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# Horticultural Characteristics of Native *Vaccinium darrowi, V. elliottii, V. fuscatum,* and *V. myrsinites* in Alachua County, Florida[1]

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*Abstract.* **Date of 50% anthesis, date of 50% fruit ripening, length of fruit development period, fruit size, flavor, scar and color were determined for random samples of *V. darrowi* Camp, *V. elliottii* (Chapm.) Small, *V. fuscatum* Ait., and *V. myrsinites* Lam. growing in their native habitats in Alachua County, Florida. Mean berry weight ranged from 25.1 cg for *V. fuscatum* to 17.8 cg for *V. myrsinites. V. elliottii* flowered and ripened early, with only 60 days from flowering to ripening for 5 plants. *V. myrsinites* and *V. darrowi* flowered late, about 1 to 2 weeks after commercial *V. ashei* Reade, but ripened with *V. ashei.* Fruit ranged from shiny black to moderately glaucous for *V. elliottii* and *V. darrowi* but was black for *V. fuscatum* and *V. myrsinites.* Variance analysis suggested that selecting the best clone within a species is almost as important as selecting the best species in breeding most traits.**

Although blueberries are often considered a high-latitude crop, about 10 *Vaccinium* species are native in Florida (2, 8) the exact number varying with the philosophy of the taxonomist. One Florida species, *V. ashei,* has been domesticated as the "rabbiteye blueberry." The vigor and productivity of this species promise to make it an important component of the blueberry industry in future years. The diploid species, *V. darrowi,* produces some viable *2n* or diploid gametes (1, 3) and has been hybridized with highbush blueberry cultivars from the northern United States to produce tetraploid cultivars adapted to southern conditions. The other Florida species have been used little in breeding, although Florida's *V. fuscatum* is similar to *V. australe,* which has been used in breeding blueberries for North Carolina, New Jersey, and Michigan.

This study compares horticultural characteristics of 4 blueberry species in their native habitats in Alachua County Florida and assesses the potential usefulness of each species in breeding blueberry cultivars.

## Materials and Methods

Plants of *V. fuscatum, V. myrsinites, V. elliottii* and *V. darrowi* were tagged in December 1977. *V. fuscatum* and *V. myrsinites* were in a moist pine flatwoods 13 km northwest of Gainesville, *V. elliottii* in a sandy, well-drained soil along the Santa Fe River 24 km northeast of Gainesville, and *V. darrowi* in a dry, sandy, pine-oak forest 29 km southwest of Gainesville. Thirty plants of *V. fuscatum* and 15 or more plants each of *V. elliottii, V. darrowi,* and *V. myrsinites* were observed between Feb. 18 and July 20, 1978 at intervals ranging from 1 to 2 weeks. Percent of flowers at or past anthesis and percent of ripe fruit were recorded for all plants that flowered and fruited. In some cases, particularly for *V. myrsinites,* some plants that flowered did not mature any fruit. To maintain a reasonable sample size for fruiting characteristics, fruiting data were collected for some additional plants randomly selected after anthesis. Data were used to estimate for each plant the dates of 50% anthesis, dates of 10%, 50% and 90% fruit ripening and the fruit development period (days between 50% anthesis and 50% fruit ripening). Five samples of 10 fruit each were weighed for each plant that matured 50 fruit. Fruit flavor, stem scar and color were scored for each plant on a 1 to 10 scale (5). Flowering and fruiting dates were compared with those for highbush and rabbiteye cultivars at the University of Florida's blueberry breeding farm 15 km northwest of Gainesville.

Within each of the 4 species, variance in 10 – berry samples was partitioned into among – plant and within – plant components to determine whether berry weight varied significantly among plants within species. Mean fruit weights were compared for the 4 species using a modification of Duncan's test proposed by Kramer (6).

*V. myrsinites, V. darrowi,* and *V. elliottii* presented no taxonomic problems in selecting plants for observation. Typical populations as described by Camp (2) and Ward (8) were located for each. *V. fuscatum,* on the other hand, is a heterogeneous assemblage which Camp and Ward thought might contain both diploid and tetraploid components (8). Chromosome counts for 16 plants were used in conjunction with a study of leaf types to separate the *V. fuscatum* complex in the observation area into diploid and tetraploid components. Data

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were subsequently taken only on the tetraploid component, which comprised 70-80% of the population. *V. fuscatum* x *V. myrsinites* hybrids were common in the area sampled and were excluded from the *V. fuscatum* samples.

## Results and Discussion

*Time of flowering.* There was considerable variation among and within species in time of flowering (Table 1). *V. fuscatum* and *V. elliottii* flowered early, at about the same time as the early-ripening Florida highbush cultivars. Flowering times were very uniform among plants of *V. elliottii,* but the earliest plant of *V. fuscatum* reached 50% anthesis 38 days before the latest. Both *V. darrowi* and *V. myrsinites* flowered late, *V. darrowi* averaging about 3 weeks later than the highbush cultivars and 2 weeks later than the *V. ashei* cultivars. The late flowering of these 2 lowbush species may be an evolutionary adaptation associated with their short statures and rhizomatous growth habits. The average last killing frost is later near the ground in the flowering zone of *V. myrsinites* and *V. darrowi* than at the 1 to 4 m levels where most flowers of *V. elliottii* and *V. fuscatum* are situated.

*Time of ripening.* Ripening dates varied more than bloom dates, both within and among species (Table 1). *V. elliottii* was the earliest-ripening species. Most *V. elliottii* plants reached 50% ripening at about the same time as the Florida highbush cultivars, though some *V. elliottii* plants were later. Some plants of *V. fuscatum* were also quite early, but others were late, with 58 days separating the earliest and latest-ripening plants. *V. darrowi* and *V. myrsinites* ripened late, approximately with the *V. ashei* cultivars at the University farm.

*Length of fruit development.* Early flowering increases the risk of crop reduction in spring frosts. Thus, it is more desirable to achieve early ripening in cultivars by shortening the interval between flowering and ripening than by selecting for early flowering. None of the 4 species studied had a shorter fruit development period than the Florida highbush cultivars (Table 1) although most plants of *V. elliottii* and a few of *V. fuscatum* about equaled the highbushes in this respect. Each of the 4 native species studied contained some plants with shorter fruit development periods than the *V. ashei* cultivars. The late ripening of *V. darrowi* and *V. myrsinites* (Table 1) was due to their late flowering and not to an extension of the fruit development period. The estimate of fruit development period for *V. myrsinites* was based on only 4 plants, because most plants for which time of anthesis was recorded produced no mature fruit because of cane canker disease (*Botryosphaeria corticis* (Demaree and Wilcox) Arx and Muller). Several species showed wide plant-to-plant variation in the length of time required for fruit development. The fruit development period for *V. fuscatum,* for example, ranged from 60 to 126 days for 22 plants.

Simultaneous fruit ripening on a plant is deisrable in blueberries because it allows once-over harvesting. The intervals between 10% and 90% fruit ripening were similar for the 4 species, but there was much plant-to-plant variation within

Table 1. Number of plants with various dates of 50% anthesis, dates of 50% ripening, and intervals between 50% anthesis and 50% ripening.

| Species | n | Mean | SD | No. of plants: Dates of 50% anthesis[z] 50 | 56 | 62 | 68 | 74 | 80 | 86 | 92 | 98 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *V. fuscatum* | 24 | 74.9 | 7.5 | 1 | | | 4 | 12 | 5 | 2 | | |
| *V. myrsinites* | 11 | 89.1 | 4.9 | | | | | | 2 | 2 | 6 | 1 |
| *V. elliottii* | 13 | 75.6 | 1.8 | | | | | 13 | | | | |
| *V. darrowi* | 14 | 93.8 | 4.2 | | | | | | 1 | 0 | 7 | 6 |
| 4 *x* cvs.[y] | 4 | 73.5 | 1.4 | | | | | 4 | | | | |
| 6 *x* cvs.[x] | 15 | 81.1 | 4.1 | | | | | | 12 | 3 | | |

| Species | n | Mean | SD | Dates of 50% ripening[w] 2 | 8 | 14 | 20 | 26 | 32 | 38 | 44 | 50 | 56 | 62 | 68 | 74 | 80 | 86 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *V. fuscatum* | 24 | 27.0 | 15.2 | 1 | 0 | 6 | 8 | 3 | 1 | 0 | 1 | 2 | 0 | 2 | | | | |
| *V. myrsinites* | 10 | 45.5 | 14.9 | | | | | 1 | 2 | 2 | 1 | 0 | 1 | 3 | | | | |
| *V. elliottii* | 18 | 11.3 | 6.7 | 2 | 9 | 4 | 2 | 1 | | | | | | | | | | |
| *V. darrowi* | 14 | 41.9 | 13.8 | | | | | | 7 | 1 | 2 | 3 | | | | | | 1 |
| 4 *x* cvs.[y] | 5 | 3.6 | 2.1 | 3 | 2 | | | | | | | | | | | | | |
| 6 *x* cvs.[x] | 9 | 35.3 | 10.9 | | | | | 3 | 2 | 1 | 1 | 1 | 1 | | | | | |

| Species | n | Mean | SD | Anthesis to ripening interval[v] 58 | 64 | 70 | 76 | 82 | 88 | 94 | 100 | 106 | 112 | 118 | 124 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *V. fuscatum* | 22 | 81.1 | 15.7 | 1 | 2 | 4 | 6 | 3 | 1 | 1 | 3 | 0 | 0 | 0 | 1 |
| *V. myrsinites* | 4 | 74.2 | 8.0 | | 1 | 1 | 1 | 1 | | | | | | | |
| *V. elliottii* | 12 | 67.7 | 7.4 | 5 | 1 | 4 | 1 | 1 | | | | | | | |
| *V. darrowi* | 12 | 79.6 | 14.7 | | 2 | 4 | 1 | 3 | 0 | 0 | 1 | 0 | 0 | 1 | |
| 4 *x* cvs.[y] | 4 | 60.0 | 2.5 | 2 | 2 | | | | | | | | | | |
| 6 *x* cvs.[x] | 9 | 81.8 | 5.7 | | | | 4 | 1 | 4 | | | | | | |

[z]Days past Jan. 1 (class centers).

[y]From the group 'Avonblue', 'Floridablue', 'Sharpblue', Fla. 2-1, Fla. 2-9.

[x]From the group 'Aliceblue', 'Beckyblue', 'Bluegem', 'Briteblue', 'Delite', 'Southland', 'Tifblue', 'Woodard', Fla. K, Fla. L, Fla. M, Fla. S, Fla. V, Fla. 6-104.

[w]Days past May 11 (class centers).

[v]Days.

Table 2. Number of plants with berry weight, flavor, and scar as shown.

| Species | n | Mean | SD | No. of plants | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Berry wt (cg) | | | | | | | | / 54[z] | |
| | | | | 10 | 14 | 18 | 22 | 26 | 30 | 34 | 38 | | |
| *V. fuscatum* | 24 | 25.1 | 2.12 | | 4 | 2 | 8 | 2 | 2 | 5 | | 1 | |
| *V. myrsinites* | 14 | 17.8 | 0.86 | 1 | 5 | 2 | 5 | 1 | | | | | |
| *V. elliottii* | 17 | 20.1 | 1.07 | 2 | 2 | 2 | 6 | 4 | 1 | | | | |
| *V. darrowi* | 13 | 21.9 | 1.81 | | 2 | 4 | 2 | 2 | 2 | | 1 | | |
| | | | | Flavor class[y] | | | | | | | | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| *V. fuscatum* | 23 | 5.78 | 1.38 | | | 1 | 3 | 6 | 5 | 7 | | 1 | |
| *V. myrsinites* | 16 | 5.00 | 1.67 | | 1 | 1 | 5 | 4 | 2 | 1 | 2 | | |
| *V. elliottii* | 17 | 6.41 | 1.33 | | | | 2 | 2 | 4 | 5 | 4 | | |
| *V. darrowi* | 13 | 4.69 | 1.38 | | 1 | 1 | 4 | 3 | 3 | 1 | | | |
| | | | | Scar rating[y] | | | | | | | | | |
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| *V. fuscatum* | 24 | 7.46 | 1.41 | | | | 1 | 1 | 4 | 4 | 9 | 4 | 1 |
| *V. myrsinites* | 16 | 8.81 | 0.91 | | | | | | | 1 | 5 | 6 | 4 |
| *V. elliottii* | 17 | 7.71 | 1.36 | | | | | 2 | | 5 | 5 | 4 | 1 |
| *V. darrowi* | 13 | 8.92 | 1.32 | | | | | | 1 | 1 | 2 | 3 | 6 |

[z]Class centers.

[y]Class 1 = poorest; class 10 = best.

species. The minimum, median, and maximum intervals in days between 10% and 90% fruit ripening for plants sampled in each species were *V. fuscatum* (8-22-42), *V. myrsinites* (12-34-38), *V. elliottii* (14-20-36), and *V. darrowi* (14-20-32).

*Fruit size.* Mean berry weights (cg, Table 2) were *V. fuscatum* (25.1), *V. darrowi* (21.9), *V. elliottii* (20.1), and *V. myrsinites* (17.8). Comparison of variances among species with variances among plants within species gave an F value of 2.27 which was significant only at the 10% level. Comparing species means with Kramer's modification of Duncan's test (6) showed that the only statement with less than 5% chance of error is that *V. fuscatum* fruit averages larger than that of either *V. elliottii* or *V. myrsinites*. Within each species, however, plants varied significantly in fruit size (Table 3), up to 300% for most species (Table 2). This variation was about equal to that observed by Draper and Scott (4) among seedlings from individual crosses of highbush cultivars.

One plant of *V. fuscatum* was exceptional among all plants in the test for its large fruit which averaged 53 cg compared to 37 cg for its closest competitor, a plant of *V. darrowi*. This exceptional plant bore a heavy crop, seemed not be be in a particularly favorable environment, and appeared typical of the *V. fuscatum* population sampled in all ways except fruit size.

Supplemental observations of the 4 species at other locations around Gainesville revealed an atypical population of *V. elliottii* 15 km down the Santa Fe River from the primary observation site. Several plants in this population had unusually large fruit. Fifty fruit from one plant averaged 43 cg per fruit. Except for fruit size, this population of *V. elliottii* appeared typical of the species.

Fruit size of *V. myrsinites* was probably reduced by blueberry cane canker disease which is present in most if not all stands of *V. myrsinites* in Florida. The largest *V. myrsinites* fruit occur on the vigorous new shoots produced after the old tops are removed by burning or mowing. Variation in fruit number probably accounted for part of the variation in fruit size, particularly in *V. fuscatum,* where some plants set large numbers of berries that did not size well.

Of all traits observed, small fruit size is probably the primary obstacle that has prevented domestication of the 4 wild species studied. Fruit of native *V. ashei* in Northwest Florida averages 2 to 3 times larger than fruit of any of the 4 wild species. *V. stamineum* L. is the only wild blueberry in Florida that equals wild *V. ashei* in fruit size.

*Fruit flavor.* As with most of the traits, much of the variation in flavor was among plants within species rather than among species (Table 2). However, *V. elliottii* and *V. fuscatum* average better than *V. darrowi* and *V. myrsinites.*

*Fruit stem scar.* Stem scars were small and dry for most plants observed (Table 2). *V. darrowi* and *V. myrsinites* were particularly good in this regard.

*Fruit color.* Fruit color was black for *V. fuscatum* and *V. myrsinites.* A few *V. fuscatum* with somewhat glaucous fruit were found near the observation area. Fruit of *V. elliottii* and *V. darrowi* ranged from shiny black to moderately glaucous. In these last 2 species, fruit colors appeared to vary in a continuum throughout the populations and appeared to have no taxonomic significance. The same is true of fruit color in native populations of *V. ashei* in Northwest Florida. This makes questionable the utility of separating the flatwoods, highbush,

Table 3. Means and variance components for berry weights in 4 *Vaccinium* species.

| Species | Mean[z] (cg) | Variance: Berries within plants (error variance) | Variance: Plants within species | F[y] |
|---|---|---|---|---|
| *V. fuscatum* | 25.1a | 0.025 | 4.485 | 182.4** |
| *V. myrsinites* | 17.8b | 0.115 | 0.741 | 6.5** |
| *V. elliottii* | 20.1b | 0.039 | 1.146 | 29.5** |
| *V. darrowi* | 21.9ab | 0.054 | 3.262 | 60.0** |

[z]Means followed by a common letter do not differ at the 5% probability level.

[y]The ratio of col. 4 to col. 3. F tests for significant variation among plants within species.

tetraploid Florida blueberries into species (*V. australe* vs. *V. fuscatum*) on the basis of fruit color.

*Other horticultural observations.* Despite their small fruit, the 4 blueberry species studied may be valuable in breeding blueberry cultivars. *V. elliottii* and *V. fuscatum* both contain early-ripening plants, and segregating generations from crosses with highbush cultivars may yield plants earlier than the highbush. Each species may have genes that could improve fruit flavor when introgressed into rabbiteye and highbush cultivars. Our observations of wild populations throughout Florida indicate that most plants of *V. fuscatum* and *V. elliottii* have considerable resistance to blueberry stem canker, though neither species is totally immune. In Florida *V. myrsinites* is highly susceptible to the disease and *V. darrowi* moderately susceptible. *V. darrowi* is very drought resistant, and thrives even on the coarse, dry sands of the scrubland in the Ocala National Forest in Florida, and *V. elliottii* tolerates a wide range of soils, including the upland sandy-clay soils found in parts of Northwest Florida. These species may help extend the area where highbush type blueberries can be grown, though the rabbiteye is already quite tolerant of dry soils with little organic matter. Both *V. darrowi* and *V. myrsinites* are evergreen and have low chilling requirements. *V. darrowi* grows in abundance as far south as Charlotte County near Ft. Myers, and *V. myrsinites* grows in Dade County south of Miami, *V. fuscatum* is native as far south as Highlands County at the same latitude as the north end of Lake Okeechobee. Attempts to use these 4 blueberry species in breeding should exploit the genetic variation among plants within species as well as differences among the species.

*The 4 species in areas other than Alachua County.* All 4 of the species also occur outside of Florida. As defined by Ward (8) *V. fuscatum* grows from Florida to Texas, northward to Arkansas and southern Ontario. *V. myrsinites* occurs from Alabama and Florida northward to South Carolina, *V. elliottii* from Florida to Texas, north to Arkansas and Virginia, and *V. darrowi* from Florida and adjacent Georgia, westward to eastern Texas. Studies by Camp (2) and others indicate considerable variation among local populations within blueberry species. These variations are probably due to genetic drift in individual populations, differing opportunities for introgression with other *Vaccinium* species (7), and varying selection pressures in different regions. One might expect, for example, that chilling requirements would increase from south to north in the deciduous species. Provenance tests with pines and other forest trees indicate that for some traits, region of origin and populations within regions account for more within-species variation than plants within populations (9). Thus, the variations available in sampled Alachua County populations represent minimum estimates of variability over the entire range of the species.

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