Daylength Affects Rhizome Development and Plant Growth of Two *Achimenes* Cultivars©

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Two recently developed, unnamed cultivars of achimenes (*Achimenes* hybrids) A04 and A16, were grown for 15 weeks in growth chambers at 20 °C (68 °F) at 8- and 16-h daylengths. At harvest, cultivars differed in several growth characteristics. Both cultivars grown in 8-h daylengths developed more rhizomes than plants grown in 16-h daylengths. In addition, cultivar A16 was approximately 4 cm larger and produced more nodes than A04. Cultivar A16 also had greater plant dry weight than A04. When grown in 16-h daylengths, cultivar A16 produced the most flowers. The research presented here provides evidence that a shorter daylengths affect rhizome development in achimenes.

INTRODUCTION

Achimenes are also commonly known as the hot water plant, magic plant, or monkey faced-pansy, and are a member of the Gesneriaceae,. Achimenes were first brought to England (Jungbauer, 1977) and have been cultivated since the end of the 18th century. Popularity of the genus has waned and surged over the last 200 years, with an increased interest in the 1940s after breeding efforts by Michelssen, a German company, C. Broertjes of the Netherlands, and by Paul Arnold, Binghamton, New York, and H.E. Moore of Cornell University in the United States (Vlahos, 1991). Recently there has been a renewed interest.

There is potential for increased greenhouse production and marketing. Achimenes are mainly grown as summer-flowering houseplants but are also well suited for use as pot plants, in mixed containers and for hanging baskets (De Hertogh and Le Nard, 1993; Wilkins, 2005). Plants are available in an array of colors including white, scarlet, salmon, pink, blue, lavender, purple, and yellow and bloom profusely year around indoors and from early summer to fall outdoors. Achimenes are more widely grown and distributed in Europe as compared to the United States of America, where rhizome or cutting availability is limited.

Significant research on environmental factors influencing the induction and initiation of storage organs (bulbs, tubers, corms, etc.) with numerous plant species has been conducted. In many plant species that are affected by photoperiod or daylength, short days (SD) promote storage organ initiation or development and dormancy induction with reduced vegetative growth (Rees, 1992). Achimenes growth and development has not been thoroughly investigated and characterized, including the rhizome formation stimulus (or stimuli) and subsequent dormancy period. Growth and flowering of achimenes occurs throughout the summer, and in autumn, growth begins to decline and flowering decreases or ceases and enters into a dormant phase (Lyon, 1967). An experiment was designed to investigate daylength effects on rhizome development and other growth parameters in two new achimenes selections.

MATERIALS AND METHODS

Rhizomes of recently developed, unnamed achimenes cultivars, A04 and A16, were obtained from Oglevee, Inc. (Connellsville, Pennsylvania). Rhizomes were planted in 128-cell plug trays with Metro Mix 360 (Scott's Company; Marysville, Ohio). Plugs were grown in a glass greenhouse at 42 °N latitude for 10 weeks at 21 °C (70 °F) under natural daylengths (December to February), after which 20 uniform plugs of each cultivar were selected and planted in 10-cm (4-in.) plastic pots using Metro Mix 360. Two weeks after transplanting, 10 plants of each cultivar were placed in each of two growth chambers (Scherer-Gillett Co., Marshall, Michigan) using a complete randomized design. Growth chambers were set at 20 °C (68 °F) with daylengths of 8 h and 16 h with simultaneous florescent and incandescent illumination (approximately 180 $mol \cdot m^{-2} \cdot s^{-1}$; 900 fc) photosynthetic photon flux (PPF). Plants were subirrigated and fertilized with 21–5–20 ($N–P_2O_5–K_2O$) as needed, typically once a week.

Destructive harvest occurred 15 weeks after transplanting and data were collected on the final number of nodes, flower number, final plant height, plant dry weight, and the number of rhizomes initiated. Data were analyzed using JMP® (SAS Institute, Cary, North Carolina) analysis of variance and means were analyzed using Tukey's honestly significant difference (HSD) test at $P \leq 0.05$.

RESULTS AND DISCUSSION

Rhizome development and plant growth differences were observed between the two achimenes selections (Table 1). The interaction between cultivar and daylength had an effect on the number of flowers produced and plant dry weight. The number of internodes produced ($P = 0.06$) was significant at $P = 0.10$. Significant cultivar and daylength main effects were found for number of rhizomes, dry weight, and number of nodes. Only the cultivar main effect influenced final plant height.

The number of rhizomes significantly increased under the shorter 8-h daylength for each cultivar. Rhizome numbers increased by ~55% and ~350%, for cultivar A04 and A16, respectively. Similar results were reported by Vlahos (1990a), in which the number of rhizomes increased when cultivars 'Schneewittchen' and 'Linda' were grown under 8-h daylengths compared 16-h daylengths. Long days did not inhibit rhizome development in our study, which is in agreement with Vlahos (1990 a,b). It is well known that day length (SD) influence tuberization in potatoes. Short days also promote tuber formation in tuberous begonia (Fonteno and Larson, 1982), dormancy and rhizome formation in several ornamental ginger species (Sarmiento and Kuehny, 2004), and increase tuberous root formation in dahlias (Moser and Hess, 1968; Durso and De Hertogh, 1977). Results from our study suggest shorter day lengths have an influence on rhizome initiation and formation in achimenes.

The number of flowers for cultivar A04 did not differ between daylengths. Contrastingly, cultivar A16 produced significantly more flowers under 16-h daylengths than 8-h daylengths. Vlahos (1990a) found increased flower numbers under 16-h compared to 8-h daylengths and did not observe any cultivar and daylength interac-

Table 1. Daylength effects on plant growth and development of two recently developed achimenes cultivars[z].

Cultivar	Daylength	No. flowers	No. rhizomes	No. nodes	Final height (cm)[y]	Dry weight (g)[x]
A04	8	29 a	7 a	6.9 a	12.5 a	1.43 a
	16	33 ab	4.5 b	7.7 ab	11.8 a	1.62 a
A16	8	38 b	4.6 b	8.2 b	16.1 b	2.08 b
	16	49 c	1.3 c	9.8 c	15.6 b	2.74 c
Significance						
Cultivar (C)		**	*	***	***	***
Daylength (D)		***	***	***	NS	**
C × D		*	NS	NS	NS	*

[z]Values are means of 10 plants. Means followed by different letters within each column are significantly different by Tukey's honestly significant difference test at $P \leq 0.05$.

NS, *, **, *** Nonsignificant or significant at $P \leq 0.05$, 0.001, or <0.0001.

[y]1.0 cm = 0.39 in.

[x]1.0 g = 0.035 oz.

tion in his study of six cultivars. The total number of flowers produced by A16 under both daylengths is likely due to an increased number of nodes produced for both photoperiods, as compared to cultivar A04. Achimenes have three or four whorled leaves present at each node from which a flower (or branch) may be initiated (Zimmer and Junker, 1985). The number of leaves at each node was not recorded for this study and thus, it is not possible to distinguish whether the increase in flower number is due an increased number of nodes or if it is due to cultivar differences with the number of leaves and flowers produced at each node. It is also unclear if the number of leaves developed at each node for any particular cultivar is physiologically stable or if the number of nodes may be affected by PPF and resulting metabolite production.

Plant dry weight was greater for cultivar A16 compared to A04, which can most likely be attributed to cultivar A16 being significantly taller. In this study, the increased PPF for the 16-h daylengths generally increased the number of nodes and dry weight; however it was only significantly different between photoperiods for cultivar A16. Vlahos (1990a) also found increased plant height with 16-h daylengths and found no difference in number of nodes between 8-h and 16-h daylengths.

The research presented here provides more insight into the growth and development of achimenes. Vlahos (1990a,b) showed that growth characteristics vary among older achimenes cultivars. Results presented in this paper and previous published results (Miller, 2005; Miller and Bridgen, 2005) further provide evidence of cultivar differences among newly developed selections. This study provides more evidence that shorter daylengths are involved in rhizome development in achimenes.

Acknowledgement. We thank Oglevee, Inc. (Connellsville, PA) for supplying rhizomes to conduct the experiments. Additional thanks to the Kenneth Post Laboratories greenhouse staff for their assistance.

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