Elms: the Good, the Bad and the Ugly

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NDSU NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

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American elm lined streets were once the norm for many neighborhoods

Photo by Greg Morgenson, NDSU WPIP

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American Elm (*Ulmus americana*)

- Widely adaptable to urban conditions across the US, cold hardy and pH adaptable
- Easily transplanted bareroot
- Easily obtainable, collect locally and plant yourself
- Desirable form in the landscape
- Performs well in prairie and plains communities, conservation plantings and urban settings

Photo by Greg Morgenson, NDSU WPIP

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What happened?

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What Happened? DED arrived

- Dutch Elm Disease, *Ophiostoma ulmi*, arrived in the US in the late 1920's via infected wood imports from Europe. This was followed by the outbreak of *O. novo-ulmi* in the 1940's.
- No American or European elm species have acceptable resistance, most are very susceptible.
- DED moved across most of the US and Canada killing millions of elm in city and rural plantings and removing native elm species from future plantings in these areas
- End of most American elm planting in the US

Photo Manitoba Forestry

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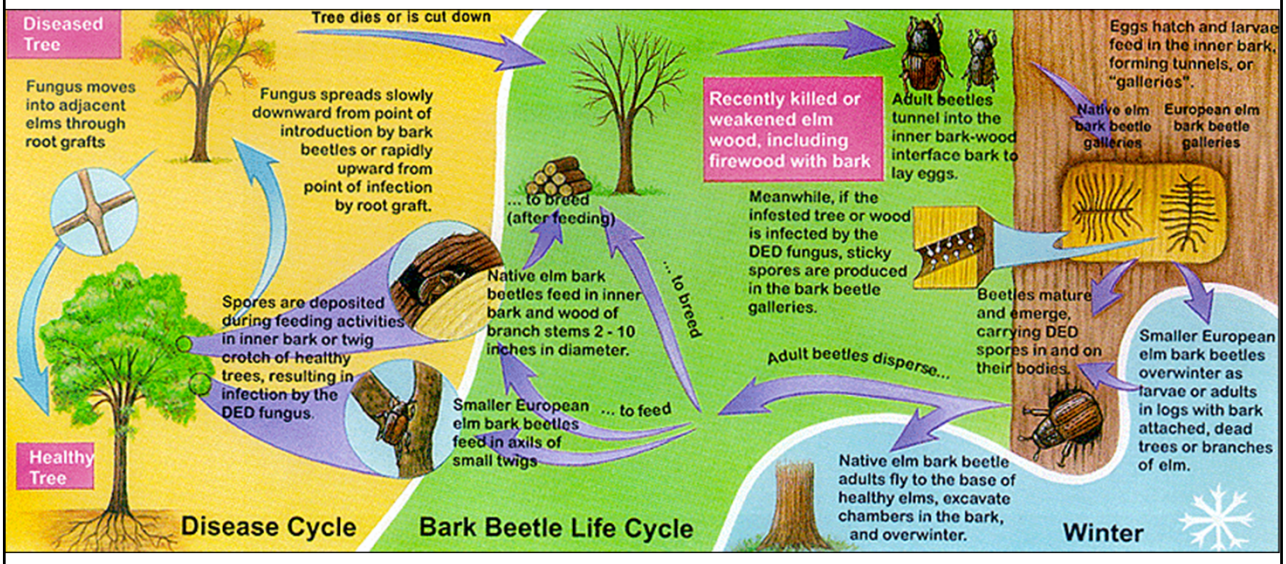

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Once elm lined streets have given way to green ash lined streets

Photo by Greg Morgenson, NDSU WPIP

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To Autumn Blaze Freeman maple lined streets

Photo by Greg Morgenson, NDSU WPIP

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Managing DED

- Monitor – look for flagging, and beetle exit holes
- Sanitation to reduce insect vectors
  - Infected wood destroyed or debarked
- Chemical – Insect Vector
  - Insecticides to kill insect vectors – used in conjunction with sanitation
  - Difficult because of tree size, drift and expense
- Chemical – Fungal
  - Inject tree with fungicide (Arbotect)
  - Can be expensive and needs to be done every 1-3 years
  - Over application can scorch foliage
- Cultural
  - Plant disease resistant or tolerant trees

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Elm Disclaimer

- All elms can get Dutch Elm Disease
- **All elms need yearly pruning** after planting for the first 10 – 15 years to produce proper branch structure
- **Utilize (save) elm for tough sites which may help control their highly vigorous growth and save ideal planting spots for other genera**.
- Ideally to match tree with specific site and not to just fill a hole to meet the diversity guideline of 20-10-5
- **Don't be afraid of Elms!!!**

Photo by Greg Morgenson, NDSU WPIP

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3 Groups

- American Elm
  - *Ulmus americana* – American Elm
  - *U. rubra* – Slippery or Red Elm
  - *U. thomasii* – Rock or Cork Elm
- European Elm
  - *U. glabra* – Scotch or Wych Elm
  - *U. carpinifolia* (syn. *U. minor*) – Smoothleaf Elm
- Asian Elm
  - *U. pumila* – Siberian Elm
  - *U. japonica* (syn. *U. davidiana var. japonica*) – Japanese Elm
  - *U. parvifolia* – Chinese Elm
  - *U wilsoniana* – (Wilson Elm)

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Asiatic elm hybrids, as with American elm, are soils and pH adaptable

Photo by Greg Morgenson, NDSU WPIP

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The Move to Asiatic Elm Species

- DED is an Asiatic pathogen, many Asiatic species have evolved with DED and have fair to good to excellent tolerance/resistance to the disease
- There are many species of Asiatic elm to choose from depending upon the region of the US they will be planted in
- Asiatic elms can be hybridized between other Asiatic species to improve form, foliage quality, hardiness and to maintain acceptable DED tolerance

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The Move to Asiatic Elm Species (cont.)

- *Ulmus japonica* (Japanese elm) complex
  - Very hardy, high DED tolerance, zone 2-3 hardiness
- *Ulmus pumila* (Siberian elm)
  - Not desirable as a species for ornamental planting, generally good to excellent DED tolerance, used in many hybidization programs, zone 3
- *Ulmus wilsoniana* (Wilson elm)
  - Zone 5, now included as part of the japonica complex
- *Ulmus parvifolia* (Chinese elm)
  - Zone 5, not hardy in our northern region but may have some potential in breeding for it's attractive mottled and exfoliating bark

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Siberian Elm
Ulmus pumila

- DED resistant
- Smaller Leaves (¾ – 3” long) as Compared to American Elm (3 – 6” long)
- Highly Invasive
- Can easily detect if present in a hybrid because of the rounded buds

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Photo by Todd West, NDSU WPIP

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Siberian Elm (*Ulmus pumila*) Introduced

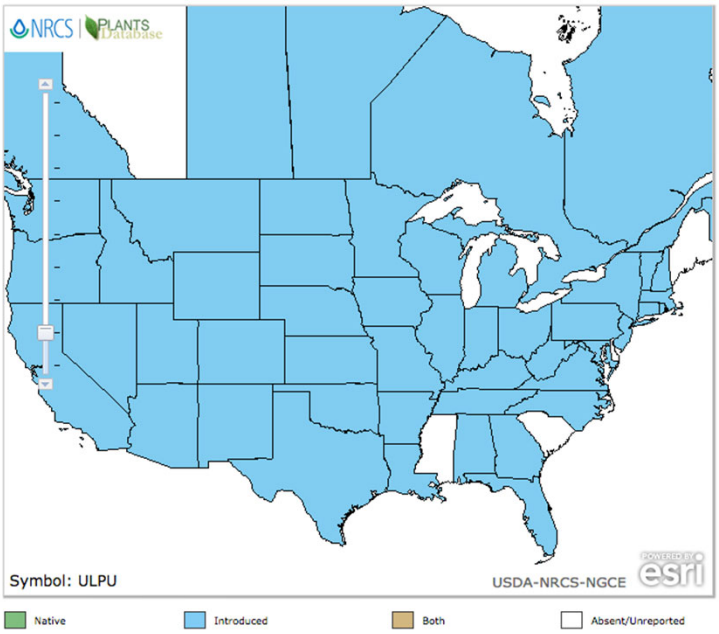

Photo from plants.sc.egov.usda.gov

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Siberian Elm (*Ulmus pumila*) – Invasive States

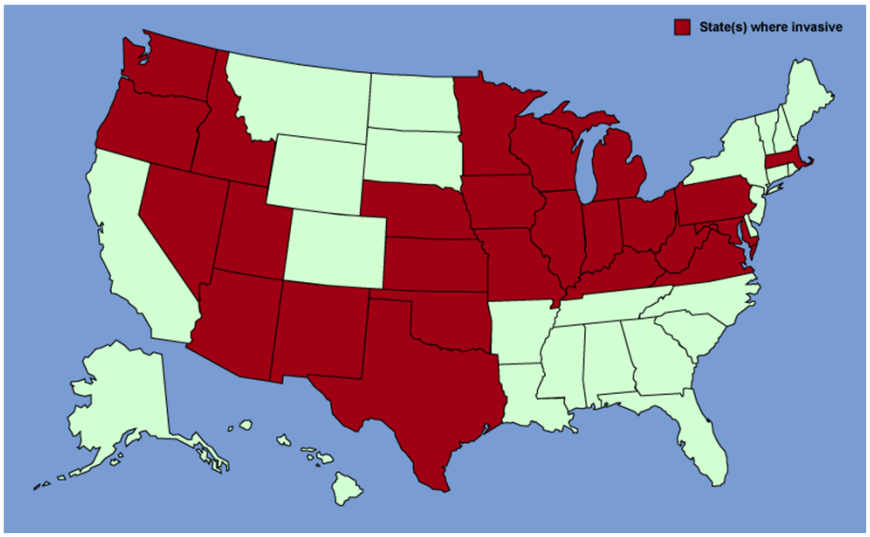

Photo from invasive.org

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Elm Genetics

- All elm species sampled worldwide are diploid
- 28 chromosomes, with the lone exception of American elm which is tetraploid, 56 chromosomes.
- American elm to date has not been able to be hybridized with Asian species to begin to incorporate DED resistance.
- DED tolerant American elms must be selected from existing American elm plantings or populations. Truly tolerant or resistant?

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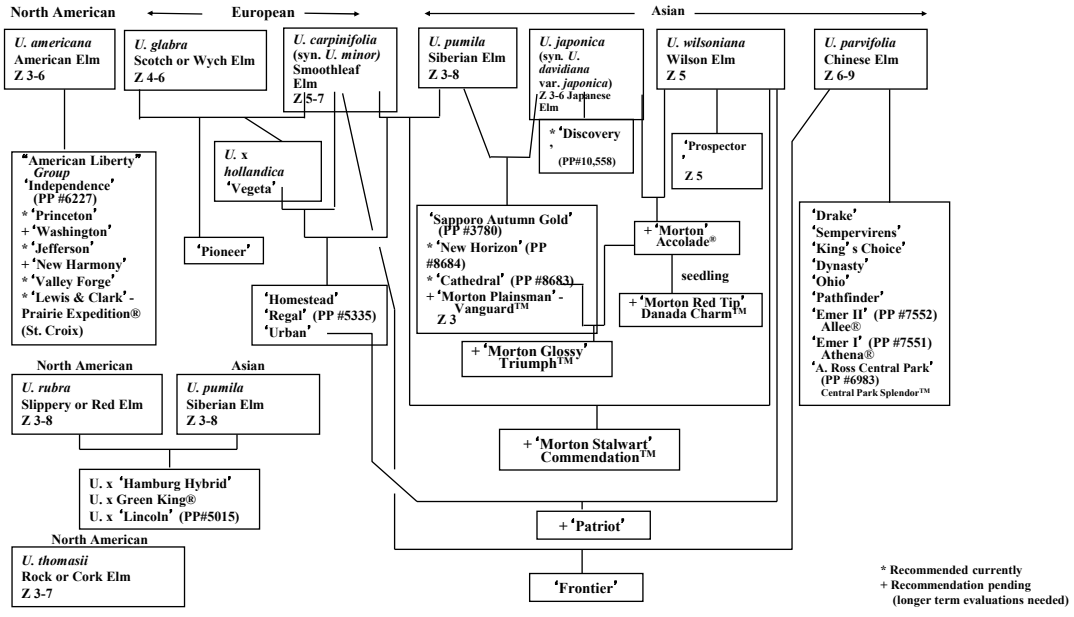
Parentage of Elm (*Ulmus*) Cultivars of Importance to the American Nursery Trade



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Elm Selection and Hybridization Programs (Asiatic species)

- University of Wisconsin – Madison
- Morton Arboretum (IL)
- USDA/ARS - Ohio
- National Arboretum (DC)
- Manitoba (Canada)
  - Dr. Wilbert Ronald and Rick Durand
- North Dakota State University

Cultivars: zone 4 hardy:

- **UW - Madison** – Cathedral, New Horizon, Sapporo Autumn Gold
- **Morton Arboretum –** Commendation™ Triumph™, Accolade®, Vanguard™, Danada Charm™
- **Manitoba** – Discovery, Freedom, Jacan, Night Rider
- **NDSU** – Prairie Expedition® American elm, Northern Empress ® Japanese elm

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Arboriculture & Urban Forestry 43(3): May 2017 107

Arboriculture & Urban Forestry 2017. 43(3):107–120

Ten-Year Performance of the United States National Elm Trial

Jason J. Griffin, William R. Jacobi, E. Gregory McPherson, Clifford S. Sadof, James R. McKenna, Mark L. Gleason, Nicole Ward Gauthier, Daniel A. Potter, David R. Smitley, Gerard C. Adams, Ann Brooks Gould, Christian R. Cash, James A. Walla, Mark C. Starrett, Gary Chastagner, Jeff L. Sibley, Vera A. Krischik, and Adam F. Newby

Abstract. *Ulmus americana* (American elm) was an important urban tree in North America prior to the introduction of the Dutch elm disease pathogen in 1930. Subsequently, urban and community forests were devastated by the loss of large canopies. Tree improvement programs produced disease tolerant American and Eurasian elm cultivars and introduced them into the nursery industry. However, consumer acceptance was slow. The National Elm Trial was established to evaluate commercially available taxa of elm across the United States. Established at 16 locations, these plantings monitored survival and growth, as well as disease and insect pressure for 7 to 10 years. 'Morton' elm had >90% survival, while 13 cultivars averaged 70% to 90%, and five cultivars ranged from 25% to 69% survival. Trunk diameter growth by location ranged from 0.5 cm/year (Colorado, U.S.) to more than 2.0 cm/year (Iowa, U.S.). By taxa, trunk diameter growth ranged from a low, by 'JFS Bieberich' elm (0.7 cm/year), to a high by 'New Horizon' elm (1.7 cm/year). Scale insects were minor issues at most trial locations, except Colorado, where scales contributed to the death of several cultivars. Performance ratings (scale 1 to 5) ranged from 2.7 for 'JFS Bieberich' elm to 4.5 for 'New Horizon' elm. Based on the ratings, the preferred cultivars of American elm were 'New Harmony' and 'Princeton', and the preferred cultivars of Asian elm were The Morton Arboretum introductions and 'New Horizon'. These findings will help green-industry professionals determine what elm cultivars will perform the best in different regions.

Key Words. Chalkbark Elm; Japanese Elm; Lacebark Elm; Scotch Elm; Siberian Elm; Smoothleaf Elm; Tree Evaluation; *Ulmus carpinifolia; Ulmus glabra; Ulmus japonica; Ulmus parvifolia; Ulmus propinqua; Ulmus pumila; Ulmus wilsoniana*; Urban Forestry; Wilson Elm.

American elm is commonly found in soils that are saturated in spring and autumn; however, it also grows well in deep soils with good drainage. The root system is generally considered shallow but will develop deeper in dry sites with good soil drainage (Harlow et al. 1991). The tall trees with broad, arching branches were a favorite of landscape developers and were once the predominant landscape and street tree across the United States (Gerhold et al. 1993; Plotnik 2000). American elm can tolerate many urban conditions, including soil compaction, flooding, air pollution, and deicing salts (Townsend 2000). Additionally, the species is easy to propagate, grow, and transplant.

In the early 1930s, the introduction of Dutch elm disease (DED) forced the green industry to abandon American elm for more disease-resistant exotic species and encouraged plant breeders to search for or develop disease-resistant elms. The result of many decades of intentional and opportunistic selection has been a rather broad selection of Asian, American, and European species and hybrid elms with various degrees of resistance to DED (Santamour and Bentz 1995; The Morton Arboretum 2015).

Diseases and Insects of Elms

The common diseases of elm (*Ulmus*) in North America include DED, elm yellows (elm phloem necrosis) and bacterial leaf scorch, bacterial wet wood, and various root, canker, and foliar diseases (Stipes and Campana 1981; Sinclair and Lyon 2005). DED is a vascular wilt disease incited by the exotic

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Table 1. Location, climate characteristics, and management of U.S. National Elm Trial sites (2005–2015).

State	City	Year planted[z]	Data year[y]	Hardiness zone[x]	Heat zone[w]	Ave. annual precip. (cm)[v]	Supplemental irrigation	Grass management[u]	Weed control[t]
CO	Fort Collins	2005	2014	5b	7	38.0	Y	mowed	Y
IN	W. Lafayette	2005	2014	5b	6	93.0	N	mowed	N
IA	Ames	2005	2013	5a	5	88.1	N	mowed	Y
KY	Lexington	2005	2012	6b	6	114.7	N	mowed	Y
MI	East Lansing	2005	2014	5b	4	81.7	Y	mowed	N
NJ	Cream Ridge	2005	2014	7a	5	124.3	N	mowed	N
NY	Cobleskill	2005	2013	5b	4	97.8	N	mowed	N
ND	Fargo	2005–2008	2015	4a	5	63.6	N	mowed	N
ND	Bismarck	2005–2008	2015	4a	5	45.6	N	not mowed	N
VT	Burlington	2005	2015	5a	4	95.5	N	mowed	N
WA	Puyallup	2005	2013	8b	3	102.7	N	mowed	Y
WV	Morgantown	2005	2013	6b	5	109.6	N	mowed	N
AL	Auburn	2007	2014	8a	8	133.5	N	mowed	N
KS	Haysville	2007	2014	6b	8	91.3	Y	mowed	N
MN	St. Paul	2004–2007	2015	4b	4	81.0	N	mowed	N
OH	Columbus	2005	2014	6a	5	99.0	N	mowed	N

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Table 5. Growth form, fall color, and preference ranking of elms in the U.S. National Elm Trial at each trial site.

Cultivar name	Form	Autumn color	Western states			Central states						Eastern states							Total
			WA	CO	KS	IA	NDF[z]	NDB[y]	MN	MI	IN	AL	NY	NJ	VT	OH	WV	KY	
American selections																			
'Lewis & Clark'	vase	yellow/green																	0
'New Harmony'	oval	yellow/orange		x[x]	x					x					x				4
'Princeton'	vase	yellow			x		x		x	x				x	x				5
'Valley Forge'	vase	yellow/brown	x						x								x	x	3
Asian selections																			
'Frontier'	vase	red/purple												x					1
'Morton Stalwart'	vase	yellow	x	x		x						x	x	x		x		x	7
'Pioneer'	vase	yellow/orange							x						x	x			3
'Homestead'	oval	green/yellow		x								x							2
'Patriot'	vase	green/yellow	x			x			x	x	x				x	x		x	7
'Morton'	vase	yellow/brown	x	x	x	x			x				x		x	x		x	9
'Morton Red Tip'	vase	yellow	x		x		x	x	x	x	x	x	x	x				x	8
'Emer I'	vase	yellow/orange		x															1
'Emer II'	oval	yellow/red			x														1
'BSNUPF'	oval	yellow/orange																	0
'JFS Bieberich'	vase	green/yellow								x									1
'Morton Plainsman'	vase	yellow				x		x	x						x	x			4
'New Horizon'	oval	green/yellow						x					x		x		x		3
'Morton Glossy'	vase	green/yellow	x	x		x		x	x		x		x	x	x	x		x	10
'Prospector'	vase	yellow/green									x				x	x	x		4

[z] Fargo, North Dakota, U.S.
[y] Bismarck, North Dakota, U.S.
[x] Cultivars with 'x' indicates the cultivar was a preferred tree at that trial site based on overall ornamental characteristics.

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Inherent Susceptibility and Resistance to Diseases and Pests

	*U. americana**	*U. glabra* & *U. carpinifolia*	*U. pumila*	*U. davidiana* complex	*U. parvifolia*
Diseases					
DED	+	o	+	+	+
Elm Yellows	-	+	+	+	+
Black Spot	o	+	+	o	+
Insect Pests					
Cankerworm	-	o	o	+	+
Leaf Beetle	o	-	-	+	+
Leaf Miner	o	-	o	+	+
Flea weevil	+	-	-	o	-

Key:
+ = Resistant
O = Intermediate Resistance
- = Susceptible

* All recommended selections possess some level of resistance to DED

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American elm, *Ulmus americana*

Selection	Comments
Independence	Best of the "American Liberty" group
Jefferson	US Park Service selection, limited distribution
New Harmony	Good DED resistance, easier to train than Valley Forge
Prairie Expedition	North Dakota selection, likely very cold hardy
Princeton	Upright form when young, easier to train
Valley Forge	Excellent DED resistance, "wild" nursery tree, training critical
Washington	US Park Service selection, limited distribution


Princeton


Smooth elm, *Ulmus carpinifolia* & Siberian elm, *U. pumila* hybrids

Selection	Comments
Cathedral	"Wild" tree, high degree of training needed
New Horizon	Nice form; leaf beetle challenge; promising tree
Sapporo Autumn Gold	Impossible to train; forget it!
Vanguard	Very *U. pumila* like; useful for tough sites


New Horizon


David's elm, *Ulmus davidiana* complex

The Right Stuff!

DED, Elm Yellows resistant, good insect resistance, & strong wood

Selection	Comments
Accolade	Strong wood; glossy foliage; coarse texture
Commendation	Rapid growing, particularly in nursery; narrower form
Danada Charm	Red/pink-colored emerging foliage
Emerald Sunshine	Promising tree; smaller stature; need to evaluate hardiness
Frontier	Not fully hardy
Patriot	Needs more testing, but highly recommended "out east"
Prospector	Not fully hardy
Triumph	Easier to train than Accolade

U. japonica
(syn. *U. davidiana* var. *japonica*)

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Elm Disclaimer

- All elms can get Dutch Elm Disease
- **All elms need yearly pruning** after planting for the first 10 – 15 years to produce proper branch structure
- Be careful with homeowners planting an elm, they water and fertilize too much
- **Utilize (save) elm for tough sites which may help control their highly vigorous growth and save ideal planting spots for other genera**
- Ideally to match tree with specific site and not to just fill a hole to meet the diversity guideline of 20-10-5
- DED exists in several strains and additional strains may present themselves in the future.
- Prompt disposal of infected wood is essential in slowing the spread of DED.
- **Don't be afraid of Elms!!!**

Photo by Greg Morgenson, NDSU WPIP

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Monoculture Planting

- Trees that perform well have increased use
  - Elm, Ash, Maple
  - Often planted in high percentages
  - Each have disease and pest issues
- Diversity Planting Guidelines
  - No more than 20% of a family (Birch Family)
  - No more than 10% of a genus within a family (*Betula*, *Alnus*, *Carpinus*, *Ostrya*)
  - No more than 5% of a species within a genus (Paper Birch)

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Tree Diversity – Fargo, ND (2018)

- Total Tree Population – city Right of Way (approx. %)
  - ~ 56,800 trees
  - 12,150 vacant sites

• Ash (Green)	27%	(Oleaceae)
• Elm (American, Hybrids)	21%	(Ulmaceae)
• Linden (American and Little Leaf)	11%	(Malvaceae)
• Maple (Sugar and Freeman)	7.5%	(Sapindaceae)
• Hackberry	5.5%	(Cannabaceae)
• Crabapple	4%	(Rosaceae)
• Oak(Bur)	4%	(Fagaceae)

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Growth and Pruning of Young Elms

- 5+ year development
- City of Fargo, ND
- Accolade™ elm
  (*Ulmus davidiana* var. *japonica* 'Morton')
- Planted on a boulevard in 2012

June 2013

Photo by Greg Morgenson, NDSU WPIP

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July 2014

Photo by Greg Morgenson, NDSU WPIP

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Winter 2014/2015

June 2015

Photos by Greg Morgenson, NDSU WPIP

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June 2016

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October 2016

December 2016

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August 2017

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January 2018

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July 2018

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January 2019

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American Elms

- Red elm (*U. rubra*) and rock elm (*U. thomasii*) are minor species occasionally used in elm plantings and are also very susceptible to DED which limits their use.
- American elm (*U. americana*) is (was) widely used in plantings across the country because of adaptability and ease of transplanting. Very susceptible to DED.

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American Elm (*Ulmus americana*)

- Widely used in plantings across the country because of adaptability and ease of transplanting.
- Species is very susceptible to DED
- Do Not Plant American Liberty Series Strains = DED susceptible.
- Many new DED resistant American elm cultivars available

- New cultivars- St. Croix™, Colonial Spirit®

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Prairie Expedition® American Elm (*Ulmus americana* 'Lewis & Clark')

- Zone 3
  - Hardiest of all the American cultivars
- U.S. native
- 60 x 40'
- DED resistant

Selection

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Prairie Expedition® American Elm

Photos NDSU

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Prairie Expedition® American Elm

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Princeton American Elm (*Ulmus americana* 'Princeton')

- Zone 4
- U.S. native
- 60 x 45'
- DED resistant
- Upright vase
- Introduced in the 1920's for form.

Photos JFS Nursery

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NDSU Research Arboretum

Casselton, ND

Photos by Greg Morgenson, NDSU WPIP

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Fully Recommended

- Prairie Expedition® ('Lewis & Clark') – A cold-hardy American elm that grows up to 4 feet per year. This cultivar has high DED resistance; the original tree was a survivor of the first wave of DED to come through North Dakota. **NDSU release.**
- 'Princeton' – A fully hardy and highly DED-resistant selection of American elm. 'Princeton' has a very upright form; managers have some concern about branch angles being too acute. However, this cultivar is easy to train when it is young.
- 'Valley Forge' – This cultivar also is fully hardy and very DED resistant, but the branch attachments may be weaker than desired. Also, some trees' growth has been so vigorous that the central leader became top-heavy and fell over, resulting in a lopsided or unsymmetrical crown.

Partially Recommended

The following cultivars have received relatively little testing in North Dakota. They have high resistance to DED and are likely hardy enough to survive North Dakota winters. Further testing and experience may allow us to move these into the Fully Recommended category.

- Colonial Spirit® ('JFS-Prince II')
- 'Jefferson'
- 'New Harmony'
- 'St. Croix' – Originated in southeastern Minnesota

Not Recommended

The following cultivars are not recommended for North Dakota due to their poor resistance to DED and/or lack of cold hardiness.

- 'American Liberty'
- 'Brandon'
- 'Independence'
- 'Minneapolis Park'
- Washington
- American elm – seedling origin

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Japanese Elm (*Ulmus davidiana* var. *japonica*)

- Native to Japan, Northern China, and Manchuria
- Northern sources are extremely cold hardy, to zone 2b
- Mature form resembles a small version of American elm with some seed sources.
- High DED resistance
- High leaf beetle feeding resistance

Photo by Greg Morgenson, NDSU WPIP

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Photos by Greg Morgenson, NDSU WPIP

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Discovery® Japanese Elm

- Upright vase shaped in form, dense crown branching
- Good dark green foliage through the growing season. Yellow fall color
- Moderate growth rate
- prune to form in younger years.
- 40 x 30 – 35’

Photo by Rick Durand, Manitoba

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Discovery® Japanese Elm

Bismarck, ND

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Discovery® Japanese Elm

NDSU (ND)

Minnesota State University Moorhead (MN)

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Freedom Japanese Elm

- 45 x 50’
- Canadian introduction
- Useful for parks and open spaces because of the spread
- Difficult to find in the trade

Photo by Greg Morgenson, NDSU WPIP

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Northern Empress® Japanese Elm
Ulmus davidiana var. *japonica* 'Burgundy Glow'

Selection

A smaller Japanese elm reaching 25-28' in height, high quality summer foliage, soils and pH adaptable. Hardy zone 3.

Photos by NDSU WPIP

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Northern Empress® Japanese Elm

Outstanding fall color changing from apricot to burgundy red.

Photos by NDSU WPIP

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Northern Empress® Japanese Elm

- Container graft 2013
- Planted 2014 at NDSU Research Arboretum (Absaraka, ND)
- Available by Baileys Nursery as bareroot in 2021 for 2022 shipping.

July 2015

Oct. 2016

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Japanese Elm

(*Ulmus davidiana* var. *japonica*)

In Asia, Japanese elm has a very large native range. Northern seed sources generally have done well in North Dakota. However, if you do not know the seed source of the tree, or if it is not one of the recommended cultivars listed below, be cautious.

Fully Recommended

- 'Discovery' – A very slow-growing tree with a very dense crown and many fine branches. Highly resistant to DED.
- 'Freedom' – This cultivar was selected in Manitoba and is very cold hardy. Mature trees achieve a compact mushroom-shaped form. Fall foliage gets a red/purple tinge. May be difficult to find in the nursery industry.
- Northern Empress® ('Burgundy Glow') – A small to medium-sized tree with a rounded crown, open branching and attractive foliage. Fall foliage changes from green to apricot-orange to burgundy red before leaf drop. First availability in retail nurseries in 2021. **NDSU release**.

Partially Recommended

- Greenstone™ ('JFS KW2UD') – A new release that has not been tested in North Dakota. However, Greenstone™ was selected from a northern seed source. Has the upright, vase-shaped form of the American elm, although a shorter mature height.
- 'Night Rider' – A new release that has not been tested in North Dakota, although it is being sold in Manitoba, Canada. Purple fall color.

Not Recommended

- Emerald Sunshine® ('JFS-Bieberich') – Lacking sufficient cold hardiness for North Dakota.

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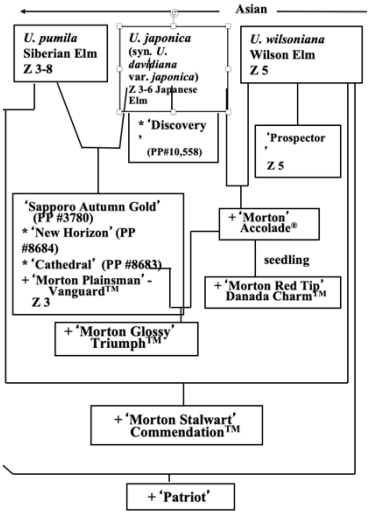
Hybrid Elms - Primarily hybrids between Asian species

- Siberian Elm (*U. pumila*)
- Japanese Elm (*U. davidiana* var. *japonica*)
- Wilson Elm (*U. wilsoniana*)



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Cathedral Elm (*U. pumila* x *japonica*)

- Very hardy and adaptable, umbrella to vase shaped form
- Rapid grower requiring attention to structural pruning when young
- 40-50 x 40-50'
- Only moderate resistance to DED

Photo by Greg Morgenson, NDSU WPIP

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Cathedral Elm, *U. pumila* x *japonica*

Photo by Greg Morgenson, NDSU WPIP

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New Horizon Elm (*U. pumila* x *japonica*)

- Has performed well at the NDSU Research Arboretum and in Fargo blvd. plantings
- Hardy and Adaptable
- 50 x 40’

Photos by Greg Morgenson, NDSU WPIP

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Accolade Elm® (*U. japonica* x *wilsoniana*)

- Vase shaped to upright in form similar to American elm
- Quality dark green glossy foliage, yellow fall color
- Rapid growing
- 60-70 x 50’

U. of Wisconsin Arboretum

Photos by Greg Morgenson, NDSU WPIP

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Triumph Elm™ (‘Morton Glossy’) (Accolade® x Vanguard™)

- Very tolerant to urban conditions
- Upright to upright oval form
- Glossy green quality foliage
- Strong branching habit
- 50-60 x 35-40’

Photos by Greg Morgenson, NDSU WPIP

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Triumph Elm™

Photos by Greg Morgenson, NDSU WPIP

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Triumph Elm™

University of Wisconsin Arboretum, Sept 30

NDSU Research Arboretum, Oct. 14, 2014

Photos by Greg Morgenson, NDSU WPIP

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Patriot Elm – Complex hybrid USDA/ARS Ohio

NDSU Research Arboretum

University of Wisconsin Arboretum

Photos by Greg Morgenson, NDSU WPIP

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Sapporo Autumn Gold (*Ulmus pumila x japonica*)

- Older cultivar
- Highly DED resistant
- Leaves look just like Siberian elm

NDSU Campus

Fargo, ND

Photos by Greg Morgenson, NDSU WPIP

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Hybrid Elms

A large number of hybrids have been developed utilizing Asian and European elm species as parents. Hardiness, growth characteristics and pest resistance are highly variable. While our list is not exhaustive, these cultivars are most likely to be seen in the nursery industry in this region.

Fully Recommended

- Accolade™ ('Morton') – A large, hardy tree that will do well in North Dakota. In one trial, it scored midrange in terms of survival, growth and natural structure; it may have codominant stems that will need pruning when young. Leaves are dark like American elm but smaller. Overall tree form similar to American elm.
- 'Cathedral' – A very fast-growing tree that requires annual pruning for the first 10 years to develop good structure. The long branches give young trees a somewhat weeping form. Only moderately resistant to DED.
- Commendation™ ('Morton Stalwart') – A somewhat upright tree, but the overall form is more oval than vase-shaped. Leaves are relatively large and fall color is a muted yellow. A good tree, but scored midrange in North Dakota trials. Likely lower maintenance than Accolade™ or 'Cathedral' elm.
- Danada Charm™ ('Morton Red Tip') – Somewhat upright tree with fast growth. Has performed extremely well in trials in Bismarck and Fargo. Emerging new growth has a reddish tinge.
- 'New Horizon' – A medium tree with slightly arching branches, upright oval form and dark green leaves. Fall color is yellowish brown and develops later than other cultivars. One of the better elm trees in NDSU trials, tolerating very dry conditions in one central North Dakota site. May suffer some damage from foliage-feeding insects.
- Triumph™ ('Morton Glossy') – Outstanding tree for much of North Dakota. Shiny, attractive dark green foliage. Somewhat upright form.

Partially Recommended

- 'Patriot' – While this tree has proven to be cold hardy, it has been midrange in other characteristics, and sometimes can have a large amount of damage from foliage-feeding insects.
- 'Pioneer' – A medium to large tree with a dense, rounded crown. Generally considered hardy to Zone 5, 'Pioneer' has shown mixed results in North Dakota trials, with survival ranging from 0 to 100 percent at three sites.
- Vanguard™ ('Morton Plainsman') – Definitely a hardy cultivar but has proved to be midrange in growth, pest-resistance and ornamental characteristics. Upright form.

Not Recommended

The following cultivars are not recommended because of hardiness problems, wildlife issues and/or high amounts of damage from foliage-feeding insects.

- 'Frontier'
- 'Homestead'
- 'Lincoln'
- 'Prospector'
- 'Regal'

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Night Rider Hybrid Elm (*Ulmus* x'ByRick')

- Hybrid of Siberia (*U. pumila*) and Japanese (*U. davidiana* var. *japonica*) elm.
- 40 x 30'
- Rounded form
- Resistant to DED and wooly aphid
- Purple fall color
- Developed by Rick Durand

Photo from Rich Durand

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Endeavor Hybrid Elm (*Ulmus* x'By1709')

- Triploid hybrid of American (*U. americana*) Japanese (*U. davidiana* var. *japonica*) elm.
- 65' (20m) by 33' (10 m)
- Shape: Upright vase
- Fall Foliage: Yellow
- Highly resistant to Dutch Elm Disease
- Soil adaptable
- Growth rate: Fast
- Root Habit: Fibrous, spreading
- Developed by Rick Durand, Bylands Nurseries

Photo from Rich Durand

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Additional Hybrid Elms to try:

Vanguard™

Danada Charm
Morton Arboretum

Commendation™

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NDSU Observations

- Patriot
  - Doing well to date, good growth, no SW trunk damage, gangly appearance, totally hardy, upright growth, deep green foliage.
- Homestead
  - SW trunk damage, ugly, do not plant, worse than Siberian.
- Prospector
  - Severe SW trunk damage to 5.5 ft height. Upright form, foliage quality fair to good, marginal leaf browning.
- Sapporo Autumn Gold
  - Older hybrid cultivar, large tree form, low branching to open upright spreading. Minor to moderate leaf miner damage on both. No SW winter trunk damage

Sapporo Autumn Gold

Photos by Greg Morgenson, NDSU WPIP

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Valley Forge American Elm (*U. americana* 'Valley Forge'

- Highly DED resistant
- Thinner canopy density and narrow branch angles are drawbacks.

Photos by Greg Morgenson, NDSU WPIP

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Jefferson and New Harmony Elms

Photos by Oregon Nursery Advisors

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Elm Problems and Concerns

- Rapid growth rate requires frequent structural pruning when young and maintenance in later years to develop a proper branch structure.

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Elm problems and concerns

- Cold hardiness
- Frontier elm
  - *Ulmus carpinifolia* x *parvifolia*
  - OK to only about -25f in Fargo and Absaraka.
  - Upright form, maroon fall color
  - Hardy in zone 5a.
  - Released by USDA/ARS Ohio

National Elm Trial Planting, Fargo, ND

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Lacebark Elm
Ulmus parvifolia

- Many cultivars and seedling origin plants available
- High DED resistance.

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Hallelujah Lacebark Elm
Ulmus parvifolia Hallelujah'

- Selected as hardy to -35 °F
- Did not survive -38 °F

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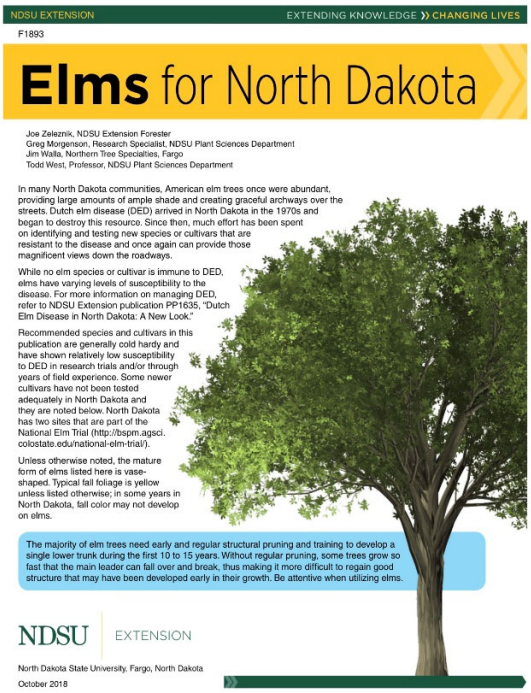
For Additional information:

NDSU Extension Publication F1893



NDSU EXTENSION EXTENDING KNOWLEDGE ›› CHANGING LIVES

F1893

Elms for North Dakota

Joe Zeleznik, NDSU Extension Forester
Greg Morgenson, Research Specialist, NDSU Plant Sciences Department
Jim Walla, Northern Tree Specialties, Fargo
Todd West, Professor, NDSU Plant Sciences Department

In many North Dakota communities, American elm trees once were abundant, providing large amounts of ample shade and creating graceful archways over the streets. Dutch elm disease (DED) arrived in North Dakota in the 1970s and began to destroy this resource. Since then, much effort has been spent on identifying and testing new species or cultivars that are resistant to the disease and once again can provide those magnificent views down the roadways.

While no elm species or cultivar is immune to DED, elms have varying levels of susceptibility to the disease. For more information on managing DED, refer to NDSU Extension publication PP1635, "Dutch Elm Disease in North Dakota: A New Look."

Recommended species and cultivars in this publication are generally cold hardy and have shown relatively low susceptibility to DED in research trials and/or through years of field experience. Some newer cultivars have not been tested adequately in North Dakota and they are noted below. North Dakota has two sites that are part of the National Elm Trial (http://bspm.agsci.colostate.edu/national-elm-trial/).

Unless otherwise noted, the mature form of elms listed here is vase-shaped. Typical fall foliage is yellow unless listed otherwise; in some years in North Dakota, fall color may not develop on elms.

The majority of elm trees need early and regular structural pruning and training to develop a single lower trunk during the first 10 to 15 years. Without regular pruning, some trees grow so fast that the main leader can fall over and break, thus making it more difficult to regain good structure that may have been developed early in their growth. Be attentive when utilizing elms.

NDSU EXTENSION

North Dakota State University, Fargo, North Dakota

October 2018

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- **No** elms are immune to DED.
- Infection, damage, and death can occur to any cultivar on any site.
- DED exists in several strains and additional strains may present themselves in
- the future.
- Prompt disposal of infected wood is essential in slowing the spread of DED.

Thanks to:
Dr. Dale Herman, Larry Chaput, NDSU retired
Dr. Jim Walla, NDSU retired and National Elm Trial participant
Scott Liudahl, Allen Lee – Fargo Forestry Department
Greg Morgenson – Photos except where noted

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Thank You!

NDSU North Dakota State University

Selection

Northern Empress® Japanese Elm

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