Byron. Therefore, it might be difficult to collect adequate seed for rootstocks, and thus this line would have to be propagated vegetatively. However, rooted cuttings of P.I. 101686 are less vigorous than lower chill cultivars and may not establish themselves as rapidly after transplanting. Currently nearly all peaches in the United States are propagated on peach seedling stocks. Fewer P.I. 101686 trees survived the scion budding process (3 of 7 *vs* 7 of 8 'Redglobe' *vs* 7 of 7 'Flordaking') but these numbers are small and not significantly different (P = 0.07 - 0.20). This line is also known to be relatively susceptible to fungal gummosis incited by *Botryosphaeria dothidea* (Moug. ex Fr.) Ces & de Not (4).

Although these results are preliminary because of the small number of trees tested, P.I. 101686 and related selections warrant further testing. A compatible rootstock providing either bloom delay or size control or both would be of value to the peach industry.

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Leaf Elemental Concentration of Highbush Blueberry Cultivars Grown on a Mineral Soil

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Abstract

Leaves from the highbush blueberry cultivars 'Bluecrop,' 'Bluejay,' 'Blueray,' 'Collins' and 'Spartan,' growing in a mineral soil with sawdust mulch, were sampled in early August for three years (1986-88) and analyzed for N, P, K, Ca, Mg, Fe, Mn, Cu and Zn to determine cultivar leaf elemental content differences. Differences among cultivars for elemental content were found for all elements analyzed except Mg, Fe, Cu, and Zn. Differences among sample years was significant for all elements. The data reveal that large enough differences exist among the cultivars sampled to warrant separate leaf samples for each in commercial blueberry fields.

Introduction

Highbush blueberry production has become an important horticultural industry in the Ozark region in the last 10 years, with about 500 ha planted as of 1989. The soils on which these blueberries are grown are all mineral types, ranging from sandy to clay loams with a natural organic matter content of 1-3%. The soils in this region are very different from the common highbush blueberry production areas that are largely sandy types high in

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organic matter. Most growers in the Ozark region use recommended organic soil amendments such as peat moss in the planting hole and surface applications of sawdust mulch to encourage growth and productivity (9).

As might be expected, symptoms of mineral nutrition problems have occurred in many fields, commonly due to improper soil pH or possible mineral imbalances (2). These problems have encouraged growers to consider soil and plant analyses on both abnormal- and normal-appearing plantings, to aid in diagnosing or preventing nutritional disorders. Since soil and plant analysis can be affected by numerous factors, including the date of sample, uniformity of the site and cultural practices, an effort has been extended to identify the effect of several variables to aid in the effective use of plant analysis as a tool for growers. The time of sampling when most elements are at a seasonally stable level in Arkansas has been determined to be between mid-July and mid-August (4).

Variation among highbush blueberry cultivars for leaf elemental concentration has been investigated in British Columbia, Canada, by Eaton and Meehan (5), for 11 cultivars growing in a mineral soil and sampled for a single season. Their results indicated that year-to-year variation among cultivars would probably occur. Other reports of differences in leaf elemental content among highbush blueberry cultivars have not been identified in the literature.

This study was conducted by sampling mature plants for three years growing on a site of higher soil pH and soil content of Ca than recommended for blueberry production in Arkansas. The objective was to evaluate cultivar differences in leaf elemental content on this type of site and try to relate these differences to possible adaptation to the mineral soils of Arkansas.

Materials and Methods

Leaf samples were taken in 1986-88 from the cultivars 'Blueray,' 'Bluecrop,' 'Bluejay,' 'Collins,' 'Coville' and 'Spartan.' Of this group, 'Bluecrop,' 'Blueray,' and 'Coville' have shown good adaptation to the Ozark region. 'Bluejay' has been planted widely in the Arkansas River Valley in Western Arkansas on the southern edge of the Ozarks and has shown more adaptation to that region. 'Collins' has been widely planted and has shown adequate adaptation although symptoms of possible nutrient problems are commonly seen on leaves. 'Spartan' has shown only limited adaptation, based on growth, productivity and overall plant health. The plants sampled were located at the University Farm, Fayetteville, planted in 1981, growing on a Captina silt loam (mixed, mesic, Typic Fragiudult). Standard cultural practices for highbush blueberry production were followed, including peat moss addition to the planting hole at planting, surface mulching with sawdust and trickle irrigation as needed (9). The planting was fertilized each year with ammonium sulfate (total N of 247 Kg/ha^{-1} in split applications) and in 1986 only, a complete fertilizer containing 12N-10.6P-9.8K was applied at a rate of 741 Kg/ha^{-1} in addition to ammonium sulfate.

Leaf samples consisted of mid-shoot leaves from fruiting canes, taken in early August of each year (4) from normal appearing plants only. Four, 4-plant replications of each cultivar were sampled, arranged in a randomized complete block design. Leaves were rinsed twice in deionized water, dried in a convection oven at 70°C for 24 hours and ground in a Wiley mill. Soil samples were taken in August, 1986 from the rootzone of the plants. Leaf and soil samples were analyzed by the Soil Testing and Research Laboratory of the University of Arkansas, Marianna. Leaf nitrogen was analyzed by microKjeldahl (7) and other leaf elements by inductively coupled plasma spectrometry (10). Soil was analyzed using ammonium acetate extraction for cations and Bray P1 for P (7). Leaf analysis data were analyzed as a two factor (cultivar and year) randomized complete block by analysis of variance and means separated by Duncan's multiple range test. A significance level of 0.01 was used in determining significant sources of variation and for mean separation.

Results and Discussion

Soil analysis results from 1986 indicated a soil pH of 5.8, P-99ppm and cation content in ppm of K-108, Ca-1136, mg-50, Fe-110, Mn-124, Cu-1.3 and Zn-48. This data confirmed that soil pH and Ca levels were above those recommended for Arkansas blueberry fields (9). The soil data is included for a characterization of the site on which the plants were grown, not for comparison to leaf elemental content of the plants.

The analysis of variance of the leaf content values revealed that cultivar was a significant source of variation for all elements except Mg, Fe, Cu and Zn. Sample year was significant for all elements. Cultivar by year interaction was significant for Cu only, but interaction means showed only numerically small differences and no prevalent trends (data not shown).

The cultivar and sample year means are presented in Table 1. Leaf N differed by 0.26% between the highest N content cultivar 'Collins' and the lowest, 'Bluecrop.' Phosphorus varied only slightly between the highest content from 'Collins' and lowest from 'Bluecrop,' 'Blueray' and 'Coville.' 'Collins' and 'Spartan' were higher in K. Calcium levels ranged from a high of 1.08% for 'Spartan' to 0.76% for 'Bluecrop.' Manganese was higher for 'Coville' and similar for the other cultivars.

Sample year values indicated highest levels of N, Cu and Zn for 1988, highest Ca, Fe and Mn for 1987 and highest P, K and Mg for 1986. Potassium and Ca varied the least among years while several elements had large year-to-year differences. Although reasons for year-to-year variation were not investigated, a possible cause might have been variation in crop load as determined by Ballinger (1).

The cultivar mean differences support the findings of Eaton and Meehan (5) for N, P, K and Ca but not for Mg and Fe, although different cultivars were sampled in their study. The data support the need to evaluate

Table 1. Elemental content differences among highbush blueberry cultivars and sample years of leaves from plants grown in a mineral soil.

Main effect	% Dry Wt.					ppm			
Cultivar	N	P	K	Ca	Mg	Fe	Mn	Cu	Zn
Bluecrop	1.67b[z]	.09b	.55b	.76c	.13a	93a	373b	6a	13a
Bluejay	1.85ab	.10ab	.52b	.80bc	.10a	98a	407b	5a	20a
Blueray	1.84ab	.09b	.53b	.99ab	.14a	87a	414b	5a	13a
Collins	1.93a	.11a	.66a	.86bc	.11a	88a	313b	6a	10a
Coville	1.81ab	.09b	.45c	1.00ab	.14a	89a	562a	6a	23a
Spartan	1.90a	.10ab	.64a	1.08a	.12a	99a	345b	6a	10a
Year									
1986	1.59c	.11a	.62a	.92ab	.14a	53c	299c	5b	10b
1987	1.80b	.08c	.52b	.96a	.12b	134a	488a	3c	5b
1988	2.12a	.09b	.54b	.86b	.11b	89b	420b	9a	30a

[z]Mean separation within main effect by Duncan's multiple range test, 1% level.

cultivars separately by leaf analysis for proper fertility management. Combining leaves from several cultivars in a field could contribute to errors in fertility recommendations, particularly for N, K and Ca of the macroelements and Mn of the microelements. Future research could focus on determining if there are optimum levels or ranges for each cultivar or for cultivar groups to allow more precise nutritional management through soil and plant analysis.

An additional aspect to consider from an examination of the data is the relationship of nutrient concentration to overall cultivar adaptation. It is interesting to note that 'Bluecrop,' which is widely adapted, was lower in N and Ca and had one of the lower values for P content, while intermediate in K, Mg and Mn. 'Spartan' is poorly adapted in Arkansas and had a high level of N, P, K, Ca and Mg, but was lower for Mn. The differences in levels of elements between 'Bluecrop' and 'Spartan' are probably not due to a dilution effect since in this planting the plants were of similar size and vigor. Using critical values suggested by Eck (6), 'Spartan' is the only cultivar with an excess value for any elements, above 1% for Ca. 'Bluecrop' was slightly deficient for N using 1.70% for the deficient level, while slight deficiencies for P existed for 'Bluecrop,' 'Blueray' and 'Coville' using 0.10% as the deficient level. Although not totally conclusive, reflection of possible adaptation could be determined by leaf analysis. A report by Clark (3) indicated that rabbiteye blueberry (*Vaccinium ashei* Reade) leaves contained less N, P and Ca, along with several other elements, compared to highbush blueberry leaves from plants growing on the same site. Rabbiteye blueberries are considered more adapted to mineral soils than highbush (8), and this adaptation may be related to the content or uptake regulation mechanisms of rabbiteye blueberries. Further research under controlled conditions could provide data to determine if a relationship exists between adaptation and leaf elemental content.

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Wilder Medal Nominations

Please submit your nominations by May 1, 1990 to Robert C. Lamb, Department of Horticultural Sciences, NYSAES, Geneva, NY 14456. Outline the accomplishments of your nominee in some detail and provide as much documentation as possible.