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SPECIES ADAPTED FOR STREET-TREE ENVIRONMENTS IN IOWA[1]

by Paul H. Wray and Carl W. Mize

Abstract. From condition classification of more than 39,000 street trees in Iowa, an analysis is presented of which species seem to be best adapted for street-tree types of environments. Species were also analyzed for change in condition with increasing size and for differences in adaption between the northwestern and southeastern halves of the state.
Keywords: *Street trees, suitability, street-tree environment, selection, street-tree size, street-tree condition.*

The concept of total system management of urban forests, developed by Jorgensen (1970), is not one of individual tree management, rather it considers tree management on an area basis with respect to how woody vegetation is influenced by the urban environment and utilized by the urban population. An important component of total system management is the selection of suitable tree species. Not all climatically adapted species are good candidates for use in street or similar environments. The environment to which street plantings are subjected goes beyond the climate of a region. In fact, street-tree planting environments are among the most severe encountered in a region. The soils may be compacted, modified, or in some cases almost nonexistent, and, as a result, root growth, as well as water and nutrient uptake, may be severely retarded. The soil may also be modified chemically with salt or snow-control chemicals, excessive fertilizer, or many other soil contaminants. The air quality may be reduced by vehicle and industrial emissions.

The stressful environment in which city trees grow affects tree populations. Tree species that

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are adapted to this environment will survive and do well; unsuitable species may not survive or, at best, will not thrive. The net effect is one of reduced species diversity, while from an urban forest management standpoint, increased species diversity is desirable.

Methods

On 1978, The Department of Forestry at Iowa State University in cooperation with the Forestry Section, Iowa Conservation Commission, initiated research on street tree populations in smaller Iowa communities. Forty towns with populations between 500-10,000 (1970 census) were selected at random from the almost 1000 towns in Iowa. For each of the 40 towns, a complete street tree (trees along streets on public property or in publicly owned parking) inventory was done to determine needs and to serve as a basis for management of the trees within each individual community.

Individual tree information included specific location in the community, species, size class of each tree (diameter classes: 0-3, 3-6, 6-12, 12-20, over 20 inches), and condition or health of each tree. There were three condition classes: good, fair, and poor. Good trees were those requiring no care or maintenance or only minimal maintenance such as minor pruning. Any problems associated with trees classified in good condition were not a threat to longevity or usefulness of the trees. Fair trees were those in need of corrective treatments if they are to function for more than 10 additional years. Poor trees were those that probably will not survive longer than 2 years without corrective action.

Results

From the more than 39,000 trees classified in this study, Table 1 lists the percentage of each species classified in good condition for those species observed at least 100 times. Species that had about 90% or more of the individuals classified as good probably are acceptable species for street-tree types of environments. Species with much less than 90% of the individuals in good classification may be less well adapted for street-tree types of environments.

As trees age, their overall condition tends to deteriorate, and all the species observed showed a general decrease in the percentage ranked good as diameter increased. Some species, however showed a much larger decrease than others (Table 2). The species listed in Table 2 may not be good choices as large specimen or landscape trees under the stress conditions found in street-tree environments.

Table 1. Number and percentage of individual trees classified as being in good condition for each species where at least 100 trees of the species were examined.

Species	*% Good*	*Number*
lilac *(Syringa sp.)*	99	824
arborvitae *(Thuja occidentalis)*	98	276
yew *(Taxus sp.)*	98	102
blue spruce *(Picea pungens)*	98	275
Austrian pine *(Pinus nigra)*	98	132
red cedar *(Juniperus virginiana)*	97	481
sycamore *(Platanus occidentalis)*	97	395
red bud *(Cercis canadensis)*	97	193
Russian olive *(Elaeagnus angustifolia)*	97	118
mountain ash *(Sorbus sp.)*	97	257
hackberry *(Celtis occidentalis)*	96	1899
little leaf linden *(Tilia cordata)*	96	296
honeylocust *(Gleditsia triacanthos)*	96	967
pin oak *(Quercus palustris)*	96	804
bur oak *(Quercus macrocarpa)*	95	187
red maple *(Acer rubrum)*	95	250
white spruce *(Picea glauca)*	95	341
willow *(Salix sp.)*	95	109
white birch *(Betula papyrifera)*	94	167
Norway maple *(Acer platanoides)*	94	3283
cherry *(Prunus sp.)*	94	264
mulberry *(Morus sp.)*	93	441
American basswood *(Tilia americana)*	93	859
Lombardy poplar *(Populs nigra italica)*	92	285
crabapple *(Malus sp.)*	90	1015
cottonwood *(Populus deltoides)*	90	195
Scotch pine *(Pinus sylvestris)*	90	101
white poplar *(Populus alba)*	89	101
red elm *(Ulmus rubra)*	89	918
sugar maple *(Acer saccharum)*	89	6814
red oak *(Quercus rubra)*	89	267
green ash *(Fraxinus pennsylvanica)*	88	5666
Norway spruce *(Picea abies)*	87	134
silver maple *(Acer saccharinum)*	87	4850
tree-of-heaven *(Ailanthus altissima)*	87	191
black walnut *(Juglans nigra)*	86	1495
black maple *(Acer nigrum)*	82	114
Siberian elm *(Ulmus pumila)*	78	1961
white ash *(Fraxinus americana)*	77	123
catalpa *(Catalpa speciosa)*	70	266
boxelder *(Acer negundo)*	61	555
American elm *(Ulmus americana)*	53	608

The climate of Iowa has a strong northwest to southeast gradient, being more warm and moist in the southeast. Also, there are major differences in the soils of the northwestern and the southeastern halves of the state. Therefore, a comparison was made to see if the condition of each tree species in the northwestern half of the state was different from that in the southeastern half. For most species there were no major differences, but sugar maple (*Acer saccharum),* silver maple *(Acer saccharinum),* and Norway maple *(Acer platanoides)* are in a substantially better condition in the northwestern half of the state than the southeastern half (Table 3).

Discussion

The number of acceptable street trees species for any community is small because they must fit situations with many limiting factors. According to Cott (1980), they should: 1) permit free movement of pedestrians and vehicles, 2) not interfere with overhead or underground utility installations, 3) not interfere with sight distance for safe vehicle traffic, 4) provide desired shade and appearance, and 5) be hardy and require minimum maintenance. Because of limited planting space, large trees with high branching habit are generally preferred. Small trees and shrubs are acceptable only on areas that can accommodate the spread

Table 2. Species that exhibited substantial reduction in percentage of trees classified as good with increasing diameter.

		% Classified as good				
		Diameter (inches)				
Species	Number	0-3	3-6	6-12	12-20	20
Sugar maple *(Acer saccharum)*	6814	96	97	93	84	80
Green ash *Fraxinus pennsylvanica)*	5666	97	98	88	81	76
Silver maple *(Acer saccharinum)*	4850	97	98	95	84	65
Norway maple *(Acer platanoides)*	3283	96	97	94	89	84
Siberan elm *(Ulmus pumila)*	1961	98	96	68	70	59
Black walnut *(Juglans nigra)*	1495	94	94	84	84	81
Crabapple *(Malus sp.)*	1015	96	83	83	74	—
Red elm *(Ulmus rubra)*	918	97	91	88	76	60
American elm *(Ulmus americana)*	608	100	84	52	43	41
Boxelder *(Acer negundo)*	555	98	90	67	45	34
Mulberry *(Morus sp.)*	441	98	95	89	90	83
Lombardy poplar *(Populus nigra italica)*	285	96	94	92	57	—
Red oak *(Quercus rubra)*	267	86	94	97	95	76
Catalpa *(Catalpa speciosa)*	266	89	79	67	74	60
Cottonwood *(Populus deltoides)*	195	96	100	89	90	83
Tree-of-heaven *(Ailanthus altissima)*	191	95	100	87	77	71
White ash *(Fraxinus americana)*	123	100	100	88	70	50

Table 3. Species that exhibited substantial change in percentage of trees classified as good between the northwestern and southeastern halves of the state.

	Northwest		Southeast	
	% good	Number	% good	Number
Sugar maple *(Acer saccharum)*	94	3134	84	3680
Silver maple *(Acer saccharinum)*	92	2932	80	1913
Norway maple *(Acer platanoides)*	95	2353	80	930

of the trees without interfering with both pedestrian and vehicular traffic. In addition, species known to be susceptible to serious insects or diseases should not be used as street trees because of increased maintenance costs.

In 1977, the Iowa Community Tree Program Extension Committee (including representatives from the Departments of Entomology, Forestry, Horticulture, Landscape Architecture, and Plant Pathology at Iowa State University) recommended, based on the recommendations of Cott (1980) and their knowledge of the species that grow in the state, the following species for street tree use: sugar maple, black maple *(Acer nigrum)*, red maple *(Acer rubrum)*, hackberry *(Celtis occidentalis)*, green ash *(Fraxinus pennsylvanica)*, white ash *(Fraxinus americana)*, ginkgo *(Ginkgo biloba)*, sycamore *(Platanus occidentalis)*, white oak *(Quercus alba)*, red oak *(Quercus rubra,* scarlet oak *(Quercus coccinea)*, bur oak *(Quercus macrocarpa)*, English Oak *((Quercus robur)*, American linden *(Tilia americana)*, and little leaf linden *(Tilia cordata)*.

All but four of the species recommended by the Extension Committee appear in Table 1. Less than 100 ginkgo, white oak, scarlet oak, and English oak were examined,so they are not listed, but for all four species, more than 90% of the trees were classified as good. Of the recommended street trees that appear in Table 1, all have more than 88% of the trees classifed as good except for black maple (82%) and white ash (78%). Therefore, the species recommended for street trees in Iowa should continue to be used, though black maple and white ash should be used cautiously.

There are 42 species listed in Table 1. Most of them seem to do well growing in the street-tree environment. Although many of them do not have the characteristics desirable for street trees, they should do well in street-tree-like environments.

As a rule, midwestern communities need more diversity and a better selection of adaptable species. Sugar maple, silver maple, Norway maple, and green ash made up 52% of the street trees that were examined. Only two of the species, sugar maple and green ash, are from the list of recommended street trees, and both are in the middle in terms of percentage of trees classified as good. Urban forest managers in Iowa, as other midwestern states, should strive for the use of well adapted species and increased diversity in street tree populations.

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