

**COLORADO GREENHOUSE  
GROWERS ASSOCIATION, INC.**



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## IRRIGATION STUDY ON CARNATIONS

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Last year, devices were installed in several commercial ranges to obtain some idea of the irrigation practices utilized by carnation growers. Porous, clay-cup tensiometers were used to indicate the suction in the soil, and is a measure of negative pressure required by a plant to remove water from the soil. All locations reported were in raised wooden benches, 6 to 8 inches deep, growing a first year crop of standard carnations. The tensiometers were read daily between October 1, 1980, and March 15, 1981. Good data were obtained from seven growers.

The general comment is that there were no two growers who irrigated the same. For example, Table 1 shows that although there were two growers who irrigated at approximately the same soil moisture tension (44 and 45) on the average, one grower irrigated an average of every 6.4 days, the other, every 9.5 days, with grower 6 usually experiencing nearly 6 days of saturation, or tensiometer values at zero after watering. Grower 2's tensiometers usually read below zero the next day after watering (0.5 days average of zero suction).

Obviously, with the change in temperature and light during the period, growers did not water at the same interval throughout the period, and Table 2 provides the ranges encountered. It was not unusual for three weeks to occur between irrigations, although Grower 2, during December and January, allowed benches to dry out a maximum of ten days. Note, in the case of Grower 7, the tensiometer gave no indication of any drying for 15 days for at least one or two periods (Fig. 1, bottom graph). Tensiometers which failed to show a reasonable response were changed in order to make sure that a good instrument was installed. This made no difference in the case of Grower 7.

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Table 1: Average maximum soil moisture suction at irrigation, average number of days between irrigations and average number of days at zero suction for seven carnation growers in the Denver region between October 1, 1980 and March 15, 1981.

| Grower | Mean maximum suction* | Mean number of days between irrigations | Mean number of days at zero suction |
|--------|-----------------------|---|-------------------------------------|
| 1      | 62                    | 12.2                                    | 3.1                                 |
| 2      | 44                    | 6.4                                     | 0.5                                 |
| 3      | 25                    | 12.6                                    | 3.7                                 |
| 4      | 16                    | 7.0                                     | 4.1                                 |
| 5      | 16                    | 13.0                                    | 8.3                                 |
| 6      | 45                    | 9.5                                     | 5.9                                 |
| 7      | 16                    | 15.8                                    | 10.2                                |

\*Tensiometer reading in decimeters of water column.

Table 2: Variability in data from seven carnation growers as to maximum soil moisture suction at watering, days between irrigations and number of days at zero suction or saturation.

| Grower | Extremes (low-high) |                          |                      |
|--------|---------------------|--------------------------|----------------------|
|        | Maximum suction*    | Days between irrigations | Days at zero suction |
| 1      | 60-64               | 5-21                     | 0-8                  |
| 2      | 18-70               | 4-10                     | 0-2                  |
| 3      | 12-44               | 10-21                    | 1-7                  |
| 4      | 6-30                | 5-10                     | 1-8                  |
| 5      | 1-30                | 8-19                     | 7-11                 |
| 6      | 10-66               | 7-12                     | 4-10                 |
| 7      | 8-25                | 11-20                    | 5-15                 |

\*Tensiometer reading in decimeters of water column.

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Although tensiometers are calibrated to a reading of 100, they are not reliable above readings of 70. Air will enter the system through the porous cup. If the soil is extremely porous and coarse, there may be poor contact between the cup and soil, resulting in bad readings.

What sort of general comments can be drawn from this exercise? First, anyone who is so bold as to recommend a general watering scheme across the board is looking for trouble. There is no uniform, standard procedure that a grower can use as a base line. Holley, several years ago, suggested that the general soils in the Denver region should be watered when suction is in the range of 30 to 50 (CFGA Bul. 130). There is no good reason to change that recommendation, as, due to differences between growers as to coverings, soils, watering systems, etc., the recommendation has nothing to do with the actual number of days between watering, or how much water is applied. Decision as to soil modification and when to water is still an art, and distinguishes a good grower from the poor.

For what it is worth, Grower 2 had the highest yield and quality of any carnation grower in the Denver region — above 50 per sq. ft. per year. Grower 1 also had good quality, but yields below 50. Note that Grower 2 had the highest irrigation frequency and the fewest number of days at zero suction. This observation leads to an argument we have made several times: that, with a suitable soil, the more water we can provide a carnation the higher the yield. The root medium remains the single most limiting factor in carnation production. Also, I suggest that when zero suction after watering exceeds one week, there may be damage to the root system. Zero suction for a long period indicates a failure to drain or a soil which retains an excessive amount of water. Obviously, the longer a soil in the winter takes to dry out, the longer the time between fertilizing; nor can the grower leach the soil if there is a high salt problem. The more often the bench can be irrigated, the better the ability to modify nutrition as required.

One should keep in mind that partial wetting is not a solution. Water moves through a soil in a "wetting front". If only enough water is applied to partially wet the soil layer, part of the soil may remain very dry and another part may be saturated. At CSU, we always attempt to apply an excess of water to ensure complete wetting and to control salts. Secondly, with partial wetting, it is doubtful that anyone knows how much water a soil can hold, so water is applied by eyeball. In many benches, particularly those allowed to reach maximum dryness, water may run down the sides of the bench and underneath the soil layer without wetting it. This is one reason for the recommendation to apply a preliminary irrigation of 3 to 5 minutes, and then to water thoroughly an hour or so after the first watering. The soil is wetted, so water in the following irrigation can penetrate the entire soil mass. Note, from Fig. 1, there is no such an animal as a "constant" moisture content in a greenhouse bench. The only control a grower has is when he waters, assuming complete saturation after watering. Water content can be changed by physically modifying the soil or changing the depth of the soil. But, this is expensive and impractical when plants are established in the bench. After watering, as the plants remove water, moisture content undergoes a gradual change. During the last day or so before the next watering, soil moisture suction can change very rapidly, with plants wilting in less than one day. Allowing suctions to exceed

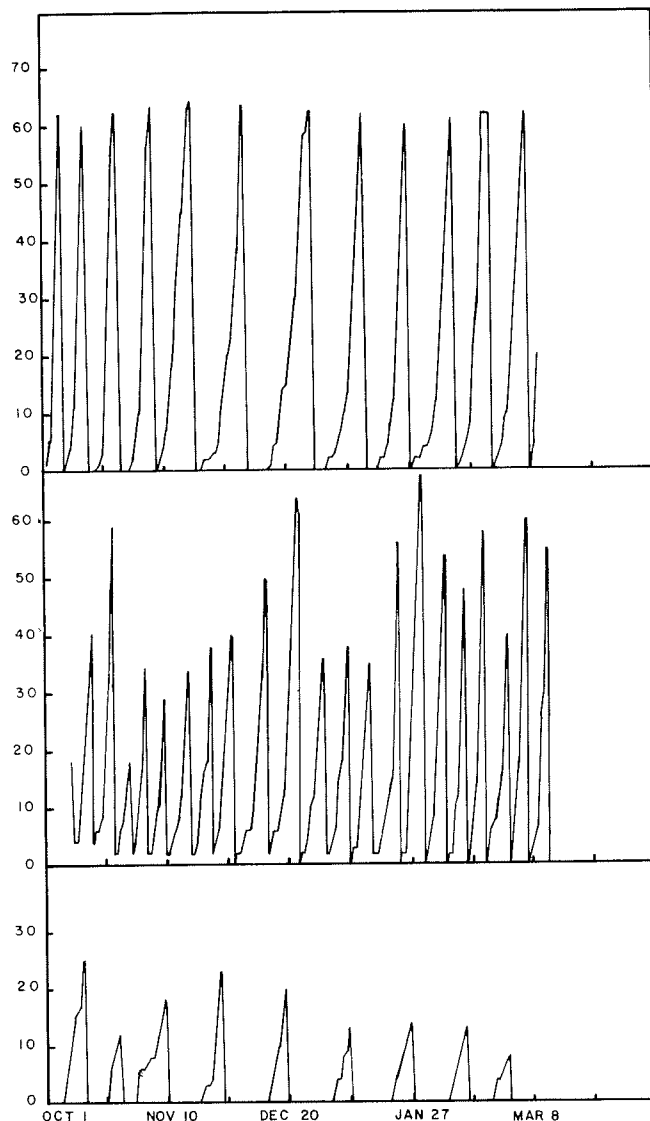


Figure 1: Daily variation in soil moisture tension for three carnation growers between October 1 and March 15. Values on the vertical axis are tensiometer readings in decimeters of water column (100 = 14.7 psi), located in raised 6-inch beds containing first year standard carnations. Top graph is Grower 1, followed by Growers 2 and 7.

50 to 60 may do more to reduce yield in a short time, than a number of days at some lower level of suction. Work by Jasper (CFGA Bul. 204) showed a 35% increase in yield over nine months when carnations were watered at suctions of 30 versus 60. However, this means a suitable soil capable of draining rapidly and not holding excessive water.

Tensiometers are valuable instruments for indicating soil behavior and adjusting watering frequency. One or two of these instruments in good repair will help to adjust watering frequencies and indicate what may be some problems with the existing soil. They may be purchased from a number of sources. They should probably not be used continuously as there is a tendency to forget that they are installed, and they must be checked periodically.