

# Development of Methods for the Restoration of the American Elm in Forested Landscapes

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## Abstract

A project was initiated in 2003 to establish test sites to develop methods to reintroduce the American elm (*Ulmus americana* L.) in forested landscapes. American elm tree strains with high levels of tolerance to Dutch elm disease (DED) were established in areas where the trees can naturally regenerate and spread. The process of regeneration will allow the American elm to co-evolve with the DED fungal pathogen to ensure this valuable tree species will not be lost from the landscape. This effort in Ohio is being carried out in partnership with the Ohio Department of Natural Resources-Division of Forestry, Franklin County Metro Parks, Worthington City Parks, and The Wilds. The project was expanded in 2005 by establishment of restoration sites in Iowa; Wisconsin; and Minnesota in partnership with the USDA Forest Service Northern Area State and Private Forestry; Luther College, Iowa; the U.S. Army Corps of Engineers; and the Carpenter St. Croix Valley Nature Center in Minnesota. In 2007, a site was established at Dago Slough near Cassville, Wisconsin in partnership with the U.S. Department of the Interior, Fish and Wildlife Service, and a test planting was established at the Bad River Indian Reservation in Wisconsin to assess tree cold hardiness. The restoration effort was expanded in 2010 in partnership with The Nature Conservancy through establishment of three sites in Vermont. To date, 12 American elm restoration test sites have been established in five states.

*Key words:* Dutch elm disease, American elm, restoration

## Introduction

The American elm (*Ulmus americana* L.) was once widely distributed throughout the eastern United States and was a preferred tree for use along city streets and in the yards of many homeowners. The Dutch elm disease (DED) fungal pathogen *Ophiostoma ulmi* was introduced into the United States in 1930 and *O. novo-ulmi* in the early 1940s (Brasier 2000). In the subsequent years, these pathogens have destroyed millions of American elm trees in the United States and Canada. By 1976, only 34 million of the estimated 77 million elms present in the urban landscape before the introduction of the DED pathogen remained, and far fewer are still present today.

One line of research on the American elm from the 1970s to the present focused on the identification of American elm isolates that could withstand the DED pathogen. Over 100,000 American elm trees were tested for resistance to DED. No trees were found that were resistant; however, a few were identified that exhibited high levels of tolerance (approximately 60 to 96 percent survival after fungal inoculation) to the disease (Sherald 1993, Smalley and Guries 1993). Out of over 100,000 American elm trees screened for DED resistance, a very small number of trees (about seven) were identified that exhibit the necessary levels of DED tolerance to withstand the disease. Five of these selections include trees that have been released to the nursery industry: Valley Forge, Princeton, and New Harmony, and two other selections, the R18-2 and Delaware 2 (Smalley et al. 1993, Townsend et al. 1995, Townsend and Douglass 2001, Townsend et al. 2005). These five selections were planted at experimental test plots to assess fitness for selected sites and to develop methods for restoration of the American elm.

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## Materials and Methods

The origin of the following American elm selections used in the test plots are:

- Princeton: A cultivar originating from Princeton, NJ that exhibits high tolerance to DED identified in 1922.
- R18-2: One of 17 survivors out of 21,000 seedlings screened for DED tolerance by Cornell University and the Boyce Thompson Institute reported in 1993.
- Delaware 2: One of the two most DED-tolerant trees identified in a screen of 35,000 seedlings by the U.S. Department of Agriculture, Bureau of Plant Industry selected in the 1940s.
- New Harmony: A clone of an ancient tree near Springfield, Ohio that was identified by Denny Townsend and Larry Schreiber in 1975 and exhibits high DED tolerance .
- Valley Forge: A selection out of hundreds that was identified by Denny Townsend and Larry Schreiber in 1975 and showed high levels of DED tolerance .
- Valley Forge x New Harmony seedling trees.

Additional selections will be added to the test sites as they become available. Test sites established to date are listed in table 1.

**Table 1. Test sites established as of June 2012**

Site	Location	Year established	Site description
Highbanks Metro Park	Delaware County, OH	2003	Upland, heavy clay
Mohican Memorial State Forest	Ashland County, OH	2003	Upland, loam
The Wilds	Muskingum County, OH	2003	Reclaimed coal mine
Maumee State Forest	Fulton County, OH	2004	Lowland, sand
Glacier Ridge Metro Park	Union County, OH	2004	Upland, heavy clay
Carpenter St. Croix Valley Nature Center	Hastings, MN	2005	Lowland, loam
Eagle Island	Stoddard Islands, WI	2005	Island within the Mississippi River
Luther College	Decorah, IA	2005	Upland, loam
Dago Slough	Cassville, WI	2007	Mississippi River floodplain
Olentangy River Park	Worthington, OH	2009	Olentangy River floodplain
Otter Creek	Cornwall, VT	2010	Otter Creek floodplain
Connecticut River	Maidstone, VT	2010	Connecticut River floodplain
LaPlatte River	Shelburne, VT	2010	LaPlatte River floodplain

American elm selections were propagated by vegetative cuttings, grown in 7.6 L pots for 2 years, and were about 2 m in height at planting. Valley Forge x New Harmony seedlings were generated by controlled pollinations, the seedlings were grown in 7.6 L pots for 1 year, and were about 1.3 m in height at planting. A 0.9 m diameter space was cleared of vegetation, 400 cm<sup>3</sup> of 10-10-10 fertilizer and 20 cm<sup>3</sup> of trace elements was added to the bottom of the planting hole, the trees were planted, and watered if the soil was dry. Mulch was added to the base around the trees with the exception of trees

planted in 2003 where weed barriers of recycled plastic were used. Wire enclosures 0.76 m in diameter were constructed of poultry wire, 12 gauge woven wire, or plastic deer fencing and were placed around the trees to prevent deer browse and deer rub. A variety of site types were selected including upland, lowland, floodplain, and island sites as indicated in table 1 above. Trees were planted in a grid pattern or in clusters with spacing of individual trees from approximately 8 to 11 m apart. Annual measurements of trunk diameter at 1.2 m in height and height were made in early spring before leaf expansion. Instances of mortality were noted and the cause determined when possible.

## Results and Discussion

All deer exclusion methods employed were effective; however, the wire enclosures made of 12 gauge woven wire were the most durable and needed no attention after placement. Mulching the base of trees provided effective weed/plant control for about 2 to 3 years after planting. Weed barrier mats provided long-term effective weed/plant control; however, they also provided nesting cover for mice which fed on bark during winter causing the loss of a few trees. The mats were removed in the spring of 2005.

At the Mohican Memorial State Forest site, average yearly growth ranged from 0.3 to 1.02 m in height for the clonally propagated selections, and from 0.25 to 0.9 m for Valley Forge x New Harmony seedling trees (fig. 1). Cumulative growth to date resulted in an average height of 6.2 m for the clonal selections and 3.5 m for the seedling trees (fig. 2). Average yearly growth ranged from 7.5 to 15 mm in stem diameter of the clonally propagated selections, and from 0.25 to 14.5 mm of Valley Forge x New Harmony seedling trees (fig. 3). Cumulative stem growth to date resulted in an average stem diameter of 80 mm for the clonal selections and 30 mm for the seedling trees (fig. 4).

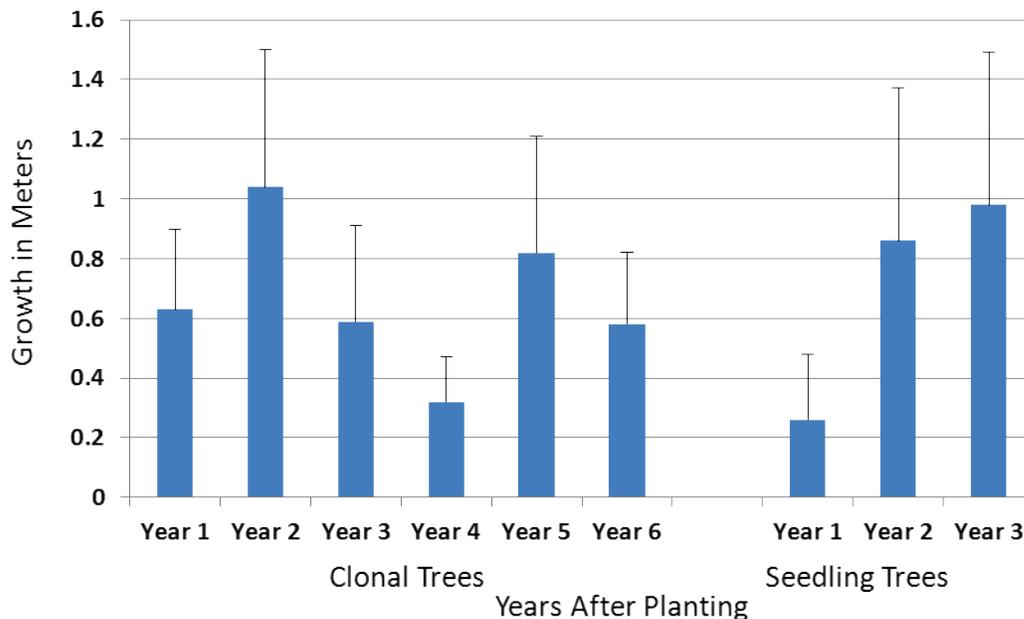


Figure 1—Average growth in American elm tree height of trees planted in 2003 at the Mohican Memorial State Forest in Ohio. The average growth plus the standard deviation for each year is shown.

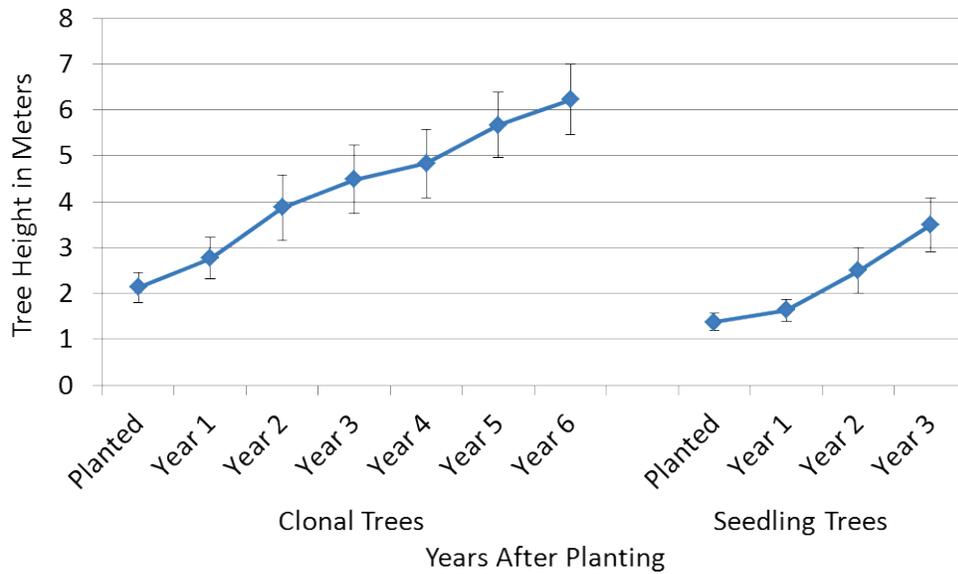


Figure 2—Cumulative growth in American elm tree height of trees planted at the Mohican Memorial State Forest in Ohio. The average cumulative height +/- the standard deviation for each year is shown.

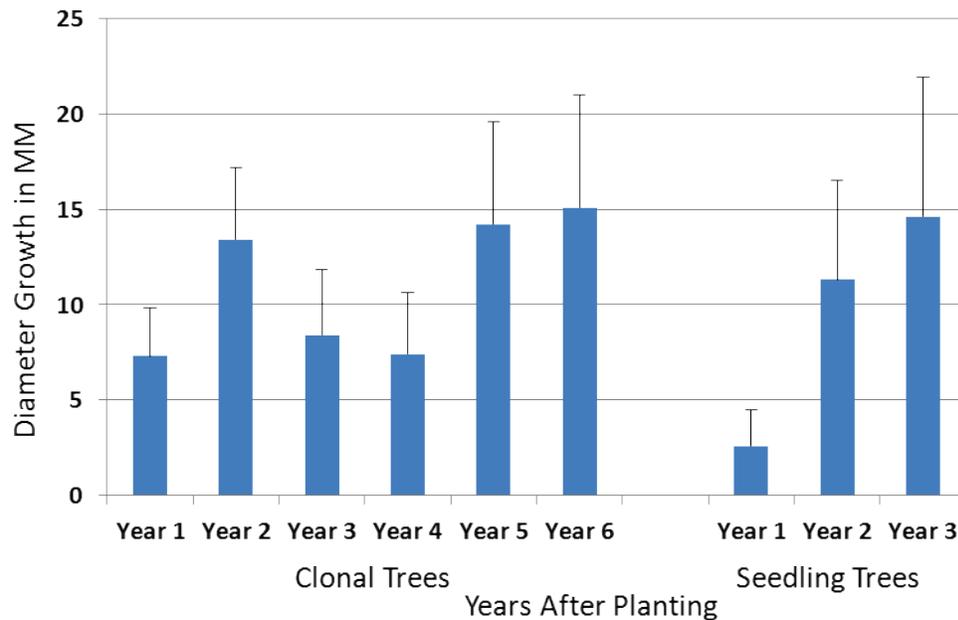


Figure 3—Average growth in American elm tree trunk diameter at 1.2 m in height of trees planted in 2003 at the Mohican Memorial State Forest in Ohio. The average growth plus the standard deviation for each year is shown.

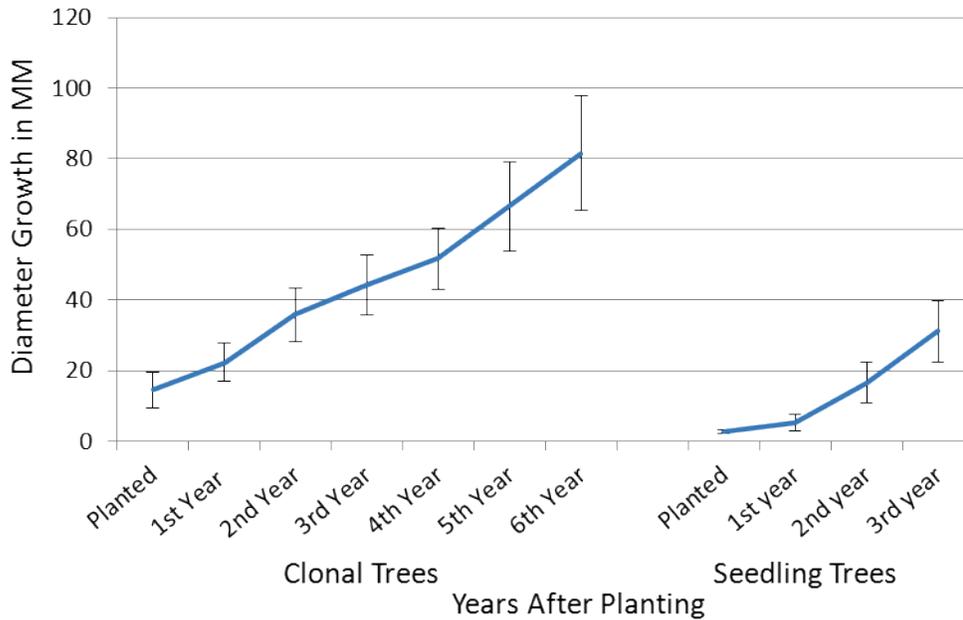


Figure 4—Cumulative growth in American elm tree trunk diameter at 1.2 m in height of trees planted in 2003 at the Mohican Memorial State Forest in Ohio. The average cumulative growth +/- the standard deviation for each year is shown.

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