

Breeding and Selection of Redbuds (*Cercis* sp.) for Northern Climates

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Introduction

Attractive trees and shrubs beautify our landscapes, benefit the environment, and improve our overall quality of life. However, Minnesota's rigorous climate presents a formidable challenge to the growth and survival of many desirable landscape plant species. The Woody Landscape Plant Breeding and Genetics program at the University of Minnesota was formally initiated in 1954 to breed trees and shrubs capable of withstanding Minnesota's harsh climate. Since that time, the program has been responsible for the release of 46 cold hardy woody landscape plants.

For the past 10 years, one area of focus for the program has been development of superior new cultivars of eastern redbud (*Cercis canadensis* L.). Naturally occurring throughout much of the eastern United States as far north as the southern portions of Wisconsin and Michigan, Eastern redbud is not native to Minnesota. Cold-tolerant redbud germplasm of unknown origin was identified through natural selection in field trials at the University of Minnesota Landscape Arboretum in the 1960s. Progeny from these original trees have been used to produce subsequent generations of cold-hardy seedlings sold today in the nursery trade as Minnesota Strain redbud. These trees exhibit horticultural attributes typical for the species,

growing 15-20 ft tall with medium green heart-shaped leaves and a profusion of rose-purple, pea-like flowers in the spring. Numerous cultivars of redbud with a range of ornamental characteristics such as purple, yellow, variegated, or glossy green foliage, and flower colors ranging from pure white to deep rose have been introduced in the nursery trade. However, none of these possess sufficient cold tolerance for use in USDA Hardiness Zone 4a. The goal of this breeding project is to develop superior new selections of redbud for northern climates by combining the cold tolerance of Minnesota Strain redbuds with the interesting foliar and floral characteristics of several non-hardy cultivars.

Materials and Methods

Controlled hybridizations were carried out between Minnesota Strain redbuds and containerized plants of several non-hardy redbud cultivars (Table 1) at the University of Minnesota Horticultural Research Center (HRC) and Minnesota Landscape Arboretum in Chaska, Minnesota. Forest Pansy is a purple-leaved eastern redbud cultivar hardy to USDA Zone 5. Oklahoma is a selection of Texas redbud (*C. canadensis* var. *texensis*) with glossy foliage and bold purple flowers hardy to Zone 6. Seeds resulting from these crosses were grown in containers at the HRC for 3-4 years. It was speculated that F1 hybrid seedlings likely would exhibit cold tolerance levels intermediate to their two parents and therefore might not survive in field trials in Minnesota. In order to provide a suitable environment for the F1 plants to survive and reach flowering age and allow for production of F2 seed and the potential genetic recombination of desirable parental traits, Minnesota researchers partnered with William Graves, Iowa State University, to grow out F1

redbud seedling populations at the ISU Horticulture Research Station.

On October 8, 2012, 175 eastern redbud trees representing three parental combinations were transported from the HRC to the ISU Horticulture Research Station and planted in rows 8 ft apart within rows with 10 ft between rows. Plants were mulched and irrigated as needed to ensure establishment throughout the first full growing season and aisles were maintained in mowed turf.

Results and Discussion

After six years in the field, survival percentages for Minnesota Strain x Forest Pansy, Minnesota Strain x Oklahoma, and Oklahoma x Minnesota Strain trees were 70, 84, and 61 percent, respectively (Table 1). The failure of trees to leaf out in the spring indicated a lack of cold tolerance was the primary cause of mortality.

A small number of surviving trees first began blooming and producing seed in 2013, and most of the trees were sexually mature by

2016. Since that time, open-pollinated seed has been collected annually from multiple, individual genotypes within each crossing population. The winter of 2018-2019 was exceptionally cold (minimum air temperature of -25°F in January 2019) so a special emphasis was placed on collecting seed from the limited number of trees that bloomed well the following spring. All seedlings currently are being grown in containers for eventual field planting at the University of Minnesota HRC where they will be evaluated for variation in cold tolerance and ornamental characteristics. Controlled hybridizations between select trees at the ISU Horticulture Station that have exhibited superior cold tolerance and desirable ornamental traits will be made in the future.

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Table 1. Crossing combinations of eastern redbud (*Cercis*) genotypes planted at the ISU Horticulture Research Station, October 2012.

Female parent	Male parent	Number of trees planted	Number of trees surviving in 2019
Minnesota Strain	Forest Pansy	67	47
Minnesota Strain	Oklahoma	37	31
Oklahoma	Minnesota Strain	73	45