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VISUAL SIMILARITY AND BIOLOGICAL DIVERSITY: STREET TREE SELECTION AND DESIGN

Introduction

The selection and placement of trees in the urban environment is a complex task requiring the consideration of many factors. Issues such as visual spatial constraints and disease and insect resistance can sometimes conflict with other design objectives. Perhaps the most troubling conflict arises between the preference for visual uniformity and the practical need for species diversity. Until recently a typical street tree planting internationally consisted of uniform rows of a single species, generally selected for its attractive appearance and high tolerance to urban stresses. However, as over planting has brought about the decline of a number of such favorite species it is clear that design objectives must be balanced against the practical need for species diversity in street tree plantings.

Current Strategies

Faced with the difficulty of balancing aesthetic and ecological concerns, current designers all too often shortchange or even abandon one or the other objective. Where they may have once planted an entire neighborhood with the same species, those favoring uniformity over practicality might now plant a single species for one or two blocks of a given street. Although this sort of compromise may feel like a bow to diversity, it isn't a true solution to the problem. Planting trees in somewhat smaller 'same species' blocks will not necessarily prevent the kinds of devastation associated with monocultures on a block by block basis, particularly if the species selected are already heavily planted in the community.

For those favoring an ecologically sensible approach, the alternative to monocultures is sometimes to plant wonderfully diverse selections of trees that share no common characteristics whatsoever. The results of such efforts can be aesthetically disappointing, and have in a number of cases led to public outcry. Unfortunately, this type of plant selection has served to fuel the idea that the only way to achieve uniformity in design is through the exclusive use of one species.

The Case for Visual Uniformity

What makes uniform plantings so appealing in the first place? What makes them so difficult to give up? The advantages to uniformity are primarily aesthetic and have a long-standing tradition over many centuries internationally. A street lined with rows of more or less identical trees brings to most observers a sense of order and tranquillity. Even in the most heterogeneous of neighborhoods, a uniform allee of trees can have a cohesive influence, tying together diverse elements and creating a sense of neighborhood identity. At a more political level, what could be more democratic than a uniform planting of trees that does nothing to reflect differences in the people, lawns, and homes just beyond the sidewalk? Street trees can also soften the potentially jarring transitions from residential to commercial areas.

The Case for Species Diversity

Unfortunately, the appeal of same species plantings is ultimately outweighed by disadvantages. Even if aesthetics were the only consideration, the fact that unhealthy or dead trees are unattractive makes the need to diversify unavoidable. A quick review of disease and pest problems in street tree populations reveals numerous cases of devastation due to over planting or the exclusive planting of a single species throughout a community. Some of the most notable examples include the American elm (Dutch elm disease), American chestnut (chestnut blight), Honey locust (honey locust plant bug), Norway maple (giant tar spot and verticillium wilt) London planetree (anthracnose) and crabapple (scab, fireblight, cedar apple rust, and powdery mildew). Over planting of some popular species can also lead to serious maintenance problems. Species with characteristics such as weak wood, a tendency to develop chlorosis, girdling roots, and messy fruits can certainly be used in street tree plantings, but are only manageable when planted in moderation. Examples include Norway maple (girdling roots) and Silver maple (weak wood).

Another factor that makes monocultures impractical is the tremendous diversity inherent in the urban environment. The challenges and stresses for trees can change dramatically within very small spaces,

often making it impossible for a single species to thrive uniformly throughout a given area. Variables such as light, temperature, drainage, soil compaction, root space, soil pH, availability of water, exposure to salt, and restrictions to crown development can vary tremendously even from one tree space to the next. A careful assessment of site conditions prior to plant selection rarely points to the selection of a single species. Even those who are aware of this fact often make the mistake of selecting one species that will purportedly survive under any and all difficult conditions. Such widely adaptable species dominate the aforementioned list of overplanted trees that have suffered decline, become unmanageable, or both.

A Solution

To avoid similar problems in the future, it is clear that uniform plantings of a limited number of species must be avoided. But, is it possible to gain the practical advantages of diversity without giving up the aesthetic advantages of uniformity? Fortunately, the answer is yes. Through careful selection and grouping of plants, communities of trees can be created which, despite their genetic diversity can satisfy our desire for visual uniformity.

By breaking down the visual characteristics that distinguish one species or cultivar from another into basic categories, we have selected a set of four criteria for putting trees into aesthetically compatible groups. The first two criteria, size and shape, are of primary importance in grouping trees because they have greater and more immediate impact on the visual impression an individual tree makes. This is particularly true as a tree matures or as the distance from the tree to the observer increases. The other two criteria, branching density and foliage texture, are given secondary consideration because they generally are not as obvious to the casual observer and can even become difficult to distinguish as the distance from the observer increases.

Primary Criteria

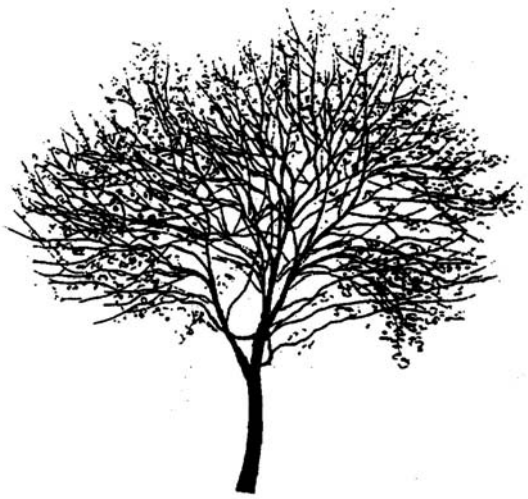
1	Size	Large	Greater than 30' at 30 years (5 – 6 M)
		Small	Less than 30 feet at 30 years (5 – 6 M)
			Height to first branch
2	Shape	Round	Width > or = height of canopy
		Oval	Width < height
		Vase	Narrow at the base, becoming distinctly wider at the top
		Columnar	Width distinctly < height

Secondary Criteria

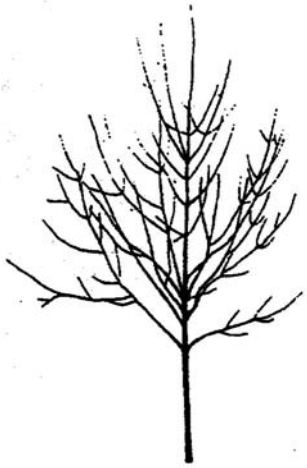
3	Branching Density	Dense	Greater than 50% opaque
		Open	Less than 50% opaque
4	Foliage Texture	Coarse	Large leaves (or leaflets) with blunt ends or lobes
		Fine	Smaller leaves (or leaflets) with acute apexes
			Foliage color

Clearly, these categories are broad, but when applied with a measure of subjective analysis and common sense, they yield some very practical and appealing groups of trees. Trees with medium or borderline characteristics have been placed subjectively on the basis of their subtle characteristics. For example, trees of the genus *Fraxinus* have medium-textured foliage but because of the narrow apexes of their leaflets have been placed in fine-textured groups. In some cases the basic groups are presented with subgroups that work particularly well together. And in other cases, a special characteristic shared by a number of trees called for the creation of an additional recommended group. The following plant lists are for temperate areas and have been designated for hardiness using U.S.D.A. zones.

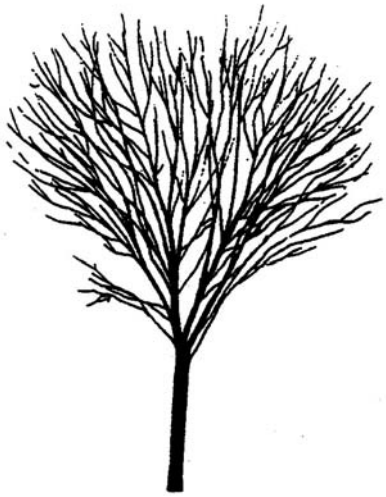
Examples of Canopy Shapes



Round



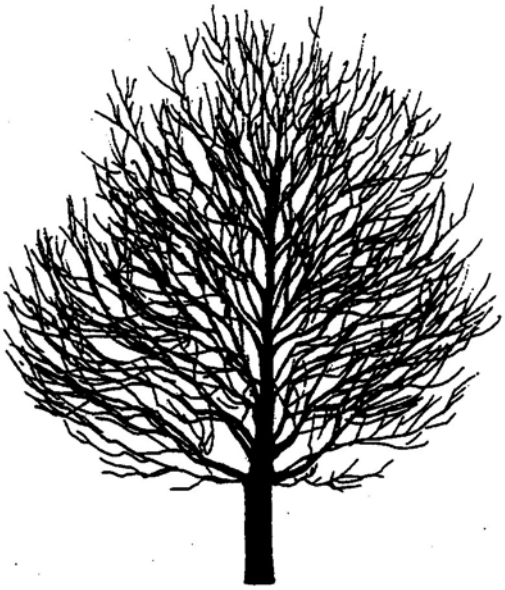
Oval



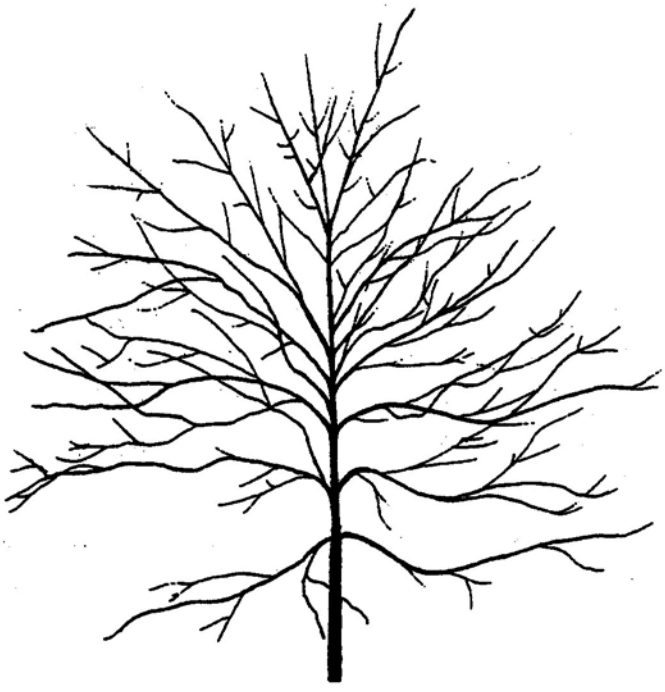
Vase

Columnar

Examples of Branching Density



Dense



Open

RECOMMEDED GROUPS OF VISUALLY COMPATIBLE TREES

In addition to cold hardiness zones, all trees have been designated using the following site characteristics typically found in urban areas which include the following:

W = tolerates poorly drained soil	A= requires acidic soil - pH < 7.0
MWD = requires moist, well drained soil	N = tolerates neutral soil - pH < 7.4
MD = tolerates moderate drought	AL = tolerates alkaline soil - pH < 8.2
SD = tolerates severe drought	

The following lists include the primary and secondary characteristics previously discussed for size, shape, and foliar texture:

Large Trees with Round Canopies, Dense Branching, and Coarse-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Acer platanoides 'Emerald Queen'	Emerald Queen Norway Maple	4a	MD	AL
Acer platanoides 'Summershade'	Summershade Norway Maple	4a	MD	AL
Acer platanoides 'Superform'	Superform Norway Maple	4a	MD	AL
Acer rubrum 'Autumn Flame'	Autumn Flame Red Maple	3b	W	A
Acer rubrum 'Northwood'	Northwood Red Maple	3b	W	A
Acer rubrum 'October Glory'	October Glory Red Maple	3b	W	A
Platanus x acerifolia ' Bloodgood'	Bloodgood London Planetree	5b	W/MD	AL
Platanus x acerifolia 'Columbia'	Columbia London Planetree	5b	W/MD	AL
Platanus x acerifolia 'Liberty'	Liberty London Planetree	5b	W/MD	AL

Large Trees with Round Canopies, Open Branching, and Fine Textured Foliage

Group 1		Cold Hardy to Zone	Moisture	pH
Celtis laevigata 'All Seasons'	All Season Sugar Hackberry	5b	MD	AL
Celtis laevigata 'Magnifica'	Magnifica Sugar Hackberry	5b	MD	AL
Celtis occidentalis 'Prairie Pride'	Prairie Pride Hackberry	3b	SD	AL
Eucommia ulmoides	Hardy Rubber Tree	5b	SD	AL
Maclura pomifera 'Park'	Park Osage Orange	5b	W/SD	AL
Maclura pomifera 'Wichita'	Wichita Osage Orange	5b	W/SD	AL
Pyrus calleryana 'Faurei'	Faurei Callery Pear	5a	W/SD	AL
Group 2				
Cladrastis kentukea	Yellowood	4b	MD	AL
Fraxinus americana 'Autumn Purple'	Autumn Purple White Ash	4a	W/MD	AL
Fraxinus pennsylvanica 'Emerald''	Emerald Green Ash	3a	W/MD	AL
Gymnocladus dioicus	Kentucky Coffee Tree	4a	SD	AL
Phellodendron amurensis	Amur Cork Tree	4b	MWD	AL
Phellodendron amurensis 'Macho'	Macho Amur Corktree	4b	MWD	AL
Group 3				
Gleditsia triacanthos var. inermis	Thornless Honey Locust	4b	MD	AL
Gleditsia triacanthos var. inermis 'Halka'	Halka Honey Locust	4b	MD	AL
Gleditsia triacanthos var. inermis 'Moraine'	Moraine Honey Locust	4b	MD	AL
Gleditsia triacanthos var. inermis 'Shademaster'	Shademaster Honey Locust	4b	MD	AL
Sophora japonica 'Princeton Upright'	Princeton Upricht Scholar Tree	5b	SD	AL

The trees in this group may be used in any combination but have been presented in three subgroups which work particularly well together. The first, second and third groups contain trees with simple, compound, and very fine compound leaves respectively.

Large Trees with Round Canopies, Open Branching, and Coarse-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Quercus macrocarpa	Bur Oak	3a	W/SD	AL
Quercus muehlenbergii	Chinkapin Oak	5a	MD	AL
Quercus ruba	Red Oak	3b	MD	N
Quercus robur	English Oak	5b	MD	AL

Large Trees with Oval Canopies, Dense Branching, and Fine-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
*Metasequoia glyptostroboides	Dawn Redwood	5b	MWD	N
*Taxodium distichum	Bald Cypress	5a	W	N
*Taxodium distichum 'Shawnee Brave'	Shawnee Brave Bald Cyrpess	5a	W	N
Cercidiphyllum japonicum	Katsura Tree	5a	MWD	AL
Corylus colurna	Turkish Filbert	5a	SD	AL
Fraxinus pennsylvanica 'Bergeson'	Bergeson Green Ash	2a	W/MD/SD	AL
Fraxinus pennsylvanica 'Cimmaron'	Cimmaron Green Ash	2a	W/MD/SD	AL
Fraxinus pennsylvanica 'Newport'	Newport Green Ash	2a	W/MD/SD	AL
Fraxinus pennsylvanica 'Patmore'	Patmore Green Ash	2a	W/MD/SD	AL
Fraxinus pennsylvanica 'Summit'	Summit Green Ash	2a	W/MD/SD	AL
Fraxinus pennsylvanica 'Urbanite'	Urbanite Green Ash	5b	W/MD/SD	AL
Nyssa sylvatica	Tupelo	5a	W	N
Ostrya virginiana	American Hophornbeam	3b	MD	AL
Pyrus calleryana 'Autumn Blaze'	Autumn Blaze Gallery Pear	5a	W/SD	AL
Pyrus calleryana 'Whitehouse'	Whitehouse gallery Pear	5a	W/SD	AL
Sorbus alnifolia	Korean Mountain Ash	4b	MWD	AL
Tilia cordata 'Chancellor'	Chancellor Littleleaf Linden	3b	MD	AL
Tilia cordata 'Glenleven'	Glenleven Littleleaf Linden	3b	MD	AL
Tilia cordata 'Greenspire'	Greenspire Littleleaf Linden	3b	MD	AL
Tilia cordata 'Olympic'	Olympic Littleleaf Linden	3b	MD	AL
Tilia cordata 'Rancho'	Rancho Littleleaf Linden	3b	MD	AL
Tilia x euchlora	Crimean Linden	4b	MD	AL

*conifers which constitute a subgroup in this category

Large Trees with Oval Canopies, Dense Branching, and Coarse-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Acer x freemanii 'Autumn Blaze'	Autumn Blaze Maple	4	W/MD	N
Acer x freemanii 'Autumn Fantasy'	Autumn Fantasy Maple	4	W/MD	N
Acer x freemanii 'Celebration'	Celebration Maple	4	W/MD	N
Acer x freemanii 'Marmo'	Marmo Maple	4	W/MD	N
Acer x freemanii 'Morgan'	Morgan Maple	4	W/MD	N
Acer x freemanii ‘Scarlet Setenal;'	Scarlet Sentinal Maple	4	W/MD	N
Acer pseudoplatanus 'Spaethii'	Spaethii Sycamore Maple	5b	MD	AL
Acer platanoides 'Cleveland'	Cleveland Norway Maple	4a	MD	AL
Acer platanoides 'Parkway'	Parkway Norway Maple	4a	MD	AL
Acer rubrum 'Red Sunset'	Red Sunset Maple	3b	W	N
Acer saccharum 'Caddo	Caddo Sugar Maple	3b	MWD	N
Acer saccharum 'Commemoration'	Commemoration Sugar Maple	3b	MWD	N

Large Trees with Oval Canopies, Dense Branching, and Coarse-Textured Foliage (cont.)

		Cold Hardy to Zone	Moisture	pH
Acer saccharum 'Green Mountain'	Green Mountain Sugar Maple	3b	MWD	N
Acer saccharum 'Legacy'	Legacy Sugar Maple	3b	MWD	N
Acer saccharum 'Majesty'	Majesty Sugar Maple	3b	MWD	N
Tilia americana 'Redmond'	Redmond Basswood	3a	MD	AL
Tilia tomentosa	Silver Linden	5a	MD	AL

Large Trees with Oval Canopies, Open Branching, and Fine-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Alnus glutinosa	Black Alder	4a	W	N
Alnus glutinosa 'Pyramidalis'	Pyramidal Black Alder	4a	W	N
Alnus glutinosa 'Fastigiata'	Upright Black Alder	4a	W	N
Betula nigra 'Heritage'	Heritage River Birch	4a	W	A
Betula platyphylla 'Japonica'	Asian White Birch	2b	MWD	A
Betula platphylla 'Whitespire'	Whitespire Birch	2b	MWD	A
Faxinus americana 'Autumn Applause'	Autumn Applause White Ash	4a	W/MD	AL
Fraxinus americana 'Champaign County'	Champaign Country White Ash	4a	W/MD	AL
Fraxinus americana 'Rose Hill'	Rose Hill White Ash	4a	W/MD	AL
Fraxinus americana 'Skyline'	Skyline White Ash	4a	W/MD	AL
Fraxinus excelsior 'Hessei'	Hess European Ash	4a	MD/SD	AL
Ginkgo biloba 'Autumn Gold'	Autumn Gold Ginkgo	4b	SD	AL
Gleditsia triacanthos inermis 'Skyline'	Skyline Honey Locust	4b	MD	AL
Pyrus calleryana 'Aristocrat'	Aristocrat Callery Pear	5a	W/SD	AL
Quercus imbricaria	Shingle Oak	5a	MD	N
Quercus phellos	Willow Oak	6b	W	A
Robinia pseudoacacia	Black Locust	4b	W/MD	AL
Ulmus carpinifolia x parvifolia 'Frontier'	Frontier Elm	5b	W	AL
Ulmus 'Homestead	Homestead Elm	5a	W	AL
Ulmus 'Pioneer	Pioneer Elm	5a	W	AL
Ulmus 'Urban'	Urban Elm	5a	W	AL

Large Trees with Oval Canopies, Open Branching, and Coarse Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Aesculus x carnea 'Briotti'	Briotti Red Horsechestnut	5a	MWD	AL
Aesculus x camea 'O'Neill'	O'N'eill Red Horsechestnut	5a	MWD	AL
Catalpa speciosa	Catalpa	4a	W	AL
Liquidambar styraciflua	Sweetgum	5b	MWD	N
Liquidambar styraciflua 'Moraine'	Moraine Sweetgum	5b	MWD	N
Liriodendron tulipifera	Tuliptree	5a	MWD	N
Quercus accutissima	Sawtooth Oak	5b	MD	N
Quercus bicolor	Swamp White Oak	4a	W	A
Quercus coccinea	Scarlet Oak	5a	MD	N
Quercus palustris 'Sovereign'	Sovereign Pin Oak T	5a	W/MD	A
Quercus palustris 'Crownright'	Crownright Pin Oak	5a	W	A
Quercus schumardii	Schumard Oak	5b	MD	N

Large Trees with Vase-Shaped Canopies and Fine-Textured Foliage

		Cold Hardy to Zone	Moisture	pH
Prunus sargentii 'Columnaris'	Upright Sargent Cherry	5a	MD	N
Ulmus americana 'Delaware #2'	Delaware American Elm	2b	W/MD	AL
Ulmus americana 'New Harmony'	New Harmony Elm	5	SD	AL
Ulmus americana 'Princeton'	Princeton American Elm	2b	W/MD	AL
Ulmus americana 'Valley Forge'	Valley Forge Elm	5	SD	AL
Ulmus americana 'Washington'	Washington American Elm	2b	W/MD	AL
Ulmus parvifolia 'Dynasty'	Dynasty Chinese Elm	5b	W/SD	AL
Ulmus parvifolia 'Ohio'	Ohio Chinese Elm	5	W/SD	AL
Ulmus parvifolia 'Prospector'	Prospector Chinese Elm	4	W/SD	AL
Ulmus parvifolia 'Pathfinder'	Pathfinder Elm	5a	SD	AL
Ulmus x 'Patriot'	Patriot Elm	4	SD	AL
Ulmus x 'Sapporo Autumn Gold'	Sapporo Autumn Gold Hybrid Elm	5a	W/MD	AL
Zelkova serrata 'Green Vase'	Green Vase Zelkova	5b	SD	AL
Zelkova serrata 'Halka'	Halka Zelkova	5b	SD	AL
Zelkova serrata 'Village Green'	Village Green Zelkova	5b	SD	AL

Large Trees with Columnar Canopies

		Cold Hardy to Zone	Moisture	pH
Acer x freemanii 'Armstorng'	Armstrong Hybrid Maple	4	W/MD	N
Acer nigrum 'Green Column'	Green Column Black Maple	5	SD	N
Acer platanoides 'Columnare'	Columnar Norway Maple	4a	MD	AL
Acer rubrum 'Bowhall'	Bowhall Red Maple	3b	W	A
Acer rubrum 'Columnar'	Columnar Red Maple	3b	W	A
Acer rubrum 'Karpick'	Karpick Red Maple	3b	W	A
Carpinus betulus 'Fastigiata'	Upright European Hornbeam	5a	MD	AL
Ginkgo biloba 'Lakeview'	Lakeview Ginkgo	4b	SD	AL
Ginkgo biloba 'Princeton Sentry'	Princeton Sentry Gingko	4b	SD	AL
Pyrus calleryana 'Capital'	Capital Gallery pear	5a	W	AL
Pyrus calleryana 'Chanticleer'	Chanticleer Gallery Pear	5a	W	AL
Quercus robur 'Attention'	Attention English Oak	5a	MD	AL
Quercus robur 'Fastigiata'	Upright English Oak	5a	MD	AL

Small Trees with Round Canopies

		Cold Hardy to Zone	Moisture	pH
Acer buergeranum	Trident Maple	6a	MD	A
Acer campestre	Hedge Maple	5a	SD	AL
Acer ginnala	Amur Maple	3a	MD	N
Acer tataricum	Tatarian Maple	3a	MD	A
Acer truncatum	Shantung Maple	4a	MD	AL
Carpinus caroliniana	American Hornbeam	3b	MD	AL
Cornua mas	Cornelian Cherry	5a	MD	AL
Crataegus phaenopyrum	Washington Hawthorn	4b	SD	AL
Crataegus punctata inermis 'Ohio Pioneer'	Thornless Ohio Pioneer Hawthorn	4a	SD	AL
Crataegus viridus 'Winter King'	Winter King Hawthorn	5a	SD	AL

Small Trees with Round Canopies (cont.)

		Cold Hardy to Zone	Moisture	pH
Koelreuteria paniculata	Goldenraintree	5b	SD	AL
Malus baccata ‘Jackii'	Jackii Crabapple	3a	SD	AL
Malus 'Donald Wyman'	Donald Wyman Crabapple	4	SD	AL
Malus floribunda	Flowering Crabapple	4b	SD	Al
Malus 'Henry Kohankie'	Henry Kohankie Crabapple	4	SD	AL
Malus 'Professor Sprenger'	Professor Sprenger Crabapple	4	SD	AL
Malus 'Sugartyme'	Sugartyme Crabapple	4	SD	AL
Malus 'White Angel'	White Angel Crabapple	4a	SD	AL
Malus x zumi 'Calocarpa'	Calocarpa Crabapple	4a	SD	AL
Sorbus intermedia	Swedish Mountain Ash	5	SD	AL
Syringa reticulata 'Summer Snow'	Summer Snow Japanese Tree Lilac	3a	SD	AL

Small Trees with Oval Canopies and Dense Branching

		Cold Hardy to Zone	Moisture	pH
Acer platanoides x truncatum 'Norwegian Sunset'	Norwegian Sunset Maple	4a	MD	AL
Acer platanoides x truncatum 'Pacific Sunset'	Pacific Sunset Maple	4a	MD	AL
Acer campestre 'Deborah'	Deborah Hedge Maple	5a	SD	AL
Amelanchier 'Autumn Brilliance'	Autumn Brilliance Serviceberry	3b	MWD	N
Amelanchier 'Autumn Sunset'	Autumn Sunset Serviceberry	3b	MWD	N
Amelanchier 'Cumulus'	Cumulus Serviceberry	3b	MWD	N
Amelanchier 'Majestic'	Majestic Serviceberry	3b	MWD	N
Amelanchier 'Princess Diana'	Princess Diana Serviceberry	3b	MWD	N
Amelanchier 'Robin Hill'	Robin Hill Serviceberry	3b	MWD	N
Amelanchier 'Tradition'	Tradition Serviceberry	3b	MWD	N
Cornus kousa	Chinese or Kousa Dogwood	5a	MWD	N
*Malus 'Adams'	Adams Crabapple	4a	MD	AL
*Malus 'Baskatong'	Baskatong Crabapple	4	SD	AL
Malus 'Centennial'	Centennial Crabapple	4	SD	AL
*Malus 'Centurion'	Centurion Crabapple	4	SD	AL
Malus 'Dolgo'	Dolgo Crabapple	3b	SD	Al
Malus 'Doubloons'	Doubloons Crabapple	4	SD	AL
Malus 'Harvest Gold'	Harvest Gold Crabapple	4	SD	AL
*Malus 'Indian Summer'	Indian Summer Crabapple	4a	SD	AL
*Malus 'Liset'	Liset Crabapple	4a	SD	AL
Malus 'Madonna'	Madonna Crabapple	4	SD	AL
Malus 'Ormiston Roy'	Ormiston Roy Crabapple	4a	SD	AL
*Malus 'Prairie Fire'	Prairie Fire Crabapple	4	SD	AL
*Malus 'Purple Prince	Purple Prince Crabapple	4	SD	AL
*Malus 'Robinson'	Robinson Crabapple	4	SD	AL
Malus 'Silver Moon'	Silver Moon Crabapple	4	SD	AL
Malus 'Zumirang'	Zumirang Crabapple	4	SD	AL
*Prunus virginiana'Canada Red'	Canada Red Choke Cherry	3a	MD	AL
Sorbus thuringiaca 'Fastigiata'	Upright Oakleaf Mountain Ash	3b	MD	AL
Syringa reticulata 'Ivory Silk'	Ivory Silk Japanese Tree Lilac	3a	SD	AL
Syringa reticulata 'Regent'	Regent Japanese Tree Lilac	3a	MD	Al

* may have a purplish or bronze tint to the foliage and are subsequently seen as a compatible subgroup in this category.

Small Trees with Vase-Shaped Canopies

		Cold Hardy to Zone	Moisture	pH
Malus 'Adirondack'	Adirondack Crabapple	4	MD	AL
Malus 'Sentinal'	Sentinel Crabapple	4	SD	AL
*Malus 'Strawberry Parfait'	Strawberry Parfait Crabapple	4	SD	AL
Prunus 'Accolade'	Accolade Flowering Cherry	5	MD	N

* may have a purplish or bronze tint to the foliage

ADDITIONAL RECOMMENDED GROUPS

In addition to the prior categories which included tree size shape and foliar textures, the following trees have similar foliage and should be considered for this characteristic alone. Also, additional unique characteristics for species groups are provided.

Trees with Oak-Shaped Leaves

		Cold Hardy to Zone	Moisture	pH
Quercus rubra	Red Oak	3b	MD	N
Quercus palustris 'Sovereign Pin Oak'	Sovereign Pin Oak	5a	W/MD	A
Quercus palustris 'Crownright'	Crownright Pin Oak	5a	W	A
Quercus schumardii	Schumard Oak	5b	MD	N
Quercus coccinea	Scarlet Oak	4	MD	N
Quercus velutina	Black Oak	3b	MD	N

Large Round Trees with Maple-Like Leaves

		Cold Hardy to Zone	Moisture	pH
Acer platanoides 'Emerald Queen"	Emerald Queen Norway Maple	4a	MD	AL
Acer platanoides 'Summershade'	Summershade Norway Maple	4a	MD	AL
Acer platanoides 'Superform'	Superform Norway Maple	4a	MD	AL
Acer rubrum 'Autumn Flame'	Autumn Flame Red Maple	3b	W	A
Acer rubrum 'Northwood'	Northwood Red Maple	3b	W	A
Acer rubrum 'October Glory'	October Glory Red Maple	3b	W	A
Platanus x acerifolia 'Bloodgood'	Bloodgood London Planetree	5b	MD	AL
Platanus x acerifolia 'Columbia'	Columbia London Planetree	5b	MD	AL
Platanus x acerifolia 'Liberty'	Liberty London Planetree	5b	MD	AL

Large Oval Trees with Maple-Like Leaves

		Cold Hardy to Zone	Moisture	pH
Acer x freemanii 'Autumn Blaze'	Autumn Blaze Maple	4	W/MD	N
Acer x freemanii 'Autumn Fantasy'	Autumn Fantasy Maple	4	W/MD	N
Acer x freemanii 'Celebration'	Celebration Maple	4	W/MD	N
Acer x freemanii 'Marmo'	Marmo Maple	4	W/MD	N
Acer x freemanii 'Morgan'	Morgan Maple	4	W/MD	N
Acer x freemanii 'Scarlet Sentinal'	Scarlet Sentinal Maple	4	W/MD	N
Acer pseudoplatanus 'Spaethii'	Spaethii Sycamore Maple	5b	MD	AL
Acer platanoides 'Cleveland'	Cleveland Norway Maple	5b	MD	AL
Acer platanoides 'Parkway'	Parkway Norway Maple	4a	MD	AL
Acer rubrum 'Red Sunset'	Red Sunset Maple	3b	W	N
Acer saccharum 'Caddo'	Caddo Sugar Maple	3b	MWD	N

Large Oval Trees with Maple-Like Leaves (cont.)

		Cold Hardy to Zone	Moisture	pH
Acer saccharum 'Commemoration'	Commemoration Sugar Maple	3b	MWD	N
Acer saccharum 'Green Mountain'	Green Mountain Sugar Maple	3b	MWD	N
Acer saccharum 'Legacy'	Legacy Sugar Maple	3b	MWD	N
Acer saccharum 'Majesty'	Majesty Sugar Maple	3b	MWD	N
Liquidambar styraciflua	Sweeetgum	5b	MWD	N
Liquidambar styraciflua 'Moraine'	Moraine Sweetgum	5b	MWD	N
Liriodendron tulipifera	Tuliptree	5a	MWD	N

Large Oval Trees with Heart-Shaped Leaves

		Cold Hardy to Zone	Moisture	pH
Cercidiphyllum japonicum	Katsura Tree	5a	MWD	AL
Corylus columa	Turkish Filbert	5a	SD	AL
Tilia cordata 'Chancellor'	Chancelor Littleleaf Linden	3b	MD	AL
Tilia cordata 'Glenleven'	Glenleven Littleleaf Linden	3b	MD	AL
Tilia cordata 'Greenspire'	Greenspire Littleleaf Linden	3b	MD	AL
Tilia cordata 'Olympic'	Olympic Littleleaf Linden	3b	MD	AL
Tilia cordata 'Rancho'	Rancho Littleleaf Linden	3b	MD	AL
Tilia x euchlora	Crimean Linden	4b	MD	AL

Small Trees with Lobed Leaves

		Cold Hardy to Zone	Moisture	pH
Acer buergeranum	Trident Maple	6a	MD	A
Acer campestre	Hedge Maple	5a	SD	AL
Acer ginnala	Amur Maple	3a	MD	N
Acer tataricum	Tatarian Maple	3a	MD	A
Acer truncatum	Shantung Maple	4a	MD	AL
Crataegus phaenopyrum	Washington Hawthorn	4b	SD	AL
Crataegus punctata inermis 'Ohio Pioneer'	Thornless Ohio Pioneer Hawthorn	4a	SD	AL
Crataegus viridus 'Winter King'	Winter King Hawthorn	5a	SD	AL
Sorbus intermedia	Swedish Mountain Ash	5	SD	AL

Birch Trees

		Cold Hardy to Zone	Moisture	pH
Betula nigra 'Heritage'	Heritage River Birch	4a	W	A
Betula platyphylla 'Japonica'	Asian White Birch	2b	MWD	A
Betula platphylla ' Whitespire'	Whitespire Birch	2b	MWD	A

Large Round Trees for Severe Drought with Compound Leaves

		Cold Hardy to Zone	Moisture	pH
Gymnocladus dioicus	Kentucky Coffee Tree	4a	SD	AL
Sophora japonica 'Princeton Upright'	Princeton Upright Scholar Tree	5b	SD	AL
Robinia pseudoacacia	Black Locust	4b	SD	AL

Small Trees for Severe Drought

		Cold Hardy to Zone	Moisture	pH
Acer campestre	Hedge Maple	5a	SD	AL
Crataegus phaenopyrum	Washington Hawthorn	4b	SD	AL
Crataegus virdis 'Winter King'	Winter King Hawthorn	5a	SD	AL
Koelreuteria paniculata	Goldenraintree	5b	SD	AL
Malus (all the recommended cultivars)	Crabapple	3-4	SD	AL
Syringa reticulata 'Summer Snow'	Summer Snow Japanese Tree Lilac	3a	SD	AL
Syringa reticulata 'Ivory Silk'	Ivory Silk Japanese Tree Lilac	3a	SD	AL
Syringa reticulata ' Regent'	Regent Japanese Tree Lilac	3a	SD	AL

Large Round Trees for Cold Climates (Zone 3b or Lower)

		Cold Hardy to Zone	Moisture	pH
Celtis occidentatlis 'Prairie Pride'	Prairie Pride Hackberry	3b	SD	AL
Fraxinus pennsylvanica 'Emerald'	Emerald Green Ash	2a	MD	AL
Quercus macrocarpa	Bur Oak	3a	SD	AL
Quercus ruba	Red Oak	3b	MD	AL
Acer rubrum 'Autumn Flame'	Autumn Flame Red Maple	3b	W	A
Acer rubrum 'Northwood'	Northwood Red Maple	3b	W	A

SELECTING AND USING A GROUP

Before selecting a group of trees to work with, it is important that a thorough assessment of the planting site be made. Spatial constraints such as overhead wires, narrow building setbacks, or limited soil volume may reduce the size or shape options. Tolerance levels for cold temperatures, moisture, and pH have been assigned to each of the recommended trees, and only trees with tolerances matching the site should be used. Other factors which must be considered in selecting a group of trees include the desired visual effect and the practical function of the planting being considered. Is the objective simply visual appeal, or will the trees be expected to provide shade, break wind, or shield sights or sounds? What is the scale of surrounding buildings, gardens, or parks? Is a formal or informal appearance more appropriate? The table below provides some examples of how various factors may lead to the selection of a group appropriate to a given situation.

SELECTION FACTORS

Factors to consider	Recommendations
Spatial constraints such as overhead wires, narrow setbacks, signage, or frequent truck traffic	may require **small trees** or narrower crown shapes such as oval or columnar
Limited soil volume	**small trees**
Screening of sight or sounds, wind break or heavy shade desired	**dense** branching possibly large trees where practicable
Trees growing with or near other plants such as turfgrass or flower beds	**open** less dense branching
Canopy effect desired	**vase-shaped** crowns (example)
Formal effect desired	**columnar** crowns (example)

Once a group of trees has been selected, it is best if at least three species or cultivars from that group be used in a given area. In making a selection, it is advisable to take into account the breakdown of species in the population around the site. Even if a wide variety of species is planted, new trees selected could be at risk if they are of a species which are already over planted in the area. Ideally, any one species should not make up more than 5 - 10% of the total tree population for a neighborhood or district. In general, the greater the number of genera used the lower the risk of serious pest or disease problems.

In the simplest situations, where site conditions and requirements are more or less consistent, trees from one group may be selected and used uniformly throughout an area. However, the groups can also be useful in more complex situations. By changing only one characteristic at a time, trees from different groups may be blended together as site conditions or the desired effect changes from one area to another. For example, if a cohesive planting is desired on a block where overhead wires limit the selection of trees on one side of the street, instead of simply planting all small trees with matching characteristics on both sides of the street, a designer could choose to plant small trees of a given shape, branching density and foliage texture on the side with overhead wires, and large trees with those same remaining characteristics on the other. Other site factors which might also call for such a blending technique include narrow setbacks, frequent truck traffic, and signage. Even within a given group, trees may need to be used selectively as factors such as pH and moisture change throughout the site.

The strategies for selecting and grouping street trees presented here provide the designer with many options for creating healthy and visually appealing street tree plantings. The recommendations made are based on careful consideration of both aesthetic and practical concerns, even when those concerns have been given more weight than aesthetic ones, it is only because, paradoxically, this practicality is ultimately the surest way to create a beautiful urban forest.