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Cold Injury to Flower Buds and Shoots of Blueberry Cultivars Following Extreme Low Fall Temperatures[1]

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Abstract

Inflorescence and shoot injury to eleven blueberry cultivars growing in central and eastern Iowa was evaluated following unseasonably low temperatures on November 11, 1986. In central Iowa, where a low of -20°C was recorded, floret survival varied among cultivars. More than 95% of florets of 'Jersey,' 'Northblue,' and 'Northsky' survived while less than 65% survived for 'Collins.' No differences in shoot injury were observed among cultivars.

Cold tolerance is a complex trait, which can be envisioned as the product of several components such as ability to acclimate rapidly and early in the fall, ability to achieve a high level of cold tolerance and ability to retain cold tolerance (5). When injury is detected following a test winter of extremely low temperatures and can be attributed to a specific time or event, researchers can evaluate the relative hardiness of cultivars. Such information about cultivar or breeding line hardiness is essential for breeders to use in selecting parents that may transmit desirable characteristics for specific components of cold tolerance.

Adapted cultivars must possess adequate levels of cold tolerance throughout the year. However, in most production areas, certain times of the year can be identified when cold tolerance is critical. One critical component of selection for blueberry breeding programs in northern areas is the ability to acclimate early and rapidly in fall (4, 6). Low temperatures occurring in parts of the midwestern U.S. on November 11, 1986, permitted us to evaluate blueberry cultivars for the ability to acclimate early in the fall on the basis of observed damage to inflorescence buds and shoots.

Materials and Methods

Plantings evaluated in this study were located at the Horticulture Research Station, Ames, Iowa, and the Muscatine Island Field Station, Muscatine, Iowa. The fall of 1986 was characterized by above normal rainfall and mild temperatures prior to November 11. Minimum temperatures on November 11 were -20°C at Ames and -13°C at Muscatine. Recorded minimum temperatures in October and November 1986 prior to November 11 -4°C at Ames and -7°C at Muscatine.

Shoots 13-15 cm long with three or more well-developed inflorescence buds per shoot were collected on November 16, 1986, from the upper third of each bush well above the less than 2 cm of snowcover present on November 11, 1986. No cold temperatures that were thought to be damaging occurred between November 11 and the time that shoots were collected. At both locations, two shoots of each cultivar were collected from three plants. Shoots were placed in vials of water and held at 23-24°C for 7 days before evaluation.

Cold injury was evaluated by cutting inflorescence buds and shoots and rating them based on visual browning to floret and shoot xylem tissues. The percentage of browned florets in each

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flower bud was recorded, and a rating scale was used to record shoot injury (Table 1). Data on percentage floret injury were transformed with the arcsine transformation and analyzed by using analysis of variance.

Table 1. Mean percent dead florets per inflorescence bud and mean shoot injury of blueberry cultivars following -20°C on November 11, 1986 at Ames, Iowa.

Cultivar	% Dead Florets[z]	Shoot Injury Rating[y]
Northblue	4.3 a	1.5
Jersey	4.3 a	1.8
Northsky	5.0 ab	2.0
Bluecrop	8.5 abc	2.5
Colville	12.5 abcd	1.8
Patriot	15.0 abcd	1.8
Blueray	15.5 abcd	2.2
Elliott	18.2 abcd	1.8
Spartan	23.2 bcd	1.8
Bluetta	29.5 cd	1.7
Collins	35.2 d	2.0

[z]Mean separation on transformed data, LSD 5%. Means followed by the same letter are not significantly different.
[y]Rating Scale: 1 = No shoot browning; 2 = shoot browning limited to area 1 cm directly below terminal bud; 3 = browning extending more than 1 cm below terminal bud.

Results and Discussion

Significant differences occurred in Ames, Iowa, among blueberry cultivars for flower bud damage after the November 11 freeze (Table 1). Only a few florets were damaged at Muscatine, Iowa, where recorded low temperatures on November 11 were -13°C compared with -20°C at Ames (data not shown). Cultivar differences in floret survival were not significant at Muscatine.

Floret survival ranged from a high of 95 percent or more for 'Northblue,' 'Northsky' and 'Jersey' to a low of less than 65 percent for 'Collins.' 'Northblue' and 'Northsky,' introductions from the University of Minnesota breeding program, both are progeny involving half-high (highbush x lowbush) parents, including 'Ashworth.' 'Ashworth' (3) and lowbush (*V. angustifolium*) blueberries are known to attain their hardiness early in the fall (2) and appear to transmit this valuable characteristic to their progeny.

'Jersey,' a highbush cultivar, had a significantly higher percentage of live florets than several other highbush cultivars. In a previous study (1), 'Jersey' flower buds appeared slightly hardier than other highbush cultivars in late fall freezing tests. 'Jersey' may be a useful parent in northern climates where highbush cultivars frequently grow late in the fall and fail to acclimate before damaging low temperatures occur (4).

Shoot injury at both Ames and Muscatine was minor (Table 1) and, in most cases, confined to the terminal 1-2 cm of the shoot. Only the cultivar 'Bluecrop' exhibited slightly more damage at Ames.

Results of this study illustrate differences in blueberry germplasm for one component of cold tolerance. Where the ability to acclimate early is a critical component of cold tolerance for an area, the information presented may be useful to breeders in selecting desirable parents for late fall and early winter cold tolerance.

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