CIRCULAR No. 118 APRIL 1957

Azalea Fertilization

AGRICULTURAL EXPERIMENT STATION
of the ALABAMA POLYTECHNIC INSTITUTE
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FIRST PRINTING 3M, APRIL 1957

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AZALEAS of the Kurume type, *Rhododendron obtusum japonicum,* are used widely as potted plants for florist sales, and as landscape plants in warmer areas of the United States. Demand for these plants increases steadily from year to year.

Fertilizer practices used for azaleas vary widely. Despite various practices, many symptoms are often observed suggesting nutrient element deficiencies. To obtain information on azalea nutrition, tests were conducted to, (1) determine appearance of nutrient deficiencies, (2) ascribe them to a specific element, and (3) determine the best fertilizer for azaleas grown in different soil mixtures.

TABLE 1. COMPLETE NUTRIENT SOLUTION APPLIED TO AZALEAS GROWN BY SAND CULTURE METHOD

Salts used	Molecular weight of salt	Parts per million in dilute solution	Grams of salt per liter of stock solution	Ml. stock solution per liter of dilute solution
Ammonium nitrate (NH_4NO_3)	80.05	100N	114.28	2.5
Monopotassium phosphate (KH_2PO_4)	136.13	50P, 63K	87.88	2.5
Magnesium sulfate ($MgSO_4.7H_2O$)	246.49	50Mg, 66S	101.35	5.0
Calcium chloride ($CaCl_2.2H_2O$)	147.03	150Ca, 265Cl	220.10	2.5
Potassium sulfate (K_2SO_4)	174.25	37K, 15S	41.23	2.0
Sodium sulfate (Na_2SO_4)	142.05	26S, 37Na	44.31	2.6
Ferric tartrate ($FeC_4H_4O_6$)	203.91		5.00	1.0
Zinc chloride ($ZnCl_2$)	136.29		0.20	1.0
Copper chloride ($CuCl_2$)	170.52		0.10	1.0
Boric acid (H_3BO_3)	61.84		1.00	1.0
Molybdic acid (MoO_3)	143.95		1.50	1.0
Manganese chloride ($MnCl_2$)	197.91		1.80	1.0
Total ppm in dilute solution:	N 100, P 50, K 100, Ca 150, Mg 50, S 107, Cl 265, and Na 37.			

* Nutient element deficiency study of project reported herein was conducted by Bell as partial fulfillment of requirements for master's degree awarded in 1952.

NUTRIENT-ELEMENT DEFICIENCY STUDY

Materials and Methods

Varieties Coralbells, Hexe, and Pink Pearl were grown in 2-gallon glazed crocks filled with 18-mesh quartz sand, one rooted cutting of each variety per crock. Nutrient solutions, as given in Tables 1 and 2, were applied to the surface of the sand and allowed to drain through three times a week on alternate days. Distilled water was applied the remaining 4 days each week. Elements omitted singly from the nutrient solution were: Nitro-

Table 2. Modifications of the Complete Nutrient Solution for Each Deficiency Treatment

Nutrient deficiency	Chemical omitted	Chemical used	Molecular weight	Parts per million in dilute solution	Gm. of salt per liter of stock solution	Ml. stock solution per liter of dilute solution
Nitrogen	Ammonium nitrate	None	----	----	----	----
Phosphorus	Mono-potassium phosphate	Potassium sulfate (K_2SO_4)	174.25	K 37 S 15	41.23	2.0
Potassium	Mono-potassium phosphate	Monosodium phosphate ($NaH_2PO_4.H_2O$)	138.01	P 50 Na 37	91.77	2.5
	Potassium sulfate	Sodium sulfate (Na_2SO_4)	142.05	S 41 Na 59	44.31	4.1
Calcium	Calcium chloride	Potassium chloride (KCl)	74.55	K 37 Cl 33	35.28	2.0
Magnesium	Magnesium sulfate	Sodium sulfate (Na_2SO_4)	142.05	S 41 Na 59	44.31	4.1
Sulfur	Magnesium sulfate	Magnesium chloride ($MgCl_2$)	95.23	Mg 50 Cl 73	97.89	2.0
	Potassium sulfate	Potassium nitrate (KNO_3)	101.10	N 13 K 37	33.61	1.0
	Sodium sulfate	Sodium nitrate ($NaNO_3$)	85.01	N 23 Na 37	136.77	1.0
Iron	Ferric tartrate	None	----	----	----	----
Copper	Copper chloride	None	----	----	----	----
Manganese	Manganese chloride	None	----	----	----	----
Boron	Boric acid	None	----	----	----	----
Zinc	Zinc chloride	None	----	----	----	----
Molybdenum	Molybdic acid	None	----	----	----	----

gen, phosphorus, potassium, calcium, magnesium, sulfur, iron, copper, manganese, boron, zinc, and molybdenum. Treatments were placed in a randomized block arrangement consisting of four replications.

RESULTS

Check plants, which received the complete nutrient solution, were more vigorous and had better color than most commercially grown plants. In general, deficiency symptoms appeared rather slowly. By the end of the experiment, however, plants that received nutrient solutions deficient in nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, or boron developed distinct nutrient deficiency symptoms.

Deficiency Symptoms

Descriptions and appearance of deficiency symptoms and plant growth observed as a result of the differential nutrient treatments are presented in chronological order. Leaf deficiency symptoms are shown in Figure 1.

NITROGEN SERIES. Nitrogen deficiency symptoms were first detected about 40 days after nutrient treatments were begun.

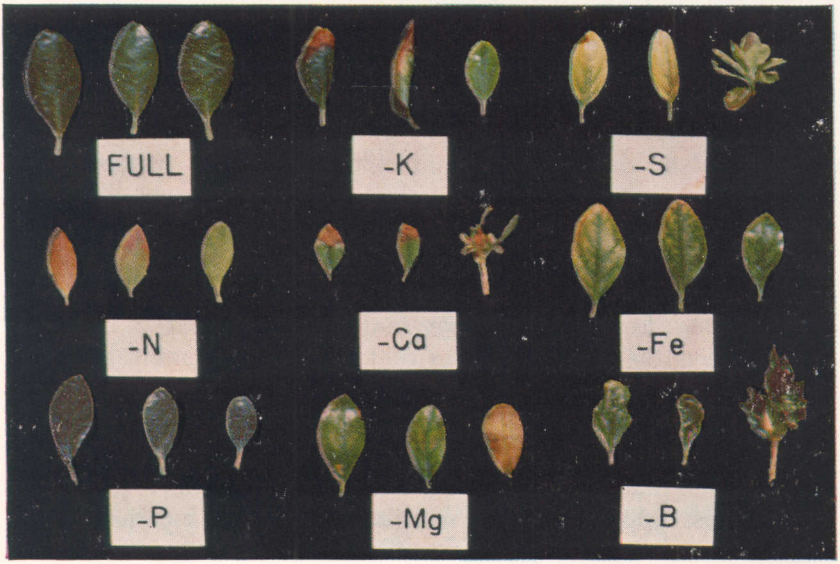

FIGURE 1. Azalea leaves above show symptoms of nutrient deficiency from each treatment. At upper left are leaves from plants grown in full nutrient solution.

The first noticeable symptom was the lighter green color of leaves. Gradually, all leaves turned a greenish yellow. Older leaves soon turned yellow or red or developed reddish blotches. In some cases small necrotic areas appeared before the leaves abscised. Growth continued for a short time but at a very slow rate. New foliage that developed was greenish yellow and much smaller than that of the check plants. As the deficiency continued, growth ceased, stems became brittle, leaf drop was severe, and plants were stunted. Flowers were few in number, small, and poor in quality.

Sulfur Series. Deficiency symptoms were first observed about 75 days after sulfur deficient treatments began. The first symptom observed was an interveinal chlorosis of the leaves, somewhat similar to the early stages of potassium, calcium, magnesium, and iron deficiencies (described later). Beginning at the apex and edge of the leaves, the green color changed to greenish yellow, except the veins which remained green. Some leaves temporarily exhibited a mottled appearance, but many of them eventually became entirely a bleached yellow or cream color. As the deficiency continued, necrotic areas were observed on the apical edges of old leaves. Leaves were of medium size and growth practically stopped after 4 months of treatment. Flowers were few in number, small, and poor in quality.

Potassium Series. Plants that were supplied with a nutrient solution deficient in potassium exhibited deficiency symptoms after about 80 days. Interveinal chlorosis of new leaves began at the apical tip and edges in much the same manner as that from sulfur deficiency. A temporary slight reddening appeared on both top and bottom surfaces of the apical end of the leaf. While the interveinal chlorosis symptoms continued to appear on new leaves, necrotic areas and marginal scorch appeared near the apex of recently matured leaves that became extremely bronzed. Tips of these leaves, and also of some exhibiting less severe symptoms, rolled upward. Although leaf drop was severe, limited growth continued. The leaves, however, were smaller than those of the check plants. As the deficiency continued, necrotic lesions became less apparent while marginal scorching increased. Foliage became increasingly chlorotic, and bronzing occurred on old leaves. Dieback was very common and severe at this stage. Flowers were extremely few in number, small, and poor in quality.

Magnesium Series. Deficiency symptoms appeared after plants were supplied with magnesium deficient solution for about 85 days. Interveinal chlorosis occurred on mature leaves located near the terminal portion of the stem. Chlorosis began at the apex. Leaf color changed from green to yellow-green, or even bleached yellow in some cases, and was accompanied by reddish-purple blotches mostly on upper leaves of the plants. All chlorotic leaves had slightly reddened veins on the under side. Later, some older leaves were bronze in color and necrotic at the tips. Leaf drop was severe, especially older leaves. Few leaves remained on the stem long enough for necrotic areas to develop, and some long bare stems were observed. Tips of affected leaves curled downward. Growth practically ceased after 6 months of treatment, and leaves were somewhat smaller than those of the check plants. Flowers were very few in number, small, and poor in quality.

Boron Series. A light flecking of brown dots on young expanding leaves following 90 days of treatment was the first boron deficiency symptom observed. The first leaves affected continued to grow and developed to normal size and shape, but the flecking remained as translucent dots. New leaves thereafter contained many small necrotic spots that were coalesced sometimes to form necrotic areas and margins throughout the leaf. Death of this tissue prevented normal development of the leaf and caused severe leaf distortion. As the deficiency continued, growing points were so affected that the terminal buds died. In some cases, numerous shoots containing excessive numbers of extremely small leaves developed at the lower part of the plant. Average leaves were slightly smaller than those of check plants, but growth of plants deficient in boron apparently was not restricted throughout the length of the experiment. Flowers were average in number and size, and were fair in quality. Flowers of the Pink Pearl variety were orange-red, whereas the normal color is light pink. Those of Coralbells had brown and necrotic areas on the inner face of the corolla.

Calcium Series. Calcium deficiency symptoms were noticed after calcium deficient solution had been supplied about 120 days. Interveinal chlorosis of new leaves marked the early stages, followed by tip burning on some of these expanding leaves. Even though all growing points did not show this symptom, all growing points did have pale yellow or cream-colored leaves that were smaller that those of the check plants. As the deficiency continued, some new terminal leaves became twisted, and the terminal buds died. Tip-burning increased toward the base on all the older leaves that curled downward in the necrotic areas. The small, bract-like leaves immediately surrounding the flower buds also developed severe tip burn. Some dieback occurred on a few of the more vigorous shoots; however, with this exception, good growth was made. Flowers were few in number, average in size, and fair in quality.

PHOSPHORUS SERIES. Plants grown in a phosphorus deficient solution exhibited deficiency symptoms after about 185 days of treatment. Leaves became dull, dark green with some slightly reddened areas along the midrib on the lower leaf surface. Growth had practically ceased. As the deficiency continued, small irregular reddish-purple blotches appeared on the upper surface of some lower leaves on the more vigorous shoots. After 8 months of treatment, these lower leaves turned a uniform dark brown and remained in a dried and shriveled form attached to the stem for several weeks. Later, these lower leaves abscised, and a long bare stem was left with only a tuft of mature reddish bronze leaves. Flowers were few in number, small, and fair in quality. Flowers of the Pink Pearl variety were creamy white, whereas the normal color is light pink.

IRON SERIES. Symptoms of iron deficiency were not apparent until after about 210 days of treatment. Interveinal chlorosis of younger leaves was the first symptom. This new foliage remained small and yellow. Later the entire surface of these leaves became cream colored and a few leaves became white. Older leaves were not affected, but newly matured leaves became chlorotic beginning at the apical end. Plants made good growth, but their appearance was poor. Flowers were average in number and size and good in quality.

Growth of Plants

Plants supplied with a complete nutrient solution made satisfactory growth throughout the experiment. Measurements of the rate of stem elongation for the Coralbells variety are presented in Table 3. The rate of stem elongation for the other two varieties was similar from each treatment. Total amount of growth was similar from each treatment. However, total growth was different because of inherent varietal characteristics for growth. Final measurements of stem elongation and stem diameter are given in Table 3. Total green weights and dry weights of leaves and stems are presented in Table 4.

TABLE 3. FINAL MEASUREMENTS OF STEM ELONGATION AND DIAMETER FOR THREE VARIETIES OF KURUME AZALEAS GROWN BY THE SAND CULTURE METHOD

Treatment	Stem elongation			Stem diameter		
	Coral-bells	Hexe	Pink Pearl	Coral-bells	Hexe	Pink Pearl
	cm.	*cm.*	*cm.*	*cm.*	*cm.*	*cm.*
Complete nutrient solution	8.00	6.50	12.45	0.37	0.32	0.36
Minus nitrogen	3.98	3.48	6.18	.28	.21	.23
Minus phosphorus	6.78	5.08	11.25	.36	.28	.32
Minus potassium	7.53	4.43	10.12	.36	.25	.35
Minus calcium	8.25	5.93	17.67	.31	.37	.53
Minus magnesium	6.78	4.98	9.98	.26	.26	.33
Minus sulfur	3.55	4.38	5.80	.29	.28	.33
Minus iron	8.15	7.23	13.38	.35	.31	.32
Minus copper	7.25	7.60	15.30	.32	.34	.49
Minus manganese	9.55	6.65	12.75	.39	.31	.49
Minus boron	11.37[1]	6.48	16.12[1]	.38	.25	.45
Minus zinc	8.95	5.25	14.07	.36	.26	.46
Minus molybdenum	8.90	7.10	15.00	.38	.29	.48

[1] Figure includes measurement of lateral growth that developed near base of the plants as terminals died.

TABLE 4. TOTAL WEIGHTS OF LEAVES AND STEMS OF THREE VARIETIES OF KURUME AZALEAS GROWN BY THE SAND CULTURE METHOD

Treatment	Coralbells		Hexe		Pink Pearl	
	Green weight	Dry weight	Green weight	Dry weight	Green weight	Dry weight
	Gm.	*Gm.*	*Gm.*	*Gm.*	*Gm.*	*Gm.*
Full nutrient	78.1	27.7	37.6	11.6	92.4	33.8
Minus nitrogen	4.6	1.9	2.6	1.2	6.0	2.7
Minus phosphorus	13.5	6.0	6.4	2.4	11.4	5.0
Minus potassium	44.1	16.7	18.8	6.2	17.7	7.2
Minus calcium	55.1	18.7	22.6	7.1	97.5	33.3
Minus magnesium	13.7	5.1	9.2	3.2	14.7	5.8
Minus sulfur	7.8	3.0	10.3	3.5	23.5	8.4
Minus iron	71.4	25.4	43.1	13.5	88.4	32.9
Minus copper	57.2	20.3	51.4	15.8	101.0	37.2
Minus manganese	62.1	18.2	30.3	9.3	165.5	59.8
Minus boron	77.3	26.4	34.2	10.8	115.9	42.1
Minus zinc	65.1	22.9	21.9	6.8	109.3	38.1
Minus molybdenum	62.5	21.8	34.3	10.7	96.5	34.9
L. S. D. .05	17.8	6.2	18.8	5.6	36.5	13.1
L. S. D. .01	23.9	8.3	25.6	7.4	49.0	17.6

STEM ELONGATION. Stem elongation of all three varieties of azaleas deficient in nitrogen, phosphorus, potassium, magnesium, or sulfur was consistently less than that of the check plants. In addition, plants of the Coralbells in the copper deficient treatment and Hexe in the calcium deficient and zinc deficient treatments had less stem elongation than the check plants, Table 3.

STEM DIAMETER. Stem diameter of all three varieties of azaleas deficient in nitrogen, phosphorus, potassium, magnesium, sulfur, or iron was smaller than stem diameter of the check plants. In addition, plants of Coralbells in the calcium deficient treatment, Hexe in the manganese deficient treatment, and Coralbells and Hexe in the zinc deficient treatment had stems of smaller diameter than the check plants, Table 3.

GREEN WEIGHT. Differences in green weight of plants of all three varieties deficient in nitrogen, phosphorus, potassium, magnesium, or sulfur were highly significant when compared with the check plants. The variety Hexe, significant only at the 5 per cent level, was an exception.

Manganese deficient plants of the Pink Pearl variety made more growth, as indicated by green weight, than the check plants. This indicated a possible toxicity from manganese in the check treatment.

TABLE 5. ANALYSIS OF VARIANCE FOR TOTAL GREEN WEIGHT OF LEAVES AND STEMS OF AZALEAS GROWN BY THE SAND CULTURE METHOD

Source of variation	Degrees of freedom	Sum of squares	Means square	"F" value
Coralbells				
Treatments	12	36,083.27	3,006.94	19.49[1]
Blocks	3	521.25	173.75	1.13
Error	36	5,554.36	154.29	
Total	51	42,158.88		
Hexe				
Treatments	12	9,999.15	833.26	4.88[1]
Blocks	3	282.74	94.25	0.55
Error	36	6,147.98	170.78	
Total	51	16,429.87		
Pink Pearl				
Treatments	12	125,765.97	10,480.50	16.20[1]
Blocks	3	251.85	83.95	0.13
Error	36	23,296.38	647.12	
Total	51	149,314.20		

[1] Significant at 1 per cent level.

TABLE 6. ANALYSIS OF VARIANCE FOR TOTAL DRY WEIGHT OF LEAVES AND STEMS OF AZALEAS GROWN BY THE SAND CULTURE METHOD

Source of variation	Degrees of freedom	Sum of squares	Means square	"F" value
Coralbells				
Treatments	12	4,122.71	343.56	18.72[1]
Blocks	3	110.97	36.99	2.02
Error	36	660.54	18.35	
Total	51	4,894.22		
Hexe				
Treatments	12	995.73	82.98	5.56[1]
Blocks	3	27.71	9.24	0.63
Error	36	537.53	14.93	
Total	51	1,560.97		
Pink Pearl				
Treatments	12	16,027.02	1,335.59	16.10[1]
Blocks	3	63.57	21.19	0.25
Error	36	2,987.10	82.98	
Total	51	19,077.69		

[1] Significant at 1 per cent level.

DRY WEIGHT. Dry weight of plants of the Coralbells variety deficient in nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, copper, or manganese was less than that of the check plants. Plants of the Hexe variety, on the other hand, were not affected by omission of potassium, calcium, copper, or manganese.

Omission of nitrogen, phosphorus, potassium, or sulfur significantly reduced the dry weight of Pink Pearl plants, whereas omission of manganese increased it.

Analysis of variance for total green and dry weights of leaves and stems are given in Tables 5 and 6.

INFLUENCE OF RATES AND GRADES OF FERTILIZERS, TYPE OF ORGANIC MATTER, AND MINOR ELEMENTS

MATERIALS AND METHODS

Rooted cuttings of the Coralbells, Hexe, and Pink Pearl varieties were greenhouse grown in glazed pots in a mixture of one-fourth peat and three-fourths sand. The following fertilizer grades were compounded, using acid peat as the filler: 0-10-8, 3-10-8, 6-10-8, 6-0-8, 6-5-8, 6-15-8, 6-10-0, 6-10-4, and 6-10-12. These fertilizers were applied at rates varying from 0 to 12,000 pounds per acre per year, Table 7. The yearly amount was divided into four equal applications, spaced 3 months apart.

TABLE 7. EFFECTS OF VARIOUS LEVELS AND GRADES OF FERTILIZERS ON GROWTH OF CORALBELLS, HEXE, AND PINK PEARL AZALEAS GROWN IN A MIXTURE OF SAND AND PEAT

Treatment per acre		Coralbells					Hexe					Pink Pearl				
Amount	Grade	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants
Lb.		*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*	*No.*
0		6.6	4.2	4.75	8.17	0	7.7	4.6	5.58	8.08	0	4.3	3.5	6.00	9.50	0
2,000	0-10-8	7.6	2.1	5.42	9.08	0	7.3	3.9	4.50	8.42	0	4.1	2.8	2.67	5.17	0
1,000	3-10-8	11.2	3.4	7.00	9.92	0	14.1	6.6	6.08	9.83	0	11.1	5.2	5.67	7.42	0
2,000	3-10-8	17.5	6.1	8.92	10.92	0	15.8	7.0	8.00	9.50	0	15.1	7.6	8.75	10.50	1
6,000	3-10-8	30.6	10.6	12.00	13.75	0	33.3	15.2	8.67	14.08	0	11.4	5.2	9.17	9.83	0
1,000	6-10-8	14.8	7.1	9.42	14.42	0	24.3	9.4	9.00	12.75	0	16.1	7.5	9.83	12.25	0
2,000	6-10-8	23.5	10.7	11.67	14.75	0	36.2	16.9	8.83	12.63	0	21.8	9.7	7.25	11.50	0
6,000	6-10-8	39.6	13.8	10.50	13.33	0	52.0	22.2	11.67	16.58	0	35.1	16.4	13.25	16.38	1
2,000	6-0-8	16.0	7.3	6.33	10.83	0	5.9	3.4	3.00	6.17	0	5.5	3.9	6.42	8.92	0
1,000	6-5-8	13.7	7.0	10.50	13.17	0	20.7	14.4	9.00	12.25	0	16.4	6.9	8.50	10.83	0
2,000	6-5-8	33.0	15.1	13.92	16.75	0	19.2	8.9	8.33	12.75	0	21.4	7.8	7.75	11.83	0
6,000	6-5-8	60.4	26.0	11.50	13.00	0	24.2	11.5	8.75	12.50	1	45.9	20.8	12.58	15.75	0
1,000	6-15-8	19.8	9.5	12.58	16.50	0	20.9	9.8	10.75	14.00	1	8.8	5.3	6.00	8.00	0
2,000	6-15-8	15.7	7.8	8.17	10.50	0	35.6	15.2	9.83	15.25	0	18.0	9.5	9.50	12.50	0
6,000	6-15-8	48.8	22.4	10.50	14.33	0	50.9	21.5	8.30	14.50	0	11.5	4.8	7.75	9.75	2
2,000	6-10-0	25.6	14.0	10.50	13.38	1	27.2	12.7	12.08	15.92	0	22.1	11.6	8.83	13.00	0
1,000	6-10-4	10.8	6.6	7.50	9.67	0	21.0	9.0	9.75	13.67	0	13.7	7.5	9.00	10.50	0
2,000	6-10-4	27.2	13.1	11.50	13.25	0	28.5	12.6	9.33	12.58	0	18.1	9.0	9.33	10.58	0
6,000	6-10-4	52.8	23.7	12.08	15.33	0	55.1	23.4	10.67	16.67	0	21.3	9.2	10.38	13.50	2
1,000	6-10-12	16.0	7.2	8.58	14.08	0	19.9	8.4	8.42	11.83	0	16.0	10.9	8.92	11.75	0
2,000	6-10-12	20.2	10.2	10.50	12.75	0	25.8	12.1	7.33	12.92	0	12.6	7.4	7.50	10.58	0
6,000	6-10-12	49.2	18.5	8.67	12.75	0	44.0	17.1	8.83	15.67	0	0	0	0	0	3
8,000	6-10-8	66.5	29.0	10.25	14.25	1	35.7	21.8	6.50	15.25	1	17.5	8.1	12.00	12.75	1
10,000	6-10-8	31.2	15.0	7.50	12.25	2	47.3	23.1	6.35	13.00	2	0	0	0	0	3
12,000	6-10-8	0	0	0	0	3	0	0	0	0	3	0	0	0	0	3

TABLE 8. GROWTH OF PLANTS OF THREE VARIETIES OF AZALEAS WHEN VARIOUS MINOR ELEMENTS WERE ADDED TO FERTILIZER

Minor[1] elements added	Coralbells					Hexe					Pink Pearl				
	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51
	No.	*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*
Check	0	23.5	10.7	11.67	14.75	0	36.2	16.9	8.83	12.83	0	21.8	9.7	7.25	11.58
Complete	0	28.5	15.7	9.83	13.08	2	18.3	7.3	8.00	11.00	0	18.4	8.6	8.33	10.17
Minus iron	1	14.8	7.8	7.50	9.63	1	29.3	13.8	9.50	11.35	0	18.5	8.4	6.00	9.92
Minus magnesium	1	18.8	4.4	8.50	7.42	0	29.9	12.1	8.08	11.67	0	13.7	6.8	5.67	8.50
Minus boron	1	19.5	7.3	7.42	10.25	1	31.1	11.9	9.00	14.25	1	18.8	7.4	6.83	9.83
Minus manganese	0	22.9	10.3	11.83	15.25	1	23.4	11.0	7.38	9.00	0	19.7	9.7	7.75	10.17
Minus copper	0	22.6	10.6	8.92	12.33	0	21.4	9.7	7.83	11.00	1	21.2	7.4	5.88	11.75
Minus zinc	0	15.0	7.1	5.00	10.25	0	25.3	11.1	6.67	11.00	0	12.0	6.0	5.58	7.67

[1] One ton 6-10-8 per acre applied; complete treatment included iron, magnesium, boron, manganese, copper, and zinc.

TABLE 9. GROWTH OF PLANTS OF THREE AZALEA VARIETIES WITH VARIOUS AMOUNTS AND TYPES OF ORGANIC MATTER INCORPORATED INTO SOIL

Type and[1] amount of organic matter	Coralbells					Hexe					Pink Pearl				
	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51	Dead plants	Fresh wt.	Dry wt.	Height 7/18/50	Height 5/17/51
	No.	*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*	*No.*	*Gm.*	*Gm.*	*In.*	*In.*
¼ foreign peat	0	22.3	10.7	12.17	14.33	1	26.1	12.5	12.13	13.50	0	30.6	14.4	9.67	12.50
¼ domestic peat	0	26.5	12.7	13.50	15.75	0	24.6	11.0	10.67	13.00	0	24.3	11.4	8.17	9.75
½ foreign peat	0	18.9	9.1	11.33	11.50	0	26.2	11.6	12.17	16.00	0	19.7	10.0	10.83	12.17
½ domestic peat	0	28.3	13.9	10.00	12.92	0	35.8	15.4	11.00	14.08	0	20.9	10.2	11.17	12.50
¾ foreign peat	0	27.3	12.5	12.33	15.50	0	26.4	11.2	8.17	11.83	0	19.6	9.4	9.67	12.75
¾ domestic peat	1	27.3	14.5	9.17	14.85	0	21.6	9.9	10.50	14.67	0	39.2	17.8	14.67	16.92
¼ peanut hulls	0	22.9	11.1	9.00	14.50	0	19.0	8.9	8.00	12.33	0	41.0	18.2	10.42	15.50
½ peanut hulls	0	34.8	16.6	11.17	17.56	1	13.7	5.1	9.25	14.25	0	35.8	13.9	9.17	20.08
¼ sawdust	0	11.6	6.1	8.00	11.08	2	27.4	10.3	8.50	13.75	0	14.7	7.5	6.25	9.83
½ sawdust	0	9.1	4.9	7.42	8.67	0	17.7	8.2	7.92	13.83	1	7.9	3.3	4.63	5.75

[1] Fertilizer rate—2,000 pounds 6-10-8 per acre.

Separate tests were made on the value of additional quantities of various minor elements and the type and amounts of organic matter used in the soil, Tables 8 and 9. In these tests, the rate of fertilization was 2,000 pounds per acre of 6-10-8 per year.

Results

Azaleas required a high level of fertilization for maximum growth. In some cases they withstood extremely high levels of fertilizer, although growth was not superior to that from lower rates. Many plants grew when a rate of as much as 10,000 pounds per acre of a 6-10-8 was applied. However, any amount over 6,000 pounds per acre was not advisable because of the danger of killing the plants. The additional growth (slight in most cases) did not warrant the extra fertilizer costs. Best growth in sand culture occurred when 6,000 pounds per acre of 6-10-4 per year were applied.

Minor elements were neither harmful nor beneficial. A sufficient supply of minor elements was available – either added as impurities in the commercial fertilizers used or was present in the peat and sand.

When sawdust or peanut hulls were used for organic matter, poor growth occurred at the level of fertilization used (2,000 pounds per acre annually of 6-10-8).

Increased growth of plants did not warrant use of more than 25 per cent peat in the soil. The source of peat (domestic or foreign) made no difference. The data cannot be applied indiscriminately to all soils, because type and reaction of the soil governs to some extent how much acid peat should be used.

SUMMARY

1. Azalea varieties Coralbells, Hexe, and Pink Pearl grown in sand culture developed deficiency symptoms in this order: nitrogen, 40 days; sulfur, 75 days; potassium, 80 days; magnesium, 85 days; boron, 90 days; calcium, 120 days; phosphorus, 185 days; and iron, 210 days.

2. The best growth of azaleas in sand-peat mixtures occurred when 6,000 pounds per acre of 6-10-4 were applied per year in four equal applications spaced 3 months apart.

3. No beneficial effect was observed from use of minor elements with plants growing in a mixture of one-fourth peat and three-fourths sand.

4. Peat was a better source of organic matter than sawdust or peanut hulls. Use of more than 25 per cent peat in the soil mixture is not necessary.