Colorado Flower Growers Association

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UNUSUALLY HIGH DAY TEMPERATURES CAUSE CARNATION CALYXES TO SPLIT

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Unusually high day temperatures during late winter and spring caused carnation calyxes to split. The higher the temperature, in relation to previous temperature, the greater was the amount of splitting.

Low night temperature treatments of 40°F for 1 or 3 consecutive nights at weekly intervals from flower bud initiation to flowering stage produced no increase in calyx splitting.

Constant temperatures of 55-60°F from calyx-opening bud stage to flowering showed significant reduction in splitting over a group of plants subjected to normal greenhouse temperature conditions where the mean day temperature varied from 52 to 74°F.

The actual splitting of the calyx occurred from 1 to 12 days after calyx opening (average 4.46 days). A stage of bud from 2 to 6 days following calyx opening was the most sensitive to splitting.

On the average for April and May, the calyx split 13 days before the flower was cut. Some calyxes split 18 days before the flowers were cut and a few split 9 days before.

The same pattern of calyx splitting occurred in the Denver-Fort Collins area from 1948 to 1951. On susceptible varieties splitting began at a very low rate in October, increased gradually until late February, when the first peak splitting period occurred. Two more splitting periods followed at approximate 4-week intervals. There were minor variations from year to year but most of the splitting came from February to May all three crop years.

Carnation calyx splitting has been attributed to many causes. More scientific papers published on carnations mention splitting than any other problem. The causes of splitting in these papers are highly contradictory. These is no doubt that heredity plays one of the biggest parts in this complex picture, for we are all familiar with varieties that are splitters (Patrician and its sports) and varieties that split few (most of the Sim sports). The fact that splitting has been a problem since the American carnation had its beginnings indicates that it may be always with us to some extent.

This report includes only the high spots in a meticulous 2-year study of calyx splitting as affected by temperature. The first phase of the problem dealt with graphing the percentage of split carnations normally cut in Colorado at various time of the year. Through the cooperation of the Ralph Hill Greenhouses of Denver, three year's records of total cut and number of splits were made available for analysis. From these it was apparent that splitting occurs on White Patrician in approximately the same pattern every year. Most of the splits came in the period from February through May. Records for the Colorado A & M Research Greenhouses during two of these years concurred with the Denver records. Observations made at wholesale houses indicated that all growers bring in splits during the same period. However, there is considerable difference in the percentage of splits brought in by individual growers. Since splitting occurs in all greenhouses of an area at the same time, the most common factor to all is weather.

Low Night Temperature

Occasional low night temperatures have been accepted by many as the cause of calyx splitting. To investigate this possible cause, plants of Frosted Patrician were subjected to 40°F night temperatures for 1 and 3 consecutive nights. These treatments were repeated at weekly intervals from the 12th week after pinching (approximate bud initiation stage) to flowering, or 14 weeks later. Each treatment contained 6 plants while 12 plants remained in the greenhouse, never being subjected to temperatures less than 50°F. These check plants produced as many or more splits than any cold temperature treatment. In another set of treatments, plants were subjected to 1, 3 and 7 consecutive nights of 40°F temperature at 10, 14 and 18 weeks after pinching. Again the untreated plants produced more split calyxes than any treatment.

Constant Temperature and Low Light Intensity

Plants of White Patrician with buds at the calyx-opening stage were placed in temperature chambers at 50 and 55-60°F with a light intensity of 200-500 foot candles. After 41 days in the chamber the 50°F treatment had produced only 4 flowers and no splits. The 55-60°F chamber had produced 39 flowers, 12 of which were split. Paired plants remaining in the greenhouse as checks during this period (Mar. 11-April 21) produced 45 flowers, 32 of which were split. These differences were significant statistically. In other words an even day to day temperature produced significantly fewer split calyxes than the highly fluctuating temperature in the greenhouse.

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1/ This paper is a part of David L. Wagner's thesis for the Master of Science degree. The investigation was financed by the Colorado Flower Growers Association.

Table 1. The incidence of splitting on 216 Frosted Patrician carnation plants and the mean daily temperatures from Feb. 22 to May 9, 1952.

Date	No. split	Mean 12 hr. day temp.	Date	No. split	Mean 12 hr. day temp.
Feb.			April		
22	--	61.3	1	3	60.2
23	--	57.0	2	11	63.2
24	4	57.4	3	11	61.5
25	4	57.0	4	15	63.0
26	4	59.7	5	12	64.6
27	2	61.3	6	23	69.1
28	5	63.8	7	24	72.2
29	13	60.3	8	4	68.9
Mar.			9	4	54.5
1	4	57.7	10	1	59.4
2	4	56.1	11	5	62.8
3	3	56.0	12	2	56.8
4	5	59.4	13	4	61.7
5	2	57.0	14	1	61.7
6	1	60.7	15	3	64.4
7	4	60.8	16	9	60.5
8	3	59.3	17	1	61.0
9	12	64.9	18	7	69.7
10	10	60.1	19	16	73.9
11	7	59.4	20	12	73.2
12	1	58.3	21	10	69.4
13	3	57.0	22	3	54.5
14	2	57.6	23	5	57.8
15	6	59.4	24	4	67.5
16	7	59.4	25	11	71.9
17	3	61.5	26	11	71.5
18	16	59.8	27	14	79.5
19	10	65.7	28	8	78.0
20	14	59.6	29	5	66.5
21	2	55.0	30	1	61.0
22	2	52.0	May		
23	7	56.1	1	5	65.5
24	4	59.9	2	4	72.8
25	4	56.4	3	4	77.5
26	11	60.3	4	5	77.8
27	14	62.7	5	5	78.8
28	17	64.0	6	4	74.3
29	17	66.9	7	2	69.9
30	6	61.3	8	-	72.8
31	7	64.3	9	-	70.8
			Total	509	

Correlation of Calyx Splitting and Mean Day Temperature

With all temperature studies made the environment in the greenhouse seemed to produce the most splits. Since night temperature was accurately controlled, day temperature was suspect. Daily records on the date and extent of splitting were kept on a bench of 216 Frosted Patrician plants from February to May 1952. Each bud was counted and tagged the morning after it actually split.

During the period from February 24 to March 31, there was a highly significant correlation between split calyxes and the mean day temperature for the day the split occurred and the day previous to splitting. For the period April 1 to May 8 there was a significant correlation between splits and the mean day temperature for the day the splitting occurred. Note that mean temperatures were used although maximum temperatures were much higher. Damage is probably caused by maximum temperature but the two follow closely.

Table 1 gives the number of splits and the mean daily temperature. Among the points that may be noted from a study of these data are: (1) splits occur at irregular intervals, (2) temperatures sufficiently high to cause splitting at the beginning of the period were not high enough to cause damage late in the period, (3) the effect of the temperature one day previous to splitting is fairly obvious in late February and early March, and (4) the ability of the buds to become accustomed to high temperatures may be noted in April and May.

High temperature alone is not enough to cause calyx splitting. In the first place, the calyx must be full before it will split. A long period of cool growing temperatures through the fall and early winter serve as preconditioning and fill the calyx with petals. Once full, any unusually warm temperature may supply the needed impetus to split the calyx. Many other reported causes of splitting may do their bit in contributing to the fullness of the calyx.

What can we do as growers to lessen this problem of splitting? We can do a lot with ventilation. If the temperature records in Table 1 are near normal, most days present no problem. We must be alert for unusually warm days and begin our ventilation early with an idea of keeping the temperature down. Anything we can do to equalize the day to day temperatures will help to reduce splitting.