COLORADO FLOWER GROWERS ASSOCIATION

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SPLIT TEMPERATURES AND REJUVENATION IN ROSES

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There does not appear to be any advantage to splitting temperatures on roses for energy conservation. However, as a benefit, it appears that a period at low temperatures on roses that have been in production for several years, may significantly rejuvenate them. Whether this effect can be carried on in consecutive years remains to be seen.

Work on splitting temperatures, that is, reducing greenhouse temperatures for a portion of the night, for purposes of energy conservation has received considerable attention. Individuals in Connecticut, Europe and elsewhere have published preliminary reports to show that this may be feasible with some crops such as chrysanthemums — although the general effect is nearly always to delay the crop. We had an opportunity last year to set up an experiment to test the effects of splitting temperatures on rose production through the 1977-78 season. The results were unexpected.

Methods and Materials

Four, 16×18 foot, fiberglass covered, steam heated greenhouses were set up with the following temperature regimes, beginning November 1, 1977:

1. Constant night temperature, 62 F.
2. Night temperature of 62 F to midnight, reducing to 50 F at midnight and returning to 62 F at 7:00 a.m.
3. Night temperature of 62 F to midnight, dropping to 50 F at midnight, then to 40 F at 4:00 a.m. and returning to 62 F at 7:00 a.m.
4. Night temperature of 62 F to midnight, dropping to 40 F at midnight and returning to 62 F at 7:00 a.m.

Roses were grown in the ground with 36 'Cara Mia' in the north beds, planted June 5, 1975, and 30 'Forever Yours' in the south beds (2 rows of 'Cara Mia' as buffers), planted May 27, 1972. Spacing was at 1 plant per sq. ft. Irrigation used automatic fertilizer injection following previous recommendations by Holley and Sadasiaviah. CO_2 was injected during the daylight hours to maintain at least 1000 ppm. The roses were cut back June, 1977, and pinched in September to time for Christmas. Starting Nov. 1, 1977, the day temperatures for all treatments were set to maintain a minimum of 72 F with ventilation starting at 86 F. High pressure mist, controlled by humidistats set at about 60%, maintained humidity.

The split temperature regime was terminated for individual houses between Feb. 8 and 18, 1978, and records terminated Mar. 5, when it appeared that the effects of split temperatures had been adequately determined. The night temperatures for all four houses were returned to 62 F for the entire night. However, observation showed that some of the treatments were showing delayed effects that warranted additional data. Records on yield and quality were started again on March 23, 1978, and continued to May 21, 1978.

Daily records were kept on yield and cut flower stem length for the north and south beds, with data presented on the basis of total weekly production.

Results

While there were no statistically significant differences in yield between treatments during the first 23 weeks of split temperatures (Fig. 1), Fig. 2 shows that lowering the night

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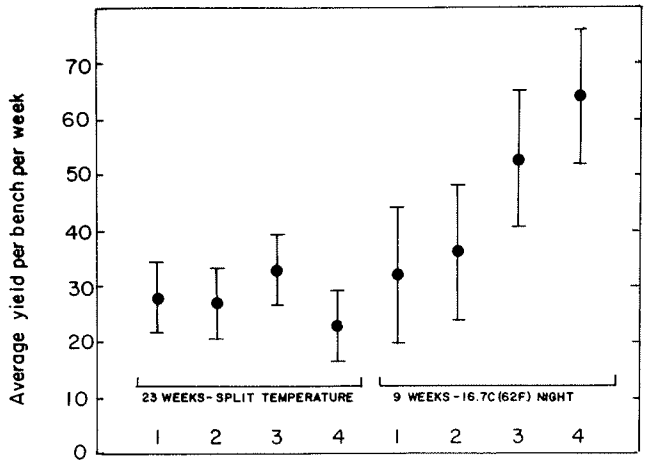

Fig. 1: Yield per bench per week of 'Forever Yours' and 'Cara Mia' roses during 22 weeks of split temperatures and 9 weeks following return of all treatments to 62 F night temperature.
Treatment 1: 62 F continuous night.
2: 62 F to midnight, 50 F 2400 to 0700, Nov. 1 to Feb. 18.
3: 62 F to midnight, 50 F 2400 to 0400, 40 F to 0700, Nov. 1 to Feb. 9.
4: 62 F to midnight, 40 F 2400 to 0700, Nov. 1 to Feb. 8.
The vertical lines show the differences required in the averages for statistical significance.

temperature gradually delayed production until Treatment 4 (40 F half the night) failed to peak for Valentine's. Fig. 3 compares Treatments 1 and 2 (62 F all night vs. 40 F half the night). On the basis of these results we concluded that, while there may be some basis for splitting temperatures to 50 F half the night, 40 F was simply too cold. Furthermore there was a considerable increase in short stems and bullheads on 'Forever Yours' under 40 F temperature regimes, as can be noted in Figures 4 and 5 and Table 1. 'Cara Mia' was not as responsive to the treatments.

However, when the temperatures were returned to 62 F night, Treatments 3 and 4 (40 F) produced two peaks of maximum cut flower production in 9 weeks, compared to one peak for Treatments 1 and 2, with Treatment 4's production double that of the preceeding 23 weeks, quality, as indicated by stem length, showed a marked improvement (Figures 4 and 5, Table 1).

On March 28, the number of new breaks originating near the graft union were counted. There were 6 times the number of new breaks developing on the rose bushes in Treatment 4 compared to Treatment 1 (Table 2).

Discussion

In general, the number of new breaks, production and quality showed more improvement the lower the temperature regime. This suggested an accumulative effect of low temperature on rose rejuvenation. Therefore, the amount of time and temperature regime each treatment regime received was expressed in terms of degree-days below 62 F. There appears to be such an effect (Fig. 6), however, the data is admittedly sparse and remains to be proven.

'Forever Yours' was much more responsive to treatment compared to 'Cara Mia' and this may be expected on the basis of varietal variation. On the other hand, the 'Forever Yours' had been in production 3 years longer than 'Cara Mia' and this difference could be important.

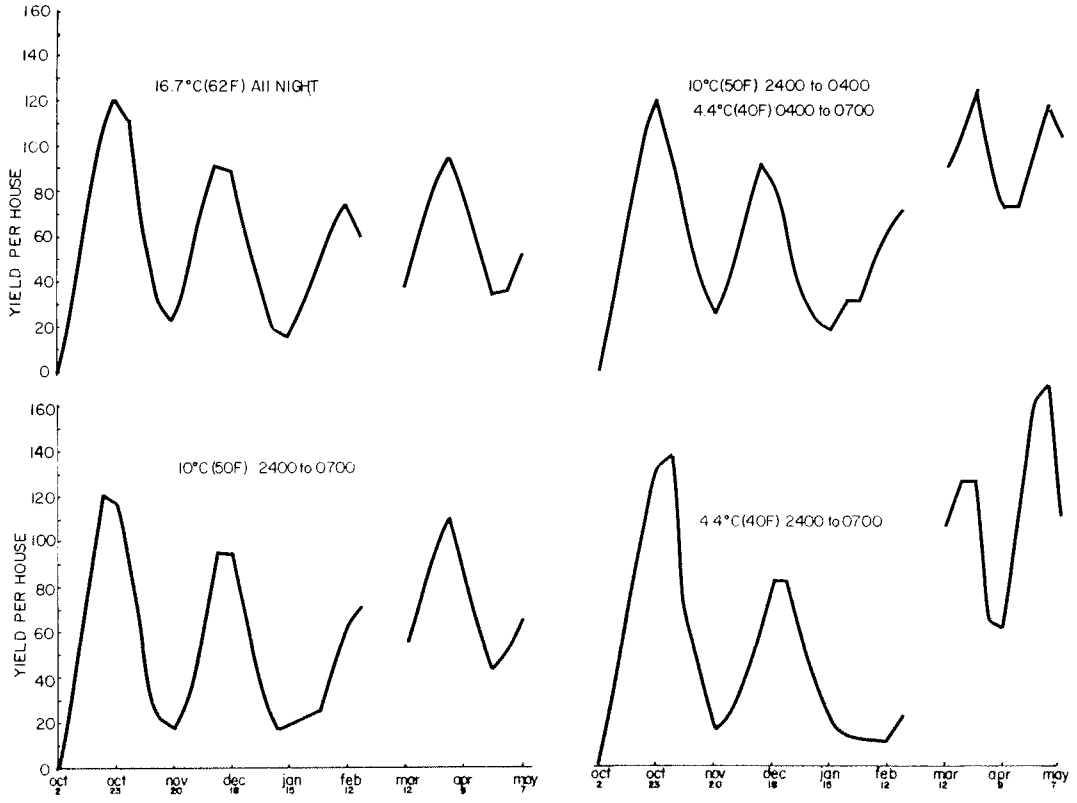

Fig. 2: Three week moving means of cut flower yield from 'Forever Yours' and 'Cara Mia' roses subjected to 4 different night temperature regimes from Nov. 1, 1977, to Feb. 8-18, 1978, 62 F night thereafter.

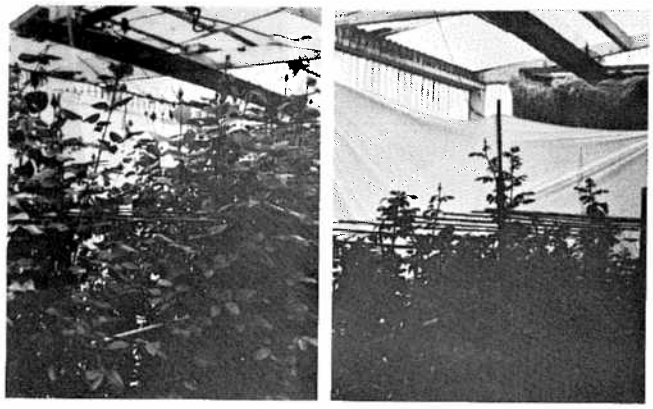

Fig. 3: Comparison between roses produced at 62 F night temperature (left), and those subjected to a split temperature regime of 62 F to midnight and 40 F midnight to 7:00 a.m., picture taken March, 1978.

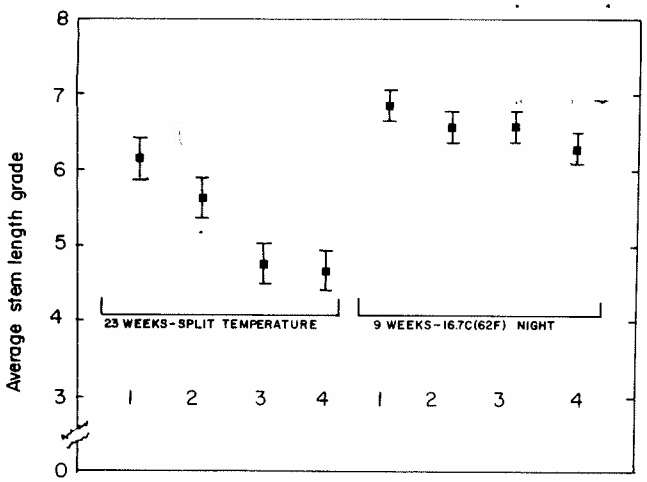

Fig. 4: Effect of night temperature regime on 'Forever Yours' and 'Cara Mia' stem length. Mean grade determined by multiplying the number of flower cut by factors ranging from 2 to 8, depending upon length, and dividing by total yield (2 = 9-in length, 8 = 27-in length). The vertical bars indicate the differences in the averages required for statistical significance.

Treatment 1: 62 F night temperature continuous.
2: 62 F to midnight, 50 F 2400 to 0700, Nov. 1 to Feb. 18.
3: 62 F to midnight, 50 F 2400 to 0400, 40 F to 0700, Nov. 1 to Feb. 9.
4: 62 F to midnight, 40 F 2400 to 0700, Nov. 1 to Feb. 8.

All treatments returned to 62 F, Feb. 8-18, 1978. First series 23 weeks, second series 9 weeks of data.

Problems of rose rejuvenation have been discussed for years, and the scientific literature is filled with investigations on the subject largely by Israeli, European and California workers. But, little or no information may be found on effects of low temperatures except as it may deal with dormancy and seed germination. We and several growers have observed in practice, that sudden severe low temperatures often enhance bottom break production. Short periods of one or two nights below freezing have been noted as being particularly effective in producing bottom breaks.

As a basis for future research, we propose that 700 degree-days below 62 F is required to rejuvenate. This can be provided in two weeks of 35 F over 24 hour periods. In Colorado, one can expect to achieve that temperature at night from Nov. 1 to Apr. 1 in an average year. It may be, however, that the ability to produce food during the day, at normal temperatures, is important. In such a situation, 540 degree-days can be achieved in 30 days, if night temperatures are reduced to 30 F — provided one doesn't freeze the heat pipe.

These results are rather startling, but not unexpected based upon practical observation, and need to be proven with some basic research. There appears to be some practical application that could be used by rose growers to rejuvenate old bushes, provided timing can be worked out and sufficiently low temperatures can be obtained in the greenhouse. One might expect such rejuvenation to be most effective where old plants have been subjected to conditions best suited for heavy production.

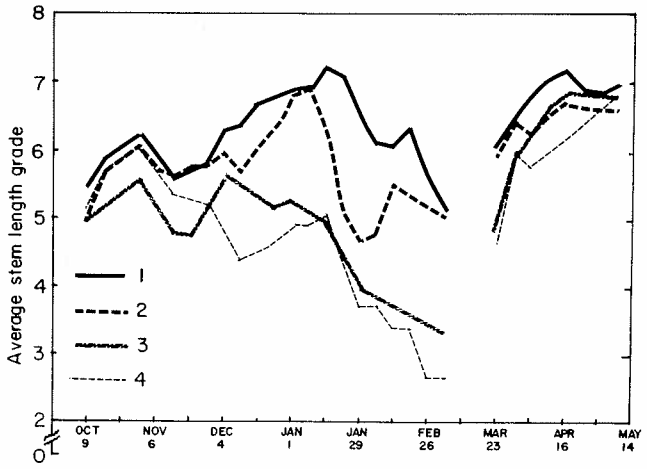

Fig. 5: Effect of night temperature regimes on quality of 'Forever Yours' and 'Cara Mia' roses, 3 week moving means.

Treatment 1: 62 F continuous.
2: 62 F to midnight, 50 F 2400 to 0700, 22 weeks.
3: 62 F to midnight, 50 F to 0400, 40 F to 0700, 22 weeks.
4: 62 F to midnight, 40 F to 0700, 22 weeks.

All treatments returned to 62 F, Feb. 8-18, 1978.

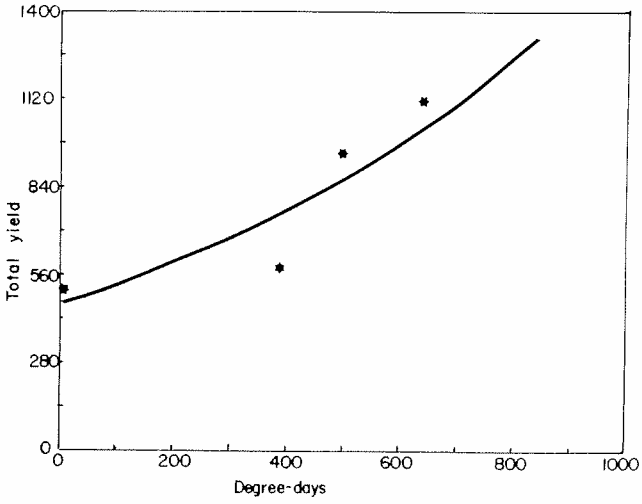

Fig. 6: Effect of number of degree-days below 62 F night temperature on yield of 'Forever Yours' and 'Cara Mia' roses for a 9 week period following split temperature regimes for 22 weeks.

Table 1: Percentage stem length distribution of two rose varieties during temperature splitting and after.

Treatment	Bench[z]	Stem length (in) 9	12	15	18	21	24	27
First 23 weeks production, Nov. 1, 1977, to Mar. 5, 1978.								
A. 62 F all night	North	1	3	5	14	23	22	32
	South	6	4	7	13	18	20	31
B. 50 F 2400 to 0700	North	3	3	9	18	23	23	21
	South	13	5	8	16	20	18	20
C. 50 F 2400 to 0400, 40 F 0400 to 0700	North	6	6	16	26	21	16	9
	South	25	5	12	20	18	13	7
D. 40 F 2400 to 0700	North	10	3	10	22	23	17	16
	South	23	6	10	17	17	13	13
Nine weeks production, Mar. 23, 1978, to May 21, 1978. Note night temperatures all treatments raised to 62 F Feb. 8 to 18, 1978.[y]								
A.	North	1	2	4	7	11	18	56
	South	2	2	3	12	11	18	51
B.	North	2	2	7	9	18	21	42
	South	5	7	4	11	14	15	44
C.	North	3	3	5	11	18	16	44
	South	3	4	6	14	16	17	41
D.	North	4	3	8	12	15	14	44
	South	6	7	7	10	13	15	37

[z]North — 30 plants cv Forever Yours, 6 plants Cara Mia as buffers.
South — 36 plants cv Cara Mia.

[y]Note, from February, 1978, on, all cut flowers cut to the knuckle or below.

Table 2: Number of major new breaks from the bottom 10 inches of rose bushes when subjected to varying night temperatures for different periods and returned to 62 F night temperature. Count made on Mar. 28, 1978.

Treatment	Breaks	Remarks
62 F night constant	4	From Nov. 1, 1977, continuous
50 F night 2400 to 0700	9	62 F first part of night, Nov. 1, 1977, to Feb. 18, 1978, 62 all night thereafter
50 F night 2400 to 0400 40 F night 0400 to 0700	12	62 F first part of night, Nov. 1, 1977, to Feb. 9, 1978, 62 thereafter all night
40 F night 2400 to 0700	24	62 F first part of night, Nov. 1, 1977 to Feb. 8, 1978, 62 F all night thereafter

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