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Effect of Size of Winter Crop on Yield and Grade of Carnations

By
W. D. Holley and Homer E. Hill /1

It has long been recognized by chrysanthemum growers that the number of stems developing in a given area limits the size and weight of those stems. Attempts have been made to demonstrate this on carnations in several experiments. In 1954, before greenhouse cooling was developed, Pink Sim was planted at densities of 3, 4, and 6 rooted cuttings per square foot, given one pinch, and two complete crops were cut. The results are included in table 1 (1).

Table 1. Yield and grade of Pink Sim carnations planted at three densities.

Plants ft^2	Grades				
	Split	Short	Standard	Fancy	Total
3	13	119	363	467	962
4	17	134	371	474	996
6	18	153	417	487	1075

When only one crop is taken from carnations, there is an advantage to close spacing. When two or more crops are produced the advantage disappears.

In 1956, still before pad and fan cooling, the number of developing breaks on first year White Sim were thinned in August to 30, 37, and 45 stems per row (2 1/3 $ft.^2$). Weakest stems were removed completely. The first crop was cut above one or two breaks. Yield of fancy flowers was the same for all treatments (2), however thinning reduced standard grade flowers by as much as 57 percent, Table 2.

Table 2. Effects of thinning on yield and grade of White Sim carnation.

	Short & Split	Standard	Fancy	Total
Thinned to 30 per row	16	77	339	432
Thinned to 37 per row	21	112	363	496
No thinning	27	178	344	549

This same year 1-year-old Pink Sim carnations were pruned back gradually in late spring. The resulting breaks were thinned on August 1, to 37 and 48 per row (2 1/3 ft^2), and compared to an unthinned treatment. The effects of this thinning on yield and grade are shown in Table 3.

/1 Homer E. Hill completed this work while a senior student at Colorado State University.

Table 3. Effects of thinning on yield and grade of flowers from two-year Pink Sim

	Short and Split	Standard	Fancy	Total
Thinned to 37 per row	40	179	345	564
Thinned to 48 per row	59	176	411	646
Not Thinned	66	249	441	756

It was again apparent that approximately the same number of fancy flowers were produced, with thinning causing a reduction in standard and short grades. It was evident up to this time that labor used in thinning was not warranted.

With the wide adoption of summer cooling of greenhouses, a different problem arose. Formerly, excess temperatures during July to September had limited the density of the winter crop. By eliminating this excess heat, plants for the first time could grow and branch normally during the period of high light. Growth was speeded up, and lateral breaks not only were more numerous but they cleared earlier and developed faster. If not removed, it was not uncommon to cut a flower in the fall on which the top lateral was 10 inches long or longer. This optimum growth in summer and fall has greatly increased the number of flowers produced in the winter crop and has shortened the time required for this second crop by as much as four weeks. The increased crop in midwinter has been seriously detrimental to the average grade of flowers in January, February, and March.

A preliminary experiment was set up in 1959 on thinning of the second crop. This work was carried by Fred M. Lehman, while he was a senior student in horticulture at Colorado State University. Although this experiment was not complete, methods of thinning were developed and results indicated that at least standard grade flowers should be cut on the first crop, otherwise plants would be seriously overloaded with flowers in mid to late winter. The most severe thinning produced the highest percentage of fancy flowers, but reduced yield too much for present price structures. When short flowers were cut the first crop, design grade flowers were increased from 30 to 90 percent. Most of these designs were cut from January to March.

1960-61 Experiment

A complete experiment was designed in 1960 to answer the following questions:

1. What are the effects of reducing the density of the second crop on yield and grade?
2. Does time of planting affect yield and grade?
3. Can more and better flowers be cut from plants grown with a single pinch?
4. Do rooted cuttings benched directly produce lower grade winter flowers than transplants?

Six greenhouse benches 35' x 3½' were set aside for this experiment. Two benches were planted on May 15, two on June 15, and the last two on July 15. On each planting date one bench was planted with rooted cuttings and one with transplants which had been grown 6 weeks in peat pots. Each bench was divided into six plots which were separated by a variety of a different color. The 7 rows of a plot were 8 inches apart and contained 6 plants per row. Three of the plots in a bench were grown with a single pinch and the other three given a pinch and a half. Plant load for the second crop was regulated by the following treatments on the first crop:

1. On treatment A vegetative laterals were removed down the flower stem leaving the bottom two. Flowers were cut to the top remaining break. A separate operation was required to remove these laterals, since they are too large at regular disbudding stage.
2. On treatment B no laterals were removed, but flowers were cut above the second or third break from the bottom.
3. On treatment C the top vegetative break was removed in disbudding and flowers were cut to the top break remaining.

The 6 benches of 6 plots were arranged in a Latin Square to minimize differences due to location within the greenhouse. Selections of Gayety, Red Gayety, White and Pink Sim were planted in the plots. Records were kept on yield and grade of flowers for the first 52 weeks after planting date.

Results of thinning

A yearly summary of the yield and grade of flowers as affected by thinning treatment is shown in Table 4. Within each total is included three planting dates, two pinching methods, and the two types of young plants. Differences caused by degree of thinning the second crop are the only ones which show in this Table.

Table 4. Effects of reducing second crop density on yield and grade of Sim carnations grown for 52 weeks.

Thinning Treatment	Grade				Mean grade	Total yield
	Design	Short	Standard	Fancy		
A	460	271	1226	3667	4.44	5624
B	513	421	2144	3131	4.27	6209
C	491	771	2741	2870	4.16	6873

Higher yield and lower average grade flowers are indicated for plants with the heaviest load of flowers on the second crop (Treatment C). As the density of the second crop increased the number of fancy flowers decreased while standard and short grades increased.

The number of flowers in the design grade was not affected by treatment in this experiment. Good day temperature control (60°F) from November 15 to March 15, and reasonably good light maintained adequate stem strength so that this factor did not increase the number of designs materially in late winter.

Designs were predominantly malformed flowers, due primarily to chilling of the buds on the air intake end of the greenhouse. Some manipulation reduced this problem, but additional engineering of the air flow is required to minimize the problem. Most of the flowers in the design grade in this experiment would have graded fancy had they not been malformed.

The totals in Table 4 are extremely misleading. Until we know when the various grades of flowers were cut and how the winter-spring grade of flowers was affected, the wrong conclusions are easily drawn. Table 5 gives the monthly yields and grades of flowers from September to May. Some plantings flowered as late as July 14, however June and July records do not change the relationships of the treatments shown by May yields.

Table 5. Yield and grade of flowers by months for the three thinning treatments.

Month		Design	Short	Standard	Fancy	Total Yield
Sept.	A	51	11	88	299	449
	B	57	24	258	102	441
	C	41	57	275	30	403
Oct.	A	18	2	43	204	267
	B	14	19	148	72	253
	C	13	30	174	53	270
Nov.	A	78	13	62	355	508
	B	97	8	210	275	590
	C	68	40	275	190	573
Dec.	A	26	5	61	313	405
	B	31	8	114	269	422
	C	32	14	169	268	483
Jan.	A	42	10	60	444	556
	B	40	12	124	420	596
	C	36	23	161	388	608
Feb.	A	57	27	128	401	613
	B	35	38	174	415	662
	C	55	49	278	452	834
Mar.	A	25	81	166	348	620
	B	57	99	227	347	730
	C	77	175	310	358	920
Apr.	A	65	50	157	448	720
	B	89	93	235	484	901
	C	81	155	333	444	1013
May	A	56	34	228	584	902
	B	61	75	404	526	1066
	C	40	165	468	466	1139

The key figures throughout Table 5 are the effects of treatment on number of fancy flowers cut each month. From January on this number was about the same for all treatments. The number of fancy flowers from September to December was affected by the treatments since they involved cutting flowers at different heights. Flowers were cut to fancy lengths in Treatment A, to standard and fancy lengths in Treatment B, and to standard and short lengths in Treatment C. While these cutting heights regulated the number of breaks for the second crop, they influenced the grade of flowers from the first crop even more.

Monthly yield was approximately the same for all treatments until February. From this time on yield was decreased in

proportion to the severity of the thinning treatment. Increases in yield were entirely in standard and short grades of flowers.

Thinning of the winter and spring crop of flowers appears less promising as a means of avoiding weak stems than proper management of temperature. Some small and weak stemmed flowers always accompany the tailout of a crop, regardless of the time of the year. The heavier the crop, the more these weak stems are a problem. When a crop terminates under low light conditions, grade of flowers is further reduced. Higher than optimum temperatures will reduce stem strength at any time. This reduction is most apparent in winter and spring, when head weight may be reduced somewhat less than stem strength and diameter.

Since the yield of fancy flowers remained almost constant regardless of treatment, it would seem inadvisable to thin the second crop severely by cutting or thinning methods on the first crop. The producer might well turn his efforts to better control of the environmental factors affecting grade and quality, thereby eliminating design grades of flowers. Markets can be found for short and standard grades, if they are of good quality.

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An analysis of the results from the standpoint of planting time, pinching method, and transplants vs. rooted cuttings will be included in Bulletin 137.

Literature cited

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Your editor,

W. D. Holley

COLORADO FLOWER GROWERS ASSOCIATION, INC.
OFFICE OF EDITOR
W. D. HOLLEY
Colorado State University
Fort Collins, Colorado

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