used to determine prices on a scale of one to six, with rankings of 1 being most important. The most important factor used to determine prices was cost of production, which received a number one ranking from 49 percent of growers. Comparison to other firms and market demand were the next most important factors, each top-ranked by 17 percent of firms. These two factors also were rated as important secondary factors by 30 percent and 29 percent of firms, respectively. Grade (quality) was the first-ranked factor by 11 percent of growers. Inventory levels (availability) of product were consistently rated as a tertiary consideration in price determination, with 22% and 23% of firms giving this a third or fourth ranking, respectively. These results support the contention that a significant portion of growers probably do not base product pricing on costs of production, and probably do not consider total costs in making business decisions. One important step towards improving the pricing of ornamental products would be to educate growers about production costs and use of cost information in business management.

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Growth and Flowering of 'Alice du Pont' Mandevilla in Response to Sumagic[1]

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Abstract

Vegetative growth of 'Alice du Pont' mandevilla can be controlled by selection of an appropriate foliar application rate of Sumagic (uniconazole) and application interval. A single application of 5 to 20 ppm ai Sumagic (uniconazole) controlled vegetative growth for only 3 to 4 weeks; after this time, growth rates were similar to control plants. Multiple applications of 5 to 20 ppm ai Sumagic (uniconazole) effectively restricted vegetative growth; as the concentration of Sumagic (uniconazole) increased, the interval between applications increased from about 4 (5 ppm) to 6 (20 ppm) weeks. A single application of higher rates (30 to 120 ppm) of Sumagic (uniconazole) was phytotoxic. Generally, time to flowering increased and flower diameter decreased when application rate increased.

Index words: growth retardant, growth regulator, tropical nursery crop, landscape plants

Growth regulator used in this study: Sumagic (uniconazole), (E)-1-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl)-1-penten-3-ol.

Species used in this study: 'Alice du Pont' mandevilla (*Mandevilla* sp. 'Alice du Pont').

Significance to the Nursery Industry

The vigorous, vining growth habit of 'Alice du Pont' mandevilla is desirable in the landscape but can be troublesome during production and marketing. Sumagic (uniconazole) can be used to effectively control excessive vegetative growth of 'Alice du Pont' mandevilla if an appropriate application rate and interval between applications are used. Lower rates of Sumagic (uniconazole) require more frequent application to maintain a compact growth habit; higher rates can delay flowering. Sumagic (uniconazole) should be reapplied when the majority of plants begin

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to grow normally. Since the growth restriction of Sumagic (uniconazole) persists for 28 to 40 days with application rates from 2.5 to 20 ppm, the final application can be timed so that manageable plants can be marketed with flower buds. By the time plants are installed in a landscape, growth inhibition from the application of Sumagic (uniconazole) should be minimal.

Introduction

The genus *Mandevilla* consists of more than 100 species of tropical and subtropical twining vines and shrubs (1). 'Alice du Pont', the most widely available cultivar of *Mandevilla*, is used as a horticultural annual in temperate areas where it flowers over a long season on arbors or other supports. Its vigorous growth rate is valued in the landscape but can be troublesome during production, shipping, and marketing. Although growers and retailers are interested in marketing manageable plants in flower, excessive vegetative growth twines around other plants and structures.

Sumagic (uniconazole), a triazole plant growth retardant, has been used to reduce stem elongation in many floricultural crops, including lisianthus (5), hybrid lilies (2), and hibiscus (6). Research on the effects of Sumagic (uniconazole) on vining plants has been limited. Sumagic (uniconazole) reduced internode lengths of *Epipremnum aureum* with a drench of 0.2 to 0.8 mg ai/pot (3) and of *Trachelospermum asiaticum* with a drench or foliar spray of 1.25 to 5 mg ai/pot (4). The objectives of this research were to determine how rate and number of foliar applications of Sumagic (uniconazole) influenced vegetative growth and flowering of 'Alice du Pont' mandevilla.

Materials and Methods

In each of 3 experiments, 2-node cuttings of 'Alice du Pont' were treated with a quick dip of 4000 ppm K-IBA dissolved in water and stuck in a commercial peat moss and perlite medium. Rooted cuttings were potted into 3.8 l (1 gal) containers using a medium of 7 pine bark:1 sand (by vol) amended per m^3 (yd^3) with 3.6 kg (6.0 lb) dolomitic limestone, 8.3 kg (14.0 lb) of Osmocote 18N-2.6P-10K (18-6-12) and 0.9 kg (1.5 lb) of Micromax. New shoots were pruned to 2 nodes before applying Sumagic (uniconazole) as a foliar spray.

In Experiment 1, one foliar application of 0, 30, 60, 90, or 120 ppm ai Sumagic (uniconazole) was applied to 5 single-plant replicates on February 9, 1989. In Experiment 2, two applications of Sumagic (uniconazole) were compared with one application using 8 single-plant replicates. Sumagic (uniconazole) at 0, 5, 10, 15, or 20 ppm ai was applied on June 14; a second application to one-half of the plants in each treatment rate was made on July 14. The criterion for timing of the second application was when the distal (youngest) internode was longer than 2.5 cm (1 in) on one-half of the plants treated with the intermediate rates (10 or 15 ppm) of Sumagic (uniconazole). In Experiment 3, all plants received multiple applications of Sumagic (uniconazole). Sumagic (uniconazole) from 0 to 20 ppm ai in 2.5 ppm increments was first applied to 10 single-plant replicates on August 16. Sumagic (uniconazole) was reapplied to each treatment as necessary when the distal internode of one-half of the plants within a treatment rate was longer than 2.5 cm (1 in). The interval between applications at each Sumagic (uniconazole) concentration was recorded.

Plants in each experiment were arranged in a completely randomized design in a double-polyethylene greenhouse with a heating set point of 22°C (72°F) and a ventilation set point of 27°C (80°F). Plants were irrigated as needed and were fertilized weekly with 300 ppm N from 20N-4.3P-16.6K (20-10-20). Sumagic (uniconazole) was applied just prior to runoff using a low pressure hand-pump sprayer. For the initial application of Sumagic (uniconazole) in all experiments, about 4 ml (0.14 oz) of solution was applied per plant; with multiple applications, volumes applied increased as plants grew. Plants were allowed to twine around strings attached to the greenhouse superstructure; plant height was determined weekly by measuring the distance between the surface of the growing medium and the tip of the shoot. When the first flower was fully open on each plant, height at flowering, flower diameter, and time to flowering were determined. Rate response to Sumagic (uniconazole) and the significance of application number were determined by regression analysis and analysis of variance (ANOVA), respectively.

Results and Discussion

In Experiment 1, plant height at flowering decreased with increasing rate of Sumagic (uniconazole) (Table 1). Growth (weekly increase in plant height) was suppressed for 5 to 7 weeks after treatment; after this time, growth rates of treated plants were similar to control plants (data not shown). All rates were excessive since cupping and twisting of leaves occurred. Time to flowering increased and flower diameter decreased with increasing rates of Sumagic (uniconazole). Starman (1991) reported delayed flowering and decreased flower size of lisianthus by foliar sprays of Sumagic (uniconazole).

In Experiment 2, plant height at flowering was suppressed with increasing rates of one application of 5 to 20 ppm Sumagic (uniconazole) (Table 2), similar to the results in Experiment 1. However, growth was suppressed for only 3 to 4 weeks regardless of rate (Fig. 1), and no phytotoxicity was observed. Effective height control until flowering was not obtained with any rate of one application of Sumagic (uniconazole).

Two applications of 5 ppm Sumagic (uniconazole) were inadequate in controlling plant height (Fig. 1). Two applications of 20 ppm resulted in cupping and twisting of leaves; the second application was made prior to the resumption of

Table 1. Influence of one foliar application of Sumagic (uniconazole) on height and flowering of 'Alice du Pont' mandevilla (Experiment 1). Time is from first application of Sumagic.

Sumagic rate (ppm)	Height at flowering (cm)	Weeks to flower	Flower diameter[z] (cm)
0	200.4	11.4	9.4
30	140.5	11.9	8.9
60	130.2	11.7	7.6
90	126.4	12.1	8.0
120	80.8	12.4	8.0
Significance of rate[y]	C*	L*	L*

[z]First flower that opened.

[y]L = linear or C = cubic regression responses, 5% level (*).

Table 2. Influence of one or 2 foliar applications of Sumagic (uniconazole) on height and flowering of 'Alice du Pont' mandevilla (Experiment 2). Time is from first application of Sumagic.

Sumagic rate (ppm)	Height at 9 weeks (cm)	Height at flowering (cm)	Weeks to flower	Flower diameter[z] (cm)
0	228.5	231.4	8.7	10.5
		One application		
5	198.6	196.9	8.8	9.9
10	223.5	204.6	8.4	9.0
15	178.9	192.8	9.0	9.4
20	194.1	181.5	8.4	9.4
Significance of rate[y]	C*	L**	NS	Q*
		Two applications		
5	178.0	193.0	9.2	9.5
10	67.1	132.3	10.7	9.0
15	55.1	135.8	11.1	9.2
20	31.5	131.1	11.7	8.1
Significance of rate	C**	Q**	C**	C**
ANOVA				
Application	***	***	***	NS
Rate*application	***	*	***	NS

[z]First flower that opened.

[y]NS, ***, **, * = not significant or significant at 0.1, 1, or 5% level, respectively; L = linear, Q = quadratic, or C = cubic regression responses. Control included in regression analyses.

normal growth. The most effective treatments in restricting vegetative growth without inducing phytotoxicity were 2 applications of 10 or 15 ppm Sumagic (uniconazole). Plant height 9 weeks after the first application of Sumagic (uniconazole), or about 2 weeks prior to flowering for these 2 treatments, was 55 to 67 cm (22 to 26 in) (Table 2), which was judged to be a desirable height range for ease of shipping. At this stage, flower buds were well developed and about 2.5 cm (1 in) long. By the time plants treated twice with 10 or 15 ppm Sumagic (uniconazole) had flowered (about 11 weeks after first treatment), growth rates were similar to control plants (Fig. 1).

Time to flowering increased by 4 to 21 days with increasing rates of Sumagic (uniconazole) after 2 applications, but not with one application when compared to control plants (Table 2). Flower diameter decreased (up to 23% compared to control plants) with increasing rates of Sumagic (uniconazole) regardless of the number of applications, but this decrease did not detract from the appearance of the plants.

In Experiment 3, multiple applications of Sumagic (uniconazole) from 5 to 20 ppm effectively suppressed vegetative growth (Fig. 2). As the rate of Sumagic (uniconazole) increased, the interval between applications increased (Table 3). The only rate that was not effective in controlling plant height for the duration of the experiment was 2.5 ppm; the growth rate of these plants was similar to control plants from week 7 to 9 (Fig. 2). However, since the growth rate of plants treated with 2.5 ppm Sumagic (uniconazole) was similar to that obtained with the other treatments after 9 weeks, we conclude that the interval between Sumagic (uniconazole) applications prior to week 9 was too great for the 2.5 ppm treatment. If Sumagic (uniconazole) had been reapplied earlier, plants treated with 2.5 ppm would be expected to perform similarly as the other treated plants. Flowering

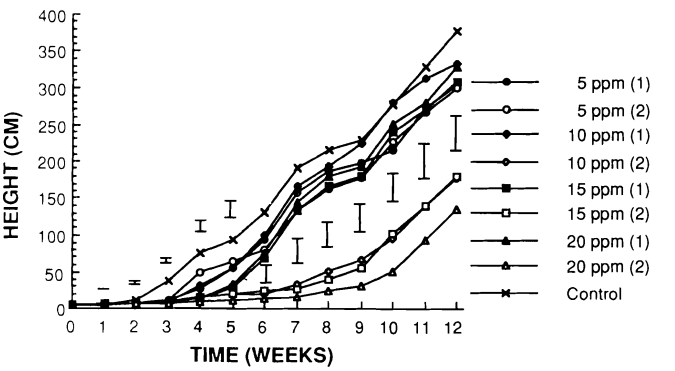

Fig. 1. Height of 'Alice du Pont' mandevilla in response to one (1) or two (2) foliar applications of Sumagic (uniconazole) in Experiment 2. Time is from first application of Sumagic. Bars indicate LSD (5% level).

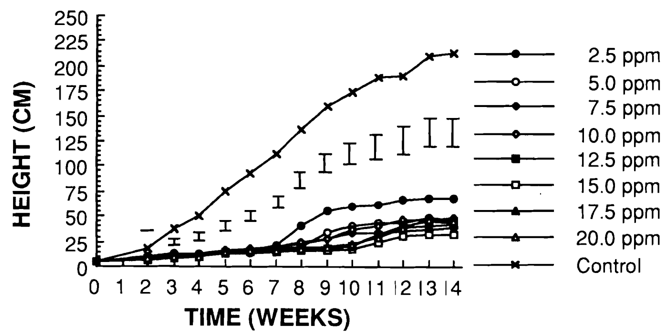

Fig. 2. Height of 'Alice du Pont' mandevilla in response to multiple foliar applications of Sumagic (uniconazole) reapplied as needed in Experiment 3. Time is from first application of Sumagic. Bars indicate LSD (5% level).

Table 3. Average interval between multiple foliar applications of different rates of Sumagic (uniconazole) for effective control of vegetative growth of 'Alice du Pont' mandevilla (Experiment 3).

Sumagic rate (ppm)	Interval (days)[z]
2.5	28
5.0	31
7.5	32
10.0	36
12.5	38
15.0	38
17.5	38
20.0	40

[z]Sumagic reapplied when the first internode of one-half of the plants within a treatment was longer than 2.5 cm (1 in).

data are not included since flower buds abscised on all plants, including control plants, probably because of overwatering.

In all experiments plants treated with the same rate of Sumagic (uniconazole) began to grow normally at different intervals following application. Therefore, timing of reapplications is important. Plants that are not retreated as they begin to grow normally will rapidly increase in height; phytotoxicity may occur if plants are retreated too soon.

Height of 'Alice du Pont' mandevilla was controlled by selection of both an appropriate rate of Sumagic (uniconazole) from 5 to 20 ppm and application interval. Time from the last application of Sumagic (uniconazole) until growth rates became similar to those of control plants was dependent upon the rate of Sumagic (uniconazole). The importance of application rate was indicated in Experiment 1 when phytotoxicity occurred with 30 ppm or greater Sumagic (uniconazole) and in Experiment 2 when the application interval for the 20 ppm treatment was too short. However, 20 ppm was not phytotoxic in Experiment 3 because Sumagic (uniconazole) was reapplied to individual treatments only after plants resumed growth.

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