species or genera and 87 on cultivars.

A panel of 33 experts was assembled to critically review drafts of the factsheets and to advise on adding or dropping species or cultivars. The panel consisted of people from the nursery industry, universities, arboreta, municipalities, and government agencies. They provided written comments prior to intensive discussions for two days. Much valuable information was acquired in this way, based on years of observations of trees in many different regions; differences of opinion were resolved by consensus. Such decisions were recorded in writing and revisions were projected simultaneously as a computer image, as each factsheet was discussed. Most of the color photographs were contributed by ten of the panel members.

How valid is this information? The thoroughness and expertise that went into its preparation gives assurance of high quality. But several kinds of uncertainties and inadequacies should be recognized. Some traits are more variable than others in response to different climates and site conditions. Growth rates and mature sizes are depressed according to severity of stresses caused by compacted soil, drought, heat, pollutants, or restricted space for root development. Disease and insect damage varies among regions and years, as they are affected substantially by climatic variations. To evaluate a cultivar thoroughly takes several decades, and exposure to a wide variety of site conditions. So information on newer cultivars should be considered less reliable than for those that have been widely planted for many years. Dates of introduction have been included to indicate relative reliability of information.

WORKSHOPS ON SELECTING STREET TREES

People who understand how street trees are selected can use "Street Tree Factsheets" as a reference without

difficulty. But many laymen and some professionals have found it useful to participate in workshops that explain how to use this publication in municipal circumstances. Two workshops held during 1989 in Pennsylvania were attended by 135 people from municipalities, state forestry agencies, electric utility companies, extension services, and the landscape architecture and nursery industry.

The workshops explained the significance of tree characteristics in relation to site conditions, nursery practices, planting methods, cultural practices, and concerns of property owners and municipal officials. These relationships were illustrated with slides, and groups of participants engaged in a selection exercise which was then discussed by the entire audience. An afternoon was devoted to a nursery visit, where many cultivars were examined and discussed.

These workshops on selecting street trees are part of a more comprehensive Municipal Tree Restoration Program of technical services, education, and research. (Gerhold 1987, Schein 1987, Municipal Tree Restoration Program 1989). The main thrust is to assist municipalities in developing better, more systematic tree care practices. In other workshops service foresters of several state agencies have received training in urban forestry, and municipal representatives were oriented to initiating or improving their tree care programs. Service foresters have assisted communities with advice on inventories, ordinances, tree commissions, commercial services, and recommendations for community needs in planting, pruning, and removal of trees. Financial support has been provided by three electric utility Companies and the U.S. Forest Service, Northeastern Area State and Private Forestry.

The utility companies' interest is to reduce multi -million dollar line clearance costs and minimize interruptions of electricity caused by conflicts of trees with wires. This can be accomplished by educating communities to the need for removal of hazardous trees and replacing them with species shorter in stature. The replanting is regarded as a preventative measure against the resurgence of unwanted trees that would cause problems again in the future. By embedding valid advice of utility companies in the MTRP program of service, education, and research, it is received and applied more effectively. Furthermore, antagonism against the utility company is replaced by favorable public relations.

PERFORMANCE TESTS OF CULTIVARS

Utility members of MTRP have been strongly supportive of research on the performance of cultivars as street trees, for several reasons. The prospect of free trees has proven to be a strong incentive for communities to become active in improving their trees. In some places problem trees are removed to make room for the

performance tests, leading directly reduced line clearance costs. Test plantings serve also as demonstrations that smaller types of trees can be appropriate under electric lines. The involvement of a respected university and an unbiased state agency in research that will aid in tree selection makes the results and recommendations much more acceptable. The need for further research on the performance of cultivars has been questioned by some, in view of substantial information already contained in the factsheets. A thorough analysis of the factsheets and of previous research would reveal serious deficiencies of knowledge about certain characteristics. Data on crown form, branching habit, and appearance of foliage, flowers, and fruit are quite reliable. But adaptation to various urban site conditions and geographic regions, including relative susceptibility to diseases and insects, is not very well defined. There have been few studies in which various cultivars of a species have been compared under the same conditions. Most of these have been conducted with young trees in nurseries or at rural sites, rather than with more mature trees under stressful urban conditions. Results of urban performance tests can lead to substantial savings in maintenance and replacement costs, and avoidance of excessive use of pesticides.

The performance testing methods used in MTRP were designed for statistical analysis that will detect practical differences at the 95% level of significance (Gerhold 1985). The initial test plantings have been limited to short or medium size cultivars because of the interests of utility companies which provide funds for purchasing the trees. Furthermore it is logical to focus initially on short cultivars, as space constraints are so common in urban settings. During the past three years 22 cultivars representing six genera have been planted at 20 locations in Pennsylvania, Maryland, and New York (Table 1). A typical test consists of two cultivars of the same species or genus represented by 25 trees each. These are planted in four to eight plots along streets and under wires. A plot contains four to sixteen trees, with approximately equal numbers of each cultivar. There are other options in designing tests (Table 2). For example 'Queen Elizabeth', the only cultivar of hedge maple that is available, may be compared with seedling trees of this species.

The planting plan is prepared by a service forester in consultation with a utility forester and a community representative. The municipality is responsible for obtaining consent of property owners, and for proper planting and care of the trees. The utility commonly will remove troublesome large trees at their cost in preparation for a test planting. B & B trees, 1 -1/4 to 2 inches in caliper, are ordered by Penn State for delivery to the municipality, at a cost for 50 trees that has ranged from $2,500 to $6,100, depending on size and species. Cultivar preferences are specified in the planting plan, including acceptable alternates.

Table 1. Cultivars in Performance Tests Planted during 1987-1989.

	Cultivar	No. of Tests
Amelanchier	'Cumulus'	1
Amelanchier	'Robin Hill'	1
Amelanchier	'Tradition'	1
Crataegus	'Ohio Pioneer'	1
Crataegus	'Vaughn'	1
Crataegus	'Winter King'	1
Malus	'Brandywine'	3
Malus	'Centurion'	3
Malus	'Harvest Gold'	2
Malus	'Madonna'	3
Malus	'Spring Snow'	2
Malus	'Sugar Tyme'	2
Prunus hillieri	'Spire'	1
Prunus sargentii	'Columnar-is'	1
Pyrus calleryana	'Aristocrat'	2
Pyrus calleryana	'Autumn Blaze'	1
Pyrus calleryana	'Bradford'	1
Pyrus calleryana	'Cleveland Select'	2
Pyrus calleryana	'Redspire'	3
Pyrus calleryana	'Whitehouse'	2
Syringa amurensis	'Ivory Silk	3
Syringa amurensis	'Summer Snow'	3

Table 2. Options in Designing Cultivar Performance Tests.

Test Options	No. of cultivars	Total trees	No. of plots	No. trees per plot
2 – cultivars test				
mixed plots	2	46-50	4 to 8	4 to 16
pure plots	2	45-50	8 to 12	4 to 8
1 – cultivar test				
mixed plots	1 or 2	46–50	4 to 8	4 to 16
pure plots	1 or 2	46–50	8 to 12	4 to 8
without comparison	1	23 -25	4 to 6	4 to 8

Measurements and observations are made by a service forester at the time of planting, then annually for three years near the end of the growing season, and subsequently at three-year intervals. Tree height, diameter, and various site conditions are recorded soon after planting. In late summer, before autumn coloration, height and diameter are measured, and health of foliage, branches, and trunk are recorded using standardized scales. Causes of injuries and maintenance needs also are noted. Data are sent to Penn State for analysis and evaluation.

The testing project has been very popular and has met with good success, though not without a few problems. Survival after the first growing season has been 100% in most places, and at least 90%. Service foresters have been thorough in carrying out their responsibilities, although finding the time has sometimes been difficult, for example during fire seasons or gypsy moth spraying. A few property owners have objected to tree planting at the last minute, sometimes because a community representative had not contacted them for permission. Occasional problems were encountered with quality of nursery stock, but nurseries have been very cooperative in resolving these. One year the Caller-y pears ordered from a northern nursery, but shipped from a southern state, had foliar injury caused by frost and/or fireblight. Borers were found in several tree lilacs when they arrived. One serviceberry cultivar did not meet tree-form specifications, as the trunk branched out within two feet of the ground. In most cases however, the cultivars were delivered in excellent condition. Limited availability of desired cultivars and sizes grown in the same nursery has been a common problem, and this may be aggravated with the current upsurge in tree planting.

It is too early to report results of the performance tests, as most of them have been measured only after one growing season. But evaluations in the next few years should lead to much better precision in matching cultivars to site requirements. For each genus there will be a series of 2-cultivar comparisons which will enable multiple comparisons across many geographic locations in an incomplete but interconnected matrix. During these early years of testing, no attempt has been made to influence the choice of cultivars or where they are to be planted. Greater control may become necessary to achieve a balanced distribution. Also, as new cultivars become available, it may be desirable to encourage communities to try these, so they may be compared to better known cultivars. No great difficulties are anticipated in choosing appropriate cultivars for test purposes, as communities have been very receptive to recommendations.

CONCLUSIONS

Several conclusions may be drawn from the efforts of the Municipal Tree Restoration Program to improve street tree selection practices.

1. Rapid sales of "Street Tree Factsheets" and the popularity of workshops on "Selecting Street Trees" indicate great interest in this subject, and a need for useful information. About 80% of the 7,000 copies printed have been sold or distributed in less than one year.

2. The free trees offered for performance tests have proven to be a strong incentive for municipalities to undertake actions to improve their tree care practices. The planting of smaller types of trees. under electric lines has gained acceptance readily. It is hoped that other utility companies will join MTRP, so that communities in their service areas can be induced to do their part in resolving conflicts of trees with wires.

3. The protocol for performance testing has been easy to learn by cooperators. Planting design requirements have sufficient flexibility to be accommodated even in small towns. The utility of results could be extended greatly if additional states would undertake testing with the same methods.

4. The cooperative program of education, research, and service to communities has been very well received by more than SO municipalities that are currently involved. Hundreds of others in Pennsylvania alone could benefit from the program. Finding time to assist them will be a challenge to the service foresters, who also must meet their more traditional responsibilities.

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