Colorado Flower Growers Association, Inc.

IN COOPERATION WITH COLORADO STATE UNIVERSITY
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PRELIMINARY OBSERVATIONS OF COLORADO GREENHOUSE SOILS

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Since the first of September, 16 greenhouse soils have been sampled in order to determine: 1) bulk density, 2) total pore space, 3) amount of air and water after irrigation, and 4) amount of air and water before irrigation.

A total of 8 "undisturbed" core samples of known volume were removed from the upper 2 to 3 inches of the greenhouse soil at each range. The attempt was made to sample the same bench before and after irrigation, or to sample identically treated benches. This was not always possible. Taking a shallow sample reduced problems in handling, disruption of the sample, and removing the cores. Immediately following irrigation and drainage, the soil will always be wetter toward the bottom of the layer. Where roots have extracted moisture over a period, the moisture distribution may not be the same and it becomes difficult to obtain representative samples even if the core includes the entire soil profile.

OBSERVATIONS

Denver soils can be charcterized by their diversity. Of the 16 sampled, no two ranges have identical soils; no two growers treat their soils the same. In a single range, soils in different areas may differ. The implications in diagnosing problems are obvious. With the exception of extreme cases, each soil must be treated individually. It shows that plants can be grown successfully in nearly anything, so long as the grower handles his soil properly.

All greenhouse soils sampled were in raised benches. The majority have boards running lengthwise. Generally, most have depths of 5 inches or less. A number of beds have contained soil for periods in excess of 15 years. Most use peat moss as an additive; one or two have used leaves. A number incorporate a mixture of fine gravel and sand; at least one grower sampled is using the McCoy-Jensen mix, and one was using a U. C. mix to which he later added manure and soil.

What one calls "wet" another might call "dry." For example: The mean moisture content of all 16 soils after watering was 38%. The mean range from wet to dry was 14% (38 to 24). However, in individual cases, high moisture contents ranged from 49 to 26% and lows from 37 to 12%. In the range from 49 to 26, what is dry? Anything less than 37%? What is wet or dry must be fitted to the individual situation. Application of the terms wet or dry to greenhouse soils in general is subject to serious misinterpretation as each person has his own definition.

The least amount of air encountered under high moisture levels was 13%. This cannot be considered as dangerous under most conditions in shallow greenhouse soils. Five soils, after watering, contained moisture in excess of 40%. In two instances, poor crop response could be attributed to excess moisture (or poor aeration). The fact that large amounts of free pore space may be present is no indication of proper aeration.

Figure 1 shows the range of bulk densities and total pore space. In no case was total pore space less than 51% or more than 74%. The majority fall between 60 and 70%. On the basis of these data and past observations, bulk densities between 0.80 and 1.00 g/cc are desirable in greenhouse soils. A grower who wishes may check bulk density by removing a known volume of soil with minimum disruption of its structure, drying it, and dividing its dry weight by volume. If volume is in cubic centimeters (cc), and weight is in grams (g), values similar to those in figure 1 should be found.

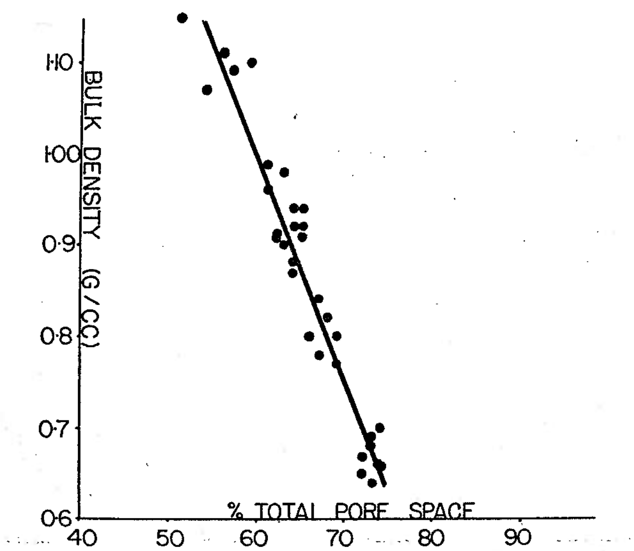

Figure 1.--Relationship between total pore space and bulk density in 16 Colorado greenhouses. Each point a mean of 4 core samples. Two points for each range, one just before and one just after irrigation.

TOTAL WATER CONTENT

As the samples were taken from the top 2 inches, the mean value of 38% is not exact for the entire soil layer. While various depths have not been sampled in this study to determine the real moisture distribution, we have proposed some possible values in figure 2. Assuming identical soils, three depths have been compared, each 2-inch layer considered separately. By reducing depth of the soil, we see that we reduce the total amount of water present, but at completion of drainage the soil is wetter. It is possible to have poorer aeration in a 4-inch depth than in an 8-inch soil depth. Each time the bench is watered, it is brought back to the values indicated in our hypothetical example. To grow carnations, the shallow depth must be watered more often than the deeper soils. In such a situation, we increase the chance of deficient aeration, and we grow our crops wetter. When all other conditions are equal, increasing the frequency of irrigation increases the average moisture content at which the plants are grown.

The majority of the soils sampled to date have depths between 4 and 5 inches. Thus, in our example (figure 2) we can arrive at an approximate mean moisture content in the 16 soils if we assume that the entire soil layer has a moisture content of 38%, and compute the maximum moisture holding content for the 4-inch depth. This would be about 4.3 quarts per square foot. At 24% moisture content, the amount would be 2.7 quarts. Less than half of the total water present in the 16 soils is utilized.

The argument is that by gradually reducing soil depth over the years, we are growing our plants wetter. We have reduced our safety factor in preventing deficient aeration, and the physical properties of our soils become more critical. Soil depth in a greenhouse bench should not be less than 6 inches. Steaming should be a regular procedure; hand watering should be avoided wherever possible. Free drainage should be assured. Some additive should be incorporated before steaming. If it is a new soil, organic matter can be mixed in, or if an old soil already high in organic matter, the additive might be a good field soil or clay.

Another point should be made. Whether or not we assume that an average moisture content of 38% is valid (entire 4-inch soil layer or upper 2 inches), it is apparent that at least 1 gallon per square foot must be applied just to insure that the soil is at maximum moisture holding capacity. If we wish to leach, water in excess of 1 gallon per square foot must be applied. If the soil is compact with a crusted layer, or extremely dry, it may be necessary to apply three times as much to leach. The higher the moisture holding capacity of a soil, the more water that must be applied to leach.

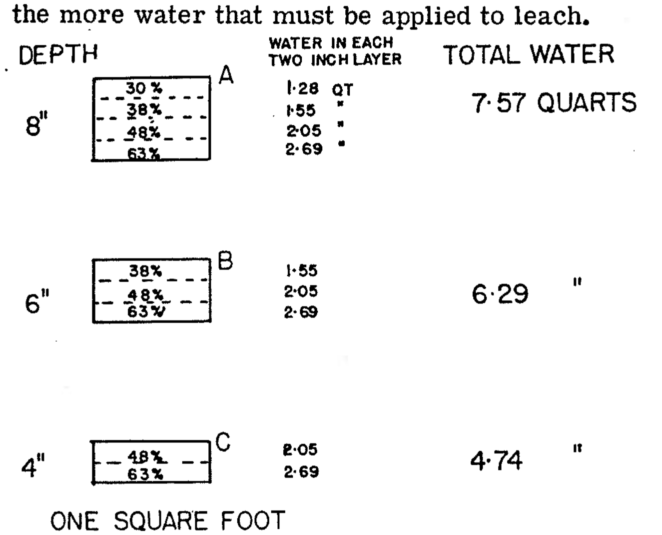

Figure 2.--Relationship between depth of soil and total water content in 1 square foot of bench soil.