INFLUENCE OF FORCING TEMPERATURE ON THE DEVELOPMENT OF FLOWER BUDS FROM THE VISIBLE BUD STAGE TO FIRST OPEN FLOWER OF THE 'ACE' EASTER LILY [1]

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Abstract. 'Ace' lilies were placed in growth chambers at the visible flower bud stage under a 12-hour photoperiod with all possible day and night temperature combinations of 60°, 70°, 80°, and 90°F. At a constant day and night temperature of 60°, 70°, 80°, and 90° the time to flowering was 50, 28, 25, and 24 days, respectively. At a day temperature of 70°, night temperatures above 70° had little effect on flowering, but 60° greatly retarded flowering.

Forcing lily bulbs to flower for Easter is particularly difficult when the Pacific Northwest field crop flowers late in the preceding summer. These bulbs are frequently small and, when harvested according to established dates, may be considered immature and dormant. On the other hand, forcing mature and non-dormant bulbs for late Easters also presents problems. This study was undertaken to obtain information on the response of Easter lily to temp applied at visible flower bud stage.

Smith and Langhans (6) reported that the optimum forcing combination for properly cooled lily bulbs from potting to flowering was a 70°F. day temp (DT)/ 60°F. night temp (NT). They found plants at 80°/80° regime flowered in less than half the time of those plants grown at a 60°/50° sequence. Further, the 16-hr NT had a greater effect on forcing time than the 8-hr DT. They later suggested (3) that the time period when temp was most effective in controlling

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1 Paper No. 8165. Scientific Journal Series, Minnesota Agricultural Experiment Station.

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the rate of flowering was 36 to 96 days after potting with 'Ace' and 30 to 84 days with 'Croft'.

For this study, bulbs (8-9 in. in circum) were harvested on Sept. 10, 1971; the controlled temp forcing treatment (1) was started on Oct. 20, 1971. Plants were grown in a commercial greenhouse at a 70°/60° regime until March 2, 1972 when 80 plants were selected on the basis of uniform plant height and visible bud development. From 50 to 60 leaves had unfolded at a 45° angle to the stem exposing the small flower buds. For 30 days, 4 temp regimes (60°, 70°, 80°, or 90°) with 16 DT/NT treatment combinations were used. Plants were grown in chambers with a 12-hr photoperiod (2800 ft-c). On March 31, 1972, those plants that had not flowered and had been grown under 80° or 90° DT, regardless of NT, were transferred to 80°/70°, and those grown under either 70° or 60° DT, regardless of NT, were transferred to 70°/60°. Greenhouse control plants were grown at 75°/68° from March 2 to 16 and at 70°/65° from March 17 to flowering.

The greenhouse grown control plants required 27 days to flower. In growth chambers, with the exception of the 70°/60° regime, plants at either 70°, 80°, or 90° DT flowered in 24 to 30 days (Table 1). Hence, rate of flowering was not significantly affected by NT except for plants in the 70°/60° treatment. Thus, the significant DT or NT was 70° or above. Plants in a continuous 60° treatment took 50 days to flower, whereas plants in continuous 70°, 80°, or 90° treatments flowered in 28, 25, or 24 days, respectively (Table 1, Fig. 1). With a NT of 70°, a DT of 60° was required to significantly delay bud development. Above 70° no DT or NT significantly accelerated bud development.

No significant differences among treatments were observed in the total no. of flower buds. This was expected, as the flower bud complement had been determined prior to initiation of this research. Abortion was arbitrarily divided into 2 stages, when flower buds were 0.4 in or less in length (Fig. 2a); and when buds were longer than 0.4 in (Fig. 2b, 2c). The various temp treatments significantly affected the no. of aborted buds (Table 1). Particularly influential in aborting buds less than 0.4 in was a 90° NT with a 70° 80°, or 90° DT. Any DT above 70° significantly increased the no. of aborted ($\leq$0.4 in & $>$0.4 in) buds, regardless of the NT. Aborted buds were not observed in the greenhouse control plants.

Plant height at flowering was significantly related to DT. Height increases appear to be related to DT over 70° (Table 1, Fig. 1).

The no. of dried leaves was significantly influenced by DT but not by NT. The loss of lower leaves is related to DT of 80° or higher.

This study may aid in elucidating DT and NT influences on growth and flowering responses in the Easter lily from visible bud stage to anthesis. "Visible bud" is the stage of development when most commercial forcers become concerned with crop timing. It appears that a 70° DT and NT is adequate for maximum forcing speed with acceptable plant quality. Recommendation of 70° DT/60° NT as an optimum forcing temp with 8-hr of natural radiation (6) was for the overall greenhouse growth period from potting to flowering.

Even though a 70° DT and NT appeared to be optimal in this growth chamber experiment, further study is needed to determine more precise NT responses, since the greenhouse control plant grown under 68° NT for the first 2 weeks and 65° NT the following 2 weeks flowered in 27 days. Larson (4) indicated that there were no significant differences between poinsettias grown under similar temp regimes in greenhouses or growth chambers. Further, poinsettias grown at lower NT were shorter and slower to flower.

The high no. of aborted flower buds obtained with DT of 80° and 90° may be due to the competition or depletion of carbohydrates to the young and developing bud in the Easter lily as suggested by Einert and Box (2) and Mastalerz (5).

Literature Cited

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Table 1. Effect of day and night temp on time of flowering, no. of flower buds, plant height, no. of dried leaves at anthesis in 'Ace' lily. (Each mean made up of 5 plants)

Temp (°F) Day	Temp (°F) Night	Days to flower	No. of Flower Buds Total	Aborted[z] ≤0.4 in	Aborted[z] >0.4 in	Plant ht (in) at flowering[y]	No. dry leaves at anthesis
90	90	24 A[x]	5.0	.92 C	.91 c	8.7 ABCD	22.4 D
90	80	24 A	4.8	.81 B	.81 b	10.3 D	20.4 C
90	70	29 AB	4.2	.81 B	.99 c	10.1 CD	17.2 BCD
90	60	28 AB	5.2	.71 A	.81 b	10.4 D	19.6 CD
80	80	25 A	4.6	.81 B	.81 b	9.3 BCD	16.6 BCD
80	90	23 A	5.6	1.20 D	.92 c	9.1 BCD	17.4 BCD
80	70	26 AB	5.2	.81 B	.81 b	9.3 BCD	15.6 BCD
80	60	30 AB	5.4	.71 A	.71 a	10.6 D	19.2 CD
70	70	28 AB	5.0	.71 A	.71 a	8.9 ABCD	13.8 ABCD
70	90	28 AB	4.6	.81 B	.71 a	8.0 AB	14.6 ABCD
70	80	26 AB	5.0	.71 A	.71 a	8.7 ABCD	14.2 ABCD
70	60	40 C	4.6	.71 A	.71 a	8.6 ABCD	13.2 ABCD
60	60	50 D	4.6	.71 A	.71 a	8.4 ABC	9.4 ABC
60	90	29 AB	4.6	.71 A	.71 a	7.0 A	7.4 AB
60	80	36 BC	4.6	.81 B	.71 a	8.1 ABC	5.4 A
60	70	45 CD	4.4	.71 A	.71 a	7.8 AB	8.6 AB
Greenhouse control		27	4.6	0	0	10.6	12.1
Level of significance[w]							
Day		**	NS	**	*	**	**
Night		**	NS	NS	*	NS	NS
Day x night		**	NS	NS	*	NS	NS

[z] Data presented are transformations achieved by the math of $(x + \frac{1}{2})^{\frac{1}{2}}$ where x is actual number of aborted buds.

[y] From pot rim to pedicel of 1st flower

[x] Mean separation in columns by Duncan's multiple range test, 5% level (lower case) or 1% level (upper case).

[w] (**) significant at 1% level; (*) 5% level; (NS) not significant.

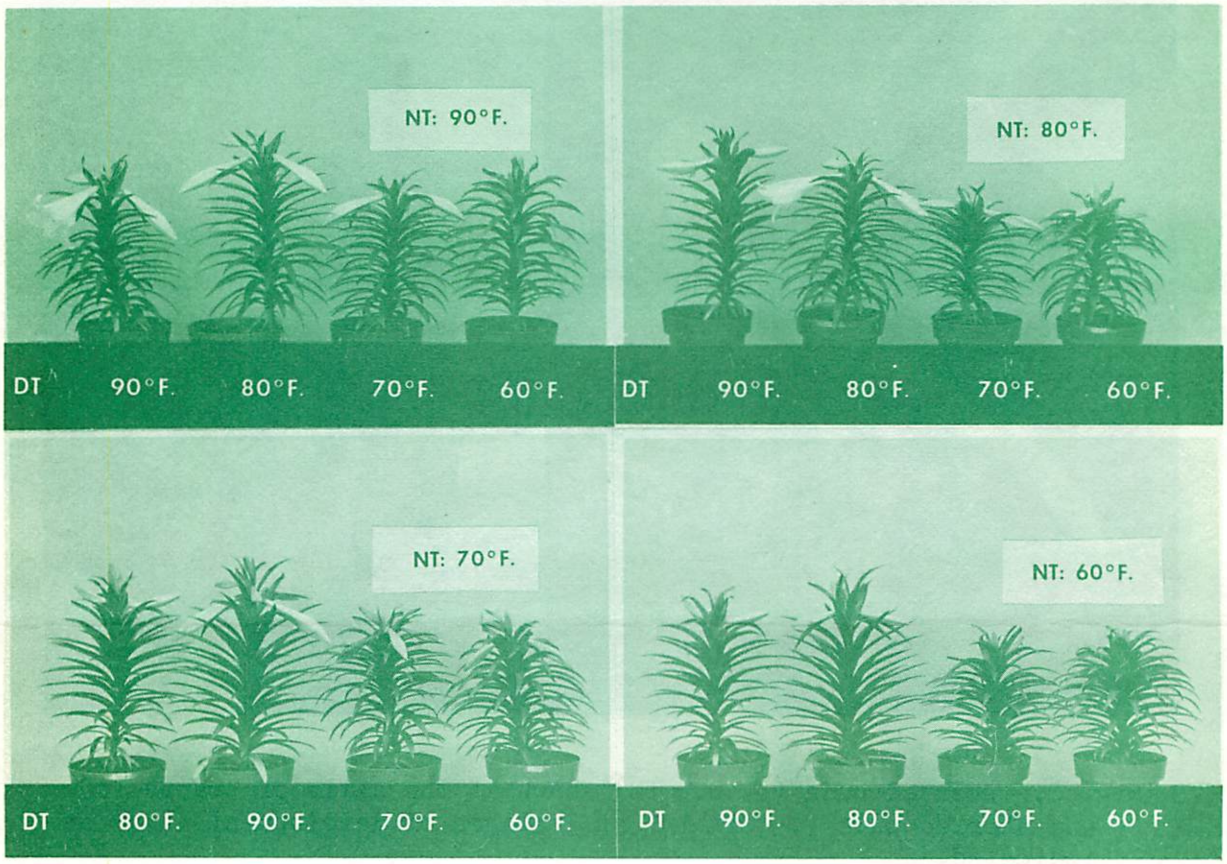

Fig. 1. The effect of day temp (DT) and night temp (NT) on flowering and plant height. (Photographed March 31, 1972.)

Fig. 2. Aborted buds ($\leq$ 0.4 in) shown at the axils of bracts (a) and aborted buds ($>$ 0.4 in) at 2 stages of development (b,c) as indicated.

Editor's Note:

This research article is based on data from plants forced for Easter 1972. Similar treatments were given and the research was repeated for Easter 1973. The forcing results and recommendations are the same and similar:

1) From the visible bud stage to open flower, a constant 70° day/night temperature developed flower buds at the same rate as continuous day/night temperatures of 80° or indeed 90°.

2) When the day and night temperatures averaged 70° or greater (example: 60° nights/80° days; 70° nights/80° days, or indeed 80° nights/90° days) plants came into flower at the same time.

3) It appears that the "brake" is the 60° night temperature with a 70° day temperature.

4) "Super high" forcing temperatures are of no value for rapid forcing if an average temperature of 70° is maintained.