INFLUENCE OF PHOTOPERIOD AND WATERING ON ACE LILIES*

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The height of potted Easter lilies is a critical factor to both the producer and the consumer. For most purposes a height of 18 to 20 inches above the pot rim is preferred.

Many factors influence the height of lilies, and plant response is often variable from year to year. Reduced light intensity (1), fertilization practices (8), precooling treatments (7) and forcing temperatures (1,3) have all influenced plant height. Incandescent lamps (4) at an intensity of 35 to 100 foot candles at the top of the plants for 6 hours each night increased the stem length of Lilium longiflorum when night temperatures were below 65°F. Later work (6) indicated that Croft lilies grown in an 18-hour daylength, as compared to a 9-hour daylength, flowered 3 to 7 days earlier, were taller and had a slightly higher flower count. Shortening the daylength (2), with black cloth applied at 5 p.m. and removed the following morning at 8 a.m., somewhat reduced the ultimate height of lilies. The effect was not very great and initiating the shade in December or early January was recommended to get any effect. Growth regulators (2) have not been effective in reducing the height of Croft and Ace lilies.

In the past, many commercial growers have withheld water from the soil of potted lilies and syringed the foliage frequently during the day. In Minnesota, this practice resulted in an undesirable residue on the foliage from the alkaline water. Another suggestion from a commercial grower has been to water the soil after potting the bulb, and then withhold water until the shoots are 4 inches high.

These studies were conducted in 1963 and 1964 to determine the effect of restricted watering, and of a shortened photoperiod on the quality of Ace Easter lilies forced in Minnesota greenhouses.

1963 Study

Non-precooled Ace lily bulbs of 6½- to 7-inch size were used. The bulbs, which were from two sources (A and B), were received on November 6 and 9, 1962, respectively, and kept in the unopened cases at 70°F. until November 15. On this date they were transferred to 35°F. On December 19 the bulbs were soaked for 30 minutes in a parathion, ferbam, Terraclor solution and planted in 6-inch pans. The potting soil was a mixture of equal parts of composted soil, muck, peat moss, and sand. Pots and soil were steam-sterilized. Bulbs were planted midway from top to bottom in the pot.

All plants were maintained at a 60°F. night temperature following potting. Each treatment consisted of three replicates of 4 plants each from each bulb source, making a total of 24 plants per treatment. Plants were properly spaced as growth progressed. All plants were fertilized regularly with a mixture of 1 part ammonium sulfate and 4 parts of sodium nitrate at 1 ounce per 2 gallons of water.

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The treatments are listed in Table 1. Normal watering constituted an application of sufficient water to wet the entire soil mass whenever the soil surface was dry. Plants in treatment 2 were watered normally after the shoots were 4 inches high. Black cloth, which was used to shorten the photoperiod of plants in treatments 4, 5, and 6, was applied at 4:30 in the afternoon and removed at 8 the next morning.

1963 Results

Results are also presented in Table 1.

Withholding water until the plants were 4 inches tall (treatment No. 2) resulted in a slight reduction in plant height, approximately $\frac{1}{2}$ flower less per plant and a less full plant base. The tallest plants in the study were those which had half of the waterings withheld (treatment No. 3).

Shortening the photoperiod with black cloth reduced plant height appreciably and increased the number of flowers per plant and the fullness of the plant base. In addition, plants grown in the shortened photoperiod had a darker foliage color.

None of the treatments had a significant influence on days to bloom, plant diameter, and number of leaves. Plants from both sources tended to react similarly to the treatments.

Bulbs from the same source and forced by the same greenhouse operator are known to vary from year to year, possibly because of variations in weather where the bulbs are produced. Therefore the study was repeated and enlarged for the 1964 season.

1964 Study

Bulbs from the same two sources were obtained on October 28, 1963. Because of a misunderstanding, both lots of bulbs had been held in storage at 36 to 40°F. for 14 days, prior to their receipt by the University. Therefore all bulbs were kept at 70°F. in the unopened cases until November 12 (14 days). On this date half of the bulbs were treated and potted. The other half remained in the packing cases until December 23, when they were treated and potted. Both potted and unpotted lilies were kept at 35°F. from November 12 until December 23, at which time they were moved to the greenhouse. In all other respects plants in the 1963 and 1964 studies were handled similarly.

Table 1. 1963 Ace Easter lily watering and photoperiod treatments

Treatment	Bulb source	Days to bloom[1]	Height[2] (cm)	Diameter[3] (cm)	Leaves above ground	Number of blooms	Shape of plant base[4]
1. Normal watering, natural photoperiod	A	132	35	25	77	4.1	3.3
	B	133	36	23	75	4.0	2.4
2. Watered after potting, then no more water until shoots 4 inches high, natural photoperiod.	A	131	33	23	79	3.6	2.5
	B	133	35	22	70	3.3	1.5
3. Watered half as often as No. 1, natural photoperiod	A	131	37	24	77	3.8	2.8
	B	127	43	23	75	4.4	2.5
4. Normal watering, black cloth starting February 15	A	131	29	24	79	5.2	4.7
	B	130	32	23	73	4.4	3.7
5. Normal watering, black cloth starting February 25	A	133	29	24	77	5.1	4.3
	B	136	30	23	77	4.5	2.8
6. Normal watering, black cloth starting March 7	A	135	30	25	73	4.3	3.6
	B	133	33	23	73	4.4	3.0

[1] From start of forcing to first open flower.
[2] Height above pot rim (1 inch = approximately 2.5 cm).
[3] Diameter of the plant half way up the stem (1 inch = approximately 2.5 cm.).
[4] Rated 1 to 5 with 5 signifying best (based on leaf size and internode length).

1964 Results

The treatments and results are shown in Table 2.

Plants which were not scheduled to receive a second watering until they were 4 inches tall did not make sufficient growth to reach 4 inches. Therefore these plants were watered regularly starting February 18 when they varied from 1 to $2\frac{1}{2}$ inches in height. Plants in this treatment were appreciably shorter than those in treatment 1, had many fewer blooms and leaves above the soil line, a poorly shaped plant base and required a longer forcing period. Once again, the tallest plants in the study were those in treatment 3, which had half of the waterings withheld. They were similar to the plants in treatment 1 in other respects.

Plants grown in the shortened photoperiod were one-third shorter, narrower, darker green and flowered up to 8 days later. All of the short-day plants were so compact that the flowers were crowded and mixed with the foliage. This excessive compactness detracted from the natural beauty of the plants.

Random measurements were taken of at least 25 flowers per treatment. The length of the floral trumpet was reduced from 15.5 to 14.5 centimeters, when the plants were watered half as often (No. 3) or the photoperiod was shortened (No. 4,5,6).

No significant or consistent differences in air temperature were noted on recorders located under the black cloth and in the open greenhouse.

Plants that were precooled in the pots were similar or shorter in height, narrower, had a 10 percent higher bud count, and required an average of 7 days more to bloom than plants precooled in the packing case.

In general, plants from the two sources tended to react similarly to the treatments.

Discussion

Research with Croft lilies (5) has shown that flower buds formed when the stems were 3 inches above the nose of the bulb, following storage for 5 weeks at 31°, 33°, or 45°F. Unpublished work at Minnesota showed that time of bud formation in Ace lilies was similar to that for Croft. Therefore withholding of water early in the forcing season might be expected to influence flower bud development and initiation negatively. The actual results in both seasons confirmed this line of reasoning.

Withholding water from the soil until the plants reached a height of four inches was more injurious in 1964 than in 1963. Data presented in Table 3 show that the weather in 1964 was much warmer and brighter during this period. This correlation certainly emphasizes the risk involved when lilies are "run dry" early in the season. Although syringing of the plants may have lessened the negative effects, this type of cultural procedure is still too risky to be recommended.

Table 2. 1964 Ace Easter lily watering and photoperiod treatments.

Treatments	Potting date	Bulb source	Days to bloom[1]	Height[2] (cm)	Diameter[3] (cm)	Leaves above ground	Number of blooms	Shape of plant base[4]
1. Normal watering, natural photoperiod	Nov. 12	A	118	41	29	85	5.3	4.4
	Nov. 12	B	112	41	30	77	5.0	4.7
	Dec. 23	A	125	41	27	93	3.8	3.6
	Dec. 23	B	121	38	28	81	4.9	4.7
2. Watered after potting, then no more water until shoots 4 inches high, natural photoperiod	Nov. 12	A	130	28	31	63	1.6	1.8
	Nov. 12	B	125	27	28	62	2.0	1.8
	Dec. 23	A	130	24	27	61	1.8	2.8
	Dec. 23	B	124	28	27	63	2.4	2.2
3. Watered half as often as No. 1, natural photoperiod	Nov. 12	A	121	45	27	82	4.5	3.8
	Nov. 12	B	116	43	29	74	4.8	4.1
	Dec. 23	A	123	41	25	82	4.2	3.9
	Dec. 23	B	120	45	28	80	4.8	3.7
4. Normal watering, black cloth starting Jan. 30	Nov. 12	A	116	24	21	79	4.2	4.6
	Nov. 12	B	116	28	25	90	5.0	4.7
	Dec. 23	A	133	24	20	91	3.8	4.0
	Dec. 23	B	128	24	22	86	4.9	4.5
5. Normal watering, black cloth starting Feb. 15	Nov. 12	A	123	25	24	84	5.0	4.8
	Nov. 12	B	116	27	25	80	5.1	4.2
	Dec. 23	A	130	25	21	87	4.0	4.6
	Dec. 23	B	126	26	22	81	4.5	4.3
6. Normal watering, black cloth starting Mar. 1	Nov. 12	A	120	29	24	84	5.3	4.8
	Nov. 12	B	112	29	26	83	5.4	4.7
	Dec. 23	A	127	27	22	85	4.4	4.3
	Dec. 23	B	123	28	25	78	5.1	4.7

[1] From start of forcing to first open flower.
[2] Height above pot rim (1 inch = approximately 2.5 cm.).
[3] Diameter of the plant half way up the stem (1 inch = approximately 2.5 cm.).
[4] Rated 1 to 5 with 5 signifying best (based on leaf size and internode length).

Table 3. Weather data*

Month	Temperature (°F) Departure from average		Percentage of possible sunshine	
	1963	1964	1963	1964
Jan.	-9.5	+7.6	42	60
Feb.	-3.8	+8.2	52	73

* From official weather bureau records taken at International Airport in Minneapolis.

Theoretically, shortening the photoperiod for Easter lilies in February and March might be expected to reduce the amount of photosynthesis taking place within the plant. This reduction in photosynthesis could in turn limit the carbohydrate supply available for flower production. The net result might then be an abortion of some of the flower buds and fewer normal flowers. The results of these studies did not support this line of reasoning. Flower count averaged 0.6 flowers more in 1963, and there was no decrease in flower count in 1964, when the plants were subjected to a shortened photoperiod. Plants shaded with black cloth for the least number of days in 1964 (treatment 6) averaged 0.3 flowers more per plant. Apparently the amount of photosynthesis conducted after 4:30 in the afternoon and before 8 in the morning was not sufficient to significantly influence plant quality. In addition, some of the carbohydrates normally used for supporting plant enlargement might conceivably have been diverted to flower development.

Results of these studies with the variety Ace confirm previous work (6) with the variety Croft, which showed that the lily is responsive to photoperiod. The findings reported herein are not in agreement with a previous report (2) which stated that shortening the day with black cloth influenced plant height only slightly, and that the black cloth shading should be initiated in December or early January.

Based on both the 1963 and 1964 results, there was little advantage in shortening the day with black cloth prior to March 1. Initiating the black cloth treatment earlier resulted in a lower flower count and weakening of smaller plants in some instances. Plants in these studies did not bloom until the second half of April. Because the commercial grower must frequently have his plants in bloom for an early Easter, the question of applying black cloth earlier must be considered. Initiation of black cloth treatment on March 1 for a late March Easter date may not limit plant elongation adequately. Small, slow plants were the ones usually injured by early application of black cloth. Therefore, the use of the shortened photoperiod treatment, starting February 15, on plants which were started earlier and which were further advanced may not have any unfavorable effects.

Future studies might include discontinuing of the black cloth shading one or two weeks prior to flowering. Possible benefits might include (1) longer floral pedicels to raise the flowers above the foliage and (2) less shortening of the floral trumpet.

The use of light to increase plant height or black cloth to decrease plant height now provides the alert grower with a desirable degree of flexibility in controlling the height of his Easter lily crop. Fortunately, neither treatment need be initiated before the potential plant height can be determined by observing the plants.

Summary

1. Plants were grown in various watering and photoperiod treatments in 1963 and 1964.

2. Withholding water early in the forcing period adversely affected flower count and plant quality.

3. Withholding every second watering during the forcing period resulted in taller plants.

4. Shortening the photoperiod with black cloth starting March 1 resulted in shorter plants of good quality with a slightly higher bud count.

5. Precooling the bulbs in the pots, rather than in the case, resulted in high quality plants and a 10 percent increase in flower count.

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