RESISTANCE OF HIMALAYAN SMALL-LEAVED ELM TO DUTCH ELM DISEASE

by Frank S. Santamour, Jr.

Abstract: Three clones of *Ulmus villosa,* the Himalayan small-leaved elm, have proved to be winter-hardy in Washington, D.C. and showed no wilt disease symptoms following artificial inoculation with "nonaggressive" strains of the Dutch elm disease (DED) fungus. Inoculation with "aggressive" strains of DED produced wilt symptoms (10% to 50%) on two clones, but one remained free of wilt. *Ulmus villosa* is worthy of further trials in the milder regions of the United States, and the clones are being vegetatively propagated for distribution to other botanic gardens and arboreta. Since the species is diploid with 2n=28 chromosomes, it is possible that *U. villosa* could be used in breeding programs for the development of disease-resistant hybrids.

Dutch elm disease, caused by "aggressive" strains of the fungus *Ceratocystis ulmi* (Buis.) C. Moreau, has been devastating the elms of Great Britain since 1971 (Gibbs, Heybroek, and Holmes 1972). Nigel Muir has been an astute observer of the British scene, and in 1978 (Muir, 1978b) he wrote, ". . . *U. villosa* has to date survived drought and disease as well as, and perhaps better than, any other elm growing at Kew, of which there were formerly a great many kinds".

What is this elm species which, at least up until now, appears to be one of the few elms that will survive in one of the major botanical gardens in the world?

Ulmus villosa Brandis *ex* Gamble, is a native of the Indian Himalayas, and was formerly known as *U. laevigata* Royle. It is one of the few potentially cold-hardy and disease-resistant species of elm that have not been given a reasonable trial in the United States. As far as I know, except for the plants discussed in this paper, there are no trees of *U. villosa* cultivated in this country. The geographical range and botanical description of *U. villosa* have recently been updated by Melville and Heybroek (1971). It has not been possible to assign this species unequivocally to any established taxonomic Section or Series in the genus *Ulmus* (Heybroek, personal communication).

Probably the oldest trees of this species cultivated outside India are growing at the Royal Botanic Gardens, Kew, England. Three trees grown from seed received in 1935 from Lahore, India are currently in the Kew collection. These are Garden Nos. 290, 297, and 328, and they have been illustrated and appraised in four papers by Muir (1969, 1976, 1978a, 1978b), who applied the common name "Himalayan small-leaved elm" to this species.

Muir (1976) reported that one specimen had survived three attacks of Dutch elm disease (presumably the "aggressive" strain) between 1971 and 1976. A recent report (Muir 1978a) indicated some variation in disease susceptibility and an abundance of epicormic branching on previously infected specimens.

There is no doubt that this species can develop into large and useful landscape trees (Fig. 1). Heights of the three Kew trees, at various ages were: No. 297, 52 feet in 1969; No. 328, 64 feet in 1967; and No. 390, 75 feet in 1971. The diameter of No. 390 in 1971, taken 4 feet above the ground, was just over 2 feet (J.L.S. Keesing, personal communication). This tree has been given the Award of Merit by the Royal Horticultural Society. This smooth, silver-grey bark with prominent lenticels (Fig. 2) on mature trees appears to be unique among the elms (Muir, 1978b).

I first saw these trees in 1968, and attempted to obtain seed or scionwood for grafting the following year. Seed production is apparently uncommon, even in the wild, and the trees at Kew are not growing sufficiently close together to insure adequate intraspecific pollination. Dormant scions were rather dry when received and all the grafts failed on the rootstocks that were available. However, in 1976 we obtained softwood cuttings for vegetative propagation. The cuttings were treated with Hormodin No. 3 and stuck under mist in coarse perlite at the U.S. National Arboretum on June 23, 1976. Rooting was about 75% from these 40-year-old trees. A diploid chromosome count of 2n=28 was made on the adventitious

root tips.

Figure 1. Himalayan small-leaved elm has grown well in England. Note leaf retention in December, 1975 (Photo courtesy of Nigel Muir).

The rooted cuttings were potted and grown outdoors during 1976. The plants had to be staked in order to develop upright stems. Probably as a result of fertilizer treatment, growth had not ceased at the time of the first frost in Washington, so the plants were placed in a cool greenhouse for the winter of 1976-77. In 1977, the plants were transferred to 5-gallon cans and grown outdoors. By the end of the growing season the plants averaged 4 feet in height and about ¾ inch in caliper. Terminal growth had stopped before the first killing frost (October 18) and no cold damage was noted up to December 1, 1977.

We still did not know the potential cold hardiness of *U. villosa,* so the trees to be inoculated with Dutch elm disease in 1978 were placed in a cool greenhouse on December 1, 1977, along with other elm species and hybrids to serve as controls for the inoculation. Other plants of the three *U. villosa* clones were mulched in their containers and left outdoors to check on cold hardiness.

Reaction to Winter Temperatures and DED Inoculation

None of the *U. villosa* trees that were left outdoors in Washington, D.C. during the winter of 1977-78 showed any signs of cold damage. This limited exposure cannot be considered as a "hardiness" trial, but the results do indicate that the species might be adaptable to large areas of the United States.

Two trees of each clone were artificially inoculated in the greenhouse with spore suspensions of "aggressive" and "nonaggressive" strains of the Dutch elm disease fungus. Both "aggressive" and "nonaggressive" strains are capable of killing American elm (*U. americana* L.), but only the "aggressive" strains, which are common in North America, cause major problems among European elm species.

All fungus cultures were obtained from William L. McDonald (West Virginia University) and had been typed as "aggressive" or "nonaggressive" by Lawrence Schreiber (USDA, SEA, AR, Delaware, Ohio). The "aggressive" strains were OH-4 (North Dakota) and OH-9 (Massachusetts). The "nonaggressive" strains were OH-10 (Tennessee) and OH-14 (North Carolina).

All three clones of *U. villosa* were highly resistant to the "nonaggressive" strains, and none showed any wilt. Reaction to inoculation with the "aggressive" strains ranged from no wilt in one clone, 10% wilt in another, to about 50% wilt in the third clone. However, even under the favorable infection conditions in the greenhouse, none of the trees was killed and most recovered rapidly and put on new growth.

Seedlings of American elm and several of our selected DED-resistant hybrids (Santamour 1974) were also inoculated as controls. As expected, the American elms suffered severe wilt and dieback and the resistant clones showed only a slight indication of wilt.

Figure 2. The gray bark and prominent lenticels distinguish Himalayan small-leaved elm from others growing at the Royal Botanic Gardens, Kew, England (Photo courtesy of Nigel Muir).

Conclusions and Comments

The Himalayan small-leaved elm does seem to have sufficient potential to warrant further trials in the milder regions of the United States. Its growth form does not approach that of American elm but it is a massive tree with interesting bark (noted above). Incidentally, the bark of the young saplings at the Arboretum is also attractive, with a deep, rich mahogany color that contrasts with the large and prominent cream-colored lenticels (Fig. 3).

Some of the plants of *U. villosa* derived from the original 1976 cuttings, and from cuttings taken from the rooted plants in 1977, produced flowers in the greenhouse in 1978. We tried controlled pollinations on the older plants with pollen of *U. macrocarpa* Hance and *U. pumila* L., but no seed matured. Unfortunately, we did not attempt any intraspecific crosses among the *U. villosa* clones, but the precocious flowering of the rooted cuttings does suggest that we might be able to produce viable seed by this method. Seedlings resulting from such inter-clonal crosses would provide greater genetic diversity than the clones, and would allow for a more adequate assessment of the species' potential. In our limited experience, we have had considerable difficulty in making the cutting-propagated plants "stand up" on their own. Seedlings may not exhibit this problem.

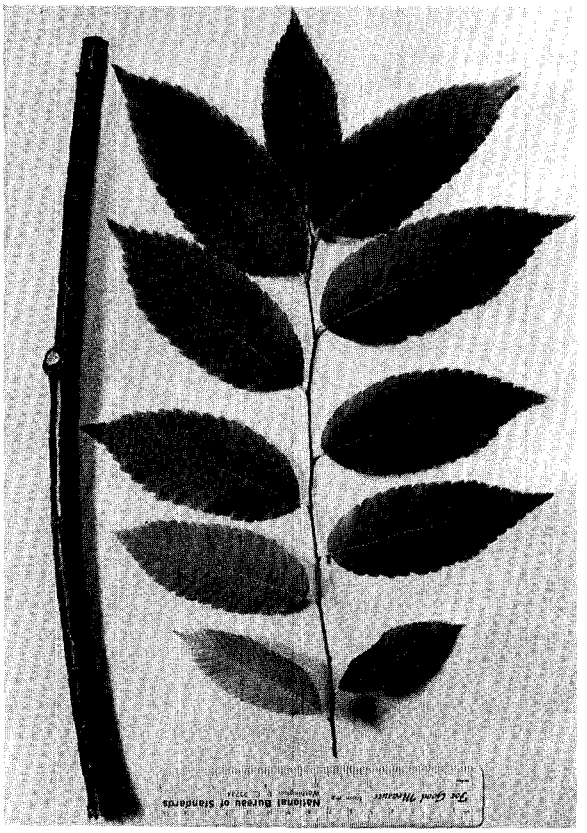

Figure 3. Leaves and twig of young Himalayan small-leaved elm.

For the present, however, we are continuing to propagate all three clones, rooted cuttings of which will be distributed through the Arboretum's regular cooperative programs to other arboreta, scientists, and interested nurserymen.

Literature Cited

Gibbs, J.N., H.M. Heybroek, and F.W. Holmes. 1972. *Aggressive strain of Ceratocystis ulmi in Britain.* Nature (Lond.) 236: 121-122.

Melville, R. and HM. Heybroek. 1971. *The elms of the Himalaya.* Kew Bull. 26(1): 5-28.

Muir, Nigel. 1969. Himalayan small-leaved elm. Gard. Chron. 166(13): 7-8.

Muir, Nigel, 1976. *DED in the news.* Gard. Chron. 179(3): 19.

Muir, Nigel. 1978a. *Elm hopes for the future.* GC & HTJ 183(4): 32-33, 35.

Muir, Nigel. 1978b. *Bark for variety.* GC & HTJ 183(23): 26-29.

Santamour, Frank S., Jr. 1974. *Resistance of the new elm hybrids to Dutch elm disease.* Plant Dis. Reptr. 58: 727-730.

U.S. National Arboretum
SEA, USDA
Washington, D.C.