NEW ELMS FOR THE LANDSCAPE AND URBAN FOREST

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I would like for us to step back in time to the 1960s. It is the time of the Beatles (no, not the insects), Vietnam War, and flower power. As a child and young adolescent, I vividly remember the background sound of chainsaws and chippers as thousands, if not, millions of American elms were being removed due to the scourge of Dutch elm disease (DED) that was sweeping North American cities.

As early as 1950, the dreaded DED was discovered in Illinois and by 1959 had been found in every county in Illinois. By the late 1950s, nearly 80% of the original elm population in central and southern Illinois had been killed due to the ravages of this fungal pathogen. Due to the removal of dead or dying elms from the urban forests and landscapes, communities throughout Illinois and the United States experienced the loss of cathedral-like tree-lined boulevards, greatly reducing landscape and property value, shade, and other ecological benefits.

As a result of this catastrophic event, a concerted and cooperative effort was begun by tree breeders and geneticists to develop and\or discover new elm species and\or hybrids that would be resistant to Dutch elm disease. Siberian elm, *Ulmus pumila*, was planted quite extensively in urban landscapes because of its fast growth, drought resistance, tolerance of poor soils, climatic adversities, and resistance to DED. However, despite its positive attributes, the Siberian elm is generally not regarded as a desirable street tree because of its brittle wood and vulnerability to wind and ice damage. In more recent years, Siberian elm has become a favored host of the elm leaf beetle, *Pyrrhalta luteola*.

With the opening of China to the West in the 1970s, seed sources of many little-known Asian elm species became available. As a result, extensive efforts by tree breeders at USDA, the National Arboretum and other arboreta, and universities began evaluating these new Asian elms for possible resistance to DED.

One particular outcome of this work was the discovery at The Morton Arboretum of what has been identified as the Thornhill elm, a Japanese-Wilson elm hybrid. The splendid vase shape and the extraordinary deep-green glossiness of the leaves of the Thornhill elm inspired the elm improvement program at The Morton Arboretum under the direction of Dr. George Ware, Research Dendrologist. Study of the growth patterns of the parents of the hybrid elm revealed that Japanese elm is moderately slow-growing with twig growth ceasing in early summer. This early-summer growth produces a somewhat compact crown. In contrast, Wilson elm continues twig and branchlet elongation throughout the summer, creating an umbrella effect. Japanese elm is native to both northeastern China and Japan especially in relatively cold areas with rather short growing seasons, hence, the early cessation of twig growth. Wilson elm is native to the mountains of central and western China, with a longer growing season.

There are more than 20 species of elms in Asia and all of these species seem to have good levels of resistance to Dutch elm disease. There are six species of elms in North America, all of which

show little resistance to Dutch elm disease. The best-known North American species is American elm (*U. americana*), which in past decades was the common street tree in towns and cities of the eastern and midwestern United States. In recent years there has been considerable interest in restoring elms to the streets of America, but only those elms that are resistant to DED. American elm cannot be crossed easily with other elms because the chromosome number is double that of other elm species. Thus, progress has been slow in developing resistant American elms.

Recent introduction of American elm cultivars show good promise for tolerance of Dutch elm disease. Breeding and development of a American elm "look-alikes" using Asian elm species is an alternative for producing attractive arcade-forming trees. In addition, street plantings of several different kinds of hybrid elms contribute to diversity and avoid the pitfalls of a monoculture.

From observations of the Thornhill elm and its parent species, criteria were formulated for continued development and selection of new elms. These are:

- DED resistance
- Appearance similar to American elm
- Tough branches and wood
- Tolerance of difficult soils
- Climate hardiness
- Reduced or lack of feeding preference by common leaf-feeding insects such as the elm leaf beetle, Japanese beetle, spring and fall cankerworm, elm leaf miner, and gypsy moth
- Glossiness and leatheriness of leaves
- Fall color
- Emerging reddish foliage

Closely related to Japanese elm is David elm (*Ulmus davidiana*), native of Manchuria and other areas of north China. Japanese elm in its native habitat prefers a forested situation. David elm is found in open areas along roads, streams, railroads, and overgrown fields. David elm appears to be a more promising tree than Japanese elm for adverse urban situations. Trees grown from seeds received from the Harbin Botanical Garden of Forestry in 1979 have produced splendid specimens up to 40 feet in height. The ultimate height of these trees is approximately 50 to 60 feet. These trees have a marked resemblance to American elm but are smaller. The size, form, and functional toughness of David elm make it a promising tree.

Additional species of elms from northern China have also been under study. Large-fruited elm (*U. macrocarpa*) also received from Harbin, has a growth form resembling American elm. Its height is up to 40 feet. *U. macrocarpa* does best on well-drained sites but tolerates clay soils. Arboretum specimens are about 25 feet in height. Szechuan elm (*U. szechuanica*) is a medium-sized elm (up to 40 feet) that spreads its branches into an umbrella-like canopy. Emerging red foliage in the spring and subdued purplish-red fall color are special features.

Lace-bark elm (*U. parvifolia*) is a handsome tree with small, thick, glossy, leathery leaves. It displays great variation of form and branching patterns. Its geographic range in China is extensive, extending northward to Horticultural Zone 5.

Criteria mentioned above for the development and selection of these new elms include their reduced or lack of preference and suitability for feeding and reproducing by leaf-feeding insects

pests such as the elm leaf beetle, Japanese beetle, spring and fall cankerworm, elm leaf miner, and gypsy moth.

The elm leaf beetle (ELB) is a defoliator of elms as both a larva and as an adult. In areas where Siberian elms have been planted, defoliation by the ELB can be quite extensive and debilitating to elm trees. Successive years of severe defoliation coupled with adverse environmental conditions, such as the 1988 Midwestern drought, can lead to plant stress, allowing potentially lethal secondary insect pests and pathogens to enter the plant. In conjunction with the plant health issue is the dilemma of trying to prevent defoliation by the ELB. Effective insecticides are currently available, but application of insecticides to kill the larvae and adults is not always practical or accepted when treating trees in sensitive landscape environments.

Like the elm leaf beetle, the Japanese beetle skeletonizes the leaves of elms. An exotic pest, native to China, the Japanese beetle arrived in the United States in the early 1900s and shows no indication of slowing down its feeding and destructive activities. Laboratory feeding and field defoliation studies by my research group have shown that many of the aforementioned Asian elms are less preferred by adult Japanese beetles particularly those elms species that have pubescent leaves.

Two early-season defoliators, the spring and fall cankerworm and gypsy moth have the potential to do serious feeding damage to elms. Sporadic outbreaks of cankerworms and the ever-expanding gypsy moth can lead to tree defoliation and stress. Again, as with the leaf-feeding beetles, recent studies in my laboratory have shown that a good number of these Asian elms have low to moderate preference and suitability for these two always-hungry insects.

The last of the leaf-feeders, the elm leaf miner, can be a chronic and extensive pest of North American and European elms, resulting in trees that appear scorched by early summer. Coupled with drought or other stressors, susceptible trees may not recover until late summer. Studies conducted over the last decade in the elm collection at The Morton Arboretum and by others have clearly shown that Asian elms are much less preferred by elm leaf miner compared to European and North American elm species.

Using these new Asian elm species in breeding programs has led to the development of many simple and complex hybrids for landscape plantings and urban forests. Recent releases into the nursery trade via the Chicagoland Grows program include *Ulmus* 'Morton'- Accolade™ elm, *U.* 'Morton Red Tip'- Danada Charm™ elm, *U.* 'Morton Plainsman' – Vanguard ™ elm, *U.* 'Morton Glossy' – Triumph™ elm, and *U.* 'Morton Stalwart' – Commendation™ elm.

An Arboretum 'Accolade' elm (*U. japonica* x *U. wilsoniana*) is from propagules of the Thornhill elm and in the last 20 years has attained a height of 40 feet and a diameter of 15 inches. Dark green foliage is one of its hallmarks. It is not particularly appetizing to the elm leaf beetle, Japanese beetle, and gypsy moth.

The 'Danada Charm' elm is a complex hybrid of *U. japonica-wilsonsiana* x *U. pumila* with an American elm form and emergent red foliage. Unfortunately it is highly preferred by the elm leaf beetle and gypsy moth, and moderately preferred by spring and fall cankerworm. It may have limited used where these insect pests are prevalent.

'Vanguard' elm a simple hybrid including *U. japonica* and *U. pumila*. It shows great promise for re-greening treeless areas in drought-prone regions, especially in the Midwest and Great Plains.

If offers a great option as a replacement tree for the Siberian elm, *U. pumila*. Overall, it is moderately preferred by elm leaf beetle, Japanese beetle, and spring and fall cankerworm.

Our fourth selection, 'Triumph' elm is a controlled cross of 'Vanguard' elm with 'Accolade' elm and includes parentage of *U. wilsoniana*, *U. pumila*, and two different sources of *U. japonica*. It has deep-green, highly glossy leaves with good form and strong branches. 'Triumph' is moderately preferred by elm leaf beetle and Japanese beetle, but has very low suitability for spring and fall cankerworm and gypsy moth.

The fifth and final selection, 'Commendation' elm is a complex hybrid of 'Accolade' elm with a *U. pumila* x *U. carpinifolia* hybrid from eastern Russia. It is a fast growing tree, tough, robust, and has large leaves. Feeding studies and field defoliation surveys has shown that 'Commendation' is appealing to the elm leaf beetle, Japanese beetle, and gypsy moth. Like the 'Danada Charm' elm, its use may be limited in areas where these insects are roaming the landscape.

One added benefit is that all five of these selections show little, if any, feeding damage from elm leaf miner which can be a major early season defoliator of certain North American and European elm species and hybrids.

While none of these selections is pest free, they all have unique horticultural attributes that make them suitable for urban forest and landscape plantings. In addition, they may fit well into a Plant Health Care program where host plant resistance is an option. Plant Health Care (PHC) is an management approach that attempts to focus on growing healthy plants using good horticultural and arboricultural practices so that plants can strive and fight off destructive pests. One ingredient in this process is the use of host plant resistance or plants that are less susceptible to damaging or lethal insects and diseases. In addition, using resistant plants minimizes the use of toxic insecticides and helps reduce the adverse effects on the environment, beneficials, and humans. Information and insights gained from these studies can guide the directions of continuing elm breeding and selection programs.

Hopefully, results from these studies and the elm improvement study will once again establish the elm to a useful place in our urban forests and landscapes without the need for intensive pest control practices. By implementing proper plant health care practices and use of resistant varieties, this goal is within reach.