

Plant breeding at North Dakota State University[©]

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Woody plant evaluations at North Dakota State University began in 1954. In 1971, Dr. Dale E. Herman initiated the Woody Plant Improvement Program (WPIP). To date, this program has released 56 woody plant selections into the ornamental nursery trade. Historically this program utilized two methods for woody plant selections, landscape observations and mass selection (seed lot variation). Prior to 2012, there were no structured breeding efforts being conducted at NDSU for ornamental woody plant improvement.

The WPIP has three primary goals:

- 1) Evaluate unreleased or released cultivars from the nursery trade to determine usability in the United States Northern Great Plains.
- 2) Select and/or breed new cultivars suitable for the Northern Great Plains (fortunately, many of the selections are suitable for much wider use).
- 3) Increase plant diversity. Diversity is important and there is a great need for adapted, winter hardy, pest resistant woody plants suitable for use in the northern USA and prairie Canada. Many of the current commercially available nursery cultivars are not suitable for USDA cold climatic Zones 3 and 4, lower annual moisture availability, and higher soil pH levels. There is also a need to increase plant diversity in response to disease and insect pest issues and loss of adapted genera and species (*Fraxinus* spp., *Ulmus americana*, *Picea* spp., and *Pinus* spp.).

The WPIP has nine research evaluation sites in North Dakota (Figure 1) There are three primary research evaluation sites:

- 1) NDSU Horticulture Research Farm (HRF) and Dale E. Herman Research Arboretum (DEHRA) (Absaraka, North Dakota).
- 2) Research plots (Fargo, North Dakota).
- 3) NDSU Langdon Research Extension Center (Langdon, North Dakota).

The other secondary sites include Williston, Grand Forks, Dickinson, and Bismarck, North Dakota. The first two primary sites are located in a USDA plant hardiness Zone 4a while the NDSU Langdon REC is classified as a hardiness zone 3b. The NDSU WPIP has evaluated 200+ genera and 3,000+ species and cultivars of trees and shrubs. Over 9500+ accessions obtained, evaluated since planting began in 1974. The largest and most diverse woody ornamental plant collection in North Dakota and the Northern Great Plains is located at the NDSU HRF and DEHRA with a total of 80 acres (~32 ha).

The NDSU WPIP selections are ideally suited for urban planting conditions. Typically, urban soils are: compacted, dry and have a high pH (>8.0). North Dakota is one of the driest states in the United States and the soil pH is typically >8.0.

The NDSU WPIP is involved with several woody plant evaluations including cultivar comparison with industry cooperators, northern site for hybrid maple evaluations (*Acer palmatum* × *A. pseudosieboldianum*). Currently, we are involved in *Cornus mas* (Cornelian cherry) evaluations (Figure 2; Table 1). To date, the program has 47 grafted cultivars in the collection which may be the largest collection in the United States. Micropropagation studies of *C. mas* are still in progress.

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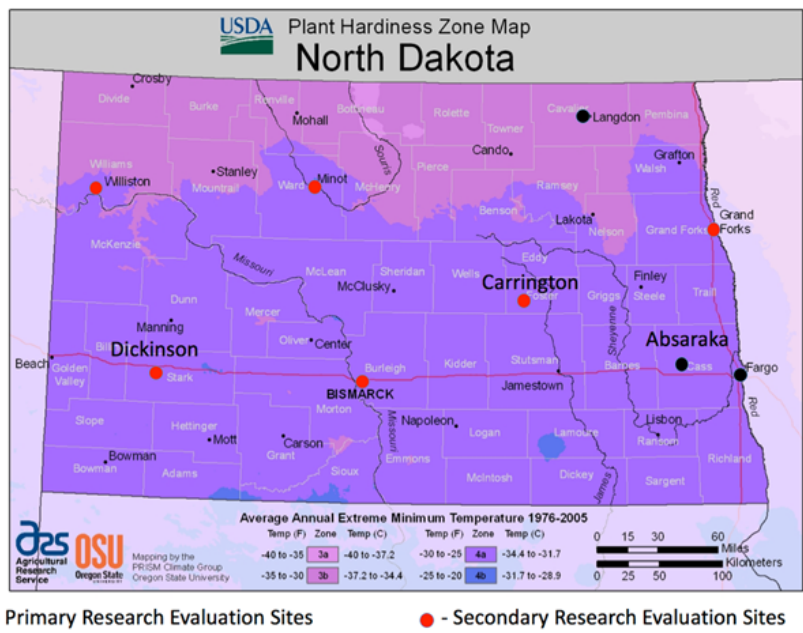


Figure 1. Evaluation site locations in North Dakota for the NDSU Woody Plant Improvement Program.

Table 1. Grafted cultivars of *Cornus mas*.

Albanos (Eppler's Black)	Juliusz	Schonbrunner Gourmet
Aurea	Kotula	Shan
Black Plum	Kuklen	Shumen
Bukouvinski	Lagodekhi #1	Slowianin
Butilochni	Lagodekhi #2	Spring Glow
Chicago	Lagodekhi Yellow	Surprise
Dripping Cherries	Lukanovski	Tcarigradski
Dublany	Lutea	TS804 (UW-Arboretum)
Early Bird	Macrocarpa	Typ 3
Early Purple	Necznyi	Vavilov
Elegant	Palzosi	Violacea
Flava	Priorski	Vladimirski
Florianka	Pyramidalis	Vrača
Gelbe Selection	Raciborski	Yantarny
Golden Glory	Red Dawn	Yellow September
Jolico	Red Star	

Cornus mas, Cornelian Cherry



Figure 2. *Cornus mas* plant, flowers, and fruit.

For plant evaluation, selections and breeding, germplasm is collected from three different methods including:

- 1) Foreign and domestic seed sources (growing out seedling populations and selection individuals with superior attributes).
- 2) Plant breeding (tradition breeding including F₂ populations to observe segregation of traits including hybridizing with both intra and interspecific hybridization).
- 3) In vitro tissue culture utilizing somaclonal variations, embryo rescue and mutagenesis.

Three plant improvement methods utilized are: Selections by landscape observation, mass selection (seed source and seed lot variation), and breeding (both traditional and mutagenic).

The NDSU WPIP is focusing on breeding four primary genera: *Acer*, *Magnolia*, *Sambucus*, and *Ulmus*. The primary goal of all of the breeding work is on increased hardiness and secondarily on aesthetic improvements. With the large germplasm collection located at the NDSU HRF and DEHRA, there are many accessions that have shown outstanding hardiness and make excellent parents for improvement through breeding efforts. These include Spring Welcome® magnolia (*Magnolia × loebneri* 'Ruth'), Fall Grandeur™ red maple (*Acer rubrum* 'Minnkota'), *Sambucus nigra* 'TS14019' (prostrate form), and Northern Empress® Japanese elm (*Ulmus davidiana* var. *japonica* 'Burgundy Glow'). Magnolia breeding objectives focus on flower tepal color, introducing any color from *M. acuminata* hybrids coupled the hardy Spring Welcome® selection (white flower color) (Figure 3). Maple (*Acer* spp.) breeding objectives are utilizing known hardy and environmental tolerant selections to develop a better adapted Freeman maple (*A. × freemanii*). The current selections, such as Autumn Blaze, do not have consistent performance with respect to pH tolerance and hardiness. Utilizing a red maple selection that is known to be pH tolerant and have outstanding hardiness would be better suited for a Freeman maple hybrid selection. Elm breeding objectives focus on crossing Northern Empress® Japanese elm (outstanding burgundy fall color and other attributes) with Hallelujah lacebark elm (*Ulmus parvifolia* 'Hallelujah') which has outstanding ornamental bark.

Ornamental breeding research at NDSU includes developing freeze test procedures for earlier hardiness screening, traditional breeding efforts (making interspecific crosses with cold hardy species and hybrids) and developing molecular markers for breeding selection. Freeze tests and molecular markers will assist in reducing time, efforts and costs with selection of desirable progeny.



Figure 3. Spring Welcome® magnolia.