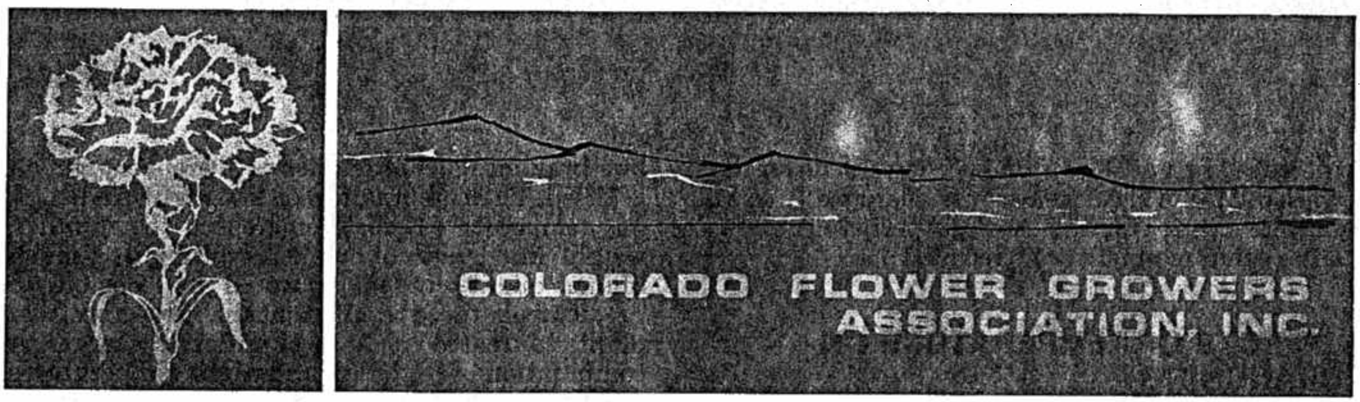

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ANOTHER LOOK AT TEMPERATURE EFFECTS ON CARNATIONS

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More research has been done on temperatures for carnation than on any other factor. A thorough experiment by Abou Dahab in Holland prompted another experiment at CSU on a semi-commercial scale. We were interested in the extent to which low night temperature can be compensated by higher day temperature. We are also beginning a series of experiments to study the influence of all factors on the production and position of lateral breaks on flower stems.

Young and one-year-old CSU Pink Sim plants were grown in a gravel medium under fiberglass with the temperatures by compartments:

Compartment	Day T	Night T
A	65F	48F
B	65F	56F
C	75F	56F
D	75F	48F

Compartments A and B were heated to 60 F at 8 am and allowed to drift up to 65 F before ventilation and cooling came on. Compartments C and D were also heated to 60F but not ventilated until the temperature reached 75F. As a consequence, day temperatures in C and D averaged only 4 to 5 degrees warmer than the two lower temperatures. December and January day temperatures in A and B averaged a low of 62F. Temperatures were recorded in aspirated boxes throughout the experiment.

The one-year-old plants were started in 1970 and the young plants were benched as rooted cuttings September 12, 1971. Each plot contained 90 plants in a 30 sq ft plot buffered on either end with another Sim cultivar.

RESULTS ON ONE-YEAR-OLD PLANTS

All stems with buds visible were cut just above the top vegetative break on October 1. The results include all flowers cut from January 12 to March 21, these being the flowers on which experimental temperatures were imposed throughout most of their development. While distribution of yield was affected by night temperature, the number of flowers produced during the 10-week period was not significantly different for the temperature combinations. Production was rather steady at around 1 flower/ft^2/week for the treatments of 56F night temperature throughout the 10-week period. On the other hand, the two 48F treatments produced from 1/3 to 2/3 flowers/week/sq ft to mid-February then

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increased to a peak of almost 3 flowers/ft^2 on the week of March 7. All treatments averaged 10 to 11 flowers per ft^2 for the 10-week period (Table 1) since each treatment occupied 30 ft^2.

EFFECTS OF TEMPERATURE ON BRANCHING

The location and development of lateral branches on the flower stems directly influenced the succeeding crop of flowers. Table 1 shows the effects of the temperature combinations on position, weight, number, and length of lateral breaks per stem. A quality index factor for breaks was calculated as follows:

$$Q.I. = \frac{\text{Mean weight of breaks per stem}}{\text{Mean length of breaks per stem}} \times \text{Mean number of breaks per stem}$$

The temperature combinations used in this experiment did not significantly affect the position of the top vegetative breaks (Table 1), but branching characteristics were very much affected. The combination of low night and high day temperatures greatly increased the number, weight, and length of breaks, resulting in a much higher quality index. It would be possible to predict from these results that the next crop from plants so treated would be significantly larger. A combination of high day and night temperatures produced the lowest quality index for breaks. Quality index for breaks decreased steadily from January 12 to March 21 in all temperature combinations.

QUALITY OF FLOWERS

The effects of these day and night temperature combinations on flower quality factors are included in Table 1. The differences in stem length were due to internode length since all flowers were cut at the ninth node from the top. No effort was made to count the total number of internodes per stem since this had been determined when the temperature treatments were imposed on October 1.

Table 1. Effects of day and night temperatures on yield and branching characteristics, stem and internode length (cm), weight of flower and stem (gm), and stem strength of carnations from one-year-old plants.

	Temperatures			
night	48F	56F	56F	48F
day	65F	65F	75F	75F
Total yield	328	300	321	326
Node number of top vegetative break	8.9	7.9	8.2	7.5
Mean weight of breaks per stem	10.2	10.3	7.1	20.9
Mean number of breaks per stem	3.8	3.9	3.5	4.5
Mean length of breaks per stem	12.8	11.1	10.0	15.5
Mean quality index	3.0	4.0	2.5	6.1*
Mean stem length [a]	66.8	60.0	63.9	69.9*
Mean internode length [a]	7.4	6.7	7.1	7.7*
Mean weight flower-stem [a]	30.3	28.7	27.7	31.1*
Mean weight of flower	7.9	8.3	7.1	7.4*
Mean weight of stem [a]	22.3	20.4	20.6	23.6*
Mean stem strength [b]	8.2	15.0	20.7	6.2*

a Flowers cut above ninth node.
b Degrees divergent from horizontal, all flowers measured.
* *Indicates significance at the 5 percent level.*

The longer internodes were produced at 48F night temperature. High night temperature significantly reduced internode length (and stem length), especially when combined with low day temperature.

Higher flower and stem weight also occurred under low night temperature. The strength and length of the stems were most important in this higher weight. Many of the flowers produced at 48F were hollow centered to some degree and therefore were lighter in weight. While shorter in stem length, flowers produced under warm night and cool day temperatures were significantly heavier. A high percentage of the nine-node flowers were standard grade because of shorter stems. Weak stems and small flowers were the result when night and day temperatures were high.

High day temperature caused shorter leaves, especially when combined with low night temperature. Low night temperature tended to increase leaf width, especially when combined with low day temperature.

Stem strength was affected differently by the temperature combinations. This was measured by the angle of bending from horizontal on a turgid 20-inch cut flower without any additional weight attached. Flower weight as well as stem strength contributes to this bending. Low night temperature significantly increased stem strength. High night temperature, especially when combined with high day temperature, significantly decreased stem strength even though flower heads were lighter in weight. High day temperature was compensated by low night temperature in that the strongest stems (least angle of bending) were produced by 48N and 75D temperatures (Table 1).

EFFECTS ON GRADE

Low night temperature produced the better grade of flowers (Table 2). As would be expected, high night temperature, especially when combined with high day temperature, decreased flower grade. With low night and day temperatures the low percentage of fancy grade flowers was due to short stems. With high night and day temperatures the majority of flowers were graded short or design due to weak stems. Low night temperature increased the hollow-centered flowers regardless of day temperature. Split calyxes and malformed flowers were produced mostly as a result of low night and day temperatures (Table 2).

COLOR

Low night temperature greatly decreased the color of flowers in January and February, while

Table 2. Effect of day and night temperatures on grade of carnation flowers from one-year-old plants.

	Temperatures			
night day	48F 65F	56F 65F	56F 75	48F 75F
Percent distribution of grades				
Fancy	67.26	37.35	6.23	68.09
Standard	14.69	42.26	21.48	19.42
Short	4.65	15.11	48.61	2.48
Design	13.40	5.28	23.67	10.01
Percent distribution of design flowers				
Weak stems	2.09	3.00	17.01	1.01
Split calyxes	3.05	0.50	—	1.00
Slabsides	1.00	0.78	2.00	0.50
Bullheads	2.00	1.00	0.72	2.50
Hollow-centered	5.26	—	3.04	4.00
Flat-centered	—	—	—	1.00
Total percent design flowers	13.40	5.28	23.67	10.01

56F nights maintained the color of CSU Pink Sim. As day temperature and light intensity increased in March, two different situations occurred. Flower color increased in compartments with either low night and day temperatures or high night and low day temperatures. High day temperature with either high or low night temperature caused a decrease in color. These results indicate that carnation color intensity is intricately correlated with both temperature and light intensity. Low night temperature was not compensated by high day temperature as far as flower color was concerned.

CUT FLOWER LIFE

The six keeping quality trials conducted during the experiment indicated no significant difference due to these temperature combinations.

YOUNG PLANTS

One bench in each temperature compartment was planted with CSU Pink Sim rooted cuttings on September 12, 1971. It is realized that this planting date is too late for good growth before winter, but lateral growths following pinching of these plants were developed entirely under the temperature regimes imposed.

Yield distribution was very much affected by the day-night temperature combinations. Figure 1 shows the cropping patterns by weeks from January 30 to March 18 for the two 56F night temperatures. The graphs were extended to April 1 and 8 for the 48F night treatments to complete records of the first crop. High night temperature caused earlier and steadier production with completion of the first crop three to four weeks early. Low night temperature caused distinct peaks of heavy production. Almost all the flowers were produced in four weeks from either low night temperature combination, but those receiving warm day temperature were about three weeks earlier.

Table 3 includes data on growth other than that of the flowers. The quality index on breaks was lower in each treatment in comparison to one-year-old plants. This was probably due to a lack of carbohydrate reserves in these late-planted young plants. There were significantly more stems without lateral breaks especially at 56 F night temperature. The node at which the top vegetative break was located showed no difference between temperatures (Table 3). Stems without breaks were not considered when determining break location but were counted in quality index.

Since these young plants were subjected to the temperature combinations at the time the terminal shoot was removed from each cutting, the temperatures imposed affected both number and length of internodes (Table 3). As a result total stem length was also affected. High night temperature increased and low night temperature reduced the number of internodes. High day temperature also tended to increase internode number. Internode number per stem increased during the sampling period indicating a shortday effect.

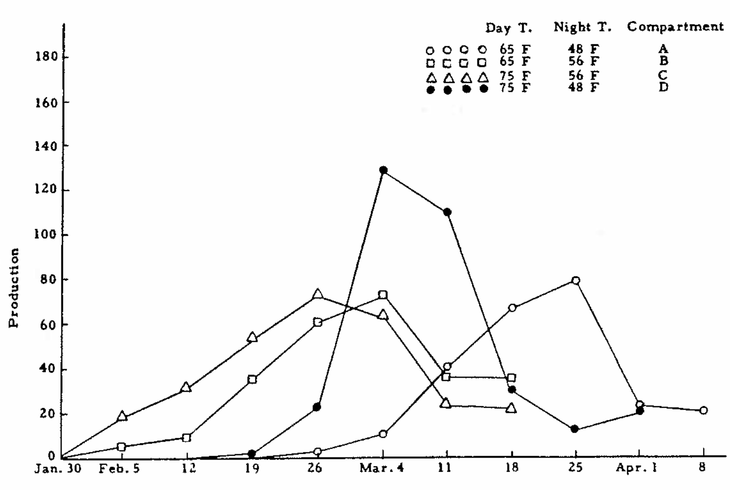

Figure 1. Effect of temperatures on yield distribution from young carnation plants.