

AMERICAN ELM CLONES OF IMPORTANCE IN DUTCH ELM DISEASE TOLERANCE STUDIES

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Abstract.—We present the background and characteristics of American elm clones that are commercially available or of interest in research on Dutch elm disease (DED) tolerance in the United States. The characteristics of interest include origin, ploidy level, whether available in nursery trade, evidence of DED tolerance, and other comments. The list includes 10 named commercially available cultivars, six additional named American elms of interest, and six numbered clones of interest.

Introduction

Group discussions were held during the 2016 American Elm Restoration Workshop, to share information about clones of American elm that have been tested for Dutch elm disease (DED) tolerance. As an outcome of those discussions, and with much further consultation of the literature, a listing has been compiled of clones commercially available or of other interest.

The purpose of this report is to provide a concise listing of the characteristics and background of these clones, as a resource for American elm researchers. The list includes both commercially available clones and clones that have been used in research on DED tolerance in the United States. Some of the selections listed are known to be susceptible, but are included because they have been used as susceptible controls, were at one time considered to be tolerant, or are important as parents of DED-tolerant clones. The first group is an alphabetical list of clones that are commercially available in the nursery industry, including some that have not been tested for DED. The second group is clones of interest, also ordered alphabetically. A third group of numbered clones follow. This is not an exhaustive list, but includes those for which we had information available at the time of publication.

The characteristics of interest that we have included are information on origin, ploidy level, availability in the nursery industry, evidence of DED tolerance, and other comments. When it was available, information on growth form, is included in the general comments section. Additional descriptions of growth form can be found for many of the cultivars in the “Manual of Woody Landscape Plants” (Dirr 2009). Note that in these groups, proper cultivar names are included in single quotations (e.g., ‘cultivar name’). Other names or numbers by which a clone has been identified follow in parentheses. Often a clone was first known by an accession number, or other identity, prior to receiving a name. The abbreviation NA, in association with a number, indicates the National Arboretum accession number.

For the sake of consistency of terminology within this paper, only the term tolerance is used to describe the relative response of elms to the DED fungus, to reflect the fact that all *U. americana* clones can be infected by the disease, but tolerant clones often recover from infection. Some researchers prefer to use the term resistance for this. No American elm has yet demonstrated immunity to DED, and the level of tolerance demonstrated varies based on growing conditions, type of inoculum, method of inoculation, and a variety of other factors (see Beier et al. 2017, Flower et al. 2017, Haugen et al. 2017, in this proceedings).

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Commercially Available Clones

'Brandon'; 'Patmore'

Origin and Notes: Selected and propagated by R.H. Patmore from a native tree in Brandon, Manitoba, Canada, with an upright compact form (listed in Santamour and Bentz 1995). Trees are sold under both cultivar names, which may or may not be synonymous.

Ploidy: Presumed tetraploid.

Availability: Available mainly in Canada. Nursery catalogs recommend it for locations without DED or with active DED sanitation programs.

Evidence of DED tolerance: No information available. Thought to be susceptible.

Other Comments: Included because it is fairly widely planted in Canada in places with no DED. Limited information on this cultivar is available on Wikipedia.

Colonial Spirit Elm® ('JFS-Prince II', Kuhar 2)

Origin and Notes: Discovered by Princeton Nursery as a surviving mature tree in New Jersey. Introduced under license by J. Frank Schmidt & Sons Co. after Princeton Nursery closed.

Ploidy: Tetraploid.²

Availability: Available through J. Frank Schmidt & Sons Co., Boring, OR.

Evidence of DED tolerance: Still under evaluation. Limited numbers were challenge inoculated by U.S. Forest Service (Flower et al. 2017, this proceedings).

Other Comments: Upright vase shape, somewhat narrow vase when young then widening and arching into a classic vase shape. Princeton Nursery preferred this cultivar to its own 'Princeton' cultivar because of better branching.³

Creole Queen™ (*Ulmus americana* 'UASNZ')

Origin and Notes: Selected in New Orleans, LA, by Select Trees.

Availability: Available through Select Trees, Inc., of Athens, GA.

Evidence of DED tolerance: No record of testing was available.

Other Comments: Promoted as having a tight branching upright form with high heat tolerance.

'Jefferson' (NPS 3-487, N3487, NA 62001)

Origin and Notes: Selected by H.V. Wester of the National Park Service from trees planted on the National Mall in Washington, D.C. (Sherald et al. 1994). Joint release by Agricultural Research Service (National Arboretum) and National Park Service in 2004.

Ploidy: Triploid (Sherald et al. 1994, Whittemore and Olsen 2011, Whittemore and Xia 2017)

² Unpublished data on file with Alan Whittemore, Botanist, USDA Agricultural Research Service, National Arboretum, Beltsville, MD.

³ Personal communication via email from Keith Warren, retired Director of Product Development, J. Frank Schmidt and Son Co., P.O. Box 189, Boring, OR 97009.

Availability: Generally available.

Evidence of DED tolerance: Tested by inoculation and found to be tolerant. Tolerance to DED tested by twig-crotch inoculations (Sherald et al. 1994) and stem inoculations (Townsend et al. 2005).

Other Comments: Thought to be a hybrid between tetraploid American elm and a diploid parent, probably a diploid “American elm” as reported by Whittemore and Olsen (2011). Spreading crown habit at maturity, suitable for and used on the National Mall (Sherald 1993). Cultivar description is available at National Arboretum ([http://www.usna.usda.gov/Newintro/Jefferson%20elm\(FinalLR\).pdf](http://www.usna.usda.gov/Newintro/Jefferson%20elm(FinalLR).pdf)). Bud break commences earlier and holds leaves longer than typical American elm. Discussion at the American Elm Restoration Workshop indicated that some material thought to be ‘Jefferson’ was commercially distributed (including to the National Elm Trial) and later determined to be mislabeled material of an unknown tetraploid elm, probably ‘Princeton’. The extent of this distribution of misidentified material is not fully known and has significant implications for tree maintenance needs. It is possible to determine whether elms are truly ‘Jefferson’ through growth characteristics (using identification keys like those shared on the University of Minnesota website at <http://trees.umn.edu/elmid>) or testing the ploidy (true ‘Jefferson’ is triploid).⁴

‘New Harmony’ (Amer. 680, NA 57844)

Origin and Notes: Original tree was found along Interstate 70 near Springfield, OH. First propagated in 1980 (Wall 2000). Selection made in Delaware, OH, for DED tolerance by A.M. Townsend and L.R. Schreiber. Released in 1995 by Agricultural Research Service (National Arboretum).

Ploidy: Tetraploid (Whittemore and Olsen 2011).

Availability: Generally available.

Evidence of DED tolerance: Tested by inoculation. Found to be tolerant (Townsend and Douglass 2001, Townsend et al 1995, 2005).

Growth Form: Narrow crown with good branch structure.

Prairie Expedition® (‘Lewis & Clark’; RFM-37)

Origin and Notes: Origin is along Wild Rice River southwest of Fargo, ND. Survivor elms were identified through a landowner survey. Released in 2004 by the North Dakota State University (NDSU) Research Foundation. Suitable trees were screened (Cheng et al. 1997).

Ploidy: Presumed tetraploid

Availability: Generally available.

Evidence of DED tolerance: Tested by inoculation. Found by NDSU to be tolerant to DED (NDSU 2016). For more information, see Capps (1997).

Other Comments: Form typical of American elm. NDSU Research Foundation has trademarked (not patented) and released this elm for commercial production. Information on licensing is available at http://www.ndsuresearchfoundation.org/prairie_expedition.

⁴Personal communications with Tom Zetterstrom, Founding Director of Elm Watch, Canaan, CT 06018; and Chad Giblin, Research Fellow, Department of Forest Resources, University of Minnesota, St. Paul, MN 55108.

‘Princeton’

Origin and Notes: Selected in 1922 by Princeton Nurseries in New Jersey (Green 1964).

Ploidy: Tetraploid.²

Availability: One of the most widely commercially available DED-tolerant clones.

Evidence of DED tolerance: Tested by inoculation. Found by ARS to be tolerant to inoculation with DED fungus (Santamour and Bentz 1995; Townsend et al. 1995, 2005).

Other Comments: Some resistance to elm leaf beetle (Green 1964). Discussion at elm meeting indicated need for high level of maintenance pruning to maintain good crown structure.

‘St. Croix’ (US Plant Patent 20,097 P3)

Origin and Notes: Selected by Mark Stennes from an agricultural property along the St. Croix River, near Afton, MN. The original tree is a very large tree and is still living (Bliska et al. 2009). The patent is held by Chris Bliska and others, with a \$2/tree royalty (Clayton 2014).

Ploidy: Tetraploid.⁵

Availability: Generally available.

Evidence of DED tolerance: Tested by inoculation. Found to be tolerant. Tested alongside Valley Forge elm; both became symptomatic, but survived when wild-type elms died (Bliska et al. 2009).

Other Comments: Bailey Nurseries in Newport, MN, is producing this elm (Clayton 2014). Described as spreading, vase-shaped crown when open grown (Bliska et al. 2009).

“Survivor Tree” (Survivor)

Origin and Notes: Surviving American elm from 1995 bombing site of the Murrah Federal Building in Oklahoma City, OK. The name implies nothing about disease resistance, but instead is a tribute to the tree’s persistence on the site. (Note the use of double quotes rather than single quotes traditionally used for cultivar names.)

Availability: Generally available.

Evidence of DED tolerance: No record of testing was available.

Other Comments: Ramets and seedlings from this tree are distributed for memorial plantings. See Oklahoma City National Memorial and Museum (2017.)

‘Valley Forge’ (Amer. 3, NA 57842)

Origin and Notes: Seedling selection made in Delaware, OH, for DED tolerance by A.M. Townsend and L.R. Schreiber. Released 1995 by Agricultural Research Service (National Arboretum). Oral tradition says the original seed source is Nebraska (Wall 2000).

Ploidy: Tetraploid.²

Availability: Widely available.

⁵ Unpublished data on file with Benjamin W. Held, University of Minnesota.

Evidence of DED tolerance: Tested by inoculation. Found to be tolerant. (Townsend and Douglass 2001; Townsend et al. 1995, 2005).

Other Comments: Has been used as a standard tolerant clone in many research studies. Propagates easily. Young tree requires significant management to produce a tree of useful form. Poor structural characteristics combined with rapid growth have made this cultivar unsuitable for many landscape situations (Costello et al. 2004).

Other Clones of Interest

American Liberty (Included W502, W503, W505, W507, W510, and M-8; also referred to as Liberty)

Origin and Notes: A collection of six clones selected by E. Smalley and R. Guries at the University of Wisconsin. Five of the clones were selected from 8000 progeny of crosses from clones originating in Wisconsin and Iowa and similar trees from Cornell University and U.S. Department of Agriculture. The sixth clone (M-8) originated as one survivor out of 1000 seedlings from Kansas in 1957. Commercial development was transferred to the Elm Research Institute (Smalley et al. 1993).

Ploidy: Presumed Tetraploid.

Availability: Available through the Elm Research Institute (ERI), Harrisville, NH. Not available through nurseries.

Evidence of DED tolerance: Tested by inoculation. See US PP6227 (Smalley and Lester 1988). W502 and W510 have performed particularly well in some DED tolerance trials (Smalley et al. 1993). In stringent trials conducted by the Agricultural Research Service, the American Liberty multi-clone did not demonstrate high tolerance to DED, but ERI did not disclose the identity of the trees that were provided for the trial (Townsend and Douglass 2001, Townsend et al. 1995).

Other Comments: These were the first commercially released products of a DED tolerance breeding program (Smalley and Lester 1988). Reported as highly susceptible to elm yellows in New York (Sinclair et al. 1994). Form was noted as vigorous upright main trunk in youth with older branches tending to become more horizontal at maturity (Smalley et al. 1993). Since this is a multiclone, there may be variation in characteristics depending on which clone is received.

'Augustine' (Augustine Ascending)

Origin and Notes: Originally selected in 1927 in Bloomington, IL (listed in Green 1964).

Ploidy: Tetraploid.²

Availability: Unknown.

Evidence of DED tolerance: Has proven to be susceptible to DED (Santamour and Bentz 1995, Townsend et al. 2005).

Other Comments: This cultivar is included because it was very commonly planted at one time and it has been tested alongside tolerant American elms.

‘Delaware’ (Delaware 2)

Origin and Notes: Selected during the 1940s by the Bureau of Plant Industry in New Jersey (Townsend 2000). Origin of seed was North Dakota. Ramets from original material are retained at USDA site in Delaware, Ohio, and the National Arboretum in Beltsville, MD.

Ploidy: Tetraploid.²

Availability: No longer sold commercially, but is available for research purposes. It was available in the past.

Evidence of DED tolerance: Tested by inoculation. Found to be tolerant (Townsend et al. 2005).

Other Comments: Original tree died in 1980 from unknown causes (Santamour and Bentz 1995). Significant information on the history of this tree is included in Santamour and Bentz 1995. ‘Delaware’ is used by U.S. Forest Service, Northern Research Station (NRS) Forestry Sciences Laboratory in a number of plantings. Used in crosses to produce DED-tolerant progeny (Slavicek and Knight 2011, Townsend et al. 2005). Wide spreading, somewhat shorter than typical American elm (based on observations of the trees of this clone that are planted on the National Mall in Washington, D.C.).

‘Independence’ (W510) (US Plant Patent 6227)

Origin and Notes: Patented tree, part of American Liberty multiclone. Originated from a controlled cross between ‘Moline’ (from Illinois) and W185-21 (Smalley and Lester 1988). The W-185 family of American elm was received by Wisconsin in 1959 as a shipment of 200 seedlings from the (now defunct) Inter-state Nurseries in Hamburg, Iowa.⁶

Ploidy: Presumed tetraploid.

Availability: Not available. Only obtainable as one of American Liberty multiclone

Evidence of DED tolerance: Tested by inoculation (Smalley and Lester 1988, Townsend et al. 2005). Found by University of Wisconsin to be tolerant to DED.

Other Comments: Among the clones included in the American Liberty multiclone, W510 demonstrates tolerance and is also easy to propagate (Smalley et al. 1993). Form was noted as traditional American elm architecture (Smalley et al. 1993), vase shape, dense foliage, and vigorous growth rate (Smalley and Lester 1988).

‘Moline’

Origin and Notes: Originated as a wild seedling transplanted to Moline, IL, in 1903. Has been propagated since 1916 (Green 1964).

Ploidy: Presumed tetraploid.

Availability: Currently unknown.

Evidence of DED tolerance: Reported both as slightly resistant [tolerant] (Smalley et al. 1993) and highly susceptible (Gibbs et al. 1975).

⁶ Personal communication from Raymond P. Guries, Professor Emeritus, Department of Forest and Wildlife Ecology, University of Wisconsin, Madison, Wisconsin 53706. Information was provided to Linda Haugen as notes during American Elm Restoration Workshop.

Other Comments: This is the female parent of ‘Independence’, developed by University of Wisconsin (Smalley and Lester 1988).

NPS 3-178 (“Washington”)

Origin and Notes: Selected by H. V. Wester from among trees planted on the National Mall in Washington, D.C. “Washington” is not considered a valid cultivar name (Santamour and Bentz 1995) and therefore appears in double, rather than single quotation marks here.

Ploidy: Triploid (Whittemore and Olsen 2011)

Availability: Currently not available. At one time was sold through Princeton Nurseries as “Washington” (Santamour and Bentz 1995, Sherald 1993).

Evidence of DED tolerance: Experiments by the National Park Service in the 1960s indicate this clone is DED tolerant. This clone demonstrated greater vigor, including seasonally earlier foliage development, than other clones (Wester 1972).

Growth Form: Spreading crown habit at maturity, suitable for use on the National Mall (Sherald 1993).

Other Numbered Clones

(None of these is available in the nursery trade.)

NA 57845

Origin and Notes: “A randomly selected American elm clone” (Townsend et al. 2005). Used as a fully susceptible control in many ARS and NRS studies.

Ploidy: Tetraploid.²

Evidence of DED tolerance: Tested by inoculation. Fully susceptible to DED (Townsend et al. 2005).

Other Comments: This clone has been referred to informally as “FUBAR”, but this is not a valid name. It has been used as a susceptible control in many ARS and NRS studies. Inoculations were applied to replicate plantation trees at Glenn Dale, MD, and Delaware, OH. At the Ohio site, NA 57845 was more susceptible to DED than average unselected seedlings grown from seed obtained from F. W. Schumacher Seed Company (Sandwich, MA). Ramets of this clone were also found to be susceptible in a field test conducted at University of California-Davis prior to 2000. These trees were mistakenly labeled as 8630 and later revealed through DNA testing to be NA 57845.⁷

Growth Form: Poor form.

R18-2 (NA 57846)

Origin and Notes: Originally selected by Cornell University and the Boyce Thompson Institute. Was one of 11 survivors out of 21,000 seedlings screened (Townsend et al. 2005).

⁷ Personal communication from Steven Eshita, retired microbiologist, U.S. Forest Service, Northern Research Station, Delaware, Ohio. Information was provided to Linda Haugen as notes during American Elm Restoration Workshop.

Ploidy: Tetraploid.²

Evidence of DED tolerance: Tested by inoculation. Found to be tolerant (Townsend and Douglass 2001; Townsend et al. 1995, 2005).

Other Comments: Susceptible to elm yellows (EY). Original tree succumbed to EY in 1979 (Smalley et al. 1993). This clone was a parent in some of the clones included in American Liberty (Smalley et al. 1993) and is planted in several NRS plantings in Wisconsin, Iowa, Minnesota, and Connecticut.

Growth Form: Well-formed, vase-shaped tree.

Amer 180 (NA 55342)

Origin and Notes: Survivor of disease epiphytotic from near Findlay, Ohio.

Evidence of DED tolerance: Tested by inoculation. Found to be somewhat tolerant (Townsend 2000; Townsend et al. 1995, 2005).

Other comments: Not vigorous slow-growing. Cuttings are difficult to root.⁸

Amer 190 (NA 63507)

Origin and Notes: Originated from controlled cross between ‘Valley Forge’ and ‘Delaware’ (Townsend et al. 2005).

Ploidy: Tetraploid.²

Evidence of DED tolerance: Tested by ARS in 1984. Found to be among the best progeny from this cross (Townsend 2000). Tested by inoculation and found tolerant (Townsend et al. 2005).

Amer 290 (NA 63508)

Origin and Notes: Originated from controlled cross between ‘Valley Forge’ and ‘Delaware’ (Townsend et al. 2005).

Ploidy: Tetraploid.²

Evidence of DED tolerance: Tested by ARS in 1984. Found to be among the best progeny from this cross (Townsend 2000). Tested by inoculation. Found to be tolerant (Townsend et al. 2005).

Amer 8630

Origin and Notes: Survivor from selections made by Roger Swingle and associates at the Columbus, OH, U.S. Forest Service laboratory in Delaware, OH. Was selected in Kentucky as a survivor of initial DED and EY epiphytotics (Smalley et al. 1993).

Evidence of DED tolerance: Has never been tested for DED tolerance.⁹

Other Comments: This cultivar is included because of its potential for resistance to elm yellows.

⁸ Personal communication from Susan E. Bentz, Horticulturist, USDA Agricultural Research Service, U.S. National Arboretum, Beltsville, MD 20705.

⁹ Personal communication from James M. Slavicek, Project Leader, U.S. Forest Service, Northern Research Station, 359 Main Road, Delaware, OH, 43015.

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The content of this paper reflects the views of the authors, who are responsible for the facts and accuracy of the information presented herein.