Fruit Varieties Journal 44(2):63-68 1990

Half-high Blueberry Cultivars

CHAD E. FINN,[1] JAMES J. LUBY,[2] AND DAVID K. WILDUNG[3]

'Half-high' blueberry cultivars are *Vaccinium corymbosum* L./*V. angustifolium* Ait. derivatives that have been developed to meet the needs of commercial blueberry growers in northern climates. A low statured, crown forming bush would have a larger fruiting area than the lowbush blueberry, *V. angustifolium*. It would be more amenable to commercial production, and would retain most of the fruiting surface beneath the snow line (24).

History

The task of developing a low-statured blueberry for northern regions was not mentioned in F. V. Coville's earliest publications (3). He clearly had conceived of it, however, because Brierly and Kenety (1) reported receiving *V. corymbosum* x *V. angustifolium* seedlings from him in 1916 for evaluation in Minnesota. Coville actually made *V. corymbosum* x *V. angustifolium* crosses as early as 1913 and introduced a half-high cultivar, 'Greenfield,' that never became commercially established (4).

In 1926, Stanley Johnston realized that highbush x lowbush plants might provide a new crop for northern Michigan (15). He spent the summers of 1925 to 1930 exploring northern Michigan for superior lowbush genotypes. These were crossed with highbush genotypes, and although most of the resulting seedlings produced disappointingly small and dark fruit (14) the progeny of one selection, designated Michigan Lowbush 1, were somewhat taller and had lighter colored fruit than the others. Darrow et al. (5) suspected that Michigan Lowbush 1 was a *V. angustifolium* x tetraploid *V. myrtilloides* Michx. derivative because of its "robust" plant habit, pubescent leaves, and frosty blue fruit.

Michigan Lowbush 1 appears as an ancestor of the half-high cultivars 'Northland,' and 'Tophat' from Johnston's Michigan program (7, 21, 16). The USDA continued to work with highbush x lowbush crosses involving Johnston's lowbush selections (5, 6) eventually producing several selections including one designated US-3 ('Dixi' x Michigan Lowbush 1) which is a parent of 'Patriot' from the Maine-USDA program (13) and 'Northblue' and 'St. Cloud' from the Minnesota program. In 1965, seeds from several crosses of the 'Ashworth' clone with highbush genotypes were received in Minnesota from USDA breeders D. H. Scott and A. D. Draper. 'Ashworth' was selected from wild stands of *V. corymbosum* in the St. Lawrence valley of northern New York, at the northern limit of the range of *V. corymbosum*. These selections appear in the ancestry of most Minnesota breeding material. Hardiness of the 'Ashworth'-derived material has been confirmed by our observations in Minnesota (9).

Other germplasm used as sources of cold hardiness has included *V. angustifolium* genotypes from Minnesota (9,

Scientific Journal Series Paper No. , , Minnesota Agricultural Experiment Station. We are grateful to S. Munson, K. Sargent, D. Bedford, C. Fear, E. Hoover, and D. Trinka for their contribution to blueberry cultivar evaluation in Minnesota.

[1]Department of Horticulture, University of Missouri, Columbia, MO 65211.
[2]Department of Horticultural Science, University of Minnesota, Saint Paul, MN 55108.
[3]University of Minnesota, North Central Experiment Station, Grand Rapids, MN 55744.

22) and natural half-high populations collected at the Harvard Forest in Massachusetts (9, 19, 22). Several researchers (5, 14, 15, 20) reported difficulty in obtaining half-high genotypes of desired stature and fruit characteristics in early generations of *V. corymbosum V. angustifolium* crosses. However, we have observed considerable segregation for plant stature, bloom and ripening dates, fruit development interval, ripening uniformity, fruit size, color, picking scar, and firmness in advanced generations (10, 11, 17, 18).

Cultivars

'Northblue' is the most widely planted Minnesota developed cultivar. At Becker, MN, 13-year-old plants were approximately 1 m tall and 1.3 m in diameter. The plants are heavily branched, but may be suitable for mechanical harvesting with modified pruning. 'Northblue' fruit is large (1.8 g), medium dark blue, and somewhat flattened. The berries have small dry pedicel scars and comparable firmness to commercial *V. corymbosum* cultivars (17). The fruit are more acidic than 'Northsky' or 'Northcountry,' but this may enhance their ability to tolerate long storage (17). In yield trials, 'Northblue' has averaged 3-4.5 kg/plant, with some plants producing up to 6.5 kg/plant.

'Northcountry' and **'Northsky'** have very similar plant form. They are nonrhizomatous, heavily branched, and resemble *V. angustifolium* in plant foliage characters more than other half-high cultivars. Thirteen-year-old 'Northcountry' and 'Northsky' plants are 0.8 m tall X 1.5 m diameter and 0.6 m tall X 1 m diameter, respectively. The fruit of 'Northsky' and 'Northcountry' are medium size (0.8 g), light blue due to a heavy wax bloom, and are sweet, with a mild flavor typical of *V. angustifolium*. 'Northcountry' and 'Northsky' have a lower yield potential (2-3 kg/plant and 1-2 kg/ plant, respectively) than 'Northblue.' 'Northcountry' is often included as a secondary variety in commercial plantings. 'Northsky' is appropriate for home plantings, but in the more extreme climate of northern Minnesota, the yields of the other cultivars decrease to approximately the same levels 'Northsky.'

'St. Cloud' is the newest release from the Minnesota program. Thirteen-year-old plants are 1.3 m tall X 1.7 m diameter. In Minnesota, the crop ripens 4-7 days earlier than 'Northblue' and with 'Bluetta,' and ripening is concentrated. Fruit are medium blue, large (1.2 g), and slightly flattened. The flavor is well balanced, fruit firmness is comparable to commercial *V. corymbosum* cultivars, and the pedicel scar is small and dry. Yield potential is large (3-4 kg/plant), similar to 'Northblue.' In commercial production, the earlier ripening 'St. Cloud' should complement 'Northblue' and 'Northcountry' to extend the fruiting season.

'Northland' was developed at Michigan State University (16). In Michigan and Minnesota, the plants reach approximately 1.2 m tall. In Minnesota, 'Northland' crops every year, but appears to be more sensitive to winter injury than the Minnesota cultivars and 'Patriot.' 'Northland' wood is pliable and, theoretically, snow will accumulate on the plant, bending the branches beneath snow protection. Berries are medium in size, round, medium blue, moderately firm, have good flavor and the pedicel scar is medium-small and dry (16). The crop ripening is concentrated and with appropriate pruning may be harvested with small picking machines (16).

'Patriot' is a product of the cooperative effort between the University of Maine and the U.S.D.A. (13). In Minnesota, this clone has been moderately productive with minimal winter injury. Plants are upright, relatively open and vigorous. The plant attains a height of about 1.5 m in Maine, and in

Minnesota it is slightly smaller. In southern Minnesota, 'Patriot' can yield large crops of large, slightly flattened, medium blue, firm fruit which have a small dry scar. Fruit flavor is good but acidic until the fruit is completely ripe. The crop ripens over the course of 2-3 weeks (13). 'Patriot' has been recommended as a cultivar for trial in commercial plantings in Minnesota.

'Bluetta' was released as an early ripening highbush cultivar to replace 'Weymouth' and 'Earliblue' (8). North Sedgwick lowbush, one of the ancestors of 'Bluetta,' appears to have contributed winter hardiness to 'Bluetta.' 'Bluetta' produces a commercially acceptable crop in some years in Minnesota. Plants are upright and maintained at about 1.3 m by winter injury to the tops of the plant. The mild flavored fruit are medium sized and light blue, and although the pedicel scar can be large, this has not proved detrimental in N.J. (8). The crop ripens very early in the eastern U.S.

'Tophat' and 'Ornablue' are two half-high cultivars released for their aesthetic rather than their commercial value.

'Tophat' is a spherical dwarf plant about 30 cm in diameter developed at Michigan State University. The fruit are bright blue and the fall foliage is brilliant red, making the plant suitable for landscape gardens or containers.

'Ornablue' is a *V. pallidum* Ait. (collected by Batchelor in Alabama) x *V. corymbosum* ('Concord') hybrid, developed by Childs in West Virginia. Plants reach 1 m tall, and have attractive blooms and fall foliage. Although the fruit are attractive, they are fairly dark and unacceptable for commercial production. The yields, for 6-year-old plants, were considered good

Table 1. Half-high blueberry (*Vaccinium corymbosum/V. angustifolium* derivative) cultivars introduced with potential for cultivation in northern environments.

Cultivar	Year	Test No.	Parentage
		University of Minnesota	
Northblue[1]	1983	MN-360	B-10 (G65 X Ashworth) X US-3 (Dixi X MI Lowbush No. 1)
Northsky[1]	1983	MN-332	B-6 (G65 X Ashworth) X R2P4 (*V. angustifolium* X *V. corymbosum*)
Northcountry[1]	1986	MN-350	"
St. Cloud	1988	MN-167	B19 (G65 X Ashworth) X US-3
		Michigan State University	
Northland[2]	1967	MI 48-H	Berkeley X MI 19—H (MI Lowb. No. 1 X MI Highb. Selec. 120)
Tophat[3]	1977	MI 100-H	MI 19-H X MI 36-H (MI 19-H X Berkeley
		U.S.D.A./N.J. Agric. Exp. Stat.	
Bluetta[4]	1968	G-3	No. 3 (N. Sedgwick Lowb. X Coville) X Earliblue
		U.S.D.A./University of Maine	
Patriot[5]	1976	MeUS-32	US-3 (Dixi X Mich. Lowb. 1) X Earliblue
		West Virginia Agric. Exp. Stat.	
Ornablue[6]	1969	—	*V. pallidum* (HC1401 X *V. corymbosum* ('Concord')

[1]Luby et al., 1986.
[2]Johnston and Moulton, 1967.
[3]Moulton et al., 1977.
[4]Draper et al., 1968.
[5]Hepler and Draper, 1976.
[6]Childs, 1969.

(4-6 liters/plant) in W. Virginia, and appear comparable to other half-high cultivars. The northern limits of adaptation for 'Ornablue' are unknown.

Commercial Production Practices

Commercial production practices for half-high blueberries are similar to those for highbush cultivars. Typically, 2-3 year old clones, which have been micropropagated, are planted in the spring, with sphagnum peat incorporated in the oil. Plantings at the Sand Plains Research Station in Becker, MN have grown well on a loamy sand with soil pH 5.2-5.7. Despite successful cultivation at this pH level, recent studies found that the plants will grow more vigorously on this soil when the pH level is amended to 4.5 using iron sulfate. Recommended plant spacings are 1 to 1.3 m between plants within rows and 2 to 3 m between rows. Usually the first and second year blossoms are removed to encourage plant growth.

Vaccinium angustifolium genotypes are typically self unfruitful, whereas *V. corymbosum* cultivars will usually set an adequate crop with self fertilization. The Minnesota half-high cultivars vary in their self fruitfulness (23). 'Northblue' had nearly equal cross- and self-fruitfulness, whereas 'Northsky,' 'Northcountry' and 'St. Cloud' often set very few fruit following self-pollination (23). Berry weights were significantly lower for self-pollinated fruit for all genotypes tested except 'Northblue' and 'Northcountry' (23). Berries ripen earlier if cross-pollinated. At present, we do not recommend solid block plantings of any of these cultivars, although 'Northblue' can potentially produce acceptable crops in solid block plantings.

At maturity, the half-high cultivars reach approximately 0.5 to 1.5 m tall. Half-high cultivars are usually more heavily branched than typical highbush cultivars and are generally not well suited to mechanical harvesting with machines used for highbush blueberries (19). Mechanical harvesting is not a standard practice in most northern climates because the plantings tend to be small and geared to pick-your-own or manual harvesting for local markets. All of these cultivars are suitable for home plantings.

The pruning practices for half-high cultivars are similar to those used in highbush blueberry production. Wood damaged by winter injury may be removed annually. Thinning cuts of old canes usually are necessary when the plants are 5-6 years old to encourage new growth and facilitate harvesting of heavily branched plants.

Winter protection studies have been conducted for several years at the University of Minnesota North Central Experiment Station in Grand Rapids, MN (25, 26). At Becker, MN (U.S.D.A. hardiness zone 4), special winter protection is not usually necessary for successful berry production, but to ensure production in Northern MN (U.S.D.A. zone 3), increased winter protection would be advantageous. Most of the effort has been made to develop snow management systems, which include snow catch systems, snow transfer from row centers to rows, and artificial snow production. The snow catch systems are the most economical in commercial production. The variety of systems studied have included snow fences, intercropping with other crops such as asparagus, light straw mulch on plants, and various synthetic nettings, mulches, or row covers over the plants. The row covers are promising, despite their expense, because they not only act as snow catches, but they impart some protection above the snow line from desiccating winds in winter. The growers must reconcile the large expense of the row covers with the possibility of obtaining yields which are twice the yield of nonprotected control plants in years with little or no snow cover.

A 1987 survey of 358 prospective Minnesota blueberry growers indicated that 75 producers had planted more than 84,000 plants, with additional plantings of 35,000 plants planned in the next two years. We are also aware of plantings in Wisconsin, Michigan, New York, New England, Ontario, Quebec, and the Maritime Provinces.

In an effort to determine the costs and returns associated with half-high production, seven Minnesota blueberry growers are conducting feasibility studies in cooperation with Dr. David Wildung of the University of Minnesota North Central Experiment Station at Grand Rapids, MN. Their average cost to establish a hectare of half-high blueberries was $9650, the yearly maintenance costs, after year one, were about $960/ha. In general, the first commercial harvest occurred in year 4, and the first positive, annual net return was in year 6.

The half-high blueberry cultivars allow production in northern environments where commercial *V. corymbosum* cultivars are not adapted. 'Northblue,' 'Northcountry,' 'St. Cloud,' and 'Patriot' should serve as good primary cultivars as the blueberry industry develops in northern environments. Newer cultivars will be necessary to improve fruit quality, extend the cropping season, as well as improve the winter injury avoidance.

Literature Cited

1. Brierly, W. G. and W. H. Kenety. 1920. Blueberry culture in Minnesota—a report of progress. Proc. Amer. Soc. Hort. Sci. 17:43-49.
2. Childs, W. H. 1969. 'Ornablue' new blueberry variety. W. Virginia Agriculture and Forestry. 2:10-12.
3. Coville, F. V. 1920. Experiments in blueberry culture. USDA Bureau of Plant Industry Bul. 193.
4. Coville, F. V. 1937. Improving the wild blueberry. USDA Yearbook of Agriculture. 1937:559-574.
5. Darrow, G. M., E. B. Morrow, and D. H. Scott. 1952. An evaluation of interspecific blueberry crosses. Proc. Amer. Soc. Hort. Sci. 59:277-282.
6. Darrow, G. M., L. Whitton, and D. H. Scott. 1960. The Ashworth blueberry as a parent in breeding for hardiness and earliness. Fruit Var. Hort. Dig. 14:43-46.
7. Draper, A. D. 1979. Highbush blueberry cultiars. Fruit Var. J. 33:48-50.
8. Draper, A. D., L. F. Hough, D. H. Scott and A. W. Stretch. 1969. Bluetta, a new early ripening blueberry variety. Fruit Var. and Hort. Digest 23(1):2.
9. Fear, C. D., F. I. Lauer, J. J. Luby, R. L. Stucker and C. Stushnoff. 1985. Genetic components of variance for winter injury, fall growth cessation, and off-season flowering in blueberry progenies. J. Amer. Soc. Hort. Sci. 110:262-266.
10. Finn, C. E. and J. J. Luby. 1986a. Inheritance of fruit development interval and fruit size in blueberry progenies. J. Amer. Soc. Hort. Sci. 111:784-785.
11. Finn, C. E. and J. J. Luby. 1986b. Inheritance of fruit color, scar, and firmness in *Vaccinium*. HortScience 21:767 (Abstr.).
12. Galleta, G. J. 1975. Blueberries and cranberries. pp. 154-196. In: J. Janick and J. Moore (eds.). Advances in fruit breeding. Purdue University Press. W. Lafayette, IN.
13. Hepler, P. R. and A. D. Draper. 1976. 'Patriot' blueberry. HortScience 11:272.
14. Johnston, S. 1946. Observations on hybridizing lowbush and highbush blueberries. Proc. Amer. Soc. Hort. Sci. 47:199-200.
15. Johnston, S. 1956. Blueberry breeding in Michigan. Fruit Var. Dig. 11:20.
16. Johnston, S. and J. E. Moulton. 1967. The Bluehaven and Northland blueberry varieties. Quart. Bul. Mich. Agr. Expt. Sta. 50(1):46-49.
17. Luby, J. J. and C. E. Finn. 1986. Quantitative inheritance of plant growth habit in blueberry progenies. J. Amer. Soc. Hort. Sci. 111:609-611.
18. Luby, J. J. and C. E. Finn. 1987. Inheritance of ripening uniformity and relationship to crop load in blueberry progenies. J. Amer. Soc. Hort. Sci. 112:167-170.
19. Luby, J. J., D. K. Wildung, C. Stushnoff, S. T. Munson, P. E. Read and E. E. Hoover. 1986. 'Northblue,' 'Northsky,' and 'Northcountry' blueberries. HortScience 21:1240-1242.
20. Meader, E. M., W. W. Smith, and A. F. Yeager. 1954. Bush types and fruit colors in hybrids of highbush and lowbush blueberries. Proc. Amer. Soc. Hort. Sci. 63:272-278.
21. Moulton, J. E., S. Johnston, and R. L. Andersen. 1977. Tophat blueberry. HortScience 12:509.
22. Quamme, H. A., C. Stushnoff, and C. J. Weiser. 1972. Winter hardiness of several blueberry species and cultivars in Minnesota. HortScience 7:500-502.
23. Rabaey, A. and J. Luby. 1988. Fruit set in half-high blueberry genotypes following self and cross pollination. Fruit Var. J. 42:126-129.
24. Stushnoff, C. 1976. Development of cold hardy blueberry varieties. Fruit Var. J. 30:28-29.

25. Wildung, D. K. and K. L. Sargent. 1989a. The effect of row covers on the winter survival and productivity of Minnesota blueberries. Acta. Hort 241:238-243.

26. Wildung, D. K. and K. L. Sargent. 1989b. The effect of snow depth on winter survival and productivity of Minnesota blueberries. Acta. Hort 241:232-237.

Fruit Varieties Journal 44(2):68-72 1990

Rabbiteye Blueberry

JAMES M. SPIERS[1]

Rabbiteye blueberries (*Vaccinium ashei* Reade) are the most important species of blueberries native to the South. The first known commercial planting was made in 1893 in western Florida, using bushes transplanted or propagated from the wild. Similar plantings were later made in Alabama, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina. At one time, more than 3500 acres (1400 ha) were planted in the south, consisting mainly of unselected bushes, many of which produced small, dark, gritty-fleshed berries that lacked flavor. These characteristics gave rabbiteye blueberries a poor reputation in markets and most commercial plantings were eventually abandoned.

A cooperative cultivar development program between the Georgia Coastal Plain Experiment Station, North Carolina Agricultural Experiment Station and the U.S. Department of Agriculture was started in 1940 to improve the horticultural quality of rabbiteye blueberries. Later, the University of Florida initiated blueberry breeding studies and presently most southern states conduct research on rabbiteye blueberries.

During the past 10 years, rabbiteye blueberry production has greatly increased in the south. In 1979 less than 2000 acres were in commercial production, with Georgia, North Carolina, and Florida being by far the leading states in rabbiteye acreage. States such as Alabama, Mississippi, Louisiana, and Texas had about 5 to 50 acres of blueberries per state.

From this point, acreage has increased 400% and in most southern states, blueberries are now listed along with other fruit crops as being a valuable commercial agricultural enterprise.

Paul Eck, in *Blueberry Science* (Rutgers University Press) stated that perhaps the greatest improvement in cultivated blueberry fruit quality has occurred in the rabbiteye as a result of cultivar development research for the past two decades by the Georgia, Florida, and North Carolina Agricultural Experiment Stations in cooperation with the USDA. The following cultivars are listed in order of acreage currently being planted (Table 1).

'Tifblue' is the leading rabbiteye cultivar, accounting for over 50% of the present acreage. It is the most popular cultivar in all southern states except Florida where chilling is not sufficient for normal flowering. Plants are very vigorous and widely adapted. Fruit ripens mid- to late-season and has good quality. This cultivar was released from the Georgia-USDA pro-

[1]Research Horticulturist, USDA-Agriculture Research Service, USDA Small Fruit Research Station, Poplarville, MS 39470.

[2]The author thanks the following research and/or extension specialists for their assistance: Alabama, Arlie Powell; Arkansas, John Clark and James Moore; Florida, Paul Lyrene; Georgia, Max Austin; Kentucky, Gerald Brown; Louisiana, Gregory Lane; Mississippi, John Braswell; North Carolina, Mike Mainland; South Carolina, Ansel King; Tennessee, Dennis Deyton and Alvin Rutledge; Texas, Kim Patten; Virginia, Herbert Stiles.