Nitrogen Nutrition of Container Grown *Hemerocallis* x 'Stella de Oro'[1]

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Abstract

We compared growth for plants 90 days from potting in 4 l (#1) nursery pots and growing outdoors in either peat moss: sandy loam: perlite (2:2:3 by vol) or peat moss: pine bark: perlite (1:1:1 by vol). Both media received the same nutrient charge and fertilizer treatments. During the 1985 season we applied weekly fertilizer levels of 0, 100, 200, 300, 400, 500, and 600 ppm of reagent grade ammonium nitrate, to which was added 125 ppm potassium chloride. During the 1986 season we repeated the study with fertilizer levels of 0, 400, 800, and 1200 ppm ammonium nitrate. For fertilizer levels there were significant differences in plant width, grade, fresh and dry weights and sum of fans—sum of fan diameters 2 cm (0.8 in) above soil surface—both years with 400 ppm resulting in optimum growth. For media there were no differences during 1985, but there were significant differences for fresh and dry weights during 1986, and for root dry weight and fresh weight gain, with the highest means from the soil-based medium.

Index words: daylily, herbaceous perennial, fertilization

Significance to the Nursery Industry

When all measurements from both years are examined, 400 ppm ammonium nitrate applied weekly and the soil-based medium result in the optimum growth for *Hemerocallis* x 'Stella de Oro.' On the other hand, 200 ppm ammonium nitrate is the lowest level of nitrogen that can be used to result in salable plants (grade 3 or above). With increasing industry interest in lowering production inputs, and decreasing potential contamination of water, 200 ppm may indeed be the optimum level. Whether the increased growth from using a soil-based medium is economical will depend on each nursery.

These results are similar to those for the other cultivars in our study including Puddin, Pardon Me, Maybe So, Ancient Trail, and Mary Todd with amount of nutrient uptake varying with cultivar (1). In addition, we found 3 to 4% tissue nitrogen to be a suitable range for favorable growth of *Hemerocallis*. This genus of herbaceous perennials obviously responds to high levels of ammonium nitrogen fertility. Whether it responds similarly to nitrate sources remains to be studied, as does the effect of fertility on subsequent year's flowering.

Introduction

Production of herbaceous perennial plants has traditionally taken place in the field, but recently this trend has shifted toward container grown plants that facilitate establishment in the landscape, and extend the planting season (5, 8, 14). In order to successfully adapt container production practices for herbaceous perennial plants, efficient management of fertility, container media, and other cultural practices are essential. The objectives of this study were to observe the interaction of nutrient levels and potting media and to ascertain the optimal level of nitrogen fertility for *Hemerocallis* x 'Stella de Oro' production. *Hemerocallis* (daylily) is one of the most important herbaceous perennial genera, and 'Stella de Oro' exhibits a comparatively long period of flowering (3, 4, 17, 18).

Container production of landscape plants originally utilized a sand-based mixture (8). With increased costs of shipping, light weight mixes containing peat became available to growers (7, 8). As the cost of peat escalated, other alternatives have been used for herbaceous perennial production including sewage sludge, bark, soil and peat mixtures (6, 13, 15, 16).

Compared to traditional greenhouse crops and bedding plants, little information exists on the nutritional requirements of many herbaceous perennials (9, 14). For daylily, cultivation is best in acid soil, fertilized in spring and summer with moderate applications of 5N-4.3P-4.2K (5-10-5) or 5N-4.3P-8.3K (5-10-10), depending upon existing soil nutritional status (12). For daylily grown in containers, additional fertilizer is needed to compensate for leaching (2, 10).

Materials and Methods

In the 1985 field season, treatments were a soil-based medium of Canadian sphagnum peat moss: sandy loam soil: horticultural grade perlite (2:2:3 by vol) and bark-based medium of Canadian sphagnum peat moss: horticultural grade perlite: Premier pine bark minichips® (1:1:1 by vol). Each was amended with 43.1 kg/cu m (72.8 lb/cu yd) dolomitic limestone, 14.4 kg/cu m (24.3 lb/cu yd) superphosphate (0-20-0), 5.8 kg/cu m (9.7 lb/cu yd) gypsum (Cal-sul®), and 0.072 kg/cu m (0.12 lb/cu yd) Peter's Fritted Trace Elements®. Both media received 0, 100, 200, 300, 400, 500, or 600 ppm of reagent grade ammonium nitrate (0, 34, 68, 102, 136, 170, and 204 ppm N); 125 ppm (79 ppm K) potassium chloride was combined in solution with all ammonium nitrate levels. Treatment solutions were applied weekly at 500 ml per pot.

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Table 1. *Hemerocallis* 'Stella de Oro' width, sum of fans, grade and weights for levels of ammonium nitrate averaged over soil and bark media in containers, 90 days after planting in 1985.

Level (ppm)	Plant width (cm)	Sum of fans (cm)[z]	Grade[y]	Fresh weight (g)	Dry weight (g)
0	12.4	4.0	2.2	57.9	12.1
100	19.3	6.1	2.7	78.1	14.3
200	25.0	9.1	3.3	103.1	19.5
300	27.3	11.0	3.3	108.4	21.3
400	30.4	13.0	3.9	122.1	22.1
500	30.4	15.7	4.3	132.2	24.1
600	31.9	20.9	4.8	139.1	28.9
Regression equations			R^2		
Plant width	Y = 16.0 + 0.03X		0.84		
Sum of fans	Y = 3.5 + 0.03X		0.92		
Grade	Y = 2.2 + 0.004X		0.94		
Fresh weight	Y = 66.1 + 0.13X		0.80		
Dry weight	Y = 12.5 + 0.03X		0.80		

[z]Sum of fan diameters measured 2 cm above soil and summed for each pot.
[y]Grade: 0 = dead, 3 = saleable, 5 = excellent.

On June 9, 1985, plants obtained from Klehm Nurseries, South Barrington, Illinois were assigned to treatments randomly after sizing to a fresh weight class of 25 to 40g (1.0 to 1.5 oz). Plants were potted into both media in 4 l (# 1) containers and placed on Propex® ground cloth at 30 cm (1 ft) final spacing (center to center) at the Horticulture Research Center in South Burlington, Vermont. One plant per pot constituted a replicate, with treatments replicated four times in a randomized complete block design and randomly placed within each block.

During 1985, the following measurements were taken 90 days after potting: plant width (at the widest foliar point), sum of fans, grade, and total fresh and dry weights. Sum of fans was an objective measurement of the diameter of each of the fans (ramets) taken 2 cm (0.8 in) above the soil surface, then summed, to give the total plant (pot) value. Grade was a subjective salability rating from 0 to 5, 0 being dead and 5 denoting exceptional size, depth of green foliage color, and number of fans.

Second season treatments included the same two media used in the first season and fertilizer levels of 0, 400, 800, and 1200 ppm of reagent grade ammonium nitrate (0, 136, 272, and 408 ppm N). These levels were selected on the basis of the first year's work, reducing number of treatments from 14 to 8 to permit increased replication from 4 to 12. Additional measurements included total fresh weight at the beginning and end of the 90 days, and root dry weights at the end.

Data for all studies were analyzed by Analysis of Variance (ANOVA) and regression methods. Dependent variables were transformed where needed to satisfy the assumptions of homogeneity of variance and normal distribution (11).

Results and Discussion

In 1985, means for plant width, grade, sum of fans and weights increased linearly with increasing nitrogen levels (Table 1). There were no interactions between level of ammonium nitrate and type of medium, and no significant differences between media. Peaks for widths occurred at 200 ppm ammonium nitrate in the soil-based medium and at 300 ppm in the bark-based medium. Peaks for sum of

Table 2. *Hemerocallis* 'Stella de Oro' sum of fans, grade and weights in container treatments 90 days after planting in 1986.

Treatment	Sum of fans (cm)[z]	Grade[y]	Fresh weight (g)	Dry weight (g)
NH_4NO_3 level (ppm)				
0	6.6	2.4	64.0	12.6
400	13.9	3.8	111.8	19.0
800	12.8	3.8	113.5	18.5
1200	14.9	3.9	119.9	20.3
Media[x]				
Bark	11.3NS	2.1NS	94.8*	16.0*
Soil	12.8	3.5	109.9	19.2
Regression equations				R^2
Sum of fans	$Y = 7.2 + 0.02X - 0.0X^2$			0.78
Grade	$Y = 2.5 + 0.004X - 0.0X^2$			0.90
Fresh weight	$Y = 66.6 + 0.12X - 0.001X^2$			0.79
Dry weight	$Y = 13.1 + 0.01X - 0.0X^2$			0.60

[z]Sum of fan diameters measured 2 cm above soil and summed for each pot.
[y]Grade: 0 = dead, 3 = saleable, 5 = excellent.
[x]NS = no significant difference, significant difference at 0.05 level*.

Table 3. ***Hemerocallis*** **'Stella de Oro' root weights in response to container treatments 90 days after planting in 1986.**

Treatment	Final fresh weight (g)	Dry weight (g)	Fresh weight net gain (g)[z]
NH_4NO_3 level (ppm)			
0	55.3	11.1	27.7
400	85.5	15.2	73.3
800	85.4	14.1	79.2
1200	87.7	15.0	79.5
Media[y]			
Bark	73.8*	12.7**	56.4**
Soil	83.1	15.0	73.4
Regression equations			**R^2**
Final fresh weight	$Y = 56.9 + 0.08X - 0.0X^2$		0.74
Dry weight	$Y = 11.5 + 0.009X - 0.0X^2$		0.41
Fresh weight net gain	$Y = 29.4 + 0.1X - 0.001X^2$		0.80

[z]Root fresh weight at end of study minus initial plant fresh weight (not shown).
[y]Significant difference at 0.05 level* or 0.01 level**.

fans and grade occurred at 400 ppm in the soil-based medium and at 600 ppm in the bark-based medium. In the soil-based medium weights peaked at 100 ppm, and in the bark-based medium fresh weights peaked at 400 ppm and dry weights at 500 ppm.

In 1986, means for sum of fans, plant grade, and weights peaked at 400 ppm for both media (Table 2) and increased quadratically with increasing levels of nitrogen. As in the previous year there were no interactions between levels of ammonium nitrate and type of media, but there were significant differences between media for fresh and dry weights, the soil-based medium resulting in higher weights. Compared with 1985 peaks for grade and sum of fans means at 600 ppm, the 1986 figures are likely to give a more accurate reflection of the optimum fertility level due to the larger sample size and resulting variance stabilization.

Root weights increased quadratically with increasing levels of ammonium nitrate (Table 3). In the soil-based medium root dry weight decreased with nitrogen treatments above the 400 ppm level while it was level for the bark-based medium, resulting in a poor fit for the equation for dry weight. Although there were no interactions between level of ammonium nitrate and type of medium, there were significant differences between media for each measurement. The soil medium resulted in higher weights which is consistent with whole plant weights.

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