LIGHTING CARNATIONS

T.G. Byrne[1]

Reprinted from the *California Flower and Nursery Report,* Summer, 1982

Flower initiation is facilitated in commercial cultivars by long days (1, 2) and it increases with an increase in photoperiod to a maximum of 24 hours (4). A 24-hour photoperiod can be obtained by lighting from dusk to dawn with intensities of 3 to 20 foot-candles (8). A study in England several years ago concluded that incandescent lamps are more effective for this purpose than are "daylight" fluorescent lamps (3). This was corroborated by a commercial propagator in the U.S. (10) and by research done at the U.C. field station at San Jose. The latter study also showed a linear relationship between increased light intensities (between zero and 10 to 15 foot-candles) and decreased crop-development time. Additionally, the number of leaf pairs (nodes) below the flower bud decreased as supplemental light intensity increased (Table 1).

A 2- or 4-hour lighting period in the middle of the night is comparable to adding 8 or 10 hours of light at the beginning or end of the day (8). A minimum of 10 foot-candles of light from 10:00 p.m. to 2:00 a.m. at San Jose for 6 weeks, beginning when 5 to 7 leaf pairs were visible, reduced the average time to first-crop harvest by 3½ weeks when plants were grown at minimum night temperature of 50° F. The number of nodes below the flower was also reduced (Table 2).

Shoots are considered to be the most photosensitive when they have four to seven leaf pairs (6). Commercial experience had indicated that this stage is reached when three to five pairs can be seen, usually when the shoot is 1 to 2 inches long (10).

Long photoperiods do not increase the number of flowers produced in a crop. Rather they promote flower initiation in receptive shoots and hasten development of flowering shoots. Further data obtained at the San Jose field station illustrate the influence of supplemental lighting on a developing crop (Table 3). The halfway point of harvest was reached a week earlier for the crop lighted continuously, even though both lighting treatments resulted in flower bud initiation at about the same time (as evidenced by similar node counts at harvest).

[1]T.G. Byrne is Specialist, Environmental Horticulture, Davis.

TABLE 1. Average days to bloom and number of leaves below flower of 'Sim' carnations lighted from dusk to dawn with 0, 2 to 3, 5 to 7, or 10 to 15 foot-candles when shoots had 4 to 6 (mostly 5) visible leaf pairs. U.C. Field Station, San Jose.*

Item	No lighting	Amount of light (foot-candles)			
		2 to 3	5 to 7	10 to 15	L.S.D.$_{.05}$
Days to bloom	123	115	103	93	5.2
Number of leaves	15.7	14.8	14.0	13.0	0.6

*Lighting began September 13 for 6 weeks. Minimum night temperature 60° F, except 50° F after buds reached 3/8-inches diameter.

TABLE 2. Influence of four-hour night light break on node count and average days to one-half bloom of 'Sim' carnations grown as a single crop. U.C. Field Station, San Jose.*

Item	Number of nodes	Days to 1/2 bloom
No lighting	15.4	147
Six weeks of lighting	13.0	123

*Minimum of 10 foot-candles from 10:00 to 2:00 a.m. beginning September 7 when 5 to 7 leaf pairs were visible. Plants were grown at a minimum 50° F night temperature.

TABLE 3. Influence of 6 weeks of lighting, or lighting until harvest, on number of nodes and crop development time of 'Sim' carnations grown as a single crop. U.C. Field Station, San Jose.*

Item	Number of nodes	Days to 1/2 bloom
Six weeks lighting	13.4 ns	122
Lighting til harvest	13.3	115**

*Pinches August 15, lighted with 10 foot-candles minimum when 5 to 7 leaf pairs visible on beginning September 7 and grown at 50° F minimum night temperature until harvest.

**$L.S.D._{.01}$ = 5.4 days.

Lighting for 3 to 6 weeks has been effective in promoting earlier flowering while avoiding the problem of thin, weak stems which is associated with lighting continuously until harvest (7). There was no difference in the average number of days to bloom when single-crop 'Sim' carnations grown at San Jose were given 3 or 6 weeks of dawn-to-dusk lighting. However, the range in days for the harvest period was greater for the crop given the longer lighting period (Table 4). The extra 3 weeks of lighting probably hastened development of those shoots in which bud initiation had occurred soon after lighting was begun; the number of days until the last flower was harvested was similar for both treatments.

In these times of increasing energy costs cyclic lighting may be a useful alternative to continuous lighting. A 10-year-old report indicates that a cycle of 20 seconds every minute from dusk to dawn results in better flower quality than can be obtained by continuous lighting. However, intensity of the light applied in pulses has to be two to three times greater than that used in continuous lighting (9).

TABLE 4. A comparison of 3 weeks lighting vs. 6 weeks lighting as it relates to average days to bloom and range in days to harvest. U.C. Field Station, San Jose.*

Item	Days to bloom	Range (days)
Three weeks lighting	93	83 - 107
Six weeks lighting	90 ns	77 - 106

*Dusk to dawn lighting 10 foot-candles minimum beginning September 13 when shoots showed 4 to 6 leaf pairs. Plants were grown at 60° F minimum night temperature until buds were 3/8-inch diameter; after this, minimum temperature at nights was 50° F.

A major disadvantage in lighting carnations is the fact that the return crop may be delayed for a considerable time because of the inhibition of lateral-shoot development below the cut on the harvested shoots. Researchers therefore have been interested primarily in supplemental lighting as it applies to a single-crop situation, or to a crop that would otherwise flower too late to be sold in a favorable market (e.g., a June crop that could be made to flower in late April and early May).

Another and perhaps more critical disadvantage in lighting carnations is that of decreased stem caliper and strength and reduced leaf size, which often result in flowers being downgraded in the market. This is particularly true if the photosynthetic light has been especially low, the plants have been too-closely spaced, or the number of developing shoots per unit growing area has been too great. However, there is a temperature interaction that may mitigate the situation. Carnations grown under very cool conditions (and many now are) tend to be unduly heavy-stemmed. They may actually benefit from the "stretching" effects of light under conditions that would otherwise cause them to be downgraded. In other words, lighting may well be an economical substitute for heat in certain situations.

Literature Cited

1. Barber, B. and D.E. Hartley. 1981. Photoperiodic lighting of miniature carnations. Colo. Grenhs. Grow. Assoc. Bul. 377. November.
2. Blake, J. 1955. Photoperiodism in the perpetual flowering carnation. Rep. XIVth Inter. Hort. Congr., The Netherlands. Pp. 331-336.
3. Harris, G.P. 1968. Photoperiodism in the glasshouse carnation: the effectiveness of different light sources in promoting flower initiation. Ann. Bot. 32:87-197.
4. Harris, G.P. and M. Ashford. 1966. Promotion of flower initiation in the glasshouse carnation by continuous light. J. Hort. Sci. 41:397-406.
5. Harris, G.P. and A.P. Bradbeer. 1966. The flowering behavior of carnation cuttings produced in long and short days. J. Hort. Sci. 41:73-83.
6. Holley, W.D. and C. Rudolph. 1969. Lighting of carnations. Colo. Flow. Grow. Assoc. Bul. 224.
7. Holley W.D. and P.E. Schwartz. 1971. Lighting carnations for crop control. Colo. Flow. Grow. Assoc. Bul. 257.
8. Mastalerz, J.W. 1969. Basic facts on the photoperiodic response of carnations. PA Flow. Grow. Bul. 222:1-3. September.
9. Metzger, B. 1972. Cyclic lighting of carnations. Colo. Flow. Grow. Assoc. Bul. 265.
10. Skou, W. 1968. "Photoperiod Manipulation" — a valuable tool for more accurate carnation flower control. Florists' Review. Dec. 26. pp. 13, 64, 65.