COLORADO GREENHOUSE GROWERS ASSOCIATION, INC.

Research Bulletin

Bulletin 361
Edited by David E. Hartley
July 1980

SPLIT NIGHT TEMPERATURES NOT WORTH THE EFFORT FOR STANDARD CARNATIONS

Joe J. Hanan and Dennis Zaborski[1]

Splitting night temperatures, that is, dropping the greenhouse air temperature to a lower value for the last half of the night does not affect standard carnation production if the first half of the night is above 52°F. Although differences in yield in this experiment were not statistically significant, there was a definite trend toward decreased yield, decrease quality and increased bullheads when the night temperature was split from 52° to 43°F. Unfortunately, significant energy conservation was achieved only when temperatures were split from 54 to 45 (14% reduction over 52 all night) and 52 to 43 (33% reduction over 52 F all night). We believe that a 33% reduction in energy consumption at this time is off-set by the potential for reduced cut-flower quality, delayed flowering, and possible lower yield. Contrary to the results with miniature carnations (CGA Bul. 357), standard carnations should be grown at recommended temperatures of 52 to 54°F all night, depending upon light conditions, use of CO_2, etc.

Methods

The standard varieties 'CSU RED' and 'White No. 1' were benched June 13, 1979, given a single pinch on July 2, followed by another half-pinch the latter part of July, 1979. The plots of 72 plants each (3.6 plants per sq. ft.) were randomized in each of 4 compartments in the CSU Temperature House. The north bench was soil, the south bench gravel. CO_2 was injected to maintain about 1000 to 1500 ppm on clear days with the ventilation off, with irrigation using automatic fertilizer injection following CSU recommendations.

Beginning in October and November, 1979, as outside temperatures became colder, the aspirated thermostats in each compartment were set to maintain air temperature at: 1) 52°F between 5:00 p.m. and 8:00 a.m.

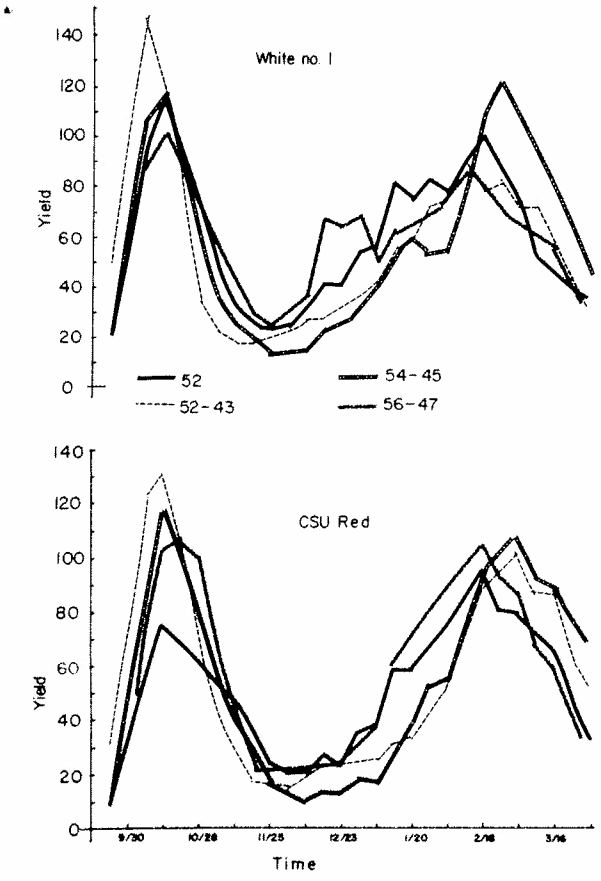

Figure 1: Weekly yield of 'White No. 1' and 'CSU Red' subjected to 4 temperature regimes. Curves use moving means to smooth them. Temperatures were dropped to the lower value at midnight, and returned at 7:00 a.m. All treatments heated to 62 during the day and ventilated at 70° F.

[1]Professor and CGA Scholar respectively, Department of Horticulture, Colorado State University, Fort Collins, Colorado.

2) 56°F to midnight, 47°F to 7:00 a.m., returning to 56°F until 8:00 a.m.
3) 54°F to midnight, dropping to 45°F until 7:00 a.m., returning to 54°F until 8:00 a.m.
4) 52°F until midnight, dropping to 43°F until 7:00 a.m., returning to 52°F until 8:00 a.m.

Temperatures in all compartments were raised to a minimum 62°F at 8:00 a.m., with ventilation at 70°F. Temperatures were turned down to their night setting at 5:00 p.m. each day.

Records were kept on flowers cut from each plot, grade, and numbers of off-types. Steam condensate meters were installed in each compartment, permitting a record of night and day steam condensate return. The meters were calibrated for compartmental differences by recording condensate return for several nights when all compartments were set to 52°F night.

Results and Discussion

Flowering time showed the typical pattern for 1½-pinched standard carnations (Fig. 1). The 54-45 and 52-43 treatments showed delay in returning to peak flowering in January and February by approximately 2 to 4 weeks, as compared to the 52 all night and 56-47 treatments, for 'CSU Red'. 'White No. 1' when subjected to 52 all night and 56-47, consistently produced more flowers during December and January, but peaked at a lower number in February compared to the 54-45 treatment. For both varieties, the 52-43 treatment resulted in some delay.

As the first flowering peak in September would not have been influenced by the temperature treatment, records from December 9, 1979, to April 6, 1980, were subjected to statistical analyses. By the first of December, outdoor temperatures had been sufficiently low to permit the actual temperature settings for slightly better than one month. Neither yield nor grade were statistically significantly different (Tables 1 and 2). There did appear to be a definite trend toward lower yield and quality, particularly for 'White No. 1.' 'White No. 1' produced 11% fewer cut-flowers compared to 52 all night (Table 3). 'CSU Red' produced 5% more flowers at 56-47 compared to 52 all night.

The 54-45 and 52-43 regimes produced a greater number of bullheads, and a slight increase (2%) in off-color flowers (Table 4). Fancy and Standard grade production was not particularly outstanding for any of the treatments — which might have been due to the fact that 52°F was two degrees

Table 1: Average yield of CSU Red and White No. 1 subjected to different night temperature regimes. Yield is average number of flowers per plot (72 plants, 3.6 per sq. ft.) per week. Records from Dec. 9 to Apr. 6, 1980.*

	Night temperature (°F)			
Variety	52 all night	56 to 47	54 to 45	52 to 43
CSU Red	27	29	28	26
White No. 1	31	31	31	27

*Night temperatures were dropped to the lower temperatures at midnight returned to the higher temperature at 7:00 a.m. All compartments heated to 62°F day and ventilated at 70°F.

Table 2: Average mean grade of CSU Red and White No. 1 subjected to different night temperatures. Records from Dec. 9 to Apr. 6, 1980.*

	Night temperature (°F)			
Variety	52 all night	56 to 47	54 to 45	52 to 43
CSU Red	3.70	3.71	3.55	3.23
White No. 1	3.44	3.39	3.24	3.05

*Night temperatures were dropped to the lower temperature at midnight and returned to the higher temperature at 7:00 a.m. All compartments heated to 62°F during the day and ventilated at 70°F.

Table 3: Total yield and yield per square foot for CSU Red and White No. 1 between Dec. 9, 1979, to Apr. 6, 1980.

Temperature treatment	Variety	Yield (Total)	Yield per sq. ft.	% difference from 52 F all night
52 all night	CSU Red	980	49	—
	White No. 1	1110	56	—
56 to 47	CSU Red	1029	51	+5
	White No. 1	1077	54	-3
54 to 45	CSU Red	1003	50	+2
	White No. 1	1112	56	0
52 to 43	CSU Red	941	47	-4
	White No. 1	984	49	-11

Table 4: Percentage of cut flowers in each grade and off-types produced between Dec. 9 to Apr. 6, 1980, from four night temperature regimes for CSU Red and White No. 1.*

Temperature treatment	Variety	Fancy	Standard	Short	Design	Off-color	Bull-head	Split
52 all night	CSU Red	31	34	15	9	—	11	—
	White No. 1	25	27	14	18	0	17	—
56 to 47	CSU Red	33	34	11	10	—	10	0
	White No. 1	21	27	14	14	—	23	0
54 to 45	CSU Red	34	29	12	8	2	27	—
	White No. 1	23	21	9	10	2	33	2
52 to 43	CSU Red	24	26	13	12	2	22	—
	White No. 1	18	20	11	16	2	32	0

*Temperature allowed to drop to lower temperature at midnight, returning to higher temperature at 7:00 a.m. each morning. Heated to 62°F during the day, ventilating at 70°F.

below the optimum night temperature under our conditions.

All split night temperature regimes tended to reduce fuel consumption as measured by the pounds of steam condensate return (Table 5). Obviously, raising the temperature above the 52 level during the first half of the night would tend to reduce the savings of a lower temperature during the second half. The average nightly value of 71 pounds condensate was not significantly different from the 73 pounds average for 52 all night. As would be expected, the 52-43 regime resulted in a third less steam condensate, which has a marked fuel saving. This saving must be off-set by the definite, but not significant, decrease in yield and quality, and delay in flowering. Raising the temperature above 52 for half the night before dropping below 52 appeared to compensate for the lower temperature. But, this considerably reduced the potential fuel saving (Table 5).

Given the present prices for natural gas in Colorado, and the fact that the 33% fuel saving would probably be achieved at the most for the 3 or 4 coldest months of the year; we question the advisability of using temperature splitting for standard carnations under commercial conditions.

Table 5: Effect of temperature splitting on night-time energy consumption. Pounds steam condensate per night between 5:00 p.m. and 8:00 a.m., average for 50 nights during December, 1979, January and February, 1980.

	Temperature regime*				
	52 all night	56 to 47	54 to 45	52 to 43	LSD**
Pounds condensate per night	73	71	63	49	7
Percent reduction from "52 all night"	—	3	14	33	

*Temperatures dropped to lower value at midnight and returned to initial setting at 7:00 a.m. Day temperatures set at 8:00 a.m.

**Least Significant Difference. The amount of condensate required before differences between condensate values are significantly different with a 95% probability of being correct.