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Dual Minimum Temperature Forcing of 'Ace', 'Croft', 'Harson', and 'Nellie White' Easter Lilies, (*Lilium longiflorum*, Thunb.) using Southern-grown Bulbs

Adolph J. Laiche, Jr.
South Mississippi Branch Experiment Station, Poplarville, Mississippi State University, MS 39470

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Abstract. **Southern-grown bulbs of 'Ace', 'Croft', 'Harson', and 'Nellie White' Easter lily were naturally cooled and greenhouse-forced with either constant minimum thermostat settings of 16.7 to 15.6°C or with thermostat settings lowered to 7.8 to 4.4° for 8 hours during the night to obtain a dual minimum night temperature regime. The actual greenhouse temperatures varied with outdoor temperatures. Average minimum temperatures obtained with constant and dual thermostat settings were 17.0 to 15.4° and 10.7 to 9.9°, respectively. With constant minimum temperature, 20 to 22 days less time was required to force 'Harson' as compared to 'Ace', 'Croft', and 'Nellie White'. Dual night temperatures delayed flowering of the cultivars tested 9 to 13 days with a slight increase in flower number and a substantial increase in stem height. Although forcing time was increased with dual minimum temperatures, about 50% reduction in fuel usage was obtained.**

'Ace' and 'Nellie White' have been the dominant Easter lily cultivars in recent years (9). The 'Croft' lily is subject to leaf scorch (6) and the 'Harson', a Georgia lily is a southern-grown cultivar (2). The main production area of bulbs for forcing is along the West Coast of the United States. Greenhouse-forcing of Easter lilies is influenced by many factors, including geographic source of bulbs and lily type (8).

The conservation of fuel by greenhouse growers is necessary with increasing fuel costs and questionable fuel availability (10). Parups (7) produced good chrysanthemums with only a 3-day delay in flowering for those grown with a reduction to 10°C from 0000 to 0800 HR, as compared to those grown continuously at 15.5° at night. Kohl and Thigpen (5) and Kohl and Mor (4) showed equal growth and flowering of chrysanthemum per unit area of greenhouse bench space with 5.6 or 15.6° night temperature, despite the delay of maturation for plants grown at lower night temperatures. Bonaminio and Larson (1) found with 'May Shoesmith' chrysanthemum that the number of days to flowering was delayed as the night temperature decreased.

The objectives of this research were to compare the performance of southern-grown 'Ace', 'Croft', 'Harson', and 'Nellie White' bulbs during greenhouse-forcing and investigate the effects of a reduced night temperature on the growth and flowering of these 4 cultivars.

Mississippi-grown bulbs of 'Harson' and Oregon-grown bulbs of 'Ace', 'Croft', and 'Nellie White' were obtained in 1973. These 4 cultivars were field-grown and propagated in Poplarville, Miss., to provide a yearly source of bulbs for forcing experiments in 1978, 1979, and 1980. In late August of each year, graded bulbs were planted in 15.2-cm pots. Bulbs in 1978 and 1979 were 10.2–12.7 cm in circumference. Bulbs in 1980 were 12.7–15.2 cm in circumference. The potted bulbs were placed outdoors for natural cooling and protected from extreme cold temperatures (2). After cooling, the plants were divided into similar groups and forced using routine cultural methods (3) in adjacent compartments of a single greenhouse.

The minimum night temperature thermostat was set at 16.7°C in 1979 and 15.6° in 1980 and 1981 from 1700 to 1830 HR in 1 greenhouse compartment. The other compartment was also maintained at these settings from 1700 to 2230 HR, but the setting was reduced to 7.8° in 1979 and 4.4° in 1980 and 1981 for an 8-hr daily period from 2230 to 0630 HR. The actual greenhouse temperatures varied with outdoor temperature. Average monthly minimum temperatures and the number of hours the heaters were active in each compartment were recorded daily. Average monthly maximum temperatures were generally 27 to 32° for sunny days.

All plants in each compartment were grown in a randomized complete block design with 2 plants per experimental plot. One experiment of 4 replications was conducted in 1978–79. Two experiments of 6 replications each were conducted in 1980–81. Temperature regime (2) and cultivar (4) treatments were analyzed factorially. In 1979–80, only the 'Harson' lily was used to compare temperature regimes with 18 plants in each regime.

On January 17, forcing was begun with all cultivars for Easter in 1979. Forcing was begun for Easter in 1980 on January 2, with 'Harson'. Forcing was begun for Easter in 1981 on Dec. 17, 1980, with 'Ace', 'Croft', and 'Nellie White' and on Jan. 7, 1981, with 'Harson' for the first experiment; for the second experiment, forcing was begun on Jan. 5, 1981, with 'Ace', 'Croft', and 'Nellie White' and on Jan. 26, 1981, with 'Harson'.

Plant height from the rim of the pot, number of flowers, and the number of days from the beginning of forcing to flowering were obtained when the first flower opened.

The use of dual thermostat setting delayed flowering with all 4 cultivars (Table 1). Flowering of 'Ace', 'Croft', 'Harson', and 'Nellie White' was delayed 9, 13, 9, and 10 days, respectively. 'Harson' flowered 20–22

Table 1. Time required to flower Easter lily bulbs forced under constant minimum temperature and under a dual minimum temperature regime.

	Time to flower (days)[z]	
	Minimum temp[y]	
Cultivars	Constant	Dual
Ace	98b	107a
Croft	96b	109a
Harson	76d	85c
Nellie White	98b	108a

[z]Each figure is a mean of 32 plants from experiments of 1979 and 1981.
[y]Mean separation by Duncan's multiple range test, 5% level.

Table 2. Flower number and plant height of Easter lily bulbs forced under constant minimum temperature and under a dual minimum temperature regime.

Treatment	No. of flowers	Plant ht (cm)
Temperature[z]		
Constant	7.9b[x]	39b
Dual	9.1a	58a
Cultivar[y]		
Ace	8.6b	52a
Croft	6.5c	48b
Harson	10.3a	53a
Nellie White	8.6b	41c

[z]Each figure is a mean of 128 plants from experiments of 1979 and 1981.
[y]Each figure is a mean of 64 plants from experiments of 1979 and 1981.
[x]Mean separation within columns for each treatment by Duncan's multiple range test, 5% level.

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Table 3. The average number of hours the heaters were active per day with a constant minimum temperature and with a dual minimum temperature regime.

	Hours per day					
	1978–79		1979–80		1980–81	
Month	Constant	Dual	Constant	Dual	Constant	Dual
December	6.2	3.1	5.6	2.4	4.3	2.1
January	8.8	6.2	4.6	1.6	5.7	3.2
February	7.0	4.5	6.7	3.3	4.3	2.2
March	3.1	1.4	3.8	1.9	2.4	1.0
April	.7	.1	1.4	.7	.2	.0
Avg	5.2	3.1	4.4	2.0	3.4	1.7

days earlier with a constant thermostat setting and 22–24 days earlier with a dual thermostat setting than 'Ace', 'Croft', and 'Nellie White'.

Dual thermostat settings resulted in a 1.2 increase in flower number and a substantial increase in plant height (Table 2). 'Harson' produced the most flowers followed by 'Ace' and 'Nellie White'. 'Croft' produced the least number of flowers. Plants of 'Ace' and 'Harson' were the tallest, 'Croft' were intermediate, and 'Nellie White' were the shortest (Table 2). Results with 'Harson' lilies forced in 1980 in both temperature regimes were similar to data obtained in 1979 and 1981.

Southern-grown bulbs produced flowering pot plants for Easter that forced in an acceptable period of time with a high flower number per plant. However, plant height, especially with 'Harson' and 'Ace' with dual night temperatures, was excessive and detrimental to plant quality.

Thermostat settings to maintain greenhouse minimum temperatures of 16.7°C in 1979 and 15.6° in 1980 and 1981 for the months of December of the previous year through April resulted in average minimum temperatures of 17.0° in 1979 and 15.4 and 15.8° in 1980 and 1981, respectively. Thermostat settings of 7.8° for 1979 and 4.4° for 1980 and 1981 for the greenhouse compartment with dual thermostat settings were not always attained and resulted in average minimum temperatures of 10.7, 9.9 and 10.5°, respectively, in 1979, 1980, and 1981.

Dual minimum temperatures reduced heater usage per day from 5.2 to 3.1 hr, a 40% reduction in 1979, from 4.4 to 2.1 hr, a 55% reduction in 1980, and from 3.4 to 1.7 hr, a 50% reduction in 1981 (Table 3).

The expense incurred to force lilies an additional 9 to 13 days with dual minimum temperatures was substantially offset by the reduction in heater usage of about 50% per day and could also allow production when fuel availability is limited. In 1980, for example, heater usage with a constant minimum temperature for the entire period of December 1979 through April 1980 amounted to 664 hr and with a dual minimum temperature amounted to 302 hours. The additional 2 weeks of forcing time required resulted in an additional 28 hr of heater usage, for a total of 330 hr when using a dual minimum temperature.

The 'Harson' lily forced in 85 days with a dual night temperature, as compared to 98, 96, and 98 days, respectively, with 'Ace', 'Croft', and 'Nellie White' with a constant temperature (Table 1). The use of 'Harson' resulted in savings not only due to less fuel usage, but also because less forcing days were required for flowering. As a result, problems of programing the lilies for an early Easter because of overlap with greenhouse crops such as poinsettia would be avoided by using 'Harson', even when using a dual night temperature regime.

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Photoperiod and Temperature Effects on NonStop Tuberous Begonias[1]

W. C. Fonteno[2] and R. A. Larson[3]

Department of Horticultural Science, North Carolina State University Raleigh, NC 27650

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Abstract. **Extended long days or interrupted night photoperiods increased leaf number and top fresh weight, and decreased tuber formation compared with short days with 2 cultivars of the "NonStop" series of tuberous begonia (*Begonia* X *tuberhybrida* Voss). Short days increased tuber size and fresh weight and reduced top fresh weight of both cultivars. 'Double Red' showed greater leaf number, top fresh weight, tuber fresh weight, and tuber size at 22°C than at 26°, while 'Double Orange' showed only greater top fresh weight at 22°. Flowering was enhanced in both cultivars under long days.**

Tuberous begonias are attractive garden plants in regions where high temperatures do not persist for extended periods. Commercial flower growers have grown tuberous begonias as flowering pot plants for spring sales with varying degrees of success, largely dependent on season and locality. Large, colorful, attractive flowers in an assortment of colors have appealed to customers when high-quality plants were produced.

Recently, the "NonStop" tuberous begonias have attracted attention and interest, as they seem more adaptable to warm temperatures than traditional tuberous begonias. In 1980, NonStop tuberous begonias were forced successfully in commercial and university greenhouses in North Carolina with little apparent difficulty. In 1981, several of the same greenhouses reported poor growth and sporadic flowering. The reasons for these failures were unknown.

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[2]Associate Professor.

[3]Professor.