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Fruit Set in Half-High Blueberry Genotypes Following Self and Cross Pollination

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Abstract

Recently introduced half-high blueberry (*Vaccinium* spp.) cultivars were derived from hybridization between the usually self-unfruitful lowbush blueberry (*V. angustifolium* Ait.) and self-fruited cultivars of the highbush blueberry (*V. corymbosum* L.). In this study, 10 half-high cultivars and advanced breeding selections were self and cross pollinated to determine their degree of self fruitfulness. Fruit set following self pollination varied among the genotypes from none to equal to that following cross pollination. Berries from self pollination were considerably lower in weight for all genotypes except 'Northblue,' 'Northcountry' and MN 359. Fruits from self pollination had fewer developed seeds/berry for all genotypes. Assuming these results are indicative of field performance, single-cultivar plantations will be feasible for only the specific genotypes which exhibited high fruit set and no reduction in average berry weight following self pollination.

Introduction

The recent introduction of cold hardy, low-statured blueberry (*Vaccinium* spp.) cultivars, 'Northblue,' 'Northsky,' and 'Northcountry' (11), has resulted in increased interest in the commercial production of blueberries in harsher, northern climates. These "half-high" cultivars are derivatives from hybridization between the highbush blueberry, *Vaccinium corymbosum* L., and the lowbush blueberry, *V. angustifolium* Ait. (11). *Vaccinium corymbosum* cultivars are generally considered self fruitful (5, 8, 12, 13) whereas, *V. angustifolium* clones are usually self unfruitful (1, 7, 10). The mechanism and inheritance of self fruitfulness in *Vaccinium* are unknown, and observations of self-pollen tube growth to the base of the style and into the ovary are not typical of classical self-incompatibility systems (5).

Early research on self fruitfulness in the highbush blueberry (*V. corymbosum*) contains several contradictory reports. In 1921, Coville (4) stated that self pollination resulted in fewer, smaller, and later maturing berries compared with cross pollination. Beckwith (3) and Bailey (2) also indicated that cross pollination was necessary for the production of a satisfactory crop. Meader and Darrow (12), however, concluded that fruit set with self pollination was similar to that with cross pollination for some cultivars. They did find that cross pollination insured earlier ripening and larger berries and, consequently, recommended interplanting of 2 or more varieties for cross pollination. Although several researchers have concluded that highbush blueberries are self fruitful, variability among genotypes was observed (5, 8, 13).

In contrast, several researchers established that lowbush blueberries require cross pollination for satisfactory productivity. Aalders and Hall (1) reported that only 11 of the 23 genotypes tested set fruit upon selfing. Levels of fruit and seed set following selfing ranged from 0 to 50% fruit set and from 0 to 19 seeds per berry. In later studies, Hall et al. (7) and Luby et al. (10) also found that 5 of 6, and 10 of 11 genotypes, respectively, were self-unfruitful. Wood (15) observed higher fruit set with cross pollination than with selfing. Fruit set was higher with open pollination in clones capable of higher self fruit set. He concluded that lowbush blueberry fields should contain two or more genotypes to obtain high yields.

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The rabbiteye blueberry (*V. ashei* Reade), the third commercially important species, has also been studied in detail. Native clones are self unfruitful (6) and cross pollination is usually critical for maximum fruit set and yield in cultivars (5, 6).

Our study examined the degree of self fruitfulness in the cultivars 'Northblue,' 'Northsky,' and 'Northcountry' and other advanced half-high breeding selections in order to determine the need for multiple-cultivar plantations.

Materials and Methods

The 10 blueberry genotypes used in this study (Table 1) were derivatives from hybridization between *V. corymbosum* and *V. angustifolium*. In March 1986 and February 1987, dormant potted plants of each genotype were brought into a greenhouse for flowering. When flowers opened, they were hand-pollinated without emasculation. At least 20 flowers from each clone were self-pollinated and at least 20 additional flowers from each clone were pollinated with a bulk pollen sample collected from several other genotypes. Pollen was obtained by rotating the flower until enough pollen was collected on the thumbnail. The stigma of the selected flower was touched to the pollen on the thumbnail. Ripened berries were harvested and weighed. The number of developed seeds in each berry was determined. Percentage fruit set was compared between self and cross pollination using chi-square, while average berry weight and seeds per berry (following square-root transformation) were compared using the t-test (14).

Results and Discussion

Excepting 'Northsky' in 1986, all genotypes set fruit on at least 40% of the flowers following cross pollination (Table 1). However, 3 patterns of fruit set were observed following self pollination. 'Northblue' and MN 359 set the same proportion of fruit regardless of pollen source. MN 167, MN 393, and MN 496 set virtually no fruit following self pollination. 'Northsky,' 'Northcountry,' MN 186, MN 368, and MN 408 exhibited substantially reduced fruit set following selfing compared to cross-pollination.

Average berry weight was similar following selfing and outcrossing for 'Northblue,' 'Northcountry' and MN 359 but was significantly reduced upon selfing for 'Northsky,' MN 186, MN 368, and MN 408 (Table 1). A high average berry weight could improve yield providing that compensation in berry number is insignificant. Harvest efficiency and consumer appeal might also be improved with larger fruit size.

Seed number per berry was reduced in all genotypes following self-pollination (Table 1), a finding consistent with previous observations in both highbush and lowbush blueberries (5, 7, 10, 12). Although larger fruit size has been related to a higher number of seeds per berry (5, 12), a high number of seeds can produce an undesirable "gritty" texture in the mouth. Therefore, the observation that several genotypes ('Northblue,' 'Northcountry,' and MN 359) produced berries of equal size following self or cross pollination, but produced fewer seeds per berry following self-pollination, seems notable. Selection for this capability will be essential not only in developing cultivars which will perform well in single-genotype plantations, but also in maintaining organoleptic texture.

The blueberry genotypes we studied were derived from crosses among presumably self fruitful *V. corymbosum* cultivars (e.g. 'Earliblue,' 'Dixi,' 'Jersey,' 'Pioneer,' 'Stanley') and self unfruitful *V. angustifolium* selections (11). Sexual reproductive systems of both parental groups are apparently operating in these half-high clones as self fruitful and self unfruitful genotypes were observed. Furthermore, we have apparently encountered segregation for genes contributing to re-

Table 1. Fruit set, berry weight and seeds per berry following cross and self pollination of half-high blueberry genotypes in 1986 and 1987.

Genotype/ Year	Type of pollination	No. of pollinations	Fruit set	Berry weight	Seeds/ berry
				(%)	(g)
Northblue	cross	24	54	2.2	17.3**
1986	self	23	56	2.0	12.9
1987	cross	71	85	1.3	16.9**
	self	81	84	1.3	11.0
MN 359	cross	17	47	1.3	32.4**
1986	self	47	51	1.2	15.9
Northsky	cross	21	10	0.8	7.0
1986	self	21	14	0.4	12.6
1987	cross	68	87**	1.1**	17.5**
	self	100	14	0.5	2.5
Northcountry	cross	27	52**	0.8*	11.6*
1986	self	31	10	0.7	8.7
1987	cross	74	92**	1.0	18.6**
	self	111	71	0.9	7.3
MN 368	cross	21	62*	1.8**	24.2**
1986	self	24	25	0.9	8.7
MN 186	cross	32	65*	1.2*	29.6*
1986	self	26	12	0.8	22.0
MN 408	cross	22	77**	1.8*	31.6*
1986	self	20	5	1.1	20.0
MN 167	cross	39	77**	1.0	21.6
1987	self	46	0	---	---
MN 393	cross	20	50**	1.6	12.0
1986	self	28	0	---	---
MN 496	cross	23	40**	1.1	29.5
1986	self	20	0	---	---

*, **The difference between cross and self is significant at $p \leq 0.05$ and 0.01, respectively, as determined by chi-square for fruit set and t-test for berry weight and seeds/berry.

productive success following self pollination. For example, the self fruitful genotypes 'Northblue,' MN 359, MN 368, and MN 186, and the self unfruitful genotypes MN 167 and MN 393 all have the same paternal parent, US 3 (Dixi x Mich. lowbush No. 1). The maternal parents of each clone were full siblings from the cross, G65 (Earliblue x US 11-93) x 'Ashworth.' In addition, 'Northcountry' and 'Northsky,' with differing levels of self fruitfulness, are full sibs.

The results from our study indicate that levels of fruit set, berry weight and seed set following self pollination compared to cross pollination vary among half-high blueberry genotypes. If the differences in fruit set from these greenhouse trials are concordant with differences which occur in field plantings, then planting recommendations will be dependent on the genotype. Single-cultivar plantations will be feasible only for genotypes which exhibit a high fruit set and average berry weight in spite of a reduced number of seeds per berry following self-pollination. Some half-high genotypes such as 'Northblue' and MN 359 could be planted in single-genotype plantations. To insure high productivity, the other genotypes would benefit from multiple-genotype planting schemes. Segregation for self-fruitfulness suggests that selection for other highly self-fruitful selections would be desirable and feasible.

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Book Review

Apple Cultivars for Puget Sound by R. A. Norton and J. King is a 72 page book published by Washington University as EB1436. This book presents the results of performance trials conducted at Mount Vernon, Washington from 1963 through 1985 on 124 apple cultivars. Cultivar origin, shape, color, flesh texture and taste are described for each, with color plates of 107. Bloom and harvest dates are presented as well as susceptibility to apple scab and mildew. This book is an excellent reference for interested parties in the coastal climates and also useful to others interested in apples as many of the tested cultivars are adaptable in other areas. Single copies are available for $8.00 from the Bulletin Office, Co-op Extension Cooper Publications Building, Washington State University, Pullman, WA 99164.