High Temperature Storage Improves Lily Quality

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High temperatures (60° to 90°) in storage or during early growth of Easter lily bulbs have had desirable (1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 20,) or detrimental (10, 12, 14, 15, 20) effects. It is important for floriculturists to maximize the benefits of the high temperature treatments and avoid the treatments which could involve loss of crops or reduced worth.

After some early work on high temperature (11, 12, 13), Miller *et al* concluded that high temperatures removed (devernalized) the effects of cold storage and, therefore, improved plant quality. Cold storage reduced forcing time, flower number and, in general, plant quality. High temperature storage after cold storage increased forcing time, but also increased flower number and plant quality.

While the devernalization hypothesis might be true, it is not necessarily the explanation of the effects of high temperature. Our recent work has concerned itself with this problem. At issue is the tremendous potential of high temperature for improving Easter lily plant quality. The reasons for the responses to high temperature must be known!

The pattern in figure 1 was observed when we applied warm storage after various periods of cold storage (18). Warm temperature applied after cold storage did prevent flowering. More cold storage after warm temperature again caused the plants to flower. There is no question that warm temperatures devernalizes.

The effects of devernalization were observed in a 60° greenhouse as delays in flowering (11, 12, 13). Since cold storage reduced the number of leaves per plant, increased leaf number after high temperature might also be entirely the result of devernalization.

Carlson and DeHertogh (3) and DeHertogh and Einert (4) observed plant quality improvements after high temperature storage, but flowering delays were not observed. They used 60° to 65° (temperatures which are mildly effective in cold treatment (19) before cold storage at 40°.

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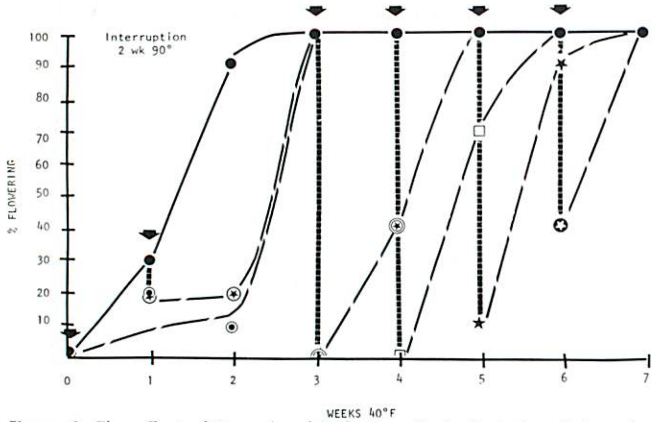

Figure 1. The effect of 2 weeks of 90° given 0, 1, 3, 4, 5 and 6 weeks after 40° storage—followed by 40° storage—on the percent of plants flowering.

Since they were working with mildly vernalizing temperatures during high temperature treatment, obviously it was not devernalization that caused improved quality. Rather, growth in high temperature before cold storage (40°) storage probably accounted for the increased quality.

Some or all of the leaf number increases and improvements in plant quality caused by temperatures of 70° and above could also be accounted for by growth at the high temperature rather than devernalization. Increased leaf numbers from high temperatures applied before cold storage when not associated with large flowering delays (9, 17) are probably the result of growth at high temperature. It is difficult to say and probably not true that devernalization occurs when high temperature is applied before any known vernalization (cold treatment) is given.

The results and interpretations of high temperature effects are tentative. Devernalization does occur and may be useful in regulating cold induction of Easter lilies. Where the usefulness occurs is not certain. Of more immediate interest is high temperature which increases leaf number, flower number, and plant quality in general. Natural cooling (2, 6), coldframing (8), and more recently, controlled temperature forcing (3, 4) all improve plant quality by allowing growth and leaf initiation before and/or during cold treatment. It is somewhat analogous to Chrysanthemum production where growth and leaf formation occur before the short day treatment which cause flowering. Once the flowering condition is set, leaf number and growth are not easily improved. Treatments *before* the flowering condition is established can greatly improve the quality of the product.

In Easter lily production the laboriousness of current programs which incorporate high temperature treatments—especially coldframing and controlled temperature forcing—put such methods at a disadvantage when compared to precooling bulbs in cases, planting, and forcing. There is no reason why some or all of the improving effects of high temperature treatment could not be achieved in storage before potting. Such a method would avoid the need for moving potted plants from the coldframe or storage area to the greenhouse.

Present methods for storing bulb cases were designed for cold storage, so it is not surprising that modifications would have to be made if cases were to be stored at high temperatures. In high temperature storage, water loss would be greater; the bulbs would metabolize more rapidly so consideration would have to be made for increased air exchange (removal of products emanating from the bulbs as well as providing sufficient oxygen in storage); growth would occur faster so, some growth controls would have to be found, and disease microorganisms and pests would be more active at higher temperatures and disease and pest control would become more important.

Those are some of the considerations needed for designing a high temperature storage method for non-potted Easter lily bulbs. The trend in floriculture toward economy and away from laborious production precedures dictates that, if possible, storage of non-potted bulbs is preferable. Developing such a storage method offers a challenge to future Easter lily researchers and industry.

Until that method is perfected, Easter lily treatments which incorporate 60° to 65° temperature treatments before and/or during cold treatment will continue to improve plant quality above pre-cooling (no high temperature), but plant quality improvements will perhaps be obtained only through increased labor and equipment costs.

Literature Cited

1. Blaney, L. T., and D. E. Hartley, and A. N. Roberts. 1963. Preheating before precooling benefits Easter lily bulbs. Florists' Rev. 133 (3439): 23-24, 70-71.
2. Box, C. O. and R. Payne. 1967. Natural cooling methods of handling bulbs. *In* Easter lilies. (Ed. R. W. Langhans and D. C. Kiplinger) Cornell Univ., Ithaca, New York, and Ohio State Univ., Columbus: 59-71.
3. Carlson, W. H. and A. A. DeHertogh. 1967. A preliminary evaluation of various cooling techniques for forcing of 'Ace' lily bulbs. Michigan Florist 441: 21, 24.
4. DeHertogh, A. A. and A. E. Einert. 1969. The controlled temperature forcing (CTF) method of potted Easter lilies, its concept, results, and commercial adaptation. Florists' Rev. 145 (3745): 25-27, 70-73.
5. Durkin, D. J. and L. L. Hill. 1968. Effect of 70° storage on response of vernalized 'Ace' lily bulbs. Proc. Amer. Soc. Hort. Science. 93: 635-639.
6. Gill, D. L. 1964. Timing of blooming of naturally cooled Georgia Easter lily bulbs. Florists' Rev. 135 (3508): 23-23, 76-77.
7. Hartley, D. E., L. T. Blaney, and A. N. Roberts. 1964. Preparing Ace lily bulbs for an early Easter. Florists' Rev. 134 (3473): 17-18, 80-81.
8. Kiplinger, D. C. 1963. Frame-grown Easter lilies. Ohio Florists' Assn. Bul. 407:8.
9. Langhans, R. W. Unpublished data, Department of Floriculture and Ornamental Horticulture, Cornell University, Ithaca, New York.
10. Lattimer, M. 1954. 1954 lily studies. Ohio Florists' Assn. Bul. 303: 4, 5.
11. Miller, R. O. and D. C. Kiplinger. 1966. Interaction of temperature and time of vernalization on Northwest Easter lilies. Proc. Amer. Soc. Hort. Sci. 88:635-645.
12. Miller, R. O. and D. C. Kiplinger. 1966. Reversal of vernalization in Northwest Easter lilies. Proc. Amer. Soc. Hort. Sci. 88:646-650.
13. Miller, R. O. and A. M. Kofranek. 1966. Temperature studies of lilies. Calif. Agric. 20(1): 2-3.
14. Stuart, N. W. 1943. Influence of temperature, storage period on forcing of lilies. Florists' Rev. 92 (2383): 13-15.

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15. Stuart, N. W. 1946. Temperature and length of storage effects on lilies. Florists' Rev. 98 (2548): 35-37.
16. Stuart, N. W. 1947. Further tests on handling lily bulbs grown in Northwest. Florists' Rev. 101 (2602): 29-31.
17. Stuart, N. W. and C. F. Doucette. 1964. Effects of field applications of toxicants and subsequent storage temperatures on forcing performance of Croft and Ace Easter lilies. Florists' Rev. 135 (3487): 15-16, 79.
18. Weiler, T. C. 1969. Studies of the cold induction requirement for flowering of *Lilium longiflorum* Thunb. cv. 'Ace.' Ph.D. Thesis. Cornell University, Ithaca, New York. 124 pp.
19. Weiler, T. C. and R. W. Langhans. 1968. Determination of vernalizing temperatures in the vernalization requirement of *Lilium longiflorum* (Thunb.) cv. 'Ace.' Proc. Amer. Soc. Hort. Sci. 93: 623-629.
20. Weiler, T. C. and R. W. Langhans. Effect of 70° and 90°F storage temperature temperatures on the flowering and growth of *Lilium longiflorum* Thunb. cv. 'Ace'. Proc. Amer. Soc. Hort. Sci. Paper submitted.