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Influence of Day and Night Temperatures on Carnations

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This report presents 2 year results of growing carnations at various day and night temperatures. It will answer many questions carnation growers have asked. However, for recommendations it might be easier to recommend 'what not to do'. So much depends upon the grower and what he wants. We would suggest a carnation grower study these results carefully.

Review of Literature

Holley and Baker (8) reported temperature effected rate of growth, size and shape of flowers, stems, leaves, water content of plant tissues and keeping quality of cut flowers. Holley and Baker (8) Laurie *et al* (10) and Post (12) considered 50° as the best growing temperature for the carnation. According to Holley and Baker, (8) Schmidt grew the variety Red Sim under accurately controlled night temperatures of 48-50°, 50-52° and 54° with a relatively constant day temperature (fluctuating between 60 and 68°). He concluded, 52 or even 54° was the ideal night temperature for the Red Sim variety in Colorado.

Hanan (4, 5) grew red and white Sim varieties at a constant night temperature of 52° and day temperatures of 60, 65, 70 and 75°. He found plants grown at a day temperature of 65° produced flowers of the highest mean grade. Hanan (4) suggested day temperatures should closely follow the available light intensity. Manring and Holley (11) made day and night temperature recommendations for different periods of the year. They suggested:

Time of Year	Young Plants	Plants older than 6 mos.
Day Temperatures		
May–Aug.	70°	65°
Mid-Sept.–Mid-Nov.	65°	60°
Mid-Nov.–March 1	60°	60°
Spring	60°	60°
Night Temperatures		
Sept.–Oct. 15	54°	
Oct. 15–March 15	50-52°	
March 15–May	54°	

Seeley (14) compared solar energy records based on Ithaca, New York and Boulder, Colorado and suggested day and night temperatures for carnation growers in New York State.

Time of Year	Day	Night
Sept. 15–Nov. 1	60°	50-52°
Nov. 1–Feb. 15	57°	50-52°
Feb. 15–May 1	60°	50-52°
May 1–Sept. 15	65°	54°

Temperatures have been found to influence the production of carnations. Increasing the growing temperature of carnations from the generally recommended temperatures have been reported to have caused the following results: stem strength decreased (3, 4, 5); stem dry weight decreased (4); internode length decreased (1, 3, 4, 13); node number increased (1); leaf width decreased (1, 4 5); growth became weak (6, 12); plants budded sooner (15); flower bud initiation was hastened (1); flower bud development was hastened (1); flowering was hastened (1, 3, 4, 5, 12); flower color was improved (13); flower size decreased (1, 3, 4, 5); flower head weight decreased (1); flower grade improved (13); petal weight and petal number decreased (1); quality of flowers decreased (3); and the keeping life of cut flowers increased (4).

Methods and Materials

Cuttings of the variety 'CSU White Pikes Peak' from disease free mother plants were used. The original cuttings were obtained through the courtesy of Professor W. D. Holley of Colorado State University. The plants were grown in 3 x 3 ft. carts which contained a steam pasteurized soil mix (2:1:1-Eel silt loam, peat moss and perlite). The spacing was 7.5 x 7.5 inches (36 plants per cart). A single pinch was used.

Five greenhouse compartments (25 x 35 ft) automatically controlled heating and cooling to main temperatures were used. The system used was described by Freeman (2) and the temperature control was excellent. Each compartment was maintained at a constant day and night temperature. Using a factorial arrangement of all possible combinations of day and night temperatures, 25 temperature treatments were obtained. Two carts (replication) were used for each temperature treatment for a total of 50. Each cart was moved to the appropriate day temperature at 8 am and to the appropriate night temperature at 5 pm. The day temperature, therefore, was 9 hours and

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night temperature was 15 hours in length. The cuttings for the first years work (1962-63 season) were planted on July 11, 1962. From July to September 30, temperature was maintained the same in all compartments, approximately 70°. On October 1, 1962 the temperature was set to maintain 40, 50, 60, 70 and 80°F. This study was terminated April 1, 1963.

In the second years study (1963-64 season) the cuttings were planted on June 6, 1963. Summer temperatures were set to maintain 60, 65, 70, 75 and 80°F. On September 1 the temperatures were set and readjusted to 50, 55, 60, 65 and 70°F. This study was terminated on May 6, 1964.

Results

1962-'63 Season

Production

The number of flowers produced is shown in Table 1 and recorded as flowers per square foot. These results are just for 9 months, but they do indicate the trend. The warmer temperatures (60°, 70°, 80°) produce more flowers than the cooler temperatures of 50° and 40°. The lowest production occurred when the plants were exposed to 40° either during the day or night.

Table 1. The number of flowers produced per square foot as influenced by 5 night and 5 day temperatures. The 1962-63 Season—planted July 11, 1962—terminated April 1, 1963

Night Temperature (°F)	Day Temperature (°F) 80	70	60	50	40	avg
80	11.4	10.0	10.7	11.1	11.5	10.9
70	11.3	10.4	11.4	11.3	11.1	11.1
60	10.1	9.9	10.7	10.5	8.5	9.9
50	9.0	9.0	10.1	7.0	1.8	7.4
40	8.6	9.8	9.7	4.6	0.3	6.6
avg	10.1	9.8	10.5	8.9	6.6	

Grade

The mean grade of the flowers is shown in Table 2. Generally a crop with a mean grade less than 4 would be unsatisfactory. Crops with a satisfactory mean grade were produced at temperatures of 60° and 70° night temperatures and 40°, 50° and 60° day temperatures, also 50° night and 60° day, (the normal commercial temperature).

Table 2. The mean grade of harvested carnation flowers as influenced by 5 night and 5 day temperatures. 1962-63 Season.

Night Temperature (°F)	Day Temperature (°F) 80	70	60	50	40	avg
80	1.8	2.7	3.1	3.6	2.3	2.7
70	2 3	3.6	4.3	4.6	4.2	3.8
60	2.4	3.4	4.5	4.7	5.0	4.0
50	2.0	3.3	4.0	3.5	3.6	3.3
40	1.9	2.9	3.2	2.2	2.0	2.4
avg	2.1	3.2	3.8	3.7	3.4	

Splitting

The percent of flowers with split calyxes is shown in Table 3. Excessive splitting occurred at the two lower night temperatures (40° and 50°), at all day temperatures and at 60° night temperature and 80° and 70° day temperatures. These results are far from conclusive as can be seen in the following year's results (Table 6).

Table 3. The percent of split flowers produced by carnations as affected by 5 night and 5 day temperatures. 1962-63 Season.

Night Temperature (°F)	Day Temperature (°F) 80	70	60	50	40	avg
80	12.4	13.3	13.2	8.1	7.7	10.9
70	10.1	9.0	7.6	7.5	8.0	8.4
60	41.7	25.6	8.4	9.3	1.0	17.2
50	68.5	34.3	23.0	55.4	43.0	44.8
40	72.0	49.0	57.5	92.7	100.0	72.2
avg	40.9	26.2	21.9	34.6	31.9	

1963-64 Season

Production

The number of flowers produced per square foot is shown in Table 4. Although the temperature range was 20°, the number of flowers per square foot were generally rather uniform. No explanation is given for the low production figures for 70° day, 70° night temperatures or 65° night, 50° day temperature nor the high figure of production reported for the 50° nights, 70° day temperature.

Table 4. The number of flowers produced per square foot as influenced by 5 night and 5 day temperatures. The 1963-64 Season—planted June 6, 1963—terminated May 6, 1964.

Night Temperature (°F)	Day Temperature (°F) 70	65	60	55	50	avg
70	15.9	20.9	23.0	20.4	20.9	20.2
65	19.9	21.0	21.4	19.6	15.7	19.5
60	21.8	22.0	23.7	22.2	19.8	21.9
55	20.5	22.2	22.0	21.1	22.3	21.6
50	27.0	21.4	22.9	18.0	21.6	22.2
avg	21.0	21.5	22.6	20.5	19.9	

Mean Grade

The mean grade for these treatments is shown in Table 5. Generally the cooler temperature (either day or night) the higher the mean grade. The mean grades were not satisfactory above night temperatures of 65°.

Table 5. The mean grade of harvested carnation flowers as influenced by 5 night and 5 day temperatures. 1963-64 Season.

Night Temperature (°F)	Day Temperature (°F) 70	65	60	55	50	avg
70	3.4	3.5	3.6	3.5	3.4	3.5
65	3.8	3.4	4.0	3.9	4.0	3.8
60	4.0	4.2	4.3	4.3	4.4	4.3
55	4.3	4.4	4.6	4.3	4.8	4.5
50	4.2	4.6	4.7	4.8	4.8	4.6
avg	3.9	4.0	4.2	4.2	4.3	

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Temperatures on Carnations

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Splitting

The percent of split flowers produced is shown in Table 6. The results were unlike the previous years work in that temperatures 65° and above produced unsatisfactory levels of split flowers.

Table 6. The percent of split flowers produced by carnations as affected by 5 night and 5 day temperatures. 1963-64 Season.

Night Temperature (°F)	Day Temperature (°F)					
	70	65	60	55	50	avg
70	24.3	23.9	19.3	27.1	31.4	25.2
65	14.0	11.4	10.0	15.4	19.0	14.0
60	8.3	5.3	4.7	7.6	5.0	6.2
55	4.8	3.7	5.3	8.8	6.0	5.7
50	6.0	2.7	4.1	8.5	13.6	7.0
avg	11.5	9.4	8.7	13.5	15.0	

General Observations

Stem strength and stem diameter generally increase with the cooler temperatures. A similar trend was seen with leaf width, thicknesses and color. The leaves increased in width, thickness and blue-gray color at the cooler temperatures. The strongest breaks occurred at the lower temperatures. Petals were larger and broader at the lower temperatures. More flat-centered flowers (that is, the petals in the center of the flower did not elongate or were small) occurred more frequently at the 60° to 80° night temperatures than the lower temperatures.

Discussion

As we mentioned in the introductions, specific recommendations would be very difficult to make. In the first season's work a wide range of temperatures was used (40, 50, 60, 70 and 80°) and the 40° and 80° temperature proved too extreme. Production was excessively reduced at the 40° and mean grade was reduced at 80°. The most obvious conclusion from the production data was that temperature did not greatly effect total production. Note the 1963-64 season's production. When the temperature limits were just 20° (50° to 70°) and except for a few "out-of-line" data, there was very little difference. This is perhaps to be expected. All of these plants were well grown and up until September there was not a great deal of observable difference in plant growth. On a crop where production records were stopped in late spring, we can almost assume all the flower buds were initiated during the later summer and fall, under ideal light conditions.

The total number of flowers produced is just a part of the picture. The grade and amount of splitting must also be considered. The mean grade figure is an indication of the grade the treatment produced. It is computed by grading the flowers (S.A.F. Grades) giving each grade a number 5, 4, 3, 2, and multiplying the number of flowers by the grade number. The higher the mean grade number the higher the average grade. The result of mean grades reported in Table 2 indicate just a few treatments with a mean grade over 4. In the second season the temperatures were centered around the most desirable treatments of the first season. Table 5 indicates high temperatures (either day or night) reduced the grade.

The effect of these temperatures or the production of split flowers is shown in tables 3 and 6. The reason for splitting has always been elusive and these results do not clarify the picture. In the first seasons' work the 50° and 40° night temperature treatment had the greatest percent of splits. The following season, 65° and 70° night temperature treatments had the greatest percent of splits.

Conclusions

What can be concluded from this work.

1. Temperature did not greatly effect the total production of flowers.
2. Temperature effected percent of split flowers produced but its relationship was still not clear.
3. Temperature did control the grade of flowers.

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Miyazaki Grand Winner

Concluding a year of exceptionally fine exhibits, O. Wesley Davidson, Chairman of the Awards Committee, of the New York Florists' Club reported the following New York State growers had won the various trophies as listed.

C. Miyazaki and Co. of Babylon, won the President John W. Kerrigan trophy. Findeis Greenhouses, Patchogue; C. J. Van Bourgondien, Inc., Babylon, Alois Gunther, Oceanside, Elwood Florist and Nursery, East North-

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The 1965 Cornell Recommendations for Commercial Floriculture Crops has just been printed. New York State Flower Growers can obtain copies of this from their county agricultural agents. Out of state growers can obtain the Cornell Recommends by writing to THE MAILING ROOM, STONE HALL, CORNELL UNIVERSITY, Ithaca, New York. The cost of this booklet is $1.00 and the check should be made payable to CORNELL UNIVERSITY.

This 68 page booklet contains the latest recommendations for Insects, Disease and Cultural control for 25 major Floriculture crops. In addition it has a wealth of information (from general culture of plants to first-aid measures for poisoning). This is the type of booklet every grower should have located in an easily accessible place for ready reference—it not only could save a crop it might even save your life.

Miyazaki Grand Winner (*continued from page 3*)

port, Mayers Flower Cottage & Greenhouses, Patchogue, and Perry & Sons, Lake Ronkonkoma were awarded New York Florists' Club Silver trophies.

All these trophies were distributed at the meeting of the New York Florists Club on Monday, February 8, 1965 at the Hotel New Yorker, New York City, during the regular monthly meeting.

May we point out the C. Miyazaki & Co. were awarded the highest trophy available, the President John W. Kerrigan Trophy, and this is understandable as the chrysanthemums grown by this organization are always of gold medal quality.

Short Takes

Bob Langhans

Peat-lite mixes are being used more and more by bedding plant growers every year. Remember Peat-lite mix is only right when everything is included, not just the peat moss and vermiculite or perlite. The following (taken from page 66 of the 1965 Cornell Recommendations for Floriculture Crops) is the only true Peat-lite mix:

Mix A

Shredded German or Canadian sphagnum peat moss	11 bushels
Vermiculite #2 or #4	11 bushels
20% superphosphate (powdered)	1 pound
Limestone (Dolomitic preferred)	5 pounds
5-10-5	2 to 12 pounds

Mix thoroughly. Presoak by wetting thoroughly. Just before transplanting, water again. After transplanting, water in plants. No further fertilizing will be necessary for two to five weeks depending on the amount of 5-10-5 used. Follow procedure under Mix C for fertilization practice to maintain good growth.

Mix B

The same as Mix A except horticultural perlite is substituted for vermiculite, increase 5-10-5 to 16 pounds.

Mix C

Use the same amounts of peat moss and either vermiculite or perlite. Add the superphosphate and limestone in the amounts listed above. For presoaking the media in the containers, use a 20-20-20 or similar fertilizer at one-half to one pound per 100 gallons of water. Continue feeding at every watering with the same rate of fertilizer.

Special attention should be given to the watering procedure before planting. Because of the excellent drainage characteristics of the mixes, they may be heavily watered and planted immediately. Because nutrients can be leached quickly, a strict program of fertilization must be followed.

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"Haste Makes Waste" a little proverb we all learned when we were children. At this extremely busy time of the year, a little careful planning and alocating of jobs will insure the seedlings don't dry off or the vents get opened, etc.

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YOUR EDITOR,

Bob Langhans