COLORADO FLOWER GROWERS ASSOCIATION, INC.

IN COOPERATION WITH COLORADO STATE UNIVERSITY
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Lighting of Carnations

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The first work at Colorado State University on the effect of extended photoperiods on carnation flowering was published in CFGA Bulletin 209. In this research it was found that the first crop on young carnation plants was accelerated by two to three weeks and that the branches producing the second crop were inhibited by lighting. In other words, there was both an acceleration and a delay obtained by long photoperiods. It was further concluded that lighting of carnations may have its most practical use on older carnation plants in their terminal year, or in hastening the second crop on young plants for areas where this crop flowers in June and July. A distinct increase in yield began 7 weeks after lighting was started on older plants and continued for the length of the lighting period.

The interest in lighting of carnations has been greater in England than in this country, but recently the work at Cornell by Langhans and his co-workers has stimulated the use of supplementary lighting on carnations in this country. Harris, of the University of Reading, England, and his co-workers have published many papers on lighting of carnations and have influenced the development of continuous lighting (so-called dusk-to-dawn lighting). Harris' paper, published in 1967, was summarized by the statement: "Carnations in a crop due to be cleared in mid-June were illuminated throughout the night for a period of six weeks in the preceeding winter from mid-January to the end of February. This resulted in an increase in production of about 4 flowers per sq. ft. in the period prior to clearing the crop."

Methods

The same three 15 by 18 foot fiberglass covered houses were used in a follow-up experiment to Novovesky's work. Two benches 4 x 13 feet were contained in each house. One bench was planted with young plants of White Sim on July, 1967. The second bench contained 1-year old plants of the cultivar Pink Mamie that had been planted in July, 1966. This second bench had been in the lighting treatments its first year but had been cut for a period of 8 months since any lighting had been applied. Supplementary carbon dioxide was added during the daylight hours to maintain the levels approximately 1000 ppm from November 1 to March 1, 1968. Temperatures in the three houses were controlled at 53-55 F nights and 60-65 F days.

Lighting was supplied with incandescent floodlights attached to the corners of the greenhouse and supplying light intensity from 20+ foot candles near the lights to a minimum of 7 foot candles at the furtherest point from a lighting fixture. No difference could be observed on the effect of these differences in light intensity. Six different treatments were supplied as follows:

House 1, east half of both benches lighted during the month of December; west half-unlighted control.

House 2, east end lighted during the month of January; west end lighted during the month of February.

House 3, east end lighted during the months of March and April, west end lighted April 1 to May 15.

Flowers were cut 4 times a week and graded according to SAF grading standards. Weekly yields after February 4 are plotted in 10 accompanying graphs. In order to remove variations due to weather the yields were calculated as 4-week moving means.

Results

Yields of the unlighted plants from the two plantings were distinctly different as can be seen in the graphs. The older plants in their second year produced steadily with slight peaks of production around April 21 and again in June and July. The first-year plants had produced heavily in November and December and were in very high production beginning the week of April 14 for a period of 4 weeks, decreasing in May to a low in late June, then beginning to increase in July. The production of both plantings was low in January and early February. The results will be discussed by months.

December lighting

December lighting on plants in their second year produced a distinct crop beginning February 18, increasing to peak production March 24, then decreasing rapidly to a low April 21. This lighting schedule on older plants reduced the yield during the critical Easter-Mother's Day marketing periods. The yield from December lighted plants was high in June and July compared to unlighted plants.

December lighting on young plants in their first year showed the same though a lower increase during the same periods, primarily in March. The major effect of December lighting on young carnation plants was a distinct decrease in production beginning the first of April and lasting through May. This indicates that first year carnation plants should not be lighted in December in Colorado unless the grower wants to throw the plants out about mid April.

January lighting

Older plants that were lighted in January showed some increased production in March, little difference in yield during the April-May period with a strong increase in yield from June through July. On the other hand, younger plants in their first year showed a strong increase in yield in late February to mid March, a decrease in yield in late March and early April, yield equal to the unlighted plants in late April and early May, another low in late May and a very strong increase in yield in June and July. The similarities between the effects of lighting on young and old plants are easy to see in the graphs showing results of January lighting.

February lighting

Even more similar results were obtained when lighting young and old plants during the month of February. The production curve showed low yields in late March and early April, increasing yields to a peak beginning about May 5, too late for the Mother's Day market. Following the May peak, low yields occurred on both treatments around late May and early June followed by strong increases in late June and July.

March-April lighting

March-April lighting produced increased production from mid May to July 1, with much higher yields on the older plants. Lighting at this time is too late to increase spring production, but the curve illustrates the advantage of lighting for two months continuously in order to reduce yield at a predetermined date.

April-May lighting increased yields from May through June on both young and old plants.

Discussion

Harris and Ashford (1966) have determined the critical sensitive stage of Sim carnations to lighting to be shoots bearing 7 visible pairs of leaves. Phillips (1968) illustrated a ten-node stage as the stage of a carnation growth most sensitive to various stimuli. This immediate pre-floral stage occurs in spring about 19 days after a lateral growth initiates. The stage described by Phillips is slightly younger than the 7 visible leaf pairs. During the spring of the year, approximately one leaf pair develops and separates each 7-9 days. This would be slower during the middle of the winter, depending primarily upon light intensity.

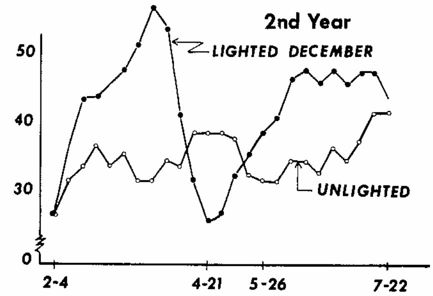
The effects of supplementary lighting on carnations should be in direct proportion to the number of growths in the susceptible stage, that is from 4 to 7 leaf pairs. This is illustrated by the graphs of December and January lighting. The young plants lighted in December and the older plants lighted in January had minimum shoots in the susceptible stage. However, both types of plants contained adequate susceptible shoots from February lighting, one or two months later. Studying more closely the March-April lighting, the older plants had many more susceptible shoots than the younger plants. In the case of the younger plants they had just produced a heavy crop of flowers that were cut low and the breaks were not sufficiently developed to be affected by lighting until late in the lighting period.

Summarizing this part of the discussion, it should be emphasized that supplementary lighting can only affect carnations if there are shoots present in the 4-7 leaf pair stage. The older shoots will be affected immediately whereas the younger shoots will be affected as soon as they develop to a slightly larger stage.

The other major effect of lighting on carnations reported by Novovesky (1967) was that of inhibiting the lateral growths on shoots that are lighted. Phillips (1968) pointed out that axillary bud growth on shoots is first evident in the 10-node sample, or 19 days after the growth initiates. His observations were made under approximately average day lengths during the spring of the year. As photoperiod increases, this axillary bud growth is delayed or inhibited entirely. This inhibition of lateral growth can delay the start of the following crop and can be used to advantage by a grower for plants that are to be thrown out on a given date. Dusk-to-dawn lighting has been reported as much more effective in eliminating return crops than the night interruption type of lighting used in these experiments.

December lighting reduced the yield around mid-April on both old and young plants. This would have been a good time to terminate the young plants, but the older plants had a heavy crop of flowers that returned shortly after April. None of the lighting treatments effectively reduced yield for a long enough period to have the plants in a "cut off" condition except the December lighting of young plants. This was due to the stage of growth when the plants were lighted and because they were lighted only one month. A two-month lighting period on the older plants in March and April shows what can be done when plants are in the proper stage for lighting. These plants were in low production most of July and they also were "off-crop" the following six weeks.

Harris (1967) recommends for England that carnations to be cleared in mid June should be lighted the preceding January 15 to March 1. This lighting resulted in an increase in production of about 4 flowers per sq. ft. in the period prior to terminating the crop. If the older plants in this study were typical of commercial carnations in their second and third years, lighting during the months of Jan. and Feb.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UNLIGHTED
50
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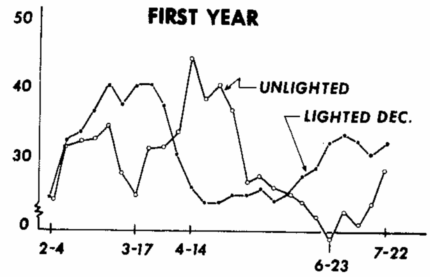
2-4
4-21
5-26
7-22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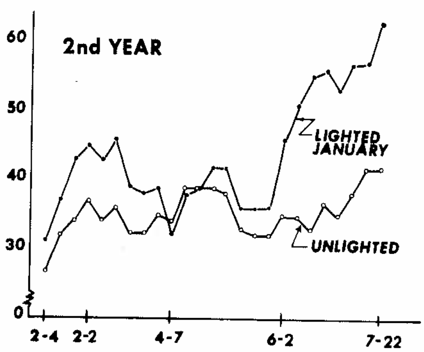
7-22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UNLIGHTED
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2-4
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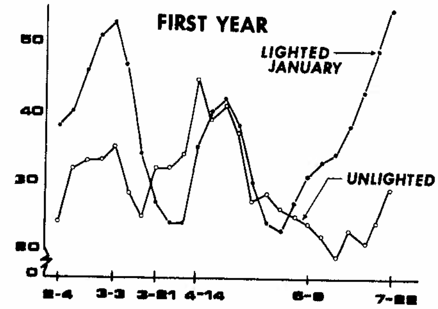
4-7
6-2
7-22


FIRST YEAR
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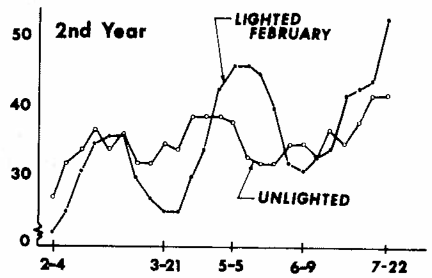
7-22


2nd Year
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UNLIGHTED
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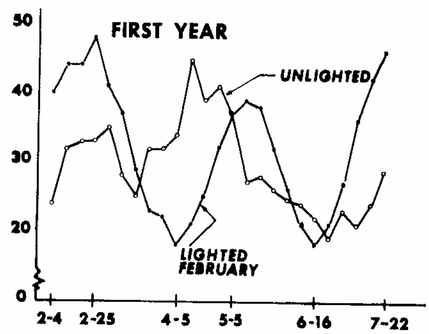
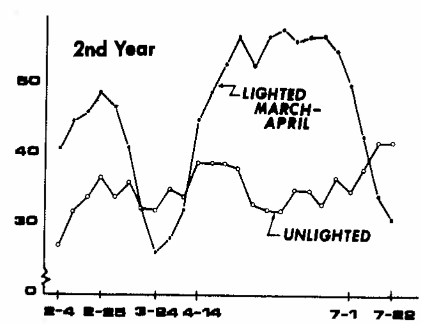
30
0
2-4
3-21
5-5
6-9
7-22


FIRST YEAR
UNLIGHTED
LIGHTED FEBRUARY
50
40
30
20
0
2-4
2-25
4-5
5-5
6-16
7-22


2nd Year
LIGHTED MARCH-APRIL
UNLIGHTED
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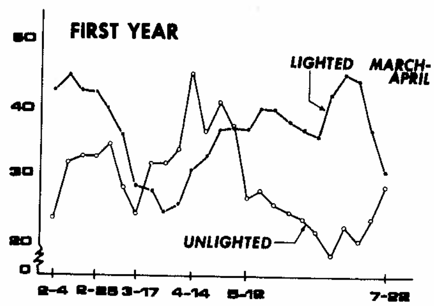
40
30
0
2-4
2-25
3-24
4-14
7-1
7-22


FIRST YEAR
LIGHTED MARCH-APRIL
UNLIGHTED
50
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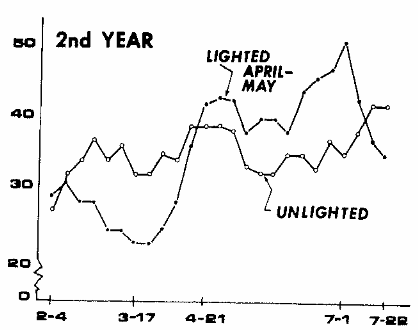
30
20
0
2-4
2-25
3-17
4-14
5-12
7-22


2nd YEAR
LIGHTED APRIL-MAY
UNLIGHTED
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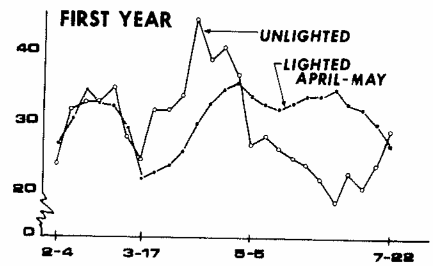
2-4
3-17
4-21
7-1
7-22


FIRST YEAR
UNLIGHTED
LIGHTED APRIL-MAY
40
30
20
0
2-4
3-17
5-5
7-22

in Colorado should insure maximum April-early May production and produce a low yield in June for terminating the crop. Lighting after February is too late to stimulate yields for the spring Holidays.

Effects of lighting on flower grade

While all flowers produced by these experiments were graded, the differences between treatments were small and were influenced in large part by the time of year the flowers were cut. For example, those treatments that produced large June-July crops such as the March-April lighting had adverse effects on grade. The unlighted plants and those producing a large percent of their flowers from February to June showed increased average grade. The grade data are being further analyzed for week by week comparisons.

Besides accelerating the flowering of specific growths and inhibiting lateral branching on these same growths, lighting causes elongation of internodes therefore longer stemmed flowers. If the longer stems are produced in low light intensities, they may be visibly weaker. On the other hand, the inhibition of lateral growths on flowers affected by lighting may in part offset this weakness by reducing the competition between side breaks and developing flowers.

In a recent letter from Dr. Harris, he writes in part; "Where we have used lighting for relatively short periods of time (about 4 weeks) there has been no obvious reduction in flower quality except in so far as more flowers have been produced at unfavorable times of year when flower quality is in any case lower. Longer periods of lighting (more than 6 weeks) have sometimes had adverse effects causing undue elongation of internodes, and reductions in flower size."

Effects of lighting on yield

It was not possible to design these experiments so the data could be analyzed statistically. Major effects on yield in these experiments were position in the houses (E vs W), houses, and plantings (1 vs 2 year). All of these effects can be removed by simple arithmetic. Four lighting treatments produced almost identical yields for the February to July period of records. Unlighted and February lighted plants produced fewer flowers but the reduced yield is attributed to their west position where they received shade from evaporative pads before February 1.

According to Harris (1967) the primary effect of lighting on carnation is on the time of flowering of shoots as distinct from the number of shoots or flowers formed. A lighting treatment may bring about a temporary increase in flower production followed normally by a decrease. Total production over an extended period should be affected very little. In other words, the major value of lighting could be the acceleration of production for a specific period, but this results in decreased yield following the period.

Photoperiod control is another tool to aid in controlling carnation growth and flowering. It is no panacea but it will be used in several ways depending upon climate and markets. In Colorado, there seems to be little advantage to lighting young carnation plants in their first crop. Planting two weeks earlier will accomplish about the same results. In fact, lighting any carnation plants before Christmas would reduce yields for all important spring holidays.

The value of lighting first-year carnation plants is questionable for results obtained in these experiments. Lighting two and three year plants during January and February may be the major use Colorado growers will have for this practice.

Literature cited

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