($P < 0.001$) between hybrid sets were observed only in Minnesota. There was a trend for an increase in the frequency of staminate flowers in the northern locations, which may be explained partially by differences in temperature, light intensity, or photoperiod during flower bud primordia development (2). No significant differences in brined fruit quality were observed between the hybrids from gynoecious and comparable andromonoecious crosses (Table 4).

A stable and high percentage of gynoecy in hybrids is critical for attaining maximum yields in once-over mechanical harvest. In addition to increasing gynoecious sex stability in hybrids, bisexual pollinators provide an opportunity for the transfer of bacterial wilt resistance (6). Hermaphroditic lines, however, have been difficult to establish because of the prevalence of staminate flowers (andromonoecious character). A reduction in staminate flowers can be achieved by self pollination of each backcross generation with subsequent rigorous selection in the progeny for hermaphroditic sex expression.

The bisexual pollinators used in the study were genotypically *FFmm* and therefore, by definition, not andromonoecious. Conclusions drawn from the data presented apply only to the *FFmm* lines used and not to andromonoecious pollinators recessive for *F*. Our data confirm previous studies regarding sex stability in G x A hybrids and suggest that the investment of resources in the development of hermaphroditic pollinators seems to be warranted. Bisexual pollinators are of particular interest, since fruit quality, yield, and shape of G x A do not differ significantly from those of G x G hybrids.

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Variation Within *Vaccinium darrowi* Blueberry in Florida

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Abstract. **Ten colonies of *Vaccinium darrowi* Camp were sampled at each of 9 sites in the Florida panhandle and 6 sites in and around the Ocala National Forest in the central Florida peninsula. The colonies averaged 53 cm tall in the panhandle, with leaves 9.8 mm long and 4.1 mm wide. By contrast, colonies in the peninsula averaged 136 cm tall—well outside the range described for the species—with leaves 12.7 mm long and 5.7 mm wide. The species was diploid and entirely evergreen in both regions. In the central Florida peninsula, natural hybrids between *V. darrowi* and a 3-m tall, deciduous, diploid race of highbush blueberry (*V. corymbosum* L.) are common where streams and lakes border the dry scrub habitat of *V. darrowi*. The robust form of *V. darrowi* in the Florida peninsula may have evolved from the petite form in the panhandle as a result of introgression from the highbush coupled with selection for characteristics that enhance survival on the deep, xeric sands of the peninsula. *V. darrowi* from the central peninsula has characteristics that make it valuable in breeding blueberry cultivars.**

Evergreen, low-statured blueberries are native throughout most of Florida, extending as far south as Miami in Dade County (2, 12). Prior to 1942, these blueberries were classified as a single species, *V. myrsinites* Lam. In 1942, Camp (1) separated what had previously been considered a glaucous, nonglandular form of *V. myrsinites* into a separate species, *V. darrowi*. His rationale for creating the new species was not only the distinctive morphology of *V. darrowi*, but also the fact that *V. darrowi* was diploid and *V. myrsinites* tetraploid. Camp described *V. darrowi* as occurring in extensive colonies 0.15 to 0.4 m high, and *V. myrsinites* as forming extensive colonies 0.25 to 1.0 m high (2).

V. darrowi from Florida has been much used in blueberry breeding during the last 30 years (5, 8–10). Two ornamental evergreen cultivars, 'Johnblue' and 'Everblue', were selected in North Carolina from seedlings grown from seed collected in central Florida (J.R. Ballington, personal communication). Crosses between tetraploid northern highbush cultivars (*V. corymbosum* L.) and *V. darrowi* have given rise to low-chilling tetraploid cultivars for Florida (10). Use of *V. darrowi* in breeding blueberry cultivars is continuing. The species' tolerance for heat,

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Table 1. Characteristics of *V. darrowi* samples from 2 regions of Florida.

Sample no.	Sample site	n[z]	Plant ht (cm)	Leaf width (mm)	Leaf length (mm)	10-internode length (mm)	Abaxial leaf glands (% of samples) None	Few	Many
				Ocala Forest Region					
2[y]	Welaka SE	10	161 a[x]	5.9 a	13.1 ab	39.4 ab	0	20	80
4	Juniper Springs	10	156 ab	5.7 a	12.7 abc	34.3 abc	100	0	0
5	Alexander Springs	10	140 bc	5.7 a	12.9 abc	40.3 ab	30	70	0
1	Welaka NW	10	126 cd	5.8 a	13.8 a	38.1 abc	0	30	70
3	Fruitland	5	113 d	5.6 a	11.3 cde	32.5 bc	80	20	0
6	Big Scrub	10	110 d	5.3 a	11.9 bcd	43.0 a	50	30	20
				Panhandle Region					
1	Gulf Shores, Ala.	20	70 e	4.2 b	10.0 ef	38.4 abc	90	10	0
9	Perry	10	70 e	4.2 b	9.6 ef	40.4 ab	60	40	0
7	Torreya Park	10	54 ef	4.1 b	10.1 ef	41.6 a	100	0	0
2	Blackwater River	10	51 fg	4.0 b	10.5 def	38.7 abc	70	30	0
8	Ochlochonee River	10	47 fg	4.2 b	9.3 f	33.8 bc	50	20	30
5	St. Josephs	10	46 fg	4.3 b	10.3 def	30.8 c	100	0	0
6	Dead Lakes	10	41 fg	3.9 b	9.1 f	39.1 ab	100	0	0
4	Chipley	10	41 fg	3.9 b	9.6 ef	33.2 bc	100	0	0
3	Garner Landing	10	34 g	3.9 b	9.8 ef	40.3 ab	100	0	0
				Region means					
	Ocala region		136	5.7	12.7	38.4			
	Panhandle region		53**	4.1**	9.8**	37.5			

[z]Number of colonies sampled per site.
[y]1–6 indicate loctions from north to south in Fig. 1 for Ocala sites. 1–9 indicate locations from west to east for panhandle sites.
[x]Within columns means not followed by a common letter differ at the 5% level by Duncan's multiple range test.
**Region means differ at 1% level according to *t* test.

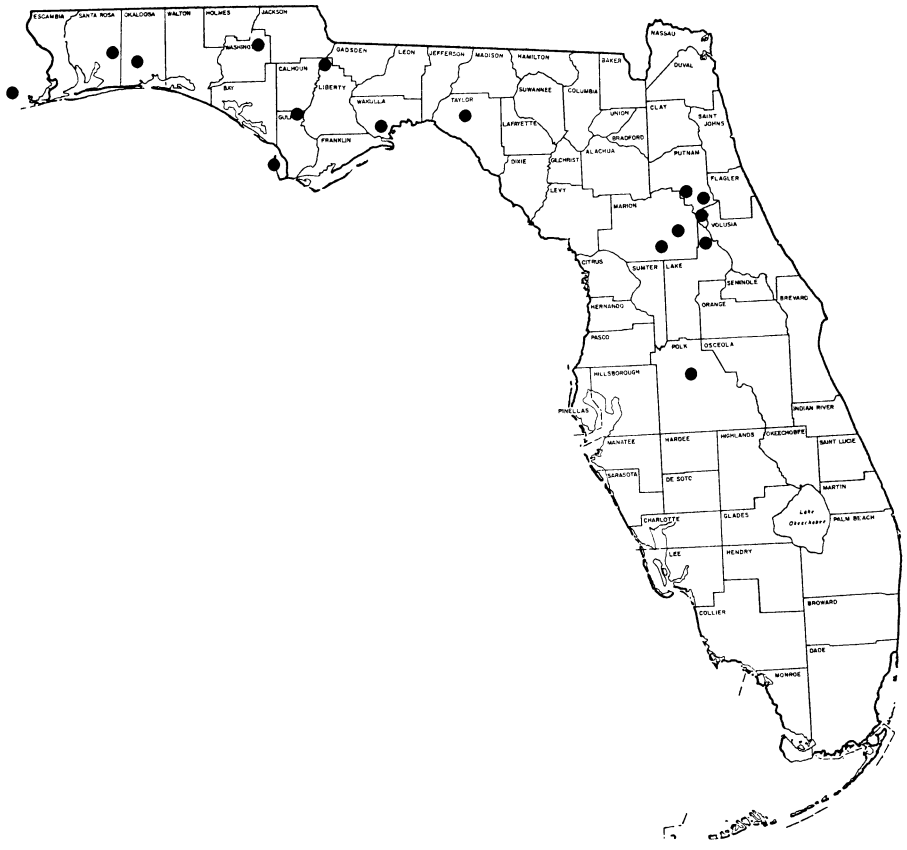

Fig. 1. Locations of sample sites in Table 1. The dot farthest south is Winter Haven—place of origin of Fla. 4B.

drought, and mineral soils would be a valuable addition to highbush-type cultivars.

The *V. darrowi* germplasm currently being used in breeding has come mostly or entirely from the central Florida peninsula. *V. darrowi* clones Fla. 4A and Fla. 4B were collected near Winter Haven in Polk County, and the seed that gave rise to cultivars 'Johnblue' and 'Everblue' came from the same area. Over the past 6 years, several hundred *V. darrowi* seedlings have been grown in field nurseries at Gainesville from seed collected in Highlands County and in the Ocala National Forest east of Ocala. These seedlings have been quite variable, but, like seedlings from Fla. 4A and Fla. 4B, nearly all exceed 1 m in height by the time they are 4 years old. This height is over twice the maximum described for the species by Camp. The discrepancy between the appearance of these seedlings and Camp's description of *V. darrowi*, along with a desire to understand the variability within this horticulturally important species, led to the following study of the variability in *V. darrowi* in Florida.

V. darrowi colonies were sampled at 6 sites in and around the Ocala National Forest in the central Florida peninsula and at 9 sites in the Florida panhandle region, one of which was in Alabama, 30-km west of the Florida state line. Most of the panhandle sites were in open longleaf pine (*Pinus palustris* Mill.) forests. Exceptions were Gulf Shores, Ala., a slash pine (*P. elliotii* Engelm.) flatwoods with much *Ilex* and scrub oak (*Quercus* spp.) 2 km inland from the Gulf of Mexico; and St. Joseph, Fla., on a 1 × 30-km sandy peninsula between the Gulf of Mexico and St. Joseph's Bay, vegetated primarily with sand pine [*P. clausa* (Chapmn.) Vasey] and scrub oaks (*Quercus* spp.). Three sites in the Ocala Forest region (Juniper Springs, Alexander Springs, and Big Scrub) were sand pine–scrub oak forests on deep, coarse, dry, sandy soils deposited as coastal dunes when the area was near the shore of an ancient, shallow sea (4, 6). The other 3 sites in the Ocala Forest region were less xeric and were probably originally longleaf pine forests. None of the 15 sites had been burned for at least 3 years.

Ten *V. darrowi* colonies were sampled at each site, except Gulf Shores (20 colonies) and Fruitland (5 colonies). Colonies were sampled randomly except for the following

restrictions: (a) colonies were sampled only if they had enough shoots to show that they were fairly old (usually 10 or more shoots); (b) a few colonies in the panhandle region that appeared to be *V. darrowi* x V. elliottii Champmn. hybrids were omitted from the sample along with a few colonies in the Ocala region that appeared to be *V. darrowi* x V. corymbosum hybrids; and (c) to insure that each sample was from a different colony, no colony was sampled if it was less than 30 m from another sampled colony. Colonies usually could be distinguished by height and by leaf color, shape, and size.

The tallest shoot in each colony was measured as the colony height. Most colonies had many shoots at or near the height of the measured shoot. Between 10 Nov. and 31 Dec. 1982, one vigorous terminal branch containing about 20 internodes was taken from each colony and pressed. Four observations were made later on each branch, including average length and width of the 5 largest leaves, length of a 10-internode segment from the central part of the branch, and presence or absence of stalked glands on the abaxial leaf surface as determined with a 25× stereomicroscope.

V. darrowi from the Ocala Forest region was markedly different from that of the Florida panhandle, averaging well over twice the height and having significantly longer and wider leaves (Table 1). Internode length did not differ between the 2 regions. Plants in both regions were entirely evergreen and had shiny leaves. Leaf color did not differ noticeably between the 2 regions. Leaves on plants at all sites ranged from slightly to moderately glaucous.

Most *V. darrowi* plants from the panhandle region lacked stalked glands on the abaxial leaf surface, and, if present, the glands were usually few. *V. darrowi* in the Ocala region ranged from nonglandular to heavily glandular. At some sites, all plants were nonglandular, whereas, at other sites not more than 40 km away, plants that were otherwise similar were nearly all heavily glandular. At sites where both glandular and nonglandular plants were abundant, plants with and without glands did not differ noticeably in other respects.

Camp (2) emphasized glands on the abaxial leaf surface as a taxonomic character by which to separate the species of *Vaccinium*. It was a key character by which he separated *V. darrowi* (nonglandular) from *V. myrsinites* (glandular). Camp believed that individuals deviating from the species norm for glandularity were the product of introgression with one or more other species differing in glandularity.

Based on experience with Florida *Vaccinium*, it appears that leaf glands are useful in defining some species but vary from absent to abundant within other species. *V. elliottii* Chapmn., for example, is nonglandular throughout much of Florida, but large populations of *V. elliottii* in parts of western Florida are highly glandular, although otherwise typical of the species. It appears that glandularity is also highly variable and has little taxonomic significance in the *V. darrowi* of the Ocala region.

Variability within *V. darrowi* for plant height and leaf glandularity, the 2 primary traits by which Camp separated it from the tetraploid species *V. myrsinites*, raises the question of how distinct the gene pools of the 2 species are and how the 2 species can be distinguished. It is likely that the plants sampled in this study were all diploid, as described by Camp (1) for *V. darrowi*. Chromosome numbers were determined for several typical plants from each region, and all were diploid. In addition, as would be expected for diploids but not for tetraploids, *V. darrowi* in the panhandle hybridizes naturally with the diploid species *V. elliottii*, and, in the Ocala Forest region, with a diploid race of *V. corymbosum*. Vander Kloet (11) has determined that *V. darrowi* from Highlands County (230 km south of Ocala) is diploid. I have found that *V. darrowi* from both the Ocala region and from the panhandle region crosses readily with diploid *V. elliottii* when hand-pollinated in the greenhouse.

V. myrsinites was not found at the sampling sites west of the Apalachicola River in the panhandle region (sites 1–6). It was not reported from Mississippi by McDaniel (7), and has seldom been reported from western Florida (12). It was abundant in the Ocala Forest region, where it could be distinguished from *V. darrowi* by its short stature and dark green leaves, which were heavily glandular and considerably smaller than those of *V. darrowi*. In parts of northeast Florida, *V. darrowi* and *V. myrsinites* are difficult to distinguish. *V. darrowi* produces up to 6% diploid gametes (3), which probably enables it to hybridize with *V. myrsinites*. Natural hybridization may be partially responsible for making the 2 species hard to distinguish in areas where they are sympatric.

The *V. darrowi* in the Ocala region and that in the Florida panhandle are similar in many ways, despite the differences found in this study. Both are evergreen, with small, shiny leaves that range from green to glaucous. Both have short internodes and are highly colonial. How the 2 varieties are related to each other and how one developed from the other are questions that require further study. One possibility is that the dwarf form found in the panhandle and described by Camp (1, 2) is ancestral, and the coarse form abundant in the Ocala Forest has evolved as a result of introgression of genes from the diploid race of highbush blueberry (*V. corymbosum*), with which *V. darrowi* comes in contact in the area. The Ocala form of *V. darrowi* may have evolved over the course of many centuries as a result of introgression and simultaneous selection for characteristics that are adaptive on the xeric sands of the region. Diploid *V. corymbosum* is abundant, surrounding sinkhole lakes and along the streams that rise from springs in the Ocala Forest. This *V. corymbosum* is deciduous, noncolonial, grows to a height of 2 to 3 m, and has leaves about 5 cm long and 2 cm wide. *V. darrowi* x V. corymbosum hybrids, intermediate in plant height and leaf characteristics, are fairly common in the area.

The tall variety of *V. darrowi* from the Ocala Forest region appears to have much to offer in blueberry breeding, both for ornamental and for fruit-producing cultivars. It thrives on the extremely dry sands where it is native. When grown in open sun, the plants reach a height of 1 to 2 m within 5 years and remain monopodial for up to a decade. The plants are tolerant (but not immune) to cane canker [*Botryosphaeria corticis* (Demaree and Wilcox) Arx and Muller]. Hybrids with tetraploid highbush cultivars, mostly tetraploid, highly fertile, and intermediate in phenotype between the parents, are not hard to obtain. The petite variety of *V. darrowi* from the Florida panhandle, the form that fits Camp's description of the species (1, 2), probably has never been used in blueberry breeding. Because of its smaller stature, it might be less useful than the Ocala form in crosses where monopodial highbush cultivars were the desired end product.

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