# Growth and Flowering Responses of *Lilium longiflorum* Thunb. 'Ace' to Different Daylengths[1]

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*Abstract.* As the length of day was increased, the amount of cold required for flowering of 'Ace' plants decreased. However, even with 24 hr of light, some cold treatment was needed for flowering.

Previous work by the authors showed that 'Ace' Easter lilies grown under an 18-hr daylength required less cold treatment for flowering than plants grown in 8 hr light (4). That result explained the basis for the observation that long days hastened anthesis (1, 2, 3, 5, 6), however, it did not answer the question whether long days could completely substitute for the cold treatment. While 'Ace' is photoperiodic, no critical daylength has been determined. We report here effects of several specific daylengths on the cold requirement, growth, and flowering of 'Ace'.

## Materials and Methods

Bulbs of *Lilium longiflorum* Thunb. 'Ace' produced in the Northern California-Southern Oregon bulb production area[4] were shipped via refrigerated truck, and arrived in Ithaca after approx 2 weeks. Between arrival and the beginning of treatments, the bulbs were held in the original shipping cases at 21°C.

1966-1967. Bulbs 10 inches in circumference arrived on October 28, 1966, and were treated beginning November 3. Each lot of 10 bulbs was placed in a sealed, unperforated plastic bag containing 1000 cm$^3$ vermiculite. Twenty-one bags of bulbs

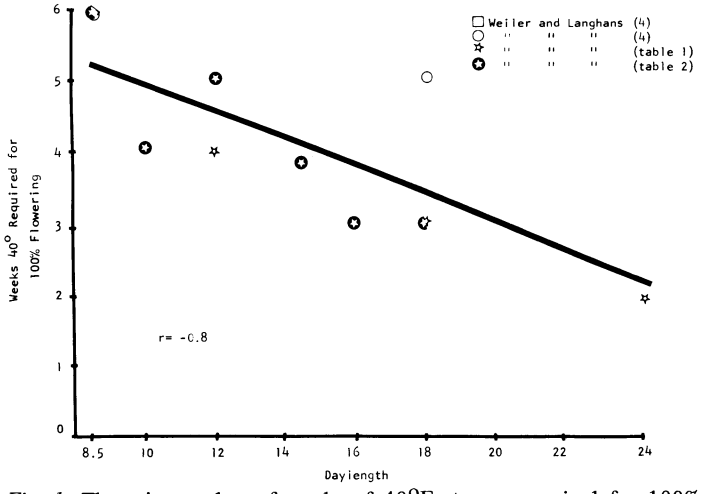


*Fig. 1.* The min number of weeks of 40°F storage required for 100% flowering of 'Ace' Easter lilies grown in a 70° greenhouse under 8.5 to 24-hr daylengths. Days consisted of 8.5 hr of sunlight plus 20 ft-c incandescent light extensions. The data are from 4 studies.

were placed in dark 5°C storage and 3 were removed after 0, 1, 2, 3, 4, 5, and 6 weeks. The bulbs were then planted and placed in a 21°C greenhouse under 12, 18, or 24-hr daylengths. All plants received 8.5 hr of natural light, accomplished by blackcloth covers from 4:45 PM to 8:15 AM. Additional light was provided by incandescent lighting with a flux of 0.0025 Langleys/min. Sixty-watt incandescent lamps were 1.2 m apart, and initially 1 m above the pots. The latter distance became less as the plants grew. Incandescent lighting began at 4:45 PM and continued until the desired daylength was achieved. The experiment was concluded after approx 1 year, on November 1, 1967.

1968-1969. Seven to 8-inch bulbs arrived October 15, 1968, and were held at 21°C until October 17, when treatments began. The bulbs were potted and placed in 5°C dark storage for 0, 1, 2, 3, 4, 5, and 6 weeks and subsequently grown under 8.5, 10, 12, 14, 16, or 18-hr daylengths in a 21° greenhouse. Five plants were used per treatment. The plants received 8.5 hr of natural light and the photoperiod was applied as described for the previous study. The experiment was concluded on June 7, 1969.

*Table 1.* 1966-1967. The effects of 0 to 6 weeks 5°C storage and 12, 18 and 24 hour daylengths on the flowering and growth of 'Ace' Easter lilies. Data are omitted for flowering percentages less than 100.

| Wk 5°C | Daylength (hr) 12 | 18 | 24 |
|---|---|---|---|
| | | % Flowering | |
| 0 | 0 | 0 | 0 |
| 1 | 10 | 40 | 0 |
| 2 | 30 | 70 | 100 |
| 3 | 90 | 100 | 100 |
| 4 | 100 | 100 | 100 |
| 5 | 100 | 100 | 100 |
| 6 | 100 | 100 | 100 |
| | | No. of leaves | |
| 0 | – | – | – |
| 1 | – | – | – |
| 2 | – | – | 159 |
| 3 | – | 124 | 126 |
| 4 | 135 | 114 | 114 |
| 5 | 120 | 102 | 107 |
| 6 | 101 | 98 | 87 |
| | | Days to flower | |
| 0 | – | – | – |
| 1 | – | – | – |
| 2 | – | – | 118 |
| 3 | – | 99 | 93 |
| 4 | 112 | 93 | 91 |
| 5 | 104 | 87 | 87 |
| 6 | 91 | 80 | 84 |

Twenty-one degrees C was maintained in the greenhouse when outdoor temp were below 21°, but no cooling equipment was in operation to reduce higher temp. The plants were grown by methods reported in a companion paper (see p. 174).

Flowering and number of leaves were evaluated by methods reported in a companion paper (see p. 174). Forcing time (days to flower) was the avg number of days the plants were in the greenhouse before the 1st flower bud opened.

## Results and Discussion

As daylength increased, the amount of cold required for 100% flowering decreased (Fig. 1). In the first study (Table 1) plants grown with a 12-hr day required 4 weeks of 5°C for

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[4]Bulbs were supplied through the courtesy of the Pacific Bulb Growers' Research and Development Committee, Gold Beach, Oregon.

*Table 2.* 1968-1969. The effects of 0 to 6 weeks of 5°C storage and 8.5 to 18-hr daylengths on the flowering and growth of 'Ace' Easter lilies. Data are omitted for flowering percentages less than 100.

| Wk 5°C | Daylengths (hr) 8.5 | 10 | 12 | 14 | 16 | 18 |
|---|---|---|---|---|---|---|
| | | | % Flowering | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 20 | 40 | 20 |
| 2 | 0 | 20 | 0 | 100 | 80 | 60 |
| 3 | 80 | 80 | 20 | 80 | 100 | 100 |
| 4 | 60 | 100 | 80 | 100 | 100 | 100 |
| 5 | 80 | 100 | 100 | 100 | 100 | 100 |
| 6 | 100 | 100 | 100 | 100 | 100 | 100 |
| | | | No. of leaves | | | |
| 0 | -- | -- | – | – | -- | – |
| 1 | -- | -- | – | -- | -- | – |
| 2 | -- | -- | – | -- | -- | -- |
| 3 | – | – | -- | – | 118 | 109 |
| 4 | -- | 118 | – | 108 | 98 | 108 |
| 5 | -- | 110 | 101 | 95 | 92 | 98 |
| 6 | 95 | 91 | 90 | 91 | 96 | 84 |
| | | | Days to flower | | | |
| 0 | – | -- | -- | -- | -- | -- |
| 1 | – | – | – | – | – | – |
| 2 | -- | -- | -- | -- | -- | – |
| 3 | – | – | – | – | 101 | 97 |
| 4 | – | 125 | – | 96 | 94 | 94 |
| 5 | – | 109 | 97 | 90 | 92 | 92 |
| 6 | 86 | 98 | 89 | 86 | 81 | 84 |

100% flowering; at 18 hr, 3 weeks; and at 24 hr, 2 weeks. In the 2nd experiment (Table 2) plants under an 8.5-hr daylength required 6 weeks of 5° for all the plants to flower, while under 10, 12, 14, 16, and 18 hr they required 4, 5, 4, 3, and 3 weeks of 5°, respectively.

These findings did not characterize a critical daylength; rather, a lengthening of the day reduced the cold requirement (Fig. 1). However, even with 24-hr of light at least 2 weeks of cold was required for flowering (Table 1).

There was no consistent effect of daylength on forcing time or number of leaves if the min amounts of cold treatment for 100% flowering were compared. However, if one duration of cold storage was evaluated (e.g., 6 weeks, 5°C), forcing time and leaf number decreased as daylength increased.

At present the interaction in *Lilium* between daylength and temp is speculative. Most papers discuss the replacement of the cold requirement by long days (1, 2, 3, 4, 5) but it is possible that short days devernalize. The interaction between growing temp and daylength has not been critically investigated, but it is known that *L. longiflorum* responds to daylength in conditions of 21°C or greater (Fig. 1), 15.5° night temp (1, 5, 6) and fluctuating temp in the field (2, 3).

Reductions in the cold requirement by alteration of daylength have practical significance. For rapid flowering, rather than applying 6 weeks of cold storage before growth under natural SD conditions, less than 6 weeks of cold treatment could be applied and under LD the plants would still flower rapidly. The min duration of LD treatment for completion of inflorescence induction was not shown in these studies since the daylength treatment was continuous.

**Literature Cited**


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