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'Elliott' Highbush Blueberry

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History

'Elliott' is a temperate region northern highbush blueberry *(Vaccinium corymbosum* L.). It is the latest ripening of all highbush cultivars and seems likely to remain so for several years to come. Over the years, interest in 'Elliott' has been primarily driven by the interest in having fresh fruit for the late season, and for this, 'Elliott' fills the bill admirably. With its late ripening season, 'Elliott' launched controlled atmosphere storage in blueberries, a practice that has grown in recent times, as blueberries move toward being a year-round commodity.

'Elliott' came from a cross made by Dr. George Darrow of the USDA in 1947. A group of seedlings from this cross was sent to Arthur Elliott at Otter Lake, Michigan in 1948. After several years of evaluation, 'Elliott' was selected from this population, given the designation E-70, and further propagated. It was further evaluated by Dr. Arlen D. Draper and Dr. Donald H. Scott of the USDA-ARS, Beltsville, MD and John W. Nelson of South Haven, Michigan. 'Elliott' was released in 1973, a full 25 years after the cross was originally made (1), and named in recognition of Arthur Elliott's many years of contributions as a cooperator with the blueberry breeding program.

Pedigree

'Elliott' was selected from a cross of 'Burlington' x US 1. US 1 has the pedigree ['Dixi' x ('Jersey' x 'Pioneer')]. All told, this pedigree can be described as being primarily germplasm from 'Rubel' and 'Pioneer'. If it is traced back to these two parents, their relative contributions are Rubel 41% and Pioneer 44%. 'Rubel' occurs once each as a grandparent and great-great-great grandparent, and twice as a great-great-grandparent. 'Pioneer' occurs once each as a grandparent, great-grandparent, and great-great-grandparent. 'Elliott's immediate parent, 'Burlington' (= 'Pioneer' x 'Rubel') is late ripening (but still 11 days earlier than 'Elliott'). One can only assume that US1, which is no longer extant, was late ripening as well. Elizabeth White (who, with Frederick Coville, were considered the primary domesticators of highbush blueberry) made crosses using clones of similar parentage, and noted, in 1949, an advanced selection provisionally named 'Omega' (undoubtedly indicating, last to ripen) from a cross of ('Jersey' x 'Pioneer') x ('Pioneer' x 'Rubel'). 'Elliott', with its large germplasm contributions from 'Rubel' and 'Pioneer', was the most inbred cultivar at the time it was released, and still ranks in or near the top 10% of inbred cultivars (2).

Characteristics

Season

'Elliott' is the latest ripening of all highbush cultivars, ripening approximately 2-3 weeks after 'Jersey' (1). In New Jersey, it is typically 50% ripe by July 25, with a 78 day ripening interval (50% flower to 50% ripe). This peak is 14d later that 'Jersey', and 20d later than 'Bluecrop'. 'Elliott' has a long harvest season, stretching over 4 to 5 weeks, and is well-suited to providing late season fruit for the fresh market.

Plant growth

The bush of 'Elliott' is vigorous, upright, winter hardy, and consistently pro-

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ductive. Its foliage has a blue-green cast that distinguishes it from most northern highbush cultivars. First and second year wood of 'Elliott' often displays bark "measling", rough irregular blotches that occur on otherwise smooth young wood. This phenonmenon is quite common on 'Elliott' and may be genetic in nature, although *Alternaria* has also been suggested (but not proven to be) the casusal agent. Measling is not usually seen on the shady side of stems, suggesting that sunlight plays a role in developing this phenomenon. No matter the cause, the measling is so common in "Elliott' that is can serve as a useful taxonomic identifier for this cultivar. 'Elliott' has orange foliage in the fall; its winter stem color is primarily burgundy, shading to a slightly golden color where exposed to bright sunlight.

Flowering

'Elliott' is also among the latest flowering cultivars, with 50% flowering typically occurring around May 8 in New Jersey. In NJ plots, only 'Little Giant' and 'Ozarkblue' have shown later flowering peaks. Late flowering suggests resistance to late spring frost damage. The flowers of 'Elliott' are narrow, fine, elongate, and smaller that typical highbush flowers. They are pure white with just traces of tawny pink in some years. Flower receptacles usually display a waxy cast, and pedicels and bracts display just the slightest traces of pink.

Fruit

The immature, developing fruit of 'Elliott' is almost white in appearnace due to its heavy wax layer and the crown usually has a very distinctive pinkish color. Mature fruit is medium sized and frosty blue, with good firmness, and is often held in relatively tight clusters. 'Elliott' fruit is inherently acid and is slow to mellow and sweeten. The Highbush Blueberry Production Guide (7) described it as "not ripe when it first turns blue." This has resulted in one New Jersey grower suggesting somewhat tongue-in-cheek that the proper way to harvest 'Elliott' is to wait until it gets good and blue....then go on vacation for two weeks, and harvest it when you get back. Few growers, however, are willing to let blue fruit hang for two weeks, so 'Elliott' fruit is often harvested quite tart. This is perhaps 'Elliott's biggest problem, and because of it 'Elliott' has incurred resistance from both shippers and consumers.

The highly acid condition of 'Elliott' fruit appears to be related to its biochemistry. In a survey of organic acid composition in 6 highbush cultivars by Ehlenfeldt, Meredith, and Ballington (3), 'Elliott' was highest in total organic acid, and also highest in relative citric acid composition at 90% of the acid total. The average citric acid composition across the six cultivars was 75%, with 'Bluetta' the lowest, possessing only 38%. Among the major acids, citric is inherently more acidic, having three titratable hydrogen ions per molecule compared to 2 each for malic and succinic acids, and 1 for quinic acid.

With its late ripening season and high acidity, 'Elliott' launched controlled atmosphere storage of blueberries. As might be expected, when harvested berries are in good initial condition they can keep very well. 'Elliott', however, has had some shelf-life problems after long-term storage and many producers/shippers perceive these problems as getting worse. 'Elliott' may go into storage with defects of 3-5% and after 8 weeks of storage have 30-40% defects. Growers with options often store late harvested 'Bluecrop' preferentially to early harvest 'Elliott'. Remedying this situation may require fine-tuning the storage regimes for 'Elliott', but it is more likely that other cultivars will supplant 'Elliott' for longer-term storage purposes.

Antioxidants

Antioxidants have become an issue of great concern to blueberry growers and marketers in recent years because of the interest in health benefits. For antioxidants, 'Elliott' scores high points. In a survey by Ehlenfeldt and Prior (5) of 87 highbush cultivars, 'Rubel' was the highest in antioxidants (31.1 Trolox Equivalent (TE) units), but 'Elliott' tied for a close second

(with 'Friendship') at 30.5 TE. These levels were approximately double the mean level of 87 cultivars (15.9 TE). 'Burlington' (a parent of 'Elliott') was also relatively high at 26.0 TE.

Yield

'Elliott' is a high yielding cultivar, consistently outyielding 'Bluecrop' in several regions. Hancock (6) examined the reasons for this productivity and found that 'Elliott' had significantly more flowers per bud, and significantly more laterals per cane than the other cultivars studied. It was also better than most of the other cultivars (but not significantly so) for canes per bush and fruit set percentage. 'Elliott' is generally considered self-fruitful, and this may also contribute to its productivity. Production in Michigan, approximates 6T/acre over a harvest season of about 5 weeks (higher than 'Bluecrop'). In New Jersey, the yield is estimated to be 4.5 to 5.5 T/acre (about 75% of 'Bluecrop'), and in Oregon production is typically 10-12 T/acre and can be as high as 15 T/acre. In Oregon 'Elliott' is among the highest yielding cultivars ('Bluecrop' is typically 20% less). It has a relatively extended harvest season especially if allowed to ripen any amount of time.

Disease resistance - susceptibility

Both the original release notice and the article of Nelson and Bittenbender (9) suggest 'Elliott' is resistant to both phases of *Monilinia vacinii-corymbosi* (mummy berry), under field conditions. In nursery screenings with high concentrations of inoculum, the USDA program at Chatsworth, NJ found it the most resistant to the blight stage of mummy berry (4), but relatively susceptible to fruit infecting stage of mummy berry (10). In USDA screenings, it has been the cultivar most highly resistant to anthracnose fruit rot (#1 of 76 screened). Its good firmness and rot resistance contribute to its good short to medium-term storage ability.

In the early 1990s, a symptom which came to be referred to as "fruit shrivel"was noted in plots of 'Elliott' in Michigan. (Dave Trinka, MBG Cooperative, personal communication). In this syndrome, a deficit of water flow within the plant causes the fruit to pucker and shrivel. Information about this syndrome is far from conclusive, but several facts have been established, 1) hydraulic conductivity in twigs of 'Elliott' is lower than that found in other cultivars, 2) some studies have shown there is a physical disruption of the phloem and a pitting of the xylem in fruit peduncles, and 3) no fungi that can conclusively be linked to shriveling have been isolated from fruit. This syndrome has subsequently been observed, with varying severity, in other regions. Management solutions for fruit shrivel have included picking early and often, more frequent watering, and misting. Experience has shown that if shrivel is avoided in first picking fruit, second picking fruit will not usually exhibit the problem.

Distribution

As a late season cultivar, 'Elliott' has never represented a large percentage of acreage planted; however, it serves a vital role as a producer of late season fresh fruit, often at a time when market prices are rebounding. Moore (8) in a survey of all major production states, found that 'Elliott' occupied 4% of the total highbush blueberry acreage nationwide with a total of about 700 acres. Its percentage plantings in various states included, Michigan 7%, New Jersey 5%, Arkansas 5%, Maryland 10%, and Ontario 10%. Its acreage has increased somewhat, with more current estimates at: Michigan 8.5% (1440 acres) (Trinka, MBG), New Jersey 5% (ca. 375 acres) (Gary Pavlis, Rutgers University), Oregon 5-6% (200-250 acres), Washington 3-5% (50-100 acres), and British Columbia 3% (ca. 200 acres) (Dave Brazelton, Fall Creek Farm and Nursery, Lowell, OR). British Columbia is currently the only North American area with an interest in increasing its acreage of 'Elliott'. With the rise of Southern Hemisphere blueberry production, 'Elliott' has also been widely planted in some regions of Chile.

Achievements of 'Elliott'... what's needed in a replacement?

No matter how much a cultivar is liked, growers are always looking for something better. Certainly, 'Elliott' has its defects, but what would growers most like to see in a replacement for 'Elliott'? The priority of the desired characters varies with growing region, but among them are a cultivar with: 1) the same season or later, 2) better flavor, 3) better post-harvest quality / better reliability of fresh product, 4) bigger size, and 5) more concentrated harvest. Can these be done? Personal experience has shown that most crosses with 'Elliott' show little transgressive segregation for lateness. How Dr. Darrow managed to produce something so late is genuinely marvelous. Still we can probably produce new highbush crosses as late as 'Elliott', and if we shift our emphasis into highbush/rabbiteye hybrids we can probably achieve further lateness, but we may lose some hardiness. With regard to flavor, late season cultivars are generally more acid, early season cultivars less acid. The real challenge in late germplasm is to boost sweetness while moderating acid levels. This and the other three goals, better post-harvest quality, bigger size, and more concentrated harvest all seem achievable. The question is, how easily can we combine them in one cultivar? A number of newer selections hold promise for all of the quality factors, but 'Elliott' may remain the latest of the late for some time to come.

Interpretive Summary

'Elliott' is a temperate region northern highbush blueberry (*Vaccinium corymbosum* L.), and is the latest ripening of all highbush cultivars. Interest in 'Elliott' has been primarily driven by an interest in having fresh fruit for the late season. With its late ripening season, 'Elliott' launched controlled atmosphere storage of blueberries. 'Elliott' fruit is inherently acid and is slow to sweeten. Because of this 'Elliott' has incurred resistance from both shippers and consumers. In a survey, 'Elliott' was highest in total organic acid, and had the highest citric acid levels. 'Elliott' is among the highest in antioxidants of all cultivars. 'Elliott' is a high yielding cultivar, consistently outyielding 'Bluecrop' in several regions. In the early 1990s, a symptom which came to be referred to as "fruit shrivel" was noted in plots of 'Elliott' in Michigan. In this syndrome, a deficit of water flow within the plant causes the fruit to pucker and shrivel. No cause for this has been conclusively established. This review of the characteristics of 'Elliott' should be useful to blueberry growers and extension workers

Technical Summary

'Elliott' is a temperate region northern highbush blueberry (*Vaccinium corymbosum* L.), and is the latest ripening of all highbush cultivars. In New Jersey, it is typically 50% ripe by July 25, with a 78 day ripening interval. It has a 4 to 5 week harvest season and is well-suited to providing late season fruit for the fresh market. With its late ripening season, 'Elliott' launched controlled atmosphere storage in blueberries. 'Elliott' fruit is inherently acid and is slow to sweeten. A survey of organic acid composition showed 'Elliott' highest in total organic acid, and highest in relative citric acid composition. Among 87 highbush cultivars, 'Elliott' ranked second for antioxidants with levels approximately double the mean of the group. 'Elliott' is high yielding, consistently outyielding 'Bluecrop' in several regions. Production in Michigan, approximates 6T/acre, and in Oregon it is approximately 10-12 T/acre. 'Elliott' is highly resistant to the blight stage of mummy berry and to anthracnose fruit rot, but relatively susceptible to fruit infecting stage of mummy berry. It is susceptible to a symptom known as "fruit shrivel", in which, a deficit of water flow within the plant causes the fruit to shrivel. Studies have shown a physical disruption of the phloem and a pitting of the xylem in fruit peduncles, but no fungi have been linked to shriveling. This syndrome has been observed in Michigan, and with varying severity, in other regions.

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Vegetative Budbreak and Fruit Development in Blueberry

Inadequate chilling in Florida and south Georgia often results in poor flowering and foliation of blueberries thereby reducing fruit ripening during the market window. Hydrogen cyanamide was applied at several concentrations in December and January while the plants were dormant. Effective concentrations enhanced leaf area development, accelerated fruit maturity, and increased both fruit size and yield of southern highbush and rabbiteye blueberries. From: Williamson, J.G., G. Krewer, B.E. Maust, and E.P. Miller. 2002. HortScience 37:539-542.

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I certify that the statements made by me above are correct and complete. R. M. Crassweller, Business Manager. December 31, 2002.