CARNATION QUALITY AND CARBON DIOXIDE

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When carbon dioxide was added to the air in commercial greenhouses, carnations growing in this atmosphere did not produce any more flowers, but they were of higher quality. These results, observed in Connecticut carnation ranges, are confirmed by experiments covering the three-year period, 1963-66, at the University of Connecticut floriculture greenhouses.

During 1963-64, four Littlefield and five Sim varieties were grown. In 1964-65, one Littlefield and two Sim and in 1965-66 three Sim varieties were used, comprising 382, 167 and 143 square feet in each of the respective years. (1)

CO_2 was supplied at 600 ppm for cylinders during the first year. (2) The level was increased to 1500 ppm from a propane burner the second year and decreased to 900 ppm during the third year. (3) The levels were very uniform during the first year when injection was metered by a light operated interval switch (Solatrol). At higher CO_2 levels, infiltration losses were proportionately greater, so injection was controlled by

(1) Many of the carnation rooted cuttings were supplied through the courtesy of the W. W. Thomson Co., West Hartford, Conn., S. Arthur Peterson, Lexington, Mass., and A. N. Pierson, Cromwell, Conn.
(2) Supplied through the courtesy of Liquid Carbonics Division of General Dynamics Corporation.
(3) A Tectrol Greenhouse Generator supplied through the courtesy of the Whirlpool Corporation and HD-5 propane gas by the Pyrofax Corporation.

time clocks. Levels varied from 20% below on bright, windy days to 40% above normal on very cloudy days. The use of CO_2 from early September to mid-April was started a half hour after sunrise and stopped an hour before sunset (other than the first year when it was controlled by light) except when ventilators were open over 4 inches.

During the first two years, some crops were grown at 55°F night temperatures (instead of the normal 50°F) in hopes that production would increase while the CO_2 would offset any decrease in quality. This did not work. Production was not increased and although CO_2 gave an increase in quality over the 55° control, quality was not as good as the 50° control. Therefore, the 55° control house was omitted during the second year and both 55° houses omitted the third year. Day temperatures were 10°F above night in the control houses and 15°F above in the CO_2 houses.

Certain nutrient levels were maintained by a weekly liquid feed program (usually 20-0-26) supplemented several times a year with a dry organic fertilizer and three times a year with boron. These levels were checked periodically with soil tests. Sufficient water was applied at each watering (about 0.4 gal./sq. ft.) to provide 10% leaching. The pH was corrected to 6.5 with dolomitic agricultural limestone before planting each crop.

Production was not statistically affected by the use of CO_2, varying from an increase of 12% to a decrease of 11% (Table 1). Some individual varieties varied even more, and no reliable pattern was established.

Table 1.

CO_2/CARNATION PRODUCTION SUMMARY, 1963-66

CROP		CO_2 LEVEL	TEMP.	LAST CUT DATE	NO. FLOWERS HARVESTED	PRODUCTION PER SQ. FT.	CO_2 EFFECT
1963-64	50^{o} CK	-	$50\text{-}60^{o}$F.	5/28/64	2931	30.6	
	50^{o} CO_2	600	$50\text{-}65^{o}$	"	2614	27.3	-11%**
	55^{o} CK*	-	$55\text{-}65^{o}$	"	2771	28.9	
	55^{o} CO_2*	600	$55\text{-}70^{o}$	"	3094	32.3	+12%
1964-65	55^{o} CO_2	1500	$55\text{-}70^{o}$	5/3/65	1510	27.2	
	50^{o} CK*	-	$50\text{-}60^{o}$	"	1671	30.1	
	50^{o} CO_2*	1500	$50\text{-}65^{o}$	"	1755	31.8	+5%
1965-66	50^{o} CK*	-	$50\text{-}60^{o}$	6/9/66	2622	34.2	
	50^{o} CO_2*	900	$50\text{-}65^{o}$	"	2545	33.2	-3%
TOTAL CK					9943	30.7	
TOTAL CO_2					9953	30.7	0%

*CROPS USED IN QUALITY ANALYSIS

**ANALYSIS OF VARIANCE DOES NOT SHOW THESE DIFFERENCES TO BE SIGNIFICANT.

Table 2.

THE EFFECT OF CO_2 ON CARNATION WEIGHT AND STEM STRENGTH

	WEIGHT OF STEM		
	CONTROL	CO_2	% INCREASE
1964	17.5 g.	20.2 g.	15.4%*
1965	16.3	18.1	11.1
1966	15.3	17.0	10.8

	DEVIATION OF STEM FROM UPRIGHT		
	CONTROL	CO_2	% INCREASE
1964	129°	61°	111%*
1965	83	54	54
1966	55	24	131

*Statistically significant at the 1% level. Analysis of covariance for regression between weight and stem strength was not significant. Stem strength of Sim vs. Littlefield varieties, and of UConn #1 White Sim vs. eight others showed 1% significance in orthoganal comparisons in 1964 data.

During this mid-winter period when stems are weakest, 59% of the carnations cut during these three years in the control houses bent past 60° from upright, the limit for SAF blue and red grades, thus placing these carnations in the green grade. In the CO_2 houses, only 24% would be downgraded to green on the basis of stem strength, giving an increase of 2 1/2 times as many downgraded carnations when CO_2 is not used.

When a seller's market condition exists, the price differential between SAF blue and red grades is small in New England. CO_2 costs less than a tenth of a cent per flower. The return of this small investment may not be apparent in a seller's market. But at any time when a buyer's market exists, and higher quality carnations sell first, this mil per flower investment is regained manyfold.

Figure 1.

DISTRIBUTION OF CARNATION STEMS ON BASIS OF STRENGTH, CO_2 VS. CONTROL