CONTROLLING SALTS IN GREENHOUSE SOILS.

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Usually growers water benches excessively in order to prevent salt build-up. Often this is wasteful of water and fertilizer. In some instances, particularly where the irrigation water is salty to begin with, a grower may have a continual struggle to prevent excessive salinity. There does exist a method to estimate the amount of water required per square foot of bench area to prevent excessive salts — contrary to the common method of experience and guess.

For example, Table 1, derived from work at the U.S. Salinity Laboratory in California, shows the percentage of water applied to the surface that must pass through the root zone if reasonable salt levels are to be maintained or reduced. The amount to leach depends upon two factors: 1) the salinity of the applied water, and 2) the upper limits of soil salinity that can be tolerated. If the salt reading of the applied water is 0.75 millimhos per centimeter (750 micromhos or 75 on an RD-15), then 18.8% of the applied irrigation water must pass through the bench if the conductivity of the drainage water is to be maintained below 4 mmhos/cm. Only 9.4% is required if 8 mmhos/cm in the drainage water can be tolerated. Work at CSU has shown several times (e.g. CFGA bulletins 95, 229) that most greenhouse plants do best when salinity is maintained as low as possible.

Many shallow wells in Colorado have salinity levels exceeding 1.0 mmhos/cm, and if fertilizer is injected, it is not unusual to have a salt reading of 2.5 or 250 on an RD-15 Solu-Bridge. A reading of 3.0 mmhos/cm is generally considered to be the maximum salt level of irrigation water at which plants can be grown successfully in the field. At Fort Collins, the domestic water supply usually has a reading of 0.06 mmhos/cm, and a complete fertilizer solution will increase salinity to about 1.4 mmhos.

To estimate the amount of water required at any irrigation, two things need to be known: 1) the total amount of water a soil can retain, and 2) the amount of water extracted between irrigations, which must be replaced. Undisturbed core samples are generally required in order to determine maximum moisture holding capacity, and the water content just before irrigation. As a guide to the first question, Table 2 provides examples of maximum water holding capacity of various soils 7 to 8 inches deep. Most of this data was provided in more detailed form by John White at Pennsylvania State University. As a rule-of-thumb, not more than a third of the maximum moisture content will be removed between irrigations. In some media, plants may be severely wilted before a third is extracted. The remaining water is retained so tightly by the substrate that the plant usually cannot take it up fast enough to prevent wilting.

For example, suppose a grower is injecting fertilizer automatically, and the salt reading of the water as it reaches the soil surface is 2.25 mmhos/cm. Assuming that the soil is a 1-1 mixture of soil and peatmoss, it will hold about 8.3 quarts per square foot if 7 to 8 inches deep (Table 2). Assuming also that a third of this is removed between irrigations, then about 2.8 quarts must be replaced at each irrigation. To maintain salts in the drainage water at or below 4.0 mmhos, 56.2% of that applied must pass through the soil layer (Table 1). Therefore:

The formula for calculating the amount of water to apply is:

$$\frac{\text{Volume of water to be replaced in soil}}{1.0 - \text{(the leaching requirement from Table 1)}}$$

$$\frac{2.8}{1.0 - 0.562} = \frac{2.8}{0.438} =$$

6.4 quarts to apply per sq.ft.

Under the conditions assumed above, 6.4 quarts of water, having a salinity reading of 2.25 mmhos/cm, must be applied at each irrigation if salinity in the soil is not to increase. Of course, if a salt problem already exists, then all the water in the soil must be replaced, using water, preferably, that has a lower salt content. More than two gallons per square foot would be required, using the example just provided.

Table 1: Leaching requirement of soils as related to salt content of irrigation water. The requirement is expressed as the percentage of applied water that must pass through the root zone in order to maintain the electrical conductivity given below.

Electical conductivity of irrigated water	Leaching requirement for the individual maximum values of EC in the drainage water of:			
(millimhos /cm)	4 mmhos /cm	8 mmhos /cm	12 mmhos /cm	16 mmhos /cm
0.1	2.5%	1.2%	0.8%	0.6%
0.25	6.2%	3.1%	2.1%	1.6%
0.75	18.8%	9.4%	6.2%	4.7%
2.25	56.2%	28.1%	18.8%	14.1%
5.0	— — —	62.5%	41.7%	31.2%

Table from USDA Handbook No. 60. Diagnosis and improvement of saline and alkali soils, L. A. Richards, ed. 1954. 160 pp.

NOTE: 1 millimho = 1000 micromhos = 100 (reading on an RD-15 Solu-Bridge)

Table 2: Water holding capacity of some common inert media and soil mixtures expressed as quarts per square foot of medium, 7 to 8 inches deep.

Material	Quarts per sq.ft.
Soil-perlite-peat moss	
10-0-0	7.7
7-3-0	7.3
5-5-0	7.4
7-0-3	7.2
5-0-5	8.3
3-0-7	10.0
1-9-0	7.0
1-0-9	12.0
0-0-10 (peat moss)	11.2
0-10-0 (perlite)	6.4
Clay loam soil	9.6
Sandy loam soil	6.2
Firbark	2.6
Sawdust	9.2
Inert Media	
Granitic sand and gravel	3.3
Regular idealite	1.8
River sand and gravel	2.0
Volcanic ash (scoria)	5.8

Adapted from the text Greenhouse Management, J. J. Hanan, W. D. Holley and K. L. Goldsberry, Springer-Verlag, Heidelberg. 1977.