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EFFECT OF BULB SOURCE ON EASTER LILIES TREATED WITH GROWTH REGULATORS

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Abstract. **Easter lily (*Lilium longiflorum* Thunb.) bulbs (8/9) were provided from two commercial sources (A and B). Bulbs were case-cooled for 7 weeks at 40F and planted in 6-inch pots on 17 Dec. 1996. Plants were grown in a glasshouse with 40% light exclusion and ambient temperature to a minimum of 45F. Growth regulators which retard plant height were applied as a soil drench on 27 Jan. 1997 when plants were 4.0 to 4.5 inches tall. Application rates of each chemical (mg ai/pot) were: ancymidol (0.25, 0.31, 0.38), paclobutrazol (1.5, 2.0, 2.5, and 3.0), and uniconazole (0.05, 0.06, 0.07, and 0.08). Plants from Source A flowered 85 days from planting compared to 92.8 days for plants from Source B. Number of flowers per plant from Source A was greater than from Source B but plant height and flower size were similar with the two bulb sources. Control plants were approximately 20 inches tall while plants treated with the lowest concentration of ancymidol, paclobutrazol, and uniconazole were 16.3, 16.4, and 15.5 inches, respectively. No interaction was determined among bulb source and chemical treatments.**

Easter lily (*Lilium longiflorum* Thunb.) production in Florida with rapidly changing ambient temperatures in the growing structures is not as precise as in environmentally controlled greenhouses in temperate areas of the United States (Miller, 1992; Weiler, 1992). Variable temperatures influence Easter lily development and make it difficult for Florida growers to flower the plants at the time of greatest demand (Wilfret, 1996). In 1996, 433,000 containerized Easter lily plants with a wholesale value of $1.715 million were grown in Florida, compared to 9.23 million plants grown in the United States (U.S. Dept. Agr., 1997). Market demand and flowering predictions from Florida researchers (Wilfret, 1994) led to a 35% increase in Florida production compared to only a 4% increase in the total U.S. from 1996 to 1997.

Environmental conditions affect plant height and flower development in Easter lilies. A plant height of 17 to 18 inches is preferred by consumers. Height is affected by both quantity and quality of light (Heins et al., 1982; Kohl and Nelson, 1963; Roh and Wilkins, 1977; Wilkins, 1980; Wilkins et al., 1986), warm day temperatures (Erwin et al., 1987; Roh and Wilkins, 1973; Wang and Roberts, 1983) and the difference between day and night temperatures (Erwin et al., 1987). Plants grown above 70F could lose their vernalization (Wang and Roberts, 1983; Wilkins, 1980). Growth regulators often are used to control plant height of Easter lilies and are applied as soil drenches, foliar sprays, bulb dips, or incorporation in the potting media. Ancymidol (A-Rest®, α-cyclopropyl-α-(p-methyxyphenyl)-5-pyrimidine-methanol) is the most commonly used growth regulator on Easter lilies and is effective as a soil drench of 0.25 to 0.75 mg ai/pot (Giafagna and Wulster, 1986; Johnson, 1973; Larson and Kimmons, 1971; Wilfret, 1987, 1990, 1996). Although ancymidol retards internode elongation, treated plants can have weak stems (Roh and Wilkins, 1977), hollow cavities in the pith area of the stems (Roh and Wilkins, 1977), a delay in flowering (White, 1972), or an increased yellowing of the basal leaves (Roh and Wilkins, 1973). Paclobutrazol (Bonzi® (2RS, 3RS)-1-(4-chlorophenyl)-4,4-dimethyl-2-(1,2,4-triazol-1-yl) pentane-3-ol) has been inconsistent in height control of Easter lilies (Giafagna and Wulster, 1986; Larson, 1986; Shanks, 1983; Wilfret, 1987, 1996), but 2 to 4 mg ai/plant applied as a soil drench has been effective in Florida (Wilfret, 1987). Paclobutrazol caused a greater dead basal leaf zone than ancymidol (Menhenett et al., 1983). An analog of paclobutrazol, uniconazole (Sumagic®, (E)-(p-chlorophenyl)-4,4-dimethyl-2-(1,2,4 triazole-1-yl)-1-pentane-3-ol) has shown greater activity for inhibition of gibberellic acid synthesis. Levels of uniconazole as low as 0.06 mg ai/pot applied as a soil drench (Bailey and Miller, 1989; Wilfret, 1987, 1996) significantly retarded plant height.

Observations on growth of Easter lilies in Florida during the past 15 years (Wilfret, 1994) indicate that bulb source affects plant and flower development. Brokers have only a limited number of bulb producers in the Pacific Northwest from which to purchase Easter lily bulbs, and individual brokers tend to use specific growers. The purpose of this research was to apply growth regulators to Easter lily bulbs obtained from two sources and to determine if plant growth and response to the growth regulators is dependent upon bulb source.

Materials and Methods

Easter lily 'Nellie White' bulbs (8/9 size) from plants grown in the Pacific Northwest of the U.S. were provided by two bulb brokers, A and B. Bulbs were case-cooled at 40F for 7 weeks and planted on 17 Dec. 1996 with one bulb per 6-inch plastic pot, which contained a medium of Florida sedge peat, coarse vermiculite, coarse white sand, and perlite (6:3:2:1, v/v). The medium was amended with 12 lb Nutricote 13N-10.8P-5.6K (100 day), 15 lb dolomitic limestone, 4 lb hydrated lime, 10 lb granulated calcium carbonate, 2 lb superphosphate, and 1 lb Florikan Sec (a minor element mixture) per yd^3. Plants were spaced on 11-inch centers on raised benches in a glasshouse with 40% light exclusion and were watered manually as needed. Insects and diseases were controlled with pesticides as needed. Plants were arranged in a randomized split plot design with four replications per treatment and each replicate consisted of three plants. Main plots were bulb source and subplots were chemical applications. Ancymidol, paclobutrazol, and uniconazole were applied as soil drenches (3.3 fluid oz/pot) when the plants were 4 to 4.5 inches tall. Chemical applications were made on 27 Jan. 1997. Application rates of each chemical were: ancymidol at 0.25, 0.31, and

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Table 1. Main effects of two bulb sources of 'Nellie White' Easter lilies on plant growth and flower development following growth regulator applications.

Bulb source	Number days to flower	Plant height (inches)	Number flowers	Flower length (inches)
A	85.0	15.2	5.4	6.4
B	92.8	15.1	3.7	6.6
LSD ($\alpha = 0.05$)	4.2	NS	0.8	NS

0.38 mg ai/pot; paclobutrazol at 1.5, 2.0, 2.5, and 3.0 mg ai/pot; and uniconazole at 0.05, 0.06, 0.07, and 0.08 mg ai/pot. Plant height was recorded at time of initial treatment and weekly until flowering. Flowering date, vegetative height, overall height, flower length, and number of flowers were recorded at time of anthesis of the basal flower. Data were analyzed using Least Significant Difference (LSD) with $\alpha = 0.05$.

Results and Discussion

Flowering dates of the plants from the two bulb sources was significantly different. Plants from Source A flowered an average of 85 days from planting compared to 92.8 days for Source B (Table 1). Overall plant height, measured from the top of the pot to the apex of the terminal flower bud, was not different between the bulb sources. Number of flowers per plant was greater with Source A than from Source B but flower size was not significantly different. Observations of plant growth from the two bulb sources indicated that plants from Source A had wider leaves, greater plant diameter, shorter internodes, and more leaves, but flower size appeared to be similar (Fig. 1). Very little yellowing of the basal leaves occurred on any of the plants regardless of chemical treatment or bulb source. Growth and flowering would indicate that phenotypic selections of 'Nellie White' have been made by specific bulb producers and this selection pressure has resulted in distinct differences within the cultivar.

Figure 1. Easter lily plants from two bulb sources: Source A (left) and Source B (right).

Table 2. Effect of growth regulators on height of 'Nellie White' Easter lilies from two bulb sources.

Chemical treatment[z]	mg ai per pot	Source A Height[y]	Source A % of Control	Source B Height	Source B % of Control
Control - water	—	19.6	—	20.2	—
Ancymidol	0.25	16.1	82	16.6	82
Ancymidol	0.31	15.5	79	14.6	72
Ancymidol	0.38	14.4	74	14.0	69
Paclobutrazol	1.5	16.7	85	15.8	78
Paclobutrazol	2.0	15.0	76	14.7	73
Paclobutrazol	2.5	14.6	74	12.8	63
Paclobutrazol	3.0	13.4	68	12.7	63
Uniconazole	0.05	15.0	76	16.1	80
Uniconazole	0.06	14.1	72	15.9	79
Uniconazole	0.07	13.9	71	14.4	71
Uniconazole	0.08	14.0	71	13.9	69
LSD ($\alpha = 0.05$)		0.7		1.1	

[z]Media drench at 3.3 oz/6-inch pot when plants were 4 to 4.5 inches tall.
[y]Overall height measured when basal flower was open.

Results of the effect of growth regulators on plant height are presented in Table 2. The control plants from Sources A and B were 19.6 and 20.2 inches tall, respectively. These differences were not significant nor were any of the comparisons between bulb source and chemical treatment. An ideal plant height was considered to be between 16 and 17 inches and the control plants (water drench) were 2.6 and 3.2 inches taller than ideal for Sources A and B, respectively. Within a given chemical, an inverse linear relationship was observed: as the chemical concentration increased, plant height decreased.

Ancymidol concentrations of 0.25, 0.31, and 0.38 yielded plants 16.1, 15.5, and 14.4 inches tall from Source A and 16.6, 14.6, and 14.0 inches tall from Source B, respectively. The 0.25 mg treatment produced plants closest to the ideal, which agrees with previous research in Florida (Wilfret, 1996). Plants treated with paclobutrazol ranged from 16.7 to 13.4 inches tall from Source A and from 15.8 to 12.7 inches from Source B. The lowest concentration (1.5 mg) produced the most desirable plants, but this concentration was lower than what had been found to be optimal (Wilfret, 1996). The low-

Table 3. Effect of growth regulators on flower development of Easter lilies from two bulb sources.

Chemical treatment[z]	mg ai per pot	Number days to flower[y] Source A	Number days to flower[y] Source B	Number flowers Source A	Number flowers Source B	Flower length (inches) Source A	Flower length (inches) Source B
Control - water	—	84.7	92.2	5.5	4.2	16.3	17.0
Ancymidol	0.25	85.3	94.3	5.4	3.4	16.5	17.0
Ancymidol	0.31	85.7	93.6	5.3	3.6	16.4	17.0
Ancymidol	0.38	85.2	94.1	5.6	3.6	16.2	16.9
Paclobutrazol	1.5	84.4	92.3	5.4	3.8	16.4	16.7
Paclobutrazol	2.0	84.2	93.6	5.0	3.8	16.5	17.1
Paclobutrazol	2.5	84.6	91.3	5.4	3.4	16.4	17.0
Paclobutrazol	3.0	84.6	93.6	5.7	3.7	16.4	16.8
Uniconazole	0.05	85.8	92.0	5.0	3.8	16.6	17.0
Uniconazole	0.06	85.5	93.0	5.4	3.7	16.3	17.0
Uniconazole	0.07	85.0	92.8	5.4	3.8	16.4	16.7
Uniconazole	0.08	85.0	90.7	5.3	3.7	16.5	16.9
LSD ($\alpha = 0.05$)		NS	NS	NS	NS	NS	NS

[z]Media drench at 3.3 oz/6-inch pot when plants were 4 to 4.5 inches tall.
[y]Plants measured when basal flower was open.

est concentration of uniconazole yielded plants that were shorter than ideal but were of an acceptable height. Previous research had shown that between 0.07 and 0.08 mg ai per 6-inch pot of uniconazole produced plants approximately between 16 and 17 inches tall when control plants were 22 inches tall (Wilfret, 1996). The cool weather during February of this year apparently retarded plant growth compared to previous years. Chemical treatment had no effect on number of days to flower, number of flowers per plant, or on flower size (Table 3).

Differences between plants from the two bulb sources indicate that certain growers in the Pacific Northwest have made phenotypic selections of 'Nellie White', producing plants that have greater uniformity of growth, shorter internodes with more leaves, and more flowers without significantly changing the flower itself. Knowledge about the source of the bulbs is very important when trying to time a crop for Easter. Generally, a grower should allow between 100 and 105 days from planting to flowering of Easter lilies when growing plants from case-cooled bulbs in Florida where a minimum night temperature of 50F is maintained. Source of bulbs could affect this schedule and potentially delay flowering beyond the Easter market. Growers should always request as much information on the history of the bulbs they purchase and how those bulbs grew in previous years. Growers should also consider applying split applications of growth regulators in anticipation of cool weather which could adversely affect plant height. Initial PGR applications would be made when plants are approximately 4 inches tall, with a second application, if needed, at the visible bud stage.

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