OREGON
ORNAMENTAL AND
NURSERY DIGEST

December 1972
Vol.16, Issue 2
Pages 1-3

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SHORT DAYS HASTEN EASTER LILY FLOWERING

Previous studies have shown that long days (LD) can substitute in whole or in part for the cold induction of flowering (vernalization) in the young, elongating mother sprout of Easter lily, *Lillum longiflorum*. Recent experiments have demonstrated that short days (SD) can either hasten or delay flowering of the daughter bulb (becoming mother), depending on whether it is the senescing leaves of the old mother plant that perceives and passes on a SD stimulus to the soon to be emerging daughter, or the young leaves of the new emerging mother that gets the SD message direct.

It is important in the following discussion to remember that in the normal sequence of events the daughter bulb becomes the mother when its axis "bolts" and starts unfolding leaves above ground. As it is elongating, a new daughter bulb is forming at its base, and this process is repeated annually. The mother shoot normally flowers and then dies, at least in part, before the daughter, which is to become the new mother, starts elongating into its flowering cycle. This elongation marks the end of the summer dormancy, or correlative inhibition that has kept the daughter in check for almost a year.

In an experiment to be reported here, we have found that prolonged exposure of the young mother to SD and above flower-inducing temperatures (near 72°F) prevented or greatly delayed flowering unless the bulbs had prior chilling. Such treatment resulted in premature elongation of the daughter and before the mother had flowered. Premature sprouting of the daughter in commercial fields is called "summer-sprouting" and causes serious losses to the growers in some seasons. This association of SD with delayed flowering and premature daughter sprouting may be of value in seeking solutions to this troublesome field problem.

The results of a second experiment are even more interesting in their implications. Evidence has been obtained that the aging leaves of the mother perceive the SD of autumn and transmit this information to the daughter bulb, thus preparing it for its next growth phase. As a consequence of this transfer of SD information, the daughter bulb is more sensitive to flower-inducing cold treatment. This information adds another dimension to our concept of bulb maturity and may aid us in timing bulb harvest.

Daughter bulbs sprout prematurely if flowering of mother is prevented or delayed-1968-1969

Bulbs of ‘Croft,’ ‘Ace,’ and ‘Nellie White’ Easter lily were harvested the third week of July, August, and September, 1968, and potted and stored for 6 weeks at 40° or 60°F before forcing in a greenhouse at constant 72° temperature under LD (16 hours) and SD (9 hours) photoperiods.

The control plants were potted and placed directly in the greenhouse at 72° without prior storage. Seventy-two degrees and above is non-flower inducing, 60° is the dormancy-breaking optimum, and 40° the flower-inducing optimum for most commercial varieties of Easter lilies. SD were maintained by covering the benches with black cloth from 5 p.m. to 8 a.m., and LD treatment consisted of extending the day with incandescent lamps (average of 40 Fc at pot height) to 16 hours. Five bulbs were used in each of the 54 treatment combinations (3 varieties x 3 harvest dates x 3 storage treatments x 2 photoperiods) for a total of 270 bulbs.

The experiment was terminated after a year and the number of daughter bulbs showing sprouts ("bolting") and the number of mothers flowering were recorded. Daughter bulbs showing sprouts above the soil and those visibly elongating in the bulb were counted.
None of the bulbs given sufficient cold and/or LD treatment for flowering had daughter bulbs that sprouted (Table 1). Flowering of non-chilled bulbs under SD was prevented or seriously delayed and there was a strong tendency for such daughter bulbs to sprout. This is a strong indication that developing flower buds exert a correlative control over daughter bulb elongation.

The "summer sprout" in the field does not appear above ground until early summer or later. However, our research has established that the sprout is usually "triggered" in the field in February-March, when the daughter bulb has initiated 30-35 scales. At this stage of develop ment, the mother shoot is only starting to initiate its flowers, and this coupled with the fact that the days are still relatively short may make it difficult for the mother to establish complete dominance over the developing daughter. At least, this is a strong possibility and suggests that growth regulator sprays might be used to assist the mother in establishing early dominance.

A second implication of this experiment is that during late summer and early autumn, SD may work through the mother to enhance the effectiveness of near 60° temperatures in removing the summer dormancy of the daughter bulbs and thereby hasten its elongation. However, this is assuming there is a SD effect on daughter sprouting independent of its influence on flowering. Earlier work, as well as the following experiment, support the position that daylength effects in Easter lily are associated with flowering, and only indirectly or in response to flowering do they influence the ability of the daughter to sprout.

Daughter bulb receives SD stimulus to flowering from senescing leaves of the mother-1971-1972

The plants (tops, bulbs, and roots) of 'Croft,' 'Ace,' and 'Nellie White' were lifted carefully from the field at the Pacific Bulb Growers Research and Development Station at Harbor, Oregon, in late September, 1971, and transplanted to 6-inch pots at Corvallis. Five pots of each of the three varieties were placed in each of two growth chambers maintained at 50°, an effective temperature for inducing flowering in the daughter bulb and comparable to field temperatures along the coast in September-October. One chamber was programmed for SD (9 hours at approximately 2,000 Fc), and the other for LD (18 hours at approximately 1,000 Fc) by daylength extension. After 6 weeks exposure to these conditions, the potted plants were removed from the growth chambers and placed in the greenhouse with near 60° night and 70° day tempera tures, and natural daylength for forcing. Senescence of the mother foliage had advanced to the yellow-leaf stage and necrosis was evident on the dying leaves. The tops were removed at this time of transfer.

Table 1. Effects of certain storage temperatures and daylength treatments on percent flowering of July, August, and September harvested 'Croft,' 'Ace,' and 'Nellie White' Easter lily bulbs, and the tendency for the daughter bulbs to sprout, 1968-69

Treatments	Storage temp.	Growing temp.	Day-length	Mother % flowering: Date harvested July	Mother % flowering: Date harvested August	Mother % flowering: Date harvested Sept.	Daughter % sprouting: Date harvested July	Daughter % sprouting: Date harvested August	Daughter % sprouting: Date harvested Sept.
Non-flower inducing	None	72°							
'Croft'			SD	0	0	0	10	100	100
'Ace'			SD	0	0	0	60	100	100
'Nellie White'			SD	0	20	0	100	40	100
'Croft'			LD	80	80	0	0	0	20
'Ace'			LD	0	20	0	0	20	20
'Nellie White'			LD	20	0	0	20	0	0
Dormancy breaking	60°	72°							
'Croft'	6 weeks		SD	0	40	60	100	40	40
'Ace'			SD	0	40	20	80	60	80
'Nellie White'			SD	0	20	20	100	100	80
'Croft'			LD	60	100	100	0	0	0
'Ace'			LD	60	100	100	0	0	0
'Nellie White'			LD	20	80	80	0	0	0
Flower in-ducing	40°	72°							
'Croft'	6 weeks		SD	40	100	100	80	0	0
'Ace'			SD	0	80	100	80	0	0
'Nellie White'			SD	80	100	100	20	0	0
'Croft'			LD	100	100	100	0	0	0
'Ace'			LD	100	100	100	0	0	0
'Nellie White'			LD	100	100	10	0	0	0

All the daughter sprouts emerged in 18-25 days, regardless of variety or daylength treatment, which supports the earlier conclusion that daylength effects are primarily on flowering, and only indirectly through flowering do they affect daughter sprouting (Table 2).

Table 2. Growth and flowering responses of daughter shoot to daylength influences transmitted to it by the mother axis,

1971-72

	Day-Length	Variety 'Croft'	'Ace'	'Nellie White'	Avg.
Days to emerge	SD	23	25	24	24
	LD	21	18	24	21
Number of leaves	SD	87	99	83	90
	LD	123	155	114	131
Days to flower	SD	114	120	113	116
	LD	127	133	127	129
Number of flowers	SD	3.0	4.2	4.2	3.8
	LD	4.0	5.0	4.8	4.6
Plant height (cm)	SD	79	83	81	81
	LD	101	116	85	101

*SD = short days. LD = long days.

A speculation at the beginning of this experiment, and based on earlier bulb "maturity" studies, was that the SD of late summer and early autumn hastens bulb maturity and enhances response to flower-inducing cold treatment. These earlier studies had shown that not only is there a shift in temperature optimum for flowering from 50° to 40° with approach of autumn, but the length of the cold treatment required is reduced with increasing bulb "maturity."

The exposure of the senescing mother plants to 6 weeks of SD at 50° induced the succeeding shoot (daughter becoming mother) to flower at an earlier date than plants exposed to LD treatment. Evidence is found in the fact that the SD plants produced 30 percent fewer leaves, one less flower, and flowered two weeks earlier than those given LD treatment. These events are often used to measure the time of floral induction. As expected, rapid flowering is at the expense of flower numbers, and plants having fewer leaves and nodes have shorter stems.

These results emphasize the fact that environmental conditions, such as daylength and temperature, have entirely different effects on plants at different stages of development. The young leaves transmit one message from a given daylength, while the old leaves may get a different signal. Thus we see that SD on young leaves of incompletely chilled plants of Easter lily may delay flowering, but may cause mature and senescing leaves to transmit a flowering stimulus to the daughter that is to take their place. The latter is then stimulated in turn by LD. These results have very practical implications, especially in timing the harvesting of lily bulbs. They provide evidence that the superior forcing qualities of late-dug bulbs can be attributed in part to the decreasing daylength of autumn. Experiments are in progress to substantiate these exciting results, and it is hoped that someday we can schedule harvesting dates and optimum cold treatments with greater precision, regardless of seasonal differences in growth and development.