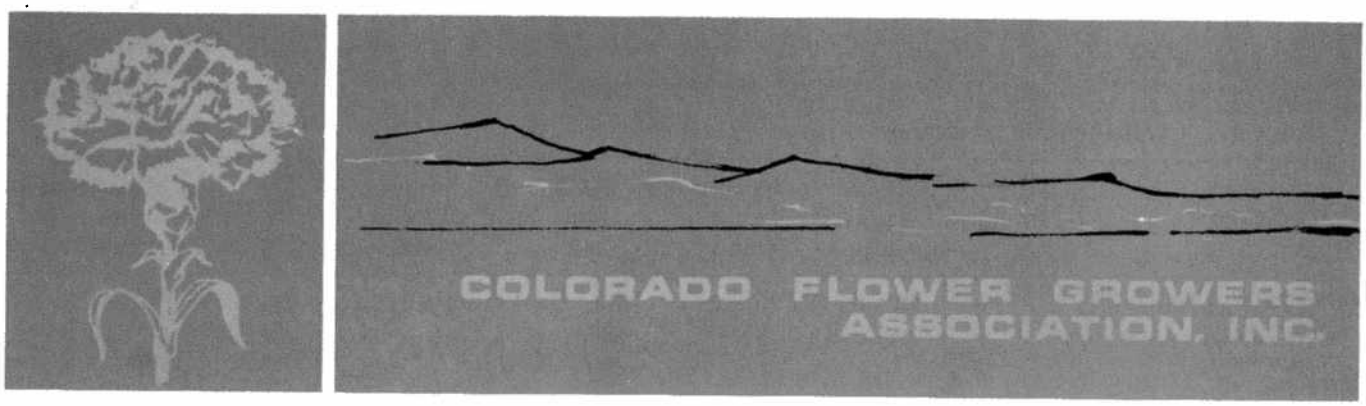

IN COOPERATION WITH COLORADO STATE UNIVERSITY
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Bulletin 265

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CYCLIC LIGHTING OF CARNATIONS

BRUCE METZGER

Plants given four weeks of cyclic dusk to dawn light (one-minute cycles) reached peak production within five days of those lighted continuously from dusk to dawn for four weeks. This comparable level of crop timing with cyclic lighting was accompanied by significant increases in the number of breaks and fresh weight (breaks removed) per stem. The majority of the flowers could be cut to fancy length leaving all breaks on the plants. Cyclic lighting resulted in better overall flower quality than that obtained with continuous night light.

PRELIMINARY WORK - 1970

A preliminary study started in October 1970 utilized 30-minute cycles and the following durations of light per cycle: 1) 100% (continuous), 2) 50% cyclic, 3) 33% cyclic, 4) 20% cyclic, and 5) 0% (no night lighting). These treatments were applied dusk to dawn for a four-week period and all received 10 to 25 ft-c of incandescent light.

The results of this work indicated that cyclic lighting (30-minute cycles) severely reduced the control of crop timing and acceleration. The number of plants having accelerated flowering was progressively decreased as the duration of light per cycle was reduced from continuous night light to 50%, 33%, and finally 20% cyclic light. Other factors such as fresh weight, stem length, internode length, and the number of nodes per stem progressively approached the values of the unlighted controls as the amount of light per cycle was decreased. Photoperiodic response also appeared to be dependent on light intensity, as response was reduced for the plants most distant from the lights. Cyclic lighting significantly increased the number of breaks and stem fresh weight compared to the continuously lighted plants.

Considering these results, the cycle length was reduced to one minute and the 20% cyclic treatment replaced with a 50% cyclic low intensity treatment. These changes were made in an attempt to regain acceleration of flowering by shortening the dark period for each cycle and to establish whether or not a higher light intensity was required for cyclic lighting.

MATERIALS AND METHODS 1971-72 STUDY

Cuttings of the genetically different varieties *CSU Pink*, *Caribe*, and *Cordoba* were planted August 7, 1971. The plants were pinched August 23 and all but the top three resulting breaks on each plant were removed two weeks later. This reduction in the number of breaks allowed more uniform growth of those remaining. Lighting was started September 20 when the majority of the shoots had five to seven leaf pairs and was terminated October 18. All treatments were separated by black polyethylene curtains from dusk to dawn during the lighting period. Each developing flower stem was disbudded, removing all reproductive breaks and the top (first) vegetative break.

The study consisted of four treatments and a control. One-minute cycles were used in all cyclic treatments (Table 1). The treatments were composed of varying durations of light for each

Table 1. Cyclic lighting treatments utilized in the experiment.

Lighting treatment	Cycle length (min.)	Time cycle lights on (sec.)	Time cycle lights off (sec.)	Hours of light at night	Intensity (ft-c)	Average ft-c hours per night
100% (Continuous)	1	60	0	13.0	10-25	227.5
50% Cyclic	1	30	30	6.5	10-25	113.5
33% Cyclic	1	20	40	4.3	10-25	78.5
50% Cyclic Low Intensity	1	30	30	6.5	2-5	22.5
0% (Control)	1	0	60	0.0	0	0.0

cycle as follows: 1) 100% (continuous), 2) 50% cyclic, 3) 33% cyclic, 4) 50% cyclic low intensity, and 5) 0% (no night light control). The 50% cyclic low intensity plants received two to five ft-c of incandescent light; all other lighting treatments received 10 to 25 ft-c.

RESULTS AND DISCUSSION

The photoperiodic response (reaction to night lighting) of each variety to cyclic dusk to dawn lighting was nearly equivalent to continuous dusk to dawn lighting. All varieties had similar growth and development response to cyclic lighting; however, each variety varied slightly in the level of response produced. The major results of the study are presented in Tables 2 and 3.

Peak production was delayed a maximum of five days for all cyclic lighted plants compared to those lighted continuously dusk to dawn. The CSU Pink continuous, 50% cyclic, and 33% cyclic plants all reached peak production at the same time. The duration of flowering was slightly increased with 50% and 33% lighting. The plants in these treatments required five to ten days longer than the continuous plants for 75% of the flowers to be cut.

Total stem lengths (calyx to shoot origin) were slightly greater with 50% and 33% cyclic light than those produced under continuous light. The maximum increase for the regular light intensity cyclic plants was 0.5 inch compared to stems up to 3.5 inches longer for the no night light controls.

Stem lengths above the top vegetative break (calyx to top break) were reduced one to three inches with 50% and 33% cyclic lighting. The majority of the flowers in these treatments could be cut to fancy length without removing any vegetative breaks from the plants. One break had to be removed to cut fancy length stems in the Cordoba 50% and 33% cyclic treatments.

The total number of nodes produced below a flower is a good indication of when flower initiation occurred (Blake). Formation of more nodes indicates later initiation. Plants under cyclic light produced an average of 0.5 to 0.7 more nodes than the continuous plants. These small increases reveal that floral initiation occurred essentially at the same time with cyclic light as under continuous light.

The use of 33% cyclic light nearly doubled the number of vegetative breaks produced per stem for each variety. With cyclic lighting it may be possible to correct the problem of severe reductions in the number of breaks produced with continuous lighting. The location of vegetative breaks on the stems was also found to occur at a lower position as the percent light per cycle was increased. This lateral shoot descent was an interaction of internodal elongation, number of nodes, and the number of vegetative breaks produced per stem.

Flower fresh weight and quality were progressively greater as the duration of light per cycle was decreased. These weight increases coupled with slightly greater stem lengths resulted in significantly improved stem strength and quality.

Cycle lengths of less than 30 minutes are required to provide the most favorable results. The preliminary study indicated that 30-minute cycles provided dark periods which were too long. One-minute cycles of 50% and 33% light per cycle corrected this and gave nearly the same level of crop timing as continuous night lighting.

Cyclic lighting will require higher light intensities to attain adequate crop timing (Harris). The 50% cyclic low intensity treatments (two to five ft-c) for each variety showed severe losses in control over crop timing and development. A light intensity of two to ten ft-c is presently used by most growers for continous lighting. This is about one-half to one-third the intensity required for cyclic lighting. The use of 33% cyclic light therefore requires one-third the duration of light per cycle but two to three times the intensity required

Table 2. Effects of lighting treatments on stem fresh weight (breaks removed), number of days from the start of lighting to peak production, and 75% bloom.[1]

Variety	Lighting treatment	Days from start of lighting to: Peak production	75% of total flowers cut	Stem fresh weight (g)[2] calyx to shoot origin (breaks removed)
CSU Pink	100% (Continuous)	95	100	38.7 a
	50% Cyclic	95	105	43.2 b
	33% Cyclic	95	100	44.7 b
	50% Cyclic Low Intensity	105	125	48.7 c
	0% (Control)	125	130	56.7 d
Caribe	100% (Continuous)	95	100	41.6 a
	50% Cyclic	100	105	44.6 b
	33% Cyclic	100	110	45.4 b
	50% Cyclic Low Intensity	105	130	48.9 c
	0% (Control)	133	140	55.5 d
Cordoba	100% (Continuous)	90	95	38.8 a
	50% Cyclic	95	100	43.7 b
	33% Cyclic	95	100	47.0 b
	50% Cyclic Low Intensity	100	110	52.1 c
	0% (Control)	125	130	60.0 d

[1] *Values are means of 72 flowers per variety for each treatment.*
[2] *Values within a variety followed by the same letter are not significantly different at the 5% level.*

Table 3. Effects of lighting treatments on stem length, number of nodes, and number of breaks per stem.[1]

Variety	Lighting treatment	Stem length (in.) calyx to top break[2]	Stem length (in.) calyx to shoot origin	No. of nodes calyx to shoot origin[2]	No. of breaks calyx to shoot origin[2]
CSU Pink	100% (Continuous)	27.5 a	32.5	12.7 a	1.7 a
	50% Cyclic	24.5 b	33.0	13.2 ab	2.8 b
	33% Cyclic	24.5 b	32.5	13.5 b	3.7 c
	50% Cyclic Low Intensity	22.5 c	33.5	14.6 c	5.2 d
	0% (Control)	22.5 c	35.0	16.0 d	7.0 e
Caribe	100% (Continuous)	26.0 a	33.5	12.8 a	1.9 a
	50% Cyclic	25.5 a	33.7	13.3 a	2.8 b
	33% Cyclic	25.0 ab	33.7	13.4 ab	3.3 c
	50% Cyclic Low Intensity	23.5 b	34.0	14.4 b	4.7 d
	0% (Control)	24.0 b	35.5	15.7 c	5.7 e
Cordoba	100% (Continuous)	25.0 a	33.5	13.0 a	2.4 a
	50% Cyclic	22.5 b	33.2	13.7 a	3.6 ab
	33% Cyclic	23.5 b	34.0	13.7 a	4.0 b
	50% Cyclic Low Intensity	21.5 c	34.5	14.6 b	5.6 c
	0% (Control)	21.5 c	37.0	16.3 c	7.4 d

[1] *Values are means of 72 flowers per variety for each treatment.*
[2] *Values within a variety followed by the same letter are not significantly different at the 5% level.*

for continuous lighting. If a grower is already using extremely low intensities (two to ten ft-c) there would be very little savings in electricity with cyclic lighting. However, if the intensity a grower is now using averages 10 to 20 ft-c a significant savings could be realized. Another factor in utilizing cyclic lighting is the slight reduction in bulb life caused by the frequent on-off switching. Bulbs are available with special filaments for this type of lighting, but not in the PS 30 type.

The major advantages of cyclic lighting are the nearly doubled production of vegetative breaks and the marked increase in stem fresh weight and quality. These advantages can be obtained for the same or lower power cost and can be accompanied by a similar level of crop timing as that achieved with continuous night lighting.

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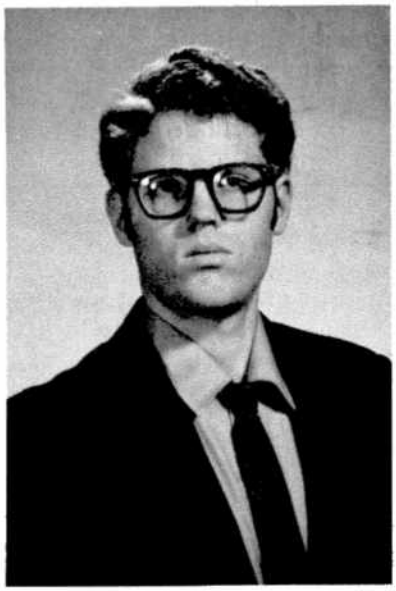

Don C. Dubois completed his undergraduate work in early June. A native of Colorado Springs, he attended the local schools and participated in track, wrestling, and basketball. Don completed two years at Fort Lewis College before coming to CSU. While with the department Don worked in our research greenhouses and did a special research problem on market acceptance of container plants. His interests include growing for and managing either a field or greenhouse production operation.

Your editor,

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