Tolerence of Carnations to Increasing Quantities of Fertilizer

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Proper fertilization is one of the more important factors in the growth and development of carnations. Experiences have shown the fertility program does not start after the plants are well established but well before the planting of the crop.

Commercial growers have often indicated how little fertilizer is required for the production of carnations. Although some of our work has indicated carnations are among the "heavy feeders" we were interested in determining how much fertilizer can be applied without affecting crop quality and plant growth. The summary of our findings is listed below.

Materials and Methods

Thirty CSU White Pikes Peak rooted cuttings were planted in a pasteurized, well drained soil on February 21, 1967 five inches by eight inches in 36 inches by 36 inch plots. There were twelve plots and six treatments with each treatment replicated twice. To avoid contamination from adjacent plots they were separated by using one inch by six inch redwood boards separated by one-inch by one-inch blocks. The cuttings originated from Meristem culture—indexed plants and the mother block was grown under 9-hour days.

Each treatment was fertilized with one of the following rates of fertilizer at each watering. One-half, 1, 2, 4, 6 or 8 pounds 20-5-30 soluble fertilizer per 100 gallons of water (¼, ½, 1, 2, 3 or 4 pounds 20-5-30 per 100 square feet respectively). A sufficient amount of water and fertilizer was applied each time to achieve some leaching. The plants were handled in a commercial manner and the study terminated following the first flowering crop.

Night temperatures were 52°F and day temperatures 60°-65°F when controllable. A regular preventative insect and disease control program was used following planting. Data recorded were date of flowering, number of shoots per plant, flower number, plant height, and grade. Flowers were graded by using the proposed Society of American Florists grading system.

Results and Discussion

Number of shoots. The number of shoots (breaks) on

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Carnations

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the plants sixty days following planting are found in Table 1. The greatest number developed on the plants in the two pound rate and slightly less developed on the one pound rate. The number of shoots was drastically reduced by the ½, 4, 6, and 8 pounds per 100 gallon rates.

Table 1. Number of shoots[a] on plants at six different fertility rates on April 29, 1967.

Fertility Rate lbs/100 gal	No. of Shoots Rep 1	Rep 2	Avg
½	28	45	36
1	79	50	64
2	65	80	72
4	24	14	18
6	5	8	6
8	7	2	4

[a] a shoot defined as one greater than 2 inches in length

Fertility levels. The fertility and total soluble salt levels for the various treatments are shown in Table 2. The most desirable levels for growth of carnations are those at the ½, 1, and 2 pound per 100 gallon rates. The 4, 6, and 8 pound per 100 gallon rates produced very high levels of nitrates, phosphorus, potash and salts in the soil. The soluble salt levels generally increased as the amount of fertilizer per 100 gallons of water increased.

Table 2. Soil test results[a] taken on April 13, 1967 for carnations grown at six different fertility levels.

Fertility Rate lbs/100 gal	Nutrients in Soil Nitrates	Phosphorus	Potassium	Soluble Salts[b]
½	35	5	20	48
1	57	6	20	75
2	67	10	40	75
4	154	18	100	122
6	118	30	125	120
8	30	40	175	180

[a] Spurway test
[b] MHOS

Mean grade. The number of flowers produced in each grade and mean grade are found in Table 3. Over 90% of the flowers were Blue or Red Grade in the ½, 1 or 2 pound per 100 gallon treatments. Mean grade was reduced however in the 4 pound per 100 gallon treatment. At the two higher rates of fertilization few if any flowers were produced.

Table 3. Number of flowers in each grade, total number of flowers produced and mean grade of carnations from plants grown at six different fertility rates.

Fertility Rate lbs/100 gal	Grade Blue	Red	Green	Splits	Total No of flowers	Mean Grade
½	149	131	..	17	297	3.4
1	106	72	1	18	197	3.4
2	107	115	3	7	232	3.4
4	3	25	3	..	31	..
6	..	..	..	..	..	..
8	..	..	..	..	..	..

Height of plants. The height of plants at flowering was affected by the rate of fertilization. This is well illustrated in Table 4 and Figure 1. The height of the ½ and 1 pound per 100 gallon rates were normal whereas the height of the 2 pounds per 100 gallon rate treatment was reduced by 5 inches. Heights from the 4, 6 and 8 pounds per 100 gallon rates were not recorded due to the very low number of flowering stems produced.

Table 4. Height of CSU White Pikes Peak carnations at flowering as affected by various fertilizer rates.

Fertility Rate lbs/100 gal	Height (inches)
½	31
1	31
2	26
4	..
6	..
8	..

FIGURE 1. Fertilizer treatments showing amount of growth about 1½ months following planting on the 8 lbs per 100 gallon rate (left) and 1 lb per 100 gallon rate of fertilization. Also note the divider between the plots.

Peak flowering period. The peak flowering period (Figure 2) was about June 25th for the plants fertilized with the ½, 1 and 2 pound per 100 gallon rates of fertil-

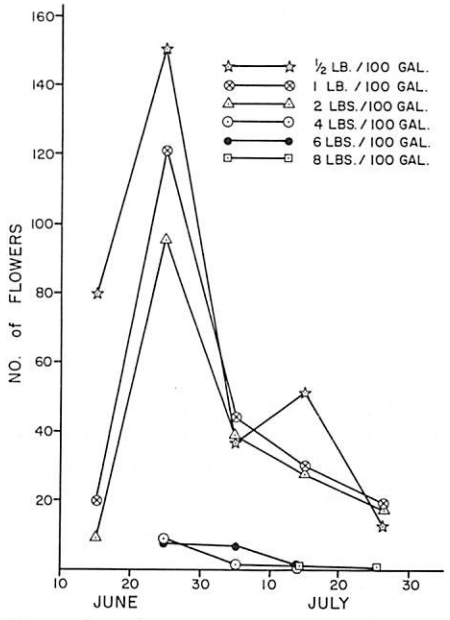

FIGURE 2. The number of flowers produced at various dates from carnations grown at six different fertility rates.

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izer. The 4, 6 and 8 pounds per 100 gallon treatments only yielded a few blooms which were not enough to indicate a peak of production. The duration of flowering was approximately four weeks.

Effect of fertilizer on root systems. The amount of fertilizer applied to each of the plots had a direct influence on the growth and development of the root systems on the carnation plants. The root systems were largest and most extensive in the ½ pound per 100 gallon plot and decreased to almost nothing in the few plants which survived the 8 pounds per 100 gallon treatment.

Discussion

General appearance of plants. Following planting and commencement of the various fertility programs all plants in all treatments were extremely vigorous and healthy. During the third to fourth week following planting plants in the 8, 6 and 4 pounds per 100 gallon treatments began to successively turn a dull greenish-gray color which was an indication of root injury. Shortly after this injury appeared, necrotic (dead) areas developed on many of the leaves in the three treatments at the higher fertility rates. The necrotic areas became more and more numerous and many merged to the point where entire plants were dead (Figure 3).

FIGURE 3. Typical damage as appeared on the plants in the 4, 6 and 8 lbs per 100 gallon rates of fertilization treatments. Due to the restriction of water uptake caused by high levels of nitrogen, phosphorus and potash plants wilted, developed necrotic (dead) spots and areas which merged, and finally complete death of the plant resulted.

The root injury was probably the result of high levels of nitrogen, phosphorus and potash in the fertilizer solution. This is an excellent example of how excessive fertilizer application can affect plants. First there is a wilting (plants turn a dark, grayish-green) due to a restriction of water uptake by the plant roots and if the soil is not leached immediately following the salt (fertilizer) build-up then permanent damage occurs. This also shows a grower can get into trouble without having high soluble salt levels. Total soluble salt levels in Table 2 are not excessively high. These levels were controlled by applying quantities of water and fertilizer to the point of leaching

at every watering/fertilization. This is a practice all growers should take advantage of regularly. In order to do this the soil must be loose and well drained.

Furthermore, this work shows excessively high fertility levels which may affect the crops growth may not show up for two to four weeks. This being the case, if a carnation grower suspects high accumulations of soluble salts or various fertilizers or notes the early stages of plant damage as described above he had better commence leaching his benches immediately. Delaying leaching can result in permanent plant damage.

Plant height. It is generally assumed well fertilized plants will be taller than those grown on the "hungry side." This is not true as demonstrated in Table 4. The data shows once minimum requirements are met increasing amounts of fertilizer will not produce taller plants.

Crop timing. Data collected on crop timing indicated the ½, 1, and 2 lbs per 100 gallon rates of fertilizer all peaked between June 20 and 30. Therefore, if a grower has a fertility program within reasonable limits, timing will not be affected by altering the fertility program within these limits.

Conclusions

Based on the data presented in this paper one can conclude there is a very definite upper limit to the amount of fertilizer which should be applied on Long Island greenhouse soils. It would appear fertility rates between ½ pound to 1 pound per 100 gallons of water (4 to 8 ounces per 100 square feet assuming 100 gallons of water will cover 200 square feet) at every watering should be the most desirable. Actually, commercial growers are applying approximately ¾ to 1¼ pounds per 100 gallons (6 to 10 ounces of fertilizer per 100 square feet). Our best results (number of shoots per plant, height, grade and soil test levels) derived from fertility rates similar to those used commercially. Since the upper limit of fertilization was established one of our next objectives is to determine the lower limit of fertilization. When results of this work is available it will appear in a future issue of this bulletin.

Soils. The authors also feel even though plants can be grown in practically any soil type, a loose, well drained, well aerated soil is of utmost importance especially when a constant feeding program is employed. If problems exist in trying to grow top quality merchandise the problem may not only be fertility but also soil structure or soil composition. Every grower must continually work with his soils until the ideal mix is achieved for his operation. Following this the soil composition should be amended periodically to maintain this ideal structure.