IN SEARCH OF NEW KINDS OF ELMS

by George H. Ware

Abstract. Trees suitable for urban use must tolerate numerous root-zone adversities such as compacted soil, restricted root space, extremes of soil wetness and dryness, wide temperature fluctuations, alkalinity, salinity, and soil disturbance. Elms have many of the necessary attributes. There is a sizable number of little-known elm species native to central and eastern Asia that should be studied more closely in the search for better urban trees. Some of these have extensive ranges and display considerable ecological variation from region to region. Certain Asian elms have been shown to have encouraging levels of resistance to Dutch elm disease.

The word "elm" often evokes negative responses when mentioned in discussions of urban trees. Indeed, because of Dutch elm disease and phloem necrosis, the future of the American elm (*Ulmus americana* L.)[1] is uncertain. Siberian elm (*U. pumila* L.) has an assortment of shortcomings, yet it continues to be planted commonly for its rapid growth and quick shade. If vigor and adaptability for urban use were the only criteria for selecting trees for urban planting, both these elms would be praiseworthy. Because most species of *Ulmus* display vigor and adaptability, there is need for a closer look at the arboricultural attributes of other elms.

For many midwestern cities and towns, the number of species and cultivars on lists of recommended trees is rather small. In northern Illinois, adversity for tree growth is attributable in great measure to clay soils that have been developed from calcareous glacial till and to fluctuational weather patterns associated with a continental climate. Soil wetness in spring and early summer creates soil aeration constraints on trees, limiting kinds suitable for urban planting. However, soil limitations on urban tree performance are almost universal, regardless of regional soil make-up.

In the selection of trees for urban use, tolerance of poor soil aeration is a prime consideration. Some of the most widely planted street trees occur naturally in swamps and floodplains. Examples are: silver maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica* var. *subintegerrima*), hackberry (*Celtis occidentalis*), river birch (*Betula nigra*), pin oak (*Quercus palustris*), and American elm. These species have good "ecological credentials", though every one has certain arboricultural faults. The excellent ecological credentials and splendid growth form of American elm accounted for the predominance of this majestic tree in cities and towns over much of the United States, setting the stage for the heart-sickening losses from Dutch elm disease and phloem necrosis during the past few decades.

A question often asked is: "Is there an elm substitute for American elm?" The question implies that the substitute should be highly resistant to Dutch elm disease. Indeed, older specimens of three other North American elm species often resemble American elm; however, all three are susceptible to Dutch elm disease. Winged elm (*U. alata* Michx.) and September elm (*U. serotina* Sarg.) are southern species with limited natural ranges. Slippery elm (*U. rubra* Muhl.), though variable in growth form, may sometimes require close examination to distinguish it from American elm. Its natural range is not quite so vast as that of American elm (Harlow & Harrar, 1968). Cultural qualities contributing to the success of American elm are its transplantability, rapid establishment, and vigorous growth. Fortunately, these cultural attributes are found in many elms.

Such qualities have been responsible for the widespread success of Siberian elm throughout the Great Plains, where few tree species are completely at home. Siberian elm, however, often makes rampant growth and its limbs become vulnerable to ice breakage and wind damage. Disfiguration from elm leaf beetles is widespread throughout the central part of the United States, creating debilitative and aesthetic problems. Despite the shortcomings of Siberian elm, its ecological attributes are good, and it appears to be quite resistant to Dutch elm disease. Because of its vigorous growth under adverse conditions, it

[1] Nomenclature follows that of Krussman (1962) except for the elms of Central Asia for which Komarov (1936) has been used.

has been proposed as a component for elm hybridization in North America. Unfortunately, Siberian elms seldom resemble American elms, but variation in form and size of Siberian elm is great, ranging from dense shrubby growth to trees over 20 meters in height.

Testing has provided encouraging evidence of resistance to Dutch elm disease in Siberian elm and in certain other Asian elms (Heybroek, 1976; Lester, 1978; Townsend, 1971; Santamour, 1974), but caution is important in that variability in resistance within species may be quite great. Acquisition of much more Asian genetic material in elm collections in North America is urgently needed. These recommendations provide a rationale for the enriching of arboretum elm collections. Moreover, they provide us with guidance as to where to look for new kinds of elms. Much material has been imported for elm breeding programs, but most Asian species are still fragmentarily known in the United States, especially the variation in their ecological attributes, their structural features, and their aesthetic qualities. Because each Asian species is represented in its homeland by a population (or populations) of individual trees with extensive geographic distribution, propagules of a species introduced from one part of the natural range of a species may exhibit ecological or morphological qualities different from previously introduced material. Such a later introduction might be considered a new kind of elm.

A good example of an Asian elm rich in variation is Chinese elm (*U. parvifolia* Jacq.) which occurs over a large area of China, Japan, and Korea. Because of its reddish mottled bark it is also known as lace-bark elm. Leaves are generally smaller than those of Siberian elm and in some cases much smaller. The kind commonly seen in California has tiny, leathery, almost evergreen leaves. Large-leaved forms are also known. Growth form also varies greatly. Pendulous forms are sometimes seen, but compact oval crowns are more common. The branching pattern of American elm is suggested by some specimens. Weak branches and excessive twigginess are sometimes given as objectionable features, but coarse-branching forms are also known. The reddish, mottled and plated bark is an outstanding feature. Some trees show impressive red autumn coloration, but in most cases persisting green leaves give way slowly to patchy yellowing and prolonged leaf-fall. Though locality of natural origin in Asia is not usually known, there is some evidence that time of leafing and flowering indicates general latitude of original Asian source of seeds. This elm has been extolled as an outstanding possibility for more general landscape use (Wyman, 1951), but is seldom seen as a planted tree. It is generally considered to be quite resistant to Dutch elm disease. Though it flowers in the fall, it has been successfully crossed with spring-flowering elms (Santamour, 1972; Townsend, 1975).

Japanese elm (*U. japonica* (Rehd.) Sarg.) may sometimes resemble American elm in growth form, branching, leaf size, and general appearance. Japanese elm occurs naturally over a large area of northern China, Japan, and Korea. Splendid specimens are known in the Prairie Provinces of Canada. At the Morton Arboretum, 18 year-old trees grown from seeds received from the Agriculture Canada Research Station at Morden, Manitoba, show a branching pattern resembling that of American elm (Fig. 1). The smooth, glossy leaves are not at all like the scabrous leaves found on some Japanese elm specimens. Because of the great range and diversity of Japanese elm, the selection possibilities are outstanding. Too, hybridization appears promising (Lester, 1978). The University of Wisconsin introduction 'Sapporo Autumn Gold' is a hybrid from Siberian elm-Japanese elm parentage (Smalley & Lester, 1973).

The elms of Central Asia are known locally as "karagaches." This collective name for elms stems from the difficulty in distinguishing species. In many of the cities of Central Asia, Russian elm (*U. laevis* Pall.) may be seen occasionally as a street and park tree, but it is quite different from the other, small-leaved elms which appear to be hybrid mixtures of two or even three species, predominantly the Central Asian form of Siberian elm, distinguished by the Russians as *U. pinnato-ramosa* Dieck. (Komarov, 1936). In the description of this species, emphasis is placed upon its geographic separation from the main body of the natural range of Siberian elm and the fact that there are several distinguishing features, namely the small, narrow, somewhat pubescent leaves.

Fig. 1. Eighteen-year-old specimen of *U. japonica* at the Morton Arboretum. This tree is 25 feet in height and six inches in diameter.

Another interesting elm from Central Asia is treated in Russian literature as *U. densa* Litv., the Uzbek elm. It is described as a large tree with a dense pyramidal crown, branching freely from a dominant central trunk. The small, narrow leaves are very leathery and strongly cutinized.

Still another species recognized by the Russians is *U. suberosa* Moench (*U. carpinifolia* Gledisch var. *suberosa* (Moench.) Rehd.). This elm is seen here and there in Central Asian cities. It has a rather compact crown and ashy-black branches with reddish-brown twigs.

In Samarkand (Uzbekistan) the most common streetside elm is recognized as *U. androssowii* Litv. (Fig. 2). This compact, globe-crowned elm is not known from the wild and is thought to be a hybrid between *U. pinnato-ramosa* and *U. densa* (Komarov, 1936).

Fig. 2. Row of elms (*U. androssowii*) on street of Samarkand, Uzbekistan. These trees are probably of seedling origin.

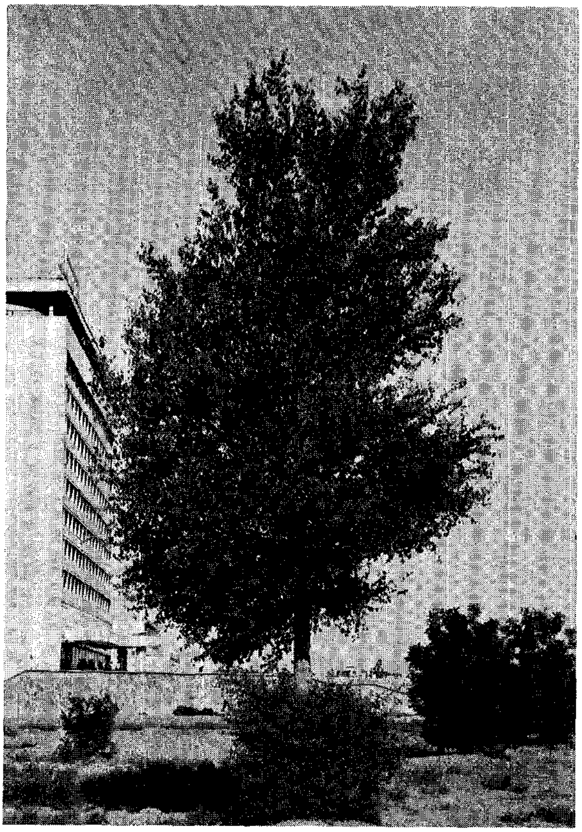
In Bukhara (Uzbekistan), urban karagaches have small, narrow, leathery leaves and reddish twigs on trees that have compact crowns, oval to columnar when young (Fig. 3 and Fig. 4), but opening up with arching branches as the trees become older. Perhaps three Central Asian elms (*U. densa, U. suberosa,* and *U. pinnato-ramosa*) are involved in the Bukhara elm make-up. The Bukhara region is more desert-like than the Samarkand region, which, to be sure, is quite arid. It is possible that selection, both fortuitous and intentional, has produced a special elm highly tolerant of the adverse climatic and soil conditions of Samarkand, and that, similarly, a rather distinct population, a desert elm, has been produced by long-time selection in Bukhara.

In our own Great Plains, perhaps karagaches offer possibilities for hybridization with appropriate selections of Siberian elm or lace-bark elm. The climate of Central Asia, with great fluctuation of temperatures, is similar to that of our southern Great Plains and southern Rocky Mountain states.

Several little known eastern Asian elm species may provide useful material from which to select urban trees or to use in hybridization efforts. *U. laciniata* (Trautv.) Mayr. is a small to medium tree occurring naturally in Manchuria, northern China, and Japan. It has a distinctive, stiff, and somewhat ungraceful form; several equal upright branches emerge at approximately the same point. Its large, rough leaves often terminate in three sharp lobes. *U. laciniata* var. *nikkoensis* Rehd. is a more attractive spreading type with somewhat smaller leaves, usually without the terminal lobes. *U. macrocarpa* Hance, *U. davidiana* Planch., and *U. glaucescens* Franch. are small trees of northern China and adjacent regions for which available information is presently meager. Remarkably strong wood is reported for *U. macrocarpa* (Ptitsin, 1939). The marked cold hardiness and drought tolerance of these species are potentially useful qualities. *U. wilsoniana* Schn. is a medium-sized elm native to central China. It has attractive ornamental qualities and appears to be quite resistant to Dutch elm disease (Townsend, 1971).

Elm seedlings from seed lots received from arboreta, botanical gardens, and experiment stations must be identified quite cautiously in view of the possibility of hybridization having occurred. In 1924, the Morton Arboretum received a packet of seeds labeled *U. crassifolia* Nutt. In time, specimens were planted throughout the grounds, and today there are ten half-century old trees displaying ten different crown patterns, all of which are attractive. Investigation and experimentation indicate that these are probably hybrids between *U. japonica* and *U. wilsoniana*. Some of the specimens have very glossy leaves and whitish, finely-plated bark (Fig. 5), both features of *U. wilsoniana*.

The exceedingly confusing situation in botanical knowledge of elms of central China is brought out in E.H. Wilson's elm descriptions in *Plantae Wilsonianae* (Sargent, 1917). There are quite a number of species or varieties of elms of China that are poorly understood by American tree scientists and are being sought as additions to arboretum material in North America.



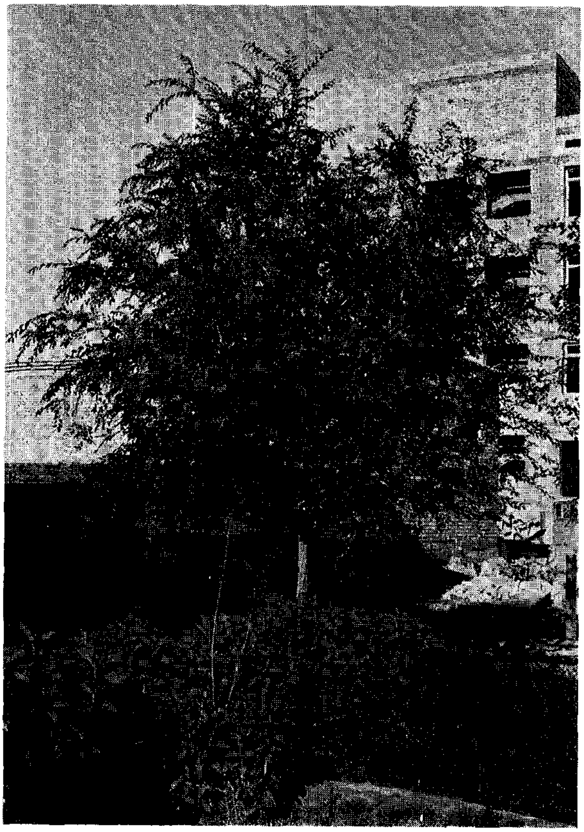


Fig. 3 and Fig. 4. Two different forms from the urban elm population of Bukhara, Uzbekistan. The unusually small fruits on both these trees are very similar.

Fig. 5. A hybrid elm (*U. japonica* × *U. wilsoniana*) at the Morton Arboretum. Features of *U. wilsoniana* are especially conspicuous.

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