Effects of Shade Level and Fertilizer Rate on Yield and Vase Life of *Aspidistra elatior* 'Variegata' Leaves[1]

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Abstract

Aspidistra elatior 'Variegata' plants were grown for 3.75 years in containers under 63% or 73% shade and fertilized with controlled-release fertilizer at rates equivalent to 448, 896, 1344 or 1792 kg N/ha (400, 800, 1200 or 1600 lb N/A) per year. Yield of variegated, but not all-green, leaves was greater under 63% than under 73% shade. Combined yield of green and variegated leaves produced under 63% shade was 42% greater by weight and 47% greater by number than under 73% shade. Fertilizer rate did not affect total yield and neither fertilizer rate nor shade level affected the percent of total leaf production that was green. Leaves were harvested August 1990, January 1991, November 1991 and March 1993 for vase life determinations. Harvested leaves were stored for one week at 4C (40F) and evaluated under indoor conditions of 23 ± 2C (74 ± 4F), 60 ± 16% relative humidity and 12-hour photoperiod at 17 $\mu mol \cdot m^{-2} \cdot s^{-2}$ (107 ft-candles). Treatments did not affect vase life except at a winter harvest when 63% shade-produced leaves lasted 14% longer than 73% shade-produced leaves. Average overall vase life for each of four harvests ranged from 22 to 34 days.

Index words: cut foliage, florists' greens, postharvest.

Species used in this study: barroom plant, cast-iron plant, iron plant (*Aspidistra elatior* Blume cv. 'Variegata').

Significance to the Nursery Industry

Aspidistra elatior 'Variegata' is a durable but slow growing landscape, potted foliage and cut foliage crop. An extremely shade-tolerant plant, significant commercial *Aspidistra elatior* 'Variegata' production occurs in Florida under 73% or greater shade. The results reported here suggest that growers might increase leaf production, with no loss in vase life, by using less shade. In addition, these results indicate that fertilizer application rates can be reduced by 55–67% below those currently published for *A. elatior* without any reduction in yield. Reduced fertilizer application rates, especially for such a slow growing crop, can reduce production costs and the potential for nitrogen leaching and runoff that can be a problem with crops requiring extended production cycles.

Introduction

Aspidistra elatior Blume (cast-iron plant) is an evergreen, subtropical member of the lily family (Liliaceae). It is a durable potted foliage plant for indoor use and a tough, shade-tolerant ground cover in the landscape (2, 3). In addition, the 45–60 cm (18–24 in) long dark green leaves are prized for use in floral arrangements (5). *Aspidistra elatior* is grown in containers for all three markets (interior foliage plant, landscape, cut foliage) and is also field-grown for the latter two. Major production of *Aspidistra elatior* occurs in Florida where it is generally grown under heavy shade (73% or greater), especially as acclimatized foliage for indoor landscaping and cut foliage use where flat leaves are desirable.

Aspidistra elatior is slow growing and the more highly valued cultivar 'Variegata' is even slower growing. This cultivar has extremely variable variegation that is unstable and can revert back to the all-green form. Essentially no research-based cultural information is available for this crop. The only published study evaluating the effects of fertilization rate on growth of *A. elatior* (1) does not provide enough information to allow application rates to be determined or to duplicate environmental conditions under which the experiment was conducted. In addition, no information is available on the effects of cultural conditions on subsequent vase life of harvested fronds. The objective of this research was to determine what effects various fertilizer rates and a reduction in production shade level would have on yield or vase life of *A. elatior* 'Variegata' leaves.

Materials and Methods

This experiment was initiated July 11, 1989, when *Aspidistra elatior* 'Variegata' in 2.8 liter (#1) pots, each pot having one plant with four to five leaves, were repotted into 9.5 liter (#3) pots using a soil mix consisting of Florida sedge peat, pine bark and builders' sand (6:3:1 by vol) amended with dolomite at 4.2 kg/m^3 (7 lb/yd^3) and a micronutrient mix (Micromax, Grace-Sierra, Milpitas, CA) at 0.9 kg/m^3 (1.5 lb/yd^3). The potting medium had an initial pH of 6.0 and contained 11.7% organic matter (Walkley-Black method, 0.5 g sample). Pots were divided into blocks according to the overall variegation of the leaves in each pot.

Half of the planted pots were then placed in a shadehouse below panels of shade fabric that provided 63% shade and the remaining half were placed under 73% shade. The resulting maximum photosynthetically active radiation levels were around 845 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (~ 4,400 ft-candles) and 615 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (~ 3,200 ft-candles) during the summer and 460 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (~ 2,400 ft-candles) and 290 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (~ 1,500 ft-candles) during the winter, respectively, under the 63% and 73% shade panels. The use of a common shadehouse minimized air temperature and humidity differences, that could occur if separate structures were used, from confounding the shade level results. Pots were centered under the 7.3 m × 7.3 m (24 ft × 24 ft) panels, no closer than 2.4 m (8 ft) from below the outside edge of the panels. The

[1]Received for publication September 24, 1993; in revised form June 19, 1995. Florida Agricultural Experiment Stations Journal Series No. R-03459.

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shadehouse was lined with polyethylene film in the winter to help retain warm air supplied by forced air heaters.

A 19N–2.6P–10K ($19N–6P_2O_5–12K_2O$) fertilizer (Osmocote, Grace-Sierra) with a 3–4 month release duration at 21C (70F) was applied every two months to avoid peaks and valleys of nutrient availability associated with using controlled-release fertilizers under high temperature conditions (6). The fertilizer was applied at four rates: 1.8, 3.6, 5.4, or 7.2 g/9.5 liter pot (0.0635, 0.127, 0.19, or 0.254 oz/#3 pot). These fertilizer application rates are equivalent to 448, 896, 1344 and 1792 kg N/ha (400, 800, 1200, 1600 lb N/A) per year on an area basis and bracket published annual rates [1,008 to 1344 kg N/ha (900 to 1200 lb N/A)] for commercial production of containerized aspidistra (8). Plants were irrigated with 2.5 cm (one in) of water using over-head sprinklers three times/week in the summer and two times/week in the winter and were treated with pesticides as needed. Air temperatures ranged from 35C (95F) during the day in the summer to 13C (55F) at night during the winter.

Individual leaves were harvested using clippers for yield and vase life determinations in August 1990, January 1991, November 1991 and March 1993. After harvest, leaves utilized for vase life determinations (3 per replicate) were completely submerged in water for 15 minutes and then placed in polyethylene bags and stored in waxed, corrugated fiberboard cartons for one week at 4.4C (40F).

Upon removal from the cooler, petioles were recut 1 cm (0.4 in) above the base and placed in trays containing floral foam (Smithers-Oasis, Kent, OH) and deionized water. Each foam block had been cut into quarters and presoaked in deionized water. Postharvest room conditions were maintained at 23 ± 2C (74 ± 4F) and 60% ± 16% RH, with 12 hours of light/day at 17 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (107 ft-candles) provided by cool white fluorescent lamps. Vase life was terminated when leaves began to show chlorosis (yellowing) or signs of desiccation (graying, curling).

The experimental design was a randomized complete block with five replications. Experimental unit for yield was the leaf production per pot and for vase life was the average vase life of the three leaves harvested per pot. Statistical analysis was performed by analysis of variance and regression analysis (SAS Institute, Cary, NC).

Results and Discussion

Yield. There were no interactions between fertilizer rate and shade level. The partial reversion of *Aspidistra elatior* 'Variegata' to the green species occurred with time, and it took a year and a half after planting for harvestable all-green leaves to develop. By the end of the experiment 45% of the plants had produced harvestable all-green leaves. Shade level had no effect on yield (fresh weight or number of leaves) or average leaf weight of green leaves (Table 1). The yield response of green leaves to fertilizer rate was quadratic and peaked at the 1,344 kg N/ha/yr (1,200 lb N/A/yr) rate—the top end of the recommended fertilizer rate for *Aspidistra elatior* (8). There was no fertilizer rate effect on average weight of green leaves.

Yield of variegated leaves produced under 63% shade was 58% greater by weight and 66% greater by number than under 73% shade but was not affected by fertilizer rate. The reduced yield of variegated but not of all-green leaves at the lower light level may have been due to reduced amounts of chlorophyll being present to trap radiant energy in the variegated leaves (10). The response of average leaf weight to fertilization rate was cubic for variegated leaves. The low weights at the highest fertilizer rate may have been due to higher soluble salts in the media but the cause of the dip in average leaf weight at the 896 kg N/ha/yr rate is unknown.

Combined yield of green and variegated leaves had a similar pattern to that for variegated leaves because variegated leaves accounted for two-thirds or more of total yield (on a fresh weight basis) for each main effects treatment. Overall

Table 1. Effects of two shade levels and four fertilizer rates on yield of *Aspidistra elatior* planted July 11, 1989, and harvested in August 1990, January 1991, November 1991 and March 1993.[z]

	Green leaves[y]			Variegated leaves			Combined		
	Weight (g)	Number	Average wt (g)	Weight (g)	Number	Average wt (g)	Total weight (g)	Total number	Average wt (g)
Shade level									
63%	139.7	12.4	11.9	431.4	44.1	9.6	571.1	56.4	10.4
73%	130.7	11.7	11.6	272.6	26.6	9.8	403.3	38.3	10.3
Significance[x]	ns	ns	ns	*	**	ns	*	**	ns
Fertilizer rate (kg N/ha/yr)									
448	120.1	11.8	12.6	401.2	38.4	10.4	521.3	50.2	10.4
896	104.2	9.1	11.3	360.0	35.3	9.2	464.2	44.4	9.2
1344	288.5	23.3	12.3	252.5	25.6	10.8	541.0	48.9	10.0
1792	28.0	3.8	10.2	394.4	42.0	8.5	422.3	45.8	8.4
Significance[x]	Q**	Q**	ns	ns	ns	C*	ns	ns	L*

[z]There were no significant interactions between shade level and fertilizer rate.

[y]Forty-five percent of the plants produced some harvestable all-green leaves.

[x]*,**,[ns]Significance at P = 0.05, 0.01 or nonsignificant, respectively. L = linear, Q = quadratic, C = cubic.

average leaf weights declined linearly as fertilizer rate increased. The percent of total leaf production that was all-green was not affected by shade level or fertilizer rate and averaged 16% by weight (data not shown). However, F-value for blocking (replication) was highly significant; the blocking sum of squares accounted for over 70% of model sum of squares indicating that blocking by level of initial variegation, as was done in this experiment, is beneficial.

Vase life. Vase life means for the four harvests ranged from 21.8 to 33.5 days, in agreement with published values (7). Vase life of virtually all leaves was terminated due to chlorosis, and there were no interactions between fertilizer rate and shade level. Interestingly, variegated leaves exhibited longer vase life than all-green leaves, possibly because initial chlorosis is more obvious on all-green leaves. This vase life increase ranged from 17% for harvest 4 to 38% harvest 3 (no harvestable all-green leaves were present at the first two harvests).

Fertilizer application rate had no effect on vase life at any harvest. Production shade level effects were only significant (P = 0.03) for the January 1991 harvest when vase life of leaves produced under 63% shade (mean = 23.3 days) had 14% longer vase life than leaves produced under 73% shade (mean = 20.4 days). This harvest occurred when ambient light levels were lowest (compared to the other harvest dates) and these levels could have resulted in lower carbohydrate reserves being present at the time of harvest in the leaves produced under the heavier shade. Reduced vase life of carnations has been associated with reduced substrate levels (4). The three day increase in postharvest longevity of aspidistra leaves would normally not be of consequence in flower arrangements since most flowers do not last longer than the 20 day average for the 73% shade-produced leaves. A similar small reduction in postharvest yellowing of leaves produced under 63% compared to 73% has been reported for leatherleaf fern (*Rumohra adiantiformis* [Forst.] Ching) (9).

These results suggest that production of containerized *A. elatior* 'Variegata' could be increased, compared to current practice, by reducing production shade levels from 73% to 63%. In addition, reducing production fertilizer application rates from 1,008 to 1344 kg N/ha (900 to 1200 lb N/acre) per year to 448 kg N/ha (400 lb N/acre) per year could reduce costs and nitrogen contamination potentials without lowering yield or vase life of *A. elatior* 'Variegata' leaves.

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