

# PROJECT ND06210

## Species-site Adaptation Study of Woody Plants Evaluated at the NDSU Dickinson Research Extension Center

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### Research Summary

2002 marked the sixteenth year of the statewide cooperative woody plant evaluation program. Since the program began in 1987, 71 accessions have been planted at the Dickinson Research Extension Center (DREC). Fifty-five of these are still under investigation, including seedling populations of several species, some clonal material plus potential and/or recently named woody plant introductions. Three larch accessions were added in 2001. Prairie Dream® Paper Birch, a new NDSU introduction, was planted in 2002 along with two species of euonymus. All plants of a seedling accession of white ash planted in 1992 and a clonal accession of arborvitae planted in 1993 were dead after ten years. Bergeson Redosier Dogwood had the greatest survival and produced the smallest statured plant of the three dogwood clones tested. Allegheny Serviceberry had 32% survival and Black Cherry 65% survival after ten years. Survival of four birch accessions planted in 1993 ranged from 8% for Piperi Birch to 92% for a seedling population of paper birch grown from seed collected in the Killdeer Mountains north of Dickinson. Three seedling populations of Kentucky Coffeetree, which continue to decline from drought stress and related environmental factors, had survival percentages ranging from 9-33% after five years. Annual branch dieback in successive winters caused vigor reduction in Centurion and Red Baron Flowering Crabapples planted in 1999, resulting in their eventual death by 2002. Thornless Cockspur Hawthorn and Snowbird Hawthorn had 78% survival after four years but plants have been slow to develop vigor. Olga Bay Larch had 67% survival and Tatarian Maple 85% survival after two years. All plants of European and Western Larch failed to establish. Replacements will be planted in 2003.

### Introduction

This project was begun in 1987 with the goal to conduct replicated trials to systematically evaluate native, domestic, and foreign woody plant accessions for cold and drought hardiness, establishment and survival, growth rate, vigor and potential for landscape, community forestry and shelter use under varying climatic and edaphic conditions throughout the state. Performance data assures greater validity to woody plant recommendations for wholesale growers, retail nurseries and garden centers, parks, golf courses and public consumers, based on regional adaptation zones in North Dakota. Some accessions being tested can only be recommended for certain portions of the state while others can be recommended throughout the state and region. Data are reinforcing the concept of introducing regionally adapted cultivars.

### Materials and Methods

Three new entries were planted in 2001 and included seedling accessions of *Larix decidua* (European Larch), *Larix occidentalis* (Western Larch) and *Larix sibirica* (Siberian Larch). Accessions planted in 2002 included a new NDSU release of Paper Birch (*Betula papyrifera* 'Varen' - Prairie Dream®) plus Nordine Winged Euonymus (*Euonymus alatus* 'Nordine') and Maack Euonymus (*E. hamiltonianus* var. *maackii*). Newly planted items were hand watered after planting to aid in establishment. Data collected included percent mean survival, mean growth measured as height increase and plant vigor for plantings five years or younger. Mean height, mean crown diameter and mean stem diameter data were collected from ten and fifteen-year-old plants.

### Results and Discussion

Adequate moisture for successful plant establishment and sustained growth of plant accessions continues to be a concern at this site. Proper management practices could reduce plant mortalities caused by drought stress. The following practices have been recommended for implementation: (1) in-row cultivation, (2) applying a ring of organic mulch, such as bark chips, around individual plants and (3) greater attention to the water needs of young stock.

Survival and growth information is presented in the following text and accompanying tables. Data were collected from nine Prairie Spire® Green Ash trees (*Fraxinus pennsylvanica* 'Rugby') which had been transplanted from their original field locations to the grounds of the Director's residence at the DREC. These fifteen-year-old ash trees had a mean height of 19¼', a mean crown diameter of 8¾' and a mean stem diameter of 5.2".

Data from Table 1 show that 32% of the Allegheny Serviceberry planted in 1992 are still alive after ten years. This species grows tree-like and is related to our native Juneberry (*Amelanchier alnifolia*). Bergeson Dogwood had significantly greater survival than Cardinal or Isanti at this site. It also produced a significantly shorter and narrower crown compared to Cardinal. This data confirms earlier findings that show Bergeson to be slower growing than Cardinal, typically producing a denser plant habit. Because of the lower mean precipitation here, all three dogwood clones are much smaller in total size compared to similar plants growing at three other branch stations. This cultivar should perform well in the southwest urban environment where supplemental water could be provided during times of extreme drought. A seedling grown accession of White Ash (*Fraxinus americana*) planted in 1992 showed continued

dieback and plant death over the ten-year period due to its lack of winter hardiness. It has been dropped from the program. Research trials at other woody plant evaluation sites around the state have shown that Autumn Blaze and Northern Blaze White Ash have the greatest winter hardiness potential of any of the current white ash cultivars in the nursery trade. Twelve-year-old trees of Autumn Blaze at Minot are performing very well to date. Plants of Black Cherry had 65% survival after ten years. Field notes indicate a few of these plants had excellent dark green foliage and good canopy density. Plants performed well until the open winter of 2001-2002 when extensive dieback occurred on this chokecherry-related species.

A 1993 planting of American Arborvitae (*Thuja occidentalis*) failed to establish, due in part to heavy browsing of young plants by deer and rabbits, reducing their vigor going into winter (Table 2). It too has been dropped. This clone has performed well at four other North Dakota sites. It should have sufficient winter hardiness for southwest ND if the browsing problems are addressed during the early years of establishment. Data from Table 2 also show that a seedling accession of Sand Birch, native to the Kamtschatka peninsula of Russia, had 47% survival after ten growing seasons. Of the two paper birch accessions planted in 1993, the Killdeer Mountain source had significantly greater survival (92%) compared to 16% survival for the Nebraska source. Mean height of the Killdeer source was also significantly greater than the Nebraska source.

Plants of a clonal accession of European White Birch (*Betula pendula*) struggled to establish in early years (Table 3). Only 50% of the plants remain after five years. This accession continues to perform much better at Langdon and Minot where more favorable moisture conditions exist, resulting in much greater growth during the first five years.

Three seedling sources of Kentucky Coffeetree (*Gymnocladus dioica*) planted in 1997 continue to struggle to survive and grow. Table 3 shows survival percentages ranging from a low of 9% for the Fargo source to 33% for the Hannover, IL source. The two Illinois sources produced a negative 4-8" of stem dieback in 2001, compared to 5" of mean growth for the Fargo source. Coffeetrees are notoriously slow to establish and could benefit greatly from supplemental watering plus the use of mulch around tree bases to reduce moisture stress.

Table 4 shows low survival percentages for both Centurion and Red Baron Flowering Crabapples in 2001, due in part to very low fall vigor. Centurion is highly recommended for eastern North Dakota but to date both cultivars have had establishment problems at the Dickinson site. Thornless Cockspur and Snowbird Hawthorns both showed positive growth in 2002 compared to dieback in previous years. Like the crabapples, the hawthorns have performed well in eastern ND and need to be evaluated more fully in the western part of the state. Olga Bay Larch had 67% survival and Tatarian Maple had 57% survival after one growing season.

All plants of Centurion and Red Baron Flowering Crabapples were dead by the fall of 2002 (Table 5). Replacements of Olga Bay Larch and Tatarian Maple were made in the spring of 2001 but not all plants established, resulting in 2<sup>nd</sup> year survival percentages of only 64% and 85% respectively for the larch and maple by the fall of 2002. Both species continue to grow rather slow. Primarily due to drought stress, the three larch species planted in 2001 have struggled to establish and only 25% of the Siberian Larch still remain (Table 5). The European and Western Larch accessions will be replanted in 2003. Prairie Dream® Paper Birch produced 11" of annual mean growth in 2002. This new NDSU introduction named in 2003 has shown a high degree of bronze birch borer resistance in university trials. It produces clean white, exfoliating bark and develops excellent golden yellow fall color. Maack Euonymus (*Euonymus hamiltonianus* var. *maackii*), also planted in 2003, produces a medium-large shrub which develops attractive white splotches on older branches and produces intense pink-red fall color. Seedlings of Nordine Winged Euonymus (*E. alatus* ('Nordine')) were also planted in the 2003 trial. This seedling strain has shown a greater degree of winter hardiness than Compactus. The latter cultivar is popular in the trade but it lacks sufficient winter hardiness and plants often suffer varying degrees of branch dieback.

In terms of plant establishment and sustained growth of tree and shrub species, the DREC site is by far the most difficult of the seven sites currently used for North Dakota cooperative woody plant evaluations. The implementation of recommended management practices, including in-row cultivation, application of wood chip mulch around the base of plants and greater attention to the water needs of young stock, could potentially reduce mortality rates on many of the planted accessions and on new accessions planted at this site in the future.

**Table 1.** Ten-Year Summary of Survival and Growth Data for Accessions Planted in 1992 at the NDSU Dickinson Research Extension Center.

PLANT ACCESSION	PERCENT MEAN SURVIVAL	10 YR. MEAN HT (IN.)	10 YR. MEAN CROWN WIDTH (IN.)	10 YR. MEAN STEM DIAM (IN.)
<b>ALLEGHENY SERVICEBERRY</b> ( <i>Amelanchier laevis</i> )	32	59	36	y
<b>REDOSIER DOGWOOD</b> ( <i>Cornus sericea</i> ) 'Bergeson' 'Cardinal' 'Isanti'	67a <sup>x</sup> 33b 33b	41a <sup>x</sup> 69b 47a	44a <sup>x</sup> 76b 62b	y y y
<b>WHITE ASH</b> ( <i>Fraxinus americana</i> )	0	0	0	0
<b>BLACK CHERRY</b> ( <i>Prunus serotina</i> )	65	75	61	y

<sup>x</sup> Column values followed by the same letter were not significant at the 0.1% level based on Student Newman Kuels Multiple Range Test.

<sup>y</sup> Ten-year mean stem diameter was not collected on these accessions which typically grow multiple-trunked.

**Table 2.** Ten-Year Summary of Survival and Growth Data for Accessions Planted in 1993 at the NDSU Dickinson Research Extension Center.

PLANT ACCESSION	PERCENT MEAN SURVIVAL	10 YR. MEAN HT (IN.)	10 YR. MEAN CROWN WIDTH (IN.)	10 YR. MEAN STEM DIAM (IN.)
<b>SAND BIRCH</b> ( <i>Betula platyphylla</i> 'Kamtschatka')	48	108	75	3.4
<b>PAPER BIRCH</b> ( <i>Betula papyrifera</i> ) Nebraska Source North Dakota Source (Killdeer Mtns.)	16a <sup>x</sup> 92b	133a <sup>x</sup> 160b	103a <sup>x</sup> 101a	4.1a <sup>x</sup> 4.6a
<b>HYBRID BIRCH</b> ( <i>Betula x piperi</i> )	8	157	44	1
<b>AMERICAN ARBORVITAE</b> ( <i>Thuja occidentalis</i> ) Riverside cemetery (Source 3)	0	0	0	0

<sup>x</sup> Column values followed by the same letter were not significant at the 0.1% level based on Student Newman Kuels Multiple Range Test.

**Table 3.** Five-year Summary of Survival and Growth Data for Accessions Planted in 1997 at the NDSU Dickinson Research Extension Center.

PLANT ACCESSION	PERCENT MEAN SURVIVAL	MEAN GROWTH (IN.)	5 YR. MEAN CROWN WIDTH (IN.)	5 YR. MEAN STEM DIAM (IN.)
<b>EUROPEAN WHITE BIRCH</b> ( <i>Betula pendula</i> )	50	14	34	1.1
<b>KENTUCKY COFFEETREE</b> ( <i>Gymnocladus dioica</i> )				
Fargo, ND (Source 1)	9a <sup>x</sup>	5a <sup>x</sup>	11a <sup>x</sup>	0.4a <sup>x</sup>
Hannover, IL (Source 2)	33b	-4b	13a	0.6a
Seneca, IL (Source 3)	18b	-8b	9a	0.6a

<sup>x</sup> Column values followed by the same letter were not significant at the 0.1% level based on Student Newman Kuels Multiple Range Test.

**Table 4.** 2001 Survival and Growth Data for Accessions Planted in 1999, 2000 and 2001 at the NDSU Dickinson Research Extension Center.

PLANT ACCESSION	YEAR PLANTED	% MEAN SURVIVAL	MEAN GROWTH (IN.)
<b>CRABAPPLE</b> ( <i>Malus</i> hybrids)			
'Centurion'	1999	11a <sup>x</sup>	-0.4a <sup>x</sup>
'Red Baron'	1999	33a	-31.2a
<b>HAWTHORN</b>			
( <i>Crataegus crus-galli</i> 'Inermis' - Thornless Cockspur H.)	1999	89a <sup>x</sup>	-7.2a <sup>x</sup>
( <i>C. x mordenensis</i> 'Snowbird' - Snowbird H.)	1999	89a	-9.9a
<b>OLGA BAY LARCH</b> ( <i>Larix gmelinii</i> var. <i>olgensis</i> )	2000	67	1.9
<b>TATARIAN MAPLE</b> ( <i>Acer tataricum</i> )	2000	57	3.9
<b>LARCH</b>			
( <i>Larix decidua</i> - European L.)	2001	y	5.4a <sup>x</sup>
( <i>Larix occidentalis</i> - Western L.)	2001	y	3.2a
( <i>Larix sibirica</i> - Siberian L.)	2001	y	3.9a

<sup>x</sup> Column values followed by the same letter were not significant at the 0.1% level based on Student Newman Kuels Multiple Range Test.

<sup>y</sup> Survival for 2001 accessions determined in the fall of 2002.

**Table 5.** 2002 Survival and Growth Data for Accessions Planted in 1999, 2000, 2001 and 2002 at the NDSU Dickinson Research Extension Center.

PLANT ACCESSION	YEAR PLANTED	% MEAN SURVIVAL	MEAN GROWTH (IN.)
<b>CRABAPPLE</b> ( <i>Malus</i> hybrids) 'Centurion' 'Red Baron'	1999	0	0
	1999	0	0
<b>HAWTHORN</b> ( <i>Crataegus crus-galli</i> 'Inermis' - Thornless Cockspur H.) ( <i>C. x mordenensis</i> 'Snowbird' - Snowbird H.)	1999	78a <sup>x</sup>	6.7a <sup>x</sup>
	1999	78a	4.2b
<b>OLGA BAY LARCH</b> ( <i>Larix gmelinii</i> var. <i>olgensis</i> )	2000	64	-1.7
<b>TATARIAN MAPLE</b> ( <i>Acer tataricum</i> )	2000	85	2.1
<b>LARCH</b> ( <i>Larix decidua</i> - European L.) ( <i>Larix occidentalis</i> - Western L.) ( <i>Larix sibirica</i> - Siberian L.)	2001	0	0
	2001	0	0
	2001	25	1.1
<b>PRAIRIE DREAM® PAPER BIRCH</b> ( <i>Betula papyrifera</i> 'Varen'- Prairie Dream®)	2002	y	11.4
<b>EUONYMUS</b> [ <i>Euonymus alatus</i> ('Nordine' sdlg. ) - Nordine or Korean E.] [ <i>Euonymus hamiltonianus</i> var. <i>maackii</i> - Maack E.]	2002	y	4.2a <sup>x</sup>
	2002	y	3.7a

<sup>x</sup> Column values followed by the same letter were not significant at the 0.1% level based on Student Newman Kuels Multiple Range Test.

<sup>y</sup> Survival for 2002 accessions determined in the fall of 2003.