THE MINERAL CONTENT OF THE LOWBUSH BLUEBERRY[1]

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Abstract

All lowbush blueberry plants receiving various levels of phosphorus had normal foliage and no leaf spotting occurred, The foliage of plants not containing phosphorus became necrotic and at the end of 3 months the plants were dead. The results indicated that blueberry plants require very little phosphorus for growth, since those receiving 1 ppm phosphorus grew as well as those receiving 64 ppm and contained about the same amount of phosphorus.

In a field survey of the mineral content of lowbush blueberry plants, manganese was found to be extremely high in both sprout and first-crop plants. The manganese levels were found to range from 629 to 3475 ppm, In first crop plants levels of nitrogen, phosphorus, potassium and copper were higher; calcium, cobalt and zinc generally were higher, and boron, iron and aluminum were lower than those in the sprout plants. Magnesium levels showed little or no differences between sprout and first-crop plants.

Introduction

In a previous study Lockhart (5) found that in the advanced stages of phosphorus deficiency necrotic spots on the older terminal leaves of lowbush blueberry were similar to a leaf spotting of undetermined origin. This observation on leaf spotting suggested the possible importance of the mineral content of the lowbush blueberry. Apart from reports by Chandler (1) and Chandler and Mason (2) on the mineral composition of the whole blueberry fruit there is little information in the literature on the mineral content of lowbush blueberry plants.

A study was therefore undertaken to determine the phosphorus content and effects of various levels of phosphorus on lowbush blueberries grown in sand culture in the greenhouse. Determinations were also made on the mineral content of blueberry plants growing naturally in the field. The results obtained are given in this paper.

Materials and Methods

Greenhouse experiment

Ten-week old lowbush blueberry seedlings, *Vaccinium angustifolium* var. *laevifolium* House, were transferred to nutrient solutions (5) containing

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0, 1, 2, 4, 8, 16, 32 and 64 pprn of phosphorus at pH 4.0 using the sand culture technique described previously (5). The treatments were replicated 4 times in randomzied blocks. The length of all shoot? was measured at weekly intervals and totalled for each plant, After 23 weeks in culture leaf samples from new growth were analyzed for total phosphorus (13). A week later the plants were removed from sand culture, the roots washed free of sand and the weights of shoots and roots were determined after drying in an oven at 50°C for 24 hours.

Table 1, Effect of P levels on the growth and phosphorus, content of blueberry plants (Mean values of 4 replicates).

P levels in pprn.	Accumulative shoot length in cm. At 3 months	At 6 months	Dry weight in gm. Shoots	Roots	% P in leaves
0	4.7	-	-	-	-
1	56.6	257.5	4.10	0.99	0.20
2	66.7	261.1	4.97	1.32	0.25
4	83.4	299.1	5.$7	1.40	0.25
8	41.6	151.4	3.82	0.95	0.20
16	73.0	233.6	3.85	0.91	0.21
32	62.4	223.6	3.75	0.74	0.21
64	61.8	243.6	3.45	1.30	0.24
L.S.D. 5% level	32.2	121.8	N. S.	N. S.	0,021

Field survey

For determinations of the mineral content of the field samples of lowbush blueberry, *V. angustifolium* var. *laevifolium*, plants were collected between July 7 and 15 from sprout and first-crop fields at West Brook, Halfway River and Parrsboro, Nova Scotia. Ten random samples were collected from each of 3 sprout and 3 first-crop fields. The samples were air-dried and analyses of the whole plant were made for nitrogen, phosphorus (9), cobalt, zinc (8), copper (3) and aluminum (10).

Boron in blueberry plant tissue was determined by the Hatcher and Wilcox carmine method (4) with the following modifications:

(i) The use of $Ca(OH)_2$ in place of CaO
(ii) Centrifuging at 2000 rpm. for 10 minutes rather than filtering.

Manganese was determined by the potassium periodate method in combination with H_3PO_4 (12). The following modifications were used:

(i) Heat gently for 30 minutes.
(ii) 12 gm sample dry ashed, then digested with 8 ml of concentrated H_2SO_4 until the color becomes white, then filtered, made to 100 ml volume and an aliquot used for the determination.

Table 2. Mineral content of lowbush blueberry plants collected in the field (Mean values of 10 samples).

	Parrsboro				Halfway River				West Brook			
	Sprouts		1st crop		Sprouts		1st crop		Sprouts		1st crop	
Mineral	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.	Range	Ave.
N (%)	2.00-2.47	2.18	1.42-1.56	1.50	1.62-2.23	1.83	1.15-1.40	1.30	1.91-2.45	2.18	1.46-1.60	1.50
P (%)	0.152-0.196	0.169	0.100-0.126	0.109	0.118-0.160	0.136	0.092-0.104	0.098	0.130-0.198	0.159	0.097-0.117	0.106
K (%)	0.57-0.76	0.64	0.43-0.56	0.46	0.49-0.63	0.57	0.37-0.49	0.42	0.56-0.83	0.67	0.45-0.63	0.51
Mg (%)	0.09-0.14	0.12	0.13-0.16	0.15	0.11-0.13	0.12	0.11-0.19	0.125	0.15-0.18	0.17	0.15-0.20	0.17
Ca (%)	0.35-0.45	0.39	0.48-0.58	0.49	0.39-0.52	0.46	0.39-0.63	0.55	0.36-0.49	0.41	0.46-0.62	0.52
Co (ppm.)	0.037-0.133	0.069	0.063-0.097	0.083	0.060-0.121	0.096	0.093-0.153	0.120	0.013-0.049	0.032	0.037-0.072	0.052
Mo (ppm.)	0.010-0.193	0.082	0.015-0.084	0.047	0.077-0.252	0.165	0.117-0.290	0.205	0.013-0.068	0.042	0.016-0.142	0.052
Zn (ppm.)	25.0-38.0	31.8	27.7-44.8	35.7	21.5-47.5	30.9	29.0-47.5	36.2	19.7-37.0	27.4	26.7-44.5	36.6
Mn (ppm.)	1659-2779	1993	1504-2317	1835	2150-2934	2442	1830-3475	2906	629-1468	1159	803-1759	1130
Cu (ppm.)	6.9-11.0	8.5	5.0-7.4	6.0	5.3-6.7	6.2	4.5-6.0	5.4	7.0-10.1	8.2	4.8-8.7	6.9
B (ppm.)	9.7-18.7	14.9	13.9-23.6	20.5	15.1-23.8	20.5	17.8-26.2	21.6	16.1-24.1	18.6	20.2-29.9	23.9
Fe (ppm.)	40.55	45	59-65	74	37.51	44	60-117	69	40-72	54	63-121	81
Al (ppm.)	70-131	88.1	102-198	155.5	89-141	106.4	86-216	148.8	59-108	89.1	122-172	143.1

Iron was determined by a dipyridyl-hydroxylaminc hydrochloride method* recommended by the Macaulay Institute for Soil Research, Aberdeen, Scotland.

Potassium, calcium and magnesium were determined by the flame photometer method (6) using a Beckman DU spectrophotometer with a flame attachment. The results of the mineral content of the blueberry plants are given in Table 2.

Results and Discussion

Greenhouse Experiment

All plants at the various levels of phosphorus had normal foliage and no leaf spotting occurred. The plants not receiving phosphorus produced little growth, the foliage gradually became completely necrotic and, at the end of 3 months, the plants were dead, Typical leaf spotting did not occur.

The data in Table 1 show that at the end of 3 months accumulative shoot length of blueberry plants was significantly better at all levels of phosphorus than in those not receiving phosphorus. Plants receiving 8 ppm. phosphorus showed significantly less growth than those receiving 4 ppm. due to the considerable variation in growth which occurred between plants of each treatment, because open-pollinated seedlings were used, These results indicate either that blueberry plants require very little phosphorus, since these receiving 1 ppm. phosphorus grew as well and contained about the same amount of phosphorus as those receiving 64 pprn., or that the continuous flow method (5) of supplying phosphorus is not suitable for studies of phosphorus deficiency in lowbush blueberries. The blueberry plants apparently absorbed all the phosphorus they required from a continuous flow of 1 ppm.

Field survey

The data in Table 2 show that the levels of nitrogen, phosphorus, potassium and copper were consistently lower in first-crop plants than they were on the sprout plants, Boron, iron and aluminum were consistently higher in first-crop plants than in the sprouts. Calcium, cobalt and zinc generally were higher in first-crop plants than in sprouts but in some instances there was overlapping of values between ranges of first-crop and sprout plants. Magnesium and manganese gave variable results. The levels of potassium, phosphorus, magnesium, calcium and iron were similar to those in highbush blueberries reported by Mikkelsen and Doehlert (7). However, the manganese content of the lowbush blueberries was over 15 times that reported for the highbush blueberry. This high manganese content may be of some significance in the physiology of the lowbush blueberry. Somers and Shive (11) considered that most plants require a 2:1 Fe/Mn ratio for normal growth and freedom from pathological symptoms. The Fe/Mn ratios in Table 2 vary from 0.018 to 0.075. It is reasonable to expect that high manganese would interfere with the uptake and utilization of iron at low pH values. Further studies on the iron and manganese content are necessary to determine their effect on growth of the lowbush blueberry.

*Personal communication.

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