Effect of Slow-Release Fertilizer Rate on Root and Shoot Growth of Container-Grown *Kalmia latifolia* 'Elf', 'Freckles', and 'Goodrich'

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***Kalmia latifolia* 'Elf', 'Freckles' and 'Goodrich' were transplanted from 1 gal (#1) containers into 3 gal (#3) containers in a fir bark/sphagnum peat medium (4:1, v/v) amended with Micromax at 1.75 lb/yd^3. Osmocote 18-6-12 was topdressed in a split application at the following rates: 0.5 lb N/yd^3, 1.0 lb N/yd^3, and 2.0 lb N/yd^3. Results indicated that growth response to fertilizer rate was cultivar-dependent. 'Elf' shoot and root growth increased with increasing fertility while shoot growth of 'Goodrich' was not increased at the high rate and its root growth decreased as fertility increased. Foliage color of all three cultivars was improved by increasing fertility; however, the flower-bud set decreased as the fertilizer rate increased.**

INTRODUCTION

Mountain laurel, *Kalmia latifolia*, grows native throughout the eastern United States and is known for its showy flowers that open in spring. It is related to the rhododendrons and azaleas Recent introductions of horticulturally-superior cultivars have increased interest in the commercial potential of this shrub. However, the lack of knowledge of mountain laurel's cultural requirements hampers its successful production In general, mountain laurel is considered to have the same cultural requirements as other ericaceous plants with special importance being attached to the need for low fertility, proper drainage, and aeration (Jaynes, 1988; Bir and Bilderback, 1989; Hummel et al., 1990) The shortage of knowledge is particularly acute in the area of container production. Jaynes (1988) indicated that an optimal container medium and fertilizer regime for mountain laurel production is not known. Bir and Bilderback (1989) visited mountain laurel nurseries in the eastern United States, surveyed growers nation-wide by telephone, and considered the most recent mountain laurel research from their own and other scientist's programs, and reached the conclusion that "we aren't even close to having all the answers for growing excellent mountain laurel consistently, but with nurserymen and researchers working together we are making progress".

The purpose of the present research was to determine the effect of slow-release fertilizer rate on shoot and root growth and flower bud formation of the mountain laurel cultivars, 'Elf', 'Goodrich' and 'Freckles', grown in three-gallon containers.

MATERIALS AND METHODS

Three mountain laurel cultivars 'Elf', considered easy to grow; 'Freckles' also easy to grow in containers, and 'Goodrich', considered difficult to grow (Bir and Bilderback, 1989; Hummel et al , 1990; Jaynes, 1988) were transplanted the last week of April, 1988, from 1-gal (#1) containers into 3-gal (#3) containers filled with a fir bark/sphagnum peat medium (4:1, v/v). The growing medium was amended by incorporating Micromax micronutrient mix (Sierra Chemical Company, Milpitas, Calif.) at the rate of 1.75 lb/yd^3 (1038 g/m^3). A slow-release fertilizer, Osmocote 18-6-12 (18N-2 6P-10K, Sierra) was applied by topdressing the containers at the following three rates of nitrogen· 0.5 lb N/yd^3 (297 g/m^3), 1.0 lb N/yd^3 (593 g/m^3), and 2 0 lb N/yd^3 (1187 g/m^3) The fertilizer was topdressed in a split application with 1/2 applied early in the season (May 23, 1988) and the other half applied in midseason (July 15, 1988). Uniform plants were selected for the experiment and each plant was measured at transplant time for an initial height and width. All plants were grown over the summer on a gravel nursery bed and watered according to standard nursery practice with overhead sprinkler irrigation.

November 2, 1988, the Virginia Tech Extraction Method (VTEM, also known as the pour-through method) was used to collect extracts of the growing medium for specific conductivity (soluble salts) and pH measurements (Wright, 1987; Yeager et al., 1983). Beginning November 4, 1988, the following growth and development measurements were made on all plants: *Foliage color* was visually evaluated on a scale of 1 to 5 (1 = brown [dead]—to 5 = deep green colored leaves). *Flower-bud set* was evaluated according to the following 1 to 5 scale: 1=no buds to 5=plant heavily loaded with buds. The height and width of the top growth was measured and later combined into a growth index ([height increase + width increase]/2) Plants were also evaluated for *root growth* visible at the periphery of the root ball. *Root length* was rated from 1 to 5 (1 = no visible roots to 5 = roots circling container bottom) *Root ball density* was rated 1 to 4 (1 = no roots visible to 4 = solid root ball with little soil visible) *Plant dry weight* was measured by severing the stems just above the crown and drying in a drying oven until no additional weight loss was measured.

The experiment was designed as a randomized complete block with 36 replications of each cultivar and fertilizer treatment. VTEM was done on 6 replicates of each cultivar and fertilizer treatment. Analysis of variance (ANOVA) was performed on each cultivar to determine the significance of fertilizer treatments and a Waller-Duncan K-ratio t test was used to make treatment comparisons (Steel and Torrie, 1960).

RESULTS AND DISCUSSION

Shoot Growth, Foliage Color and Bud Set. Cultivars were analyzed separately because they have very different growth habits and performance in containers. 'Elf' has a narrow, upright growth habit while 'Freckles' and 'Goodrich' tend to spread. 'Goodrich', as indicated previously (Jaynes, 1988; Bir and Bilderback, 1989; Hummel et al., 1990), was difficult to grow in containers while 'Freckles' and 'Elf' grew more readily.

'Elf' shoot growth, as measured by both dry weight and growth index, and 'Freckles' shoot growth, as measured by dry weight, increased significantly with increasing fertilizer rate (Table 1) Dry weight of 'Goodrich' and growth indices of 'Freckles' and 'Goodrich' were significantly greater when the nitrogen rate was increased from 0 5 to 1.0 lb/yd^3, however, growth of these cultivars was not significantly increased at 2.0 lb N/yd^3 The shoot growth response of 'Elf' to the high fertility level is most likely a genetic difference related to the fact that 'Elf' is one of the easier cultivars to grow in containers. Bir and Bilderback (1989) surveyed mountain laurel growers throughout the United States concerning which cultivar they "liked best in containers" and found that 'Elf' and 'Carol' were the most often listed as "best". In contrast, 'Goodrich' appeared on the "worst" list.

Table 1. Effect of Osmocote 18-6-12 on growth and development of three-gallon container-grown *Kalmia latifolia* cultivars, 'Elf', 'Freckles' and 'Goodrich'

Fertilizer rate lb N/yd^3	Foliage color[z]	Root length[y]	Root density[x]	Flower buds[w]	Dry weight (gm)	Growth index[v] (cm)
			'Elf'			
2.0	5.0 a[u]	4.4 a	3.9 a	2.7 c	175.7 a	16.0 a
1.0	3.9 b	4.2[x]ab	3.8 a	3.4 b	140.0 b	13.2 b
0.5	3.2 c	4.1 b	3.5 b	3.9 a	97.5 c	7.5 c
			'Freckles'			
2.0	4.8 a	3.9 a	3.2 b	2.4 c	132.9 a	12.6 a
1.0	4.1 b	4.1 a	3.8 a	3.0 b	114.6 b	11.6 a
0.5	3.5 c	3.7 a	3.5 ab	3.8 a	76.4 c	5.3 b
			'Goodrich'			
2.0	4.6 a	3.2 b	2.5 b	2.1 b	85.5 a	8.8 a
1.0	4.2 b	3.6 a	2.6 b	2.9 a	77.2 a	7.8 a
0.5	3.5 c	3.9 a	3.1 a	3.5 a	52.3 b	4.4 b

[z] Foliage color was rated from 1=brown (dead)—to 5=deep green.
[y] Root length was rated from 1=no visible roots—to 5=roots circling container bottom.
[x] Root density was rated from 1=no roots visible—to 4=solid root ball
[w] Flower bud set was rated from 1=no buds—to 5=heavily budded
[v] Growth index = (height increase + width increase)/2.
[u] Numbers within cultivars and columns followed by the same letter are not significantly different at the 5% level using a Waller-Duncan K-ratio t test

Foliage color and flower-bud set results are shown in Table 1. As the nitrogen rate increased, the foliage color rating of all three cultivars increased indicating plants at higher nitrogen rates had darker green leaves. Nitrogen rates had the opposite effect on flower bud set (Table 1). For 'Elf' and 'Freckles', as the nitrogen rate increased, the flower bud rating decreased indicating plants at the higher nitrogen rates had fewer flower buds. Flower bud set of 'Goodrich' was significantly decreased only at the highest, 2.0 lb N/yd^3, rate.

Root Growth. 'Elf' root length rating was greatest at the 2.0 and 1.0 lb N/yd^3 rates; however, the difference between the 1.0 and 0.5 lb N/yd^3 rates was not significant. 'Elf' root density was greatest at the 2.0 and 1.0 lb/yd^3 nitrogen rates. Nitrogen rate had no significant effect on 'Freckles' root length. 'Freckles' root density rating was greater at the 1.0 lb N/yd³ than at the 2 0 lb N/yd³ rate but neither rate was significantly different from the 0.5 lb N/yd³ rate. 'Goodrich' roots were shortest at the 2.0 lb/yd³ nitrogen rate. Root density of 'Goodrich' was greatest in the 0.5 lb N/yd³ treatment. The finding that root growth of 'Elf' was greater at the medium and high fertilizer rates while root growth of 'Freckles' and 'Goodrich' was, in general, greater at the low and medium fertilizer rates is comparable to the shoot growth results for these three cultivars.

Soluble Salts and pH. Fertilizer rate had no effect on pH of 3-gal container-grown 'Elf', 'Freckles' and 'Goodrich' plants in this experiment (Table 2). Although soluble salt levels increased as the fertilizer rate increased, only the 2.0 lb N/yd³ rate was significantly greater than the 0 5 and 1 0 lb N/yd³ rates. VTEM was done at the end of the growing season, November 2, while the fertilizer was applied in split applications on 23 May and 15 July. This may account for the relatively low levels of soluble salts in the VTEM extracts in this experiment. Further research is needed to determine the soluble salt level(s) associated with optimal growth of these mountain laurel cultivars.

Table 2. Effect of Osmocote 18-6-12 on end of season conductivity and pH as determined by the VTEM on three-gallon container-grown *Kalmia latifolia* cultivars 'Elf', 'Goodrich' and 'Freckles'

	'Elf'		'Freckles'		'Goodrich'	
Fertilizer rate lb N/yd³	Conductivity[z] (µS/cm)	pH	Conductivity (µS/cm)	pH	Conductivity (µS/cm)	pH
2 0	182 3 a[y]	4.2 a	213 2 a	4 4 a	254 3 a	4.1 a
1 0	122 3 b	4 0 a	122 3 b	4 3 a	130 3 b	4 1 a
0.5	103 7 b	4 1 a	92 3 b	4 2 a	104 8 b	4 2 a

[z] Soluble salts were extracted from the container by the pour-through (VTEM) method and electrical conductivity of the solution measured with Radiometer, Inc Model CDM80 conductivity meter To convert units in the table from µS/cm to mmho/cm, multiply by 0.001

[y] Numbers within cultivars and columns followed by the same letter are not significantly

When the results of all growth and development parameters for the three mountain laurel cultivars in this experiment are taken into consideration, several conclusions seem warranted. The first, and not unexpected, conclusion is that mountain laurel growth response to fertility is cultivar dependent A cultivar like 'Elf' responded to increasing fertilizer levels and produced more shoot and root growth Shoot growth of a cultivar like 'Goodrich' was not increased at the highest fertilizer rate and root growth of this cultivar decreased with increasing fertility.

In this experiment, foliage color of all three cultivars improved as the fertilizer rate increased; however, the effect of fertilizer on flower-bud set was just the opposite Flower-bud set decreased as fertilizer rate increased. A second, and again not unusual, conclusion is that mountain laurel plants fertilized to produce the maximum vegetative growth and deepest green leaves will likely not produce the greatest number of flowers the next spring. To produce high-quality mountain laurel the grower needs to understand the growth response of each cultivar to container culture, and, if it proves impossible to do all three, the grower may have to determine whether producing rapid growth, a well-developed root system, or flower-covered plants is more desirable

It is essential that researchers and nursery growers continue to work together to develop the information needed to produce high-quality mountain laurel in containers.

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