



## COLORADO FLOWER GROWERS ASSOCIATION, INC.

IN COOPERATION WITH COLORADO STATE UNIVERSITY  
Richard Kingman, Executive Director  
2785 N. Spear Blvd., Suite 230, Denver, Colorado 80211

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# THE EFFECT OF STAGE OF PLANT DEVELOPMENT ON NUTRIENT CONTENT OF THE LEAVES

JOHN B. PARKER and W. D. HOLLEY

In the extensive nutrition work done at Colorado State University over the past 7 years most experiments were terminated at flowering of the carnations. Total growth was weighed and leaf samples were taken according to methods described by Nelson and Boodley (1) and analyzed for nutrient ions. Mature leaves from vegetative growths were used for analysis since some nutrient ions are moved out of the leaves once there is a developing flower bud on that stem.

The experiment reported here was designed to explore the possibility of terminating experiments at earlier stages of development. We wanted to

know if reliable tissue tests could be obtained in 8 or 12 weeks of growth instead of the usual 16 to 20.

The experiment consisted of 6 nutrition treatments: a check treatment with optimal levels of macronutrients (Hartman's No. 18, C.F.G.A. Bulletin 249) and treatments with low levels of N, P, K, Ca, and Mg. Each treatment included 32 pots (2 plant/pot) with 8 pots/treatment being harvested at 8, 12, 16, and 18 weeks from planting. The final harvest (18th wk.) was made October 7, 1971 and the experiment terminated. Nutrient solution compositions are shown in Table I.

TABLE 1. Nutrient solution composition in ME/L.

Treatment	K	Ca	Mg	Na	NH <sub>4</sub>	NO <sub>3</sub>	H <sub>2</sub> PO <sub>4</sub>	SO <sub>4</sub>	Cl
Check	6.0	3.5	3.5	0.5	2.0	14.0	1.0	0.5	0.0
Low N	6.0	3.5	3.5	0.5	2.0	4.5	1.0	8.0	2.0
Low P	6.0	3.5	3.5	0.5	2.0	14.0	0.15	1.5	0.0
Low K	2.0	4.5	4.5	2.5	2.0	13.0	1.0	1.5	0.0
Low Ca	7.0	1.0	3.0	2.5	2.0	14.0	1.0	0.5	0.0
Low Mg	7.0	3.0	1.0	2.5	2.0	14.0	1.0	0.5	0.0

The results of these nutrient treatments by weeks are shown for yield in Table 2 and for nutrient content of the leaves in Table 3. These results indicate that deficiencies of calcium and magnesium are indicated in tissue tests by 8 weeks of growth while phosphorus and potassium hunger is

not indicated in the leaf tissue until 12 weeks. Nitrogen hunger was not indicated by testing for nitrate nitrogen. Total N was not analyzed on these samples but would probably have shown N hunger earlier than the final tests.

No difference in yield was evident in the treatment receiving only 4.5 me/l of NO<sub>3</sub> until the 18th week. This treatment was also supplied with 2 me/l NH<sub>4</sub> which, together with the small amount of NO<sub>3</sub>, evidently took care of the N needs for the plant's early development. This might suggest that we are being somewhat wasteful in supplying 14 me/l of N to young plants.

Differences in the low P treatment showed up immediately in reduced yield although tissue levels

of this nutrient were not deficient until after the 12th week.

The effect of the low K treatment was evident in tissue tests by 8 weeks, and certainly by 12 weeks. Yield of the K treatment was not reduced until after the 12-week sampling date. In most of the treatments used in this experiment there was a drain of potassium from the leaves during the final weeks of flower development (Table 3). This drain

TABLE 2. Yield of carnation harvested at 8, 12, 16, and 18 weeks under various nutrition levels.

Weeks to Harvest	Check	Low N	Low P	Low K	Low Ca	Low Mg
8	72a*	65a	44b	74a	70a	72a
12	342a	324a	240b	329a	356a	347a
16	567a	541a	400b	479b	537a	506a
18	746a	604b	462c	599b	702a	699a

\*Values with the same letter are not significantly different at the 5% level. Yields are reported as grams of fresh weight yield per pot.

TABLE 3. Tissue analyses of carnations harvested at 8, 12, 16, and 18 weeks under various nutrition levels.

Treatment	%P	%K	%Ca	%Mg	%NO <sub>3</sub> -N
Check — 8 wks	1.01	4.31	0.68	0.31	0.58
12	0.60	3.97	0.51	0.33	0.42
16	0.45	3.42	0.74	0.36	0.67
18	0.59	—	0.78	0.39	0.71
Low N — 8 wks	1.01	4.36	0.60	0.29	0.36
12	0.93	3.89	0.52	0.32	0.29
16	0.40	3.25	0.58	0.34	0.42
18	0.42	3.38	0.62	0.36	0.44
Low P — 8 wks	0.40	4.28	0.86	0.29	0.33
12	0.64	3.74	0.60	0.31	0.23
16	0.17	3.38	0.68	0.37	0.51
18	0.36	3.02	0.67	0.36	0.58
Low K — 8 wks	0.95	3.21	0.95	0.34	0.33
12	0.30	2.86	1.06	0.46	0.42
16	0.40	2.46	1.11	0.29	0.65
18	0.38	1.79	1.07	0.29	0.52
Low Ca — 8 wks	1.24	3.86	0.51	0.33	0.42
12	0.60	4.19	0.48	0.38	0.38
16	0.42	3.28	0.44	0.42	0.61
18	0.42	2.25	0.49	0.44	0.73
Low Mg — 8 wks	1.75	4.62	0.86	0.16	0.36
12	0.65	3.94	0.83	0.16	0.42
16	0.47	2.79	0.76	0.21	0.58
18	0.49	3.52	0.80	0.21	0.69

was greatest where potassium was deficient in the nutrient solution (low K).

No response as far as yields are concerned was measured for the low Ca and low Mg treatments, indicating that Ca + Mg = 4 me/l is sufficient for carnations through the first crop under the conditions of this experiment. Reduced tissue concentrations of Ca and Mg were evident 8 weeks after planting.

Indications from this experiment are that we would be better off growing plants in nutrition experiments to the stage where buds show color. Duration of experiments with P could safely be

shortened. The results also indicate a need for more information on the Ca-Mg relationship and N nutrition involving both  $\text{NH}_4$  and  $\text{NO}_3$  requirements at various stages of development. From this experiment we must conclude that tissue analysis is of questionable value in diagnosing the nutritional status of young (8-10 week) carnation plants.

## LITERATURE CITED

- (1) Nelson, V. P. and J. W. Boodley. 1963. Selection of a sampling area for tissue analysis of carnations. Proc. Amer. Soc. Hort. Sci. 83:745-752.