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Why is 'Elliot' so Productive? A Comparison of Yield Components in 6 Highbush Blueberry Cultivars![1]

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Abstract

'Elliot' yields more per bush than any other blueberry cultivar in Michigan. It also produces more flowers per bud, more laterals per cane and has a higher fruit set than any other cultivar. The higher fruit production of 'Elliot' is supported by a larger total leaf surface area.

Introduction

'Elliot' has been the highest yielding blueberry cultivar over the last 22 years at the Michigan Blueberry Growers Test Plot at Grand Junction, Michigan. In most years, its yield has ranked 1 or 2 in a group of 20 cultivars and it consistently yields 20-30% more fruit than the standard cultivars 'Jersey' and 'Bluecrop' (3, 4). Based on this record, 'Elliot' now constitutes 15-20% of the new blueberry plantings.

Siefker and Hancock (5) recently measured yield components in 10 blueberry cultivars at Grand Junction. They found that 'Elliot' produced significantly more fruit per cane than many other cultivars, but no attempt was made to contrast levels of flower production, fruit set, or leaf number. It was the intent of this study to make these comparisons.

Materials and Methods

Six highbush cultivars established in 1966 at Grand Junction, Michigan were studied. The cultivars were part of a larger planting of 20 cultivars and advanced selections. There were five replicates of each cultivar with five plants each planted in a completely randomized design (3). Plant spacing was 1.2 m within rows and 3 m between rows. The plants were maintained according to standard cultural practices (2).

During the second week of April in 1987 and 1988, all cane diameters were measured at ground level in the middle three plants per plot of 'Bluecrop,' 'Bluejay,' 'Elliot,' 'Jersey,' 'Spartan' and 'Rubel.' Flower buds per lateral were counted on each cane and cane heights were determined.

At full bloom in 1987 and 1988, flowers per bud were counted on the basal and terminal fruiting laterals of 3 randomly selected canes at the top, east and west portions of the middle three plants per plot. Fruit set was determined on the same laterals when the fruits were in stage 2 of growth about 6 weeks later.

When 60-70% of the fruit were ripe in 1987 and 1988, samples of 25 fruit were taken randomly from the middle three bushes per plot and weighed. Yield per bush was estimated by the following equation: Yield = flowers per bud x buds per cane x canes per bush x fruit set (%) x individual fruit weight. Interactions between the various yield components were analyzed using the path analysis procedure of Wright (6), where path coefficients are calculated as standardized regression coefficients (5).

Leaves were counted after harvest each year on 3 randomly selected canes of the middle three bushes per plot. Twenty-five leaves were also sampled from each plant and surface areas were determined with a LI-COR

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Model LI-3000 leaf area meter (LI-COR Inc., Lincoln, Nebraska).

Results

Yields of all 6 cultivars were significantly ($P<0.05$) higher in 1987 than 1988 (Table 1). These yield increases were probably due to the significantly higher numbers of laterals per cane and heavier individual fruit weights produced in 1987 than 1988, even though fruit set was higher in 1988 than 1987. All the other components were not significantly different between years. There were no significant genotype-environmental interactions.

There was a significant, positive relationship between yield and both laterals per cane and flowers per bud in the path analysis (Table 2). Canes per bush and % fruit set were also positively associated with yield, but the interactions were non-significant. Buds per lateral and berry weight showed negative, non-significant relationships with yield.

The majority of interactions between components were positive and non-significant (Table 2). The only significant, negative interaction was between individual fruit weight and flower buds per lateral, although fruit weight was negatively associated with all the components except % fruit set.

'Elliot' had significantly more flowers per bud, laterals per cane and higher fruit set than any other cultivar (Table 3). 'Rubel' and 'Jersey' had the most buds per lateral and 'Spartan' had the largest individual fruit weight.

'Jersey' and 'Bluecrop' were the tallest bushes (Table 4), however, cane height and yield were not significantly correlated ($r = 0.07$). 'Elliot' had the most leaves per cane and greatest total leaf area of any cultivar (Table 4). Yield per cane was significantly correlated with both leaves per cane ($r = 0.75$) and leaf area per cane ($r = 0.80$) across cultivars, although there was little association between leaf area per kg fruit and total yield ($r = 0.20$). 'Spartan,' 'Bluecrop' and 'Bluejay' had significantly less leaf area per kg fruit than 'Elliot,' 'Jersey' and 'Rubel.'

Discussion

The spring and summer of 1988 were unusually hot and dry, which may explain why fruit size was smaller in 1988 than 1987. Irrigation was applied at the rate of 2-5 cm per week, but wilting in new shoots was still observed on some dates. There was a light frost during early fruit expansion in 1988, but overhead sprinkling prevented significant damage. It is not known why lateral numbers and fruit set varied between years as fall and early spring conditions did not seem unusual in either year.

Yield increases in crops are most often associated with increases in plant size or changes in resource allocation patterns (1). 'Elliot' had the highest yield of any cultivar because it had significantly more flowers per bud, more fruiting laterals per cane and higher fruit set. The higher fruit production of 'Elliot' was supported, at least in part, by a greater leaf surface area. Three other cultivars ('Spartan,' 'Bluejay' and 'Bluecrop') had larger fruit than 'Elliot' and two had more buds per lateral ('Jersey' and 'Rubel'), but neither of these components was significantly associated with yield in the path analysis.

New cultivars with even higher fruit numbers than 'Elliot' can probably be

Table 1. Mean yield components of 6 highbush blueberry cultivars at Grand Junction, MI in 1987 and 1988.

	1987	1988
Flowers per bud	7.8	8.4
Buds per lateral	5.0	5.2
Laterals per cane	8.7	6.5*[z]
Canes per bush	23.6	23.5
Fruit set (%)	60.5	79.0*
Fruit wt (gm)	1.59	1.25*
Yield (kg/bush)	7.7	6.6*

[z]Means significantly different ($P < 0.05$) between years, F-test.

Table 2. Path coefficients between yield components of 6 blueberry cultivars. Coefficients significant at 5% level are underlined.

Canes per bush (CB)	--					
Laterals per cane (LC)	0.49	--				
Buds per lateral (BL)	0.07	0.01	--			
Flowers per bud (FB)	0.19	0.59	0.02	--		
% Fruit set (FS)	-0.16	0.73	-0.13	0.55	--	
Fruit weight (FW)	-1.18	-0.66	-1.11	-0.59	0.00	--
Yield	0.95	1.79	-0.26	1.43	1.27	-0.10
	CB	LC	BL	FB	FS	FW

Table 3. Mean yield components of six highbush blueberry cultivars at Grand Junction, MI. Values are average of two years.

Cultivar	Flowers Per Bud	Buds Per Lateral	Laterals Per Cane	Canes Per Bush	Fruit Set (%)	Fruit Weight (gm)	Yield (kg/bush)
Elliot	10.8	4.8	9.6	24.9	79	1.23	12.0
Spartan	7.7	4.2	7.4	20.6	71	2.07	7.2
Jersey	7.8	6.1	8.2	26.3	64	1.13	7.4
Bluejay	7.1	4.7	8.2	23.9	60	1.58	6.2
Bluecrop	7.8	4.0	7.2	23.9	75	1.68	6.7
Rubel	8.1	6.7	7.3	21.8	71	0.91	5.6
SE	1.3	1.2	0.9	4.7	7	0.37	2.1

Table 4. Mean cane height and leaf area of six highbush blueberry cultivars at Grand Junction, MI.

Cultivar	Mean cane Height (cm)	Leaves per cane	Leaf area (dm^2) per cane	Yield per cane (kg)	Leaf area (m^2) per kg fruit
Elliot	140.8	537	3692	0.48	0.76
Spartan	147.5	147	1430	0.35	0.40
Jersey	156.5	201	1994	0.28	0.71
Bluecrop	151.7	173	1145	0.28	0.41
Bluejay	133.7	141	1326	0.26	0.51
Rubel	138.5	324	2108	0.26	0.81
SE	11.3	107	950	0.05	0.18

generated through breeding, as variation was observed in most of the yield components. Such increases could translate into higher yields, although fruit size may diminish due to negative component interactions. To overcome this potential barrier, genotypes with higher photosynthetic rates or differing partitioning patterns must be identified. This is possible, as 'Spartan,' 'Bluecrop' and 'Bluejay' produce a kg of fruit on much less leaf surface than 'Elliot' and, therefore, may have higher photosynthetic or translocation rates.

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