



The Bismarck Plant Materials Program focuses on finding plant-based solutions for conservation issues. Field Plantings provide a way for plant species and technology to be evaluated across a variety of soils, climatic, and site conditions not found at the Bismarck Plant Materials Center (PMC). Typically, someone from a Natural Resources Conservation Service (NRCS) Field Office, Conservation District, or partner agency assists with planning and annual evaluations of the planting. The cooperator, usually a land operator/owner or partner, is responsible for planting and management at the site. The evaluation period is three years for herbaceous species and five years for woody species. Supplementary evaluations are sometimes necessary to ensure sufficient information.

Douglas fir (*Pseudotsuga menziesii*)

Purpose of Evaluation

Most technical guides in North Dakota, South Dakota, and Minnesota have limited conifer options for conservation plantings. Douglas fir could provide needed diversity and potential resilience to diseases. Thirty-plus-year-old plantings located in North Dakota near Williston, Bowman, Bismarck, and Mandan were showing adaptation and longevity (Figure 1). However, more broad testing in conservation plantings under actual use conditions in various environmental conditions was needed.

Species Characteristics

Douglas fir is a long-lived, evergreen conifer predominantly native to the Rocky Mountains and the Pacific Northwest in the United States. It is adapted to a wide range of elevations, from sea level to roughly 10,000 feet. It prefers well-drained, moist, loam soil and cool temperatures. Its common name is misleading as it is not a true fir species. Like



Figure 2 Douglas fir needles are soft, round tipped and flat.



Figure 1 Healthy trees that are ninety-years-old at Mandan ARS.

true fir species, it has soft, flat needles. However, Douglas fir needles are spirally attached to twigs singly (figure 2) and in most fir species, they are arranged in two rows on the side of the twig. Douglas fir has sharp pointed buds whereas true firs have rounded buds. Additionally, Douglas fir cones hang downward and fall from the tree whole while cones of true firs are

The shape, color, and ability to retain its needles longer than some of the fir and spruce species make Douglas fir a popular choice for Christmas trees. Its wood is dense and widely used in lumber products such as structural beams, plywood, and railroad ties.



Figure 3 Douglas fir cones have three-lobed appendages.

Planting Locations

Two Douglas fir accessions were tested: 9094434, collected from eighty-year-old trees located at the Agricultural Research Service (ARS) station in Mandan, North Dakota; and 9094435 collected from sixty-three-year-old trees located at Hillside Park in Bismarck, North Dakota. Plants were propagated by the North Dakota Forest Service Nursery near Towner, North Dakota in 2014 (9094434) and 2015 (9094435).

In 2015, ten Field Planting sites were established with the ARS accession (9094434). In 2016, twelve Field Planting sites were established with the Hillside Park accession (9094435). At each site, 25 trees were planted and evaluated for conservation purposes, typically windbreaks. Planting sites were distributed across 18 counties in North Dakota, South Dakota, and Minnesota (Figure 4).

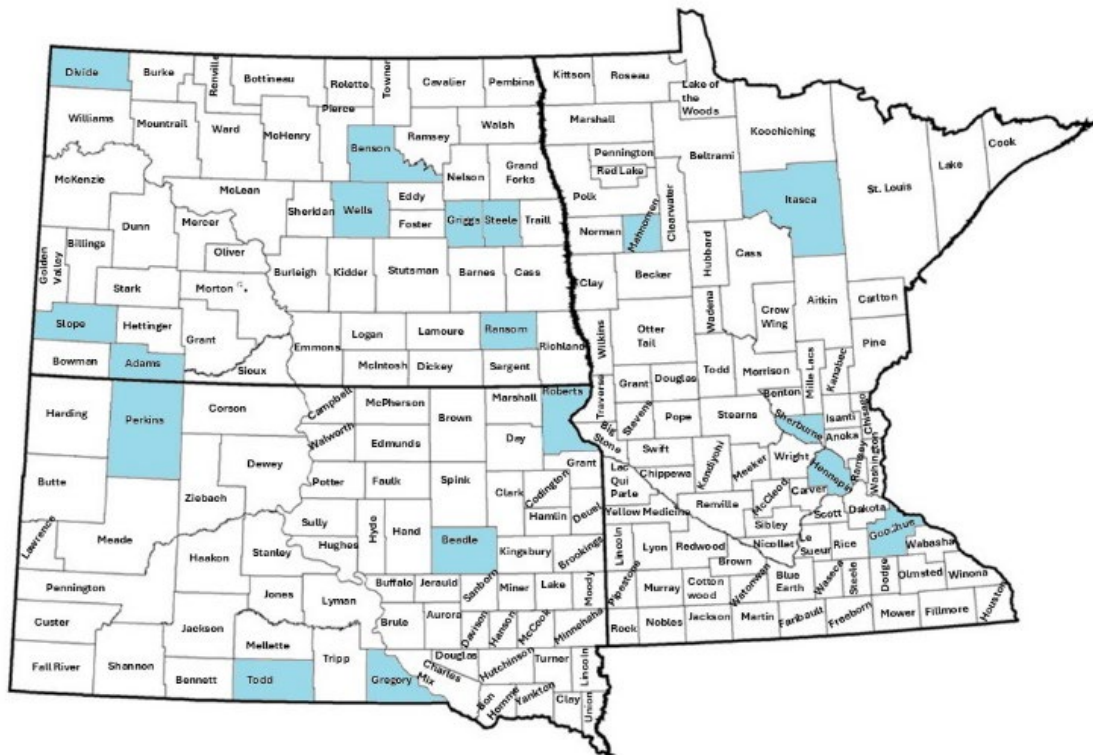


Figure 4 Douglas fir were planted in Field Planting trials in 18 Counties across North Dakota, South Dakota and Minnesota (blue highlighted).

Data and Trends

Field Plantings

Overall, survival was poor, with half the evaluation sites having no surviving trees by the fifth year (Table 1 and Table 2). However, a few select sites had good survival. (Figure 5). Growth rates were initially slow, with an average height of 1.3 feet in year five. Limited and sporadic evaluations in the eighth year showed an average height of 3.7 feet, nearly tripling in growth between years five and eight. No consistent trends were observed in survival percentages related to annual average precipitation, soil characteristics, and seed source among planting sites.

Off Center Evaluation Plantings

Douglas fir trees were also planted at OCEP locations in Dickinson ND, Brookings SD, and Becker MN (Table 3). The same stock was used as in field plantings, with accession 9094434 (ARS) being planted in 2015 and accession 9094435 (Hillside Park) planted in 2016. In Dickinson, the ARS source had significantly better survival and growth than the Hillside park source (Figure 6). The entries failed in the Brookings, SD plot. The entries in Becker, MN were removed shortly after planting due to road construction, before data could be collected.

In 1979, a Douglas fir accession, with parental origin from Douglas County, Colorado was planted in several OCEP sites across North Dakota, South Dakota, and Minnesota. Trees in most plantings were dead by 1983, except at Williston, North Dakota. Trees at the Williston site had 100% survival in 1993, an average height of 12.3 feet and a vigor score of 3.8 (1-9 scale, with 1 being most vigorous)

Conclusion

Information from this project indicates that establishing Douglas fir is challenging in general conservation planting environments. However, several plantings in North Dakota ranging from 30 to over 90 years old, remain healthy, and a few field planting sites achieved high survival percentages. Initial growth rates were slow, but evidence suggests increased growth rates with age. The species may be suitable where species diversity is a high priority and low initial survival is acceptable. To improve establishment success, use four-year-old planting stock, maintain six feet of competition control around each tree, and water at planting. Further testing involving different combinations of seed source, precipitation, soils, and management may yield different results.



Figure 5 Eight-year-old Douglas fir were vigorous at a site in Wells, County North Dakota.



Figure 6 The ARS source of Douglas fir had better establishment and growth at the Dickinson Off-Center Evaluation Planting than the Hillside Park source trees.

Table 1 Douglas fir 2015 Field Plantings (Mandan, North Dakota ARS source 9094434)

ID	State	County	MLRA	CTSG*	Survival year 1	Survival year 2	Survival year 3	Survival year 4	Survival year 5	Survival year 8	Height (ft) year 5	Height (ft) year 8
SD-1506	SD	Roberts	56	2	52%	0%	0%	0%	0%			
ND-1503	ND	Benson	55B	3	76%	40%	40%	NA	NA			
MN-1505	MN	Hennepin	103	3	76%	36%	24%	4%	0%			
SD-1505	SD	Beadle	55C	3	52%	70%	0%	0%	0%			
SD-1508	SD	Beadle	55C	3	72%	60%	44%	NA	36%		1.2	
MN-1501	MN	Mahnomen	57	5	100%	0%	0%	0%	0%			
MN-1503	SD	Todd	91A	5	88%	81%	68%	63%	40%		0.9	
ND-1505	ND	Slope	54	6	80%	30%	24%	0%	0%			
ND1506	ND	Adams	54	6d	100%	80%	80%	76%	64%	56%	1.5	5
MN-1504	MN	Sherburne	91A	7	60%	36%	0%	0%	0%			

* Conservation Tree and Shrub Group (CTSG) was determined by the majority component of the mapped soil

Table 2 Douglas fir 2016 Field Plantings (Hillside Park, Bismarck, North Dakota source 9094435)

ID	State	County	MLRA	CTSG*	Survival year 1	Survival year 2	Survival year 3	Survival year 4	Survival year 5	Survival year 8	Height (ft) year 5	Height (ft) year 8
ND-1603	ND	Ransom	55B	1	42%	8%	0%	0%	0%			
ND-1609	ND	Wells	55B	3	100%	100%	100%	100%	100%	100%	2.2	5
SD-1601	SD	Gregory	63B	3	72%	40%	NA	NA	NA			
MN-1601	MN	Goodhue	105	3	92%	76%	72%	68%	15%		1.5	
MN-1603	MN	Otasca	88	3	96%	96%	88%	84%	84%		1.2	
ND-1605	ND	Adams	54	4c	84%	72%	72%	68%	36%	4%	1.3	3
ND-1604	ND	Adams	54	5	100%	96%	84%	80%	80%	80%	1.4	3.5
SD-1602	SD	Perkins	54	6d	0%	0%	0%	0%	0%			
ND-1606	ND	Griggs	55B	6g	88%	0%	0%	0%	0%			
MN-1602	MN	Itasca	88	7	92%	88%	76%	76%	76%		1.4	
ND-1601	ND	Divide	53B	8k	92%	96%	68%	68%	60%		0.5	
ND-1602	ND	Steele	55B	8k	68%	52%	40%	28%	28%	28%	1.2	2
Averages									31%	54%	1.3	3.7

* Conservation Tree and Shrub Group (CTSG) was determined by the majority component of the mapped soil

Table 3 Douglas fir Off Center Evaluation Plots

Location	State	Accession	Survival year 10	Height (ft) year 10
Dickinson	ND	9094435	20%	2.5
Dickinson	ND	9094434	60%	4.8
Brookings	SD	9094435	0%	0
Brookings	SD	9094434	0%	0