SALINITY IV
A PROGRESS REPORT

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In this progress report, experiments showed that only one pint of water is required to leach salinized 5½-inch pot mums, but the conductivity of the drainage water cannot be used reliably to measure salt content in a pot. In the first 1.5 quarts per sq.ft., the Gates irrigation system removed more salt than the Chaplin double wall. At three quarts, however, there was no difference between the two systems. Laboratory studies are continuing to determine the effect of pore size distribution on leaching rate. It appears that the slower the water moves through a soil layer, the more efficient the leaching.

How bad can your water get?

You can have a table to help decide how bad is the water (CGGA Bull. 379). But, no simple table can cover all the points necessary in order to determine how severe is the salinity problem. Agronomists have moved away from making general standards. Each situation is different and must be evaluated independently. Factors used to judge if an irrigation water should be replaced include:

1) Total soluble salts in the water.
2) Concentrations of individual ions such as sodium, bicarbonate, and boron, and the relative proportions of these ions.
3) Irrigation management practices such as type of irrigation system, how much and how often one irrigates, whether you grow wet or dry.
4) Fertilizer practices such as constant feed, adjustment of the fertilizer components in relation to irrigation water analysis, the use of acids to remove bicarbonates.
5) Mulches since these increase leaching efficiency and reduce the concentrating effect of evaporation.
6) The crop being grown and the type of container e.g., pot, ground bed, raised bench.
7) Time of year inasmuch as plants are subjected to greater water stress in the summer and cannot tolerate as much salt.
8) The growing medium as its physical and chemical properties will determine how much salt is retained after leaching and also the salt level that the crop can tolerate.

So how does a grower then take all of these factors into account? The simplest and best way for a grower to size up a salinity problem and the water is to **check the soil.** This is the only way to know if salts are becoming a problem before it is evident from growth of the crop. One soil test is not enough where potential salinity problems exist. A grower must keep track of the salt levels in the soil. If problems are seen from the results of the soil tests, then there are practices for decreasing the salt content of the soil and reducing the chances of the problem reoccurring. If the salt problem does reappear despite control measures, then another water source should be sought or some method of desalinization should be considered. Because of the present economic realities, changes in cultural practices are usually, but not always, less expensive than changing the water supply. It is these control measures that are the focus of this research.

Very little solid information is available on the leaching process as it exists in greenhouse containers. The research outlined below is needed to understand the leaching phenomenon and to provide a base of understanding.

Completed Experiments

A. **Leaching Pot Chrysanthemums:** In this experiment we looked at the leaching of salts from 5½-inch pot mums. After about 4 weeks of growth, pots were salinized with a concentrated solution of sodium bicarbonate (25 meq/l) and magnesium sulfate (25 meq/l). They were then leached using various treatments. We compared:

1) Leaching with tap water (less than 100 μmhos/cm) to leaching with fertilizer solution (1400 μmhos/cm).
2) Peat-perlite-soil mix to peat-perlite mix.
3) One drip tube per pot, two drip tubes per pot, and one spray stake per pot.

The drainage from these pots was tested for electrical conductivity and the amount of salt removed per pot was calculated. A few of the major results included:

1) Tap water removed significantly more salt than fertilizer solution as would be expected. For one drip tube per pot, it took about one cup (¼ liter) of drainage when leaching with tap water to remove the same amount of salt as one quart (1 liter) of drainage when leaching with fertilizer solution.
2) Two drip tubes per pot removed more salt than either one drip tube or one spray stake. Only one pint (½ liter) of drainage was needed when using two drip tubes to remove the same amount of salt as one quart (1 liter) when leaching with one drip tube per pot. However, two drip tubes only aided in leaching when tap water was used. It did not help when fertilizer solution was used to leach.
3) After about 1 pint (½ liter) of drainage, no more salt was removed from the pots leached with fertilizer solution. In other words, a grower can leave the drip system on all day, but after 1 pint of drainage, there will not be any more salt removal.
4) The peat-perlite-soil mix had more salt removed than the peat-perlite mix, especially when two drip emitters were used.

The physical characteristics of the media that aid in leaching are being investigated in the column experiments described below.

Further analysis of this data will include the development of leaching equations and specific recommendations for leaching pot crops.

B. **Salt Distribution in Pots:** Some of the pot mums from the above experiment were tested for salt content before and after leaching. The pots used were from the peat-perlite-soil treatment. Each pot was sectioned into 6 parts and saturated paste extracts were run on each part to determine salt content. This experiment confirmed some of the findings from the leaching experiment.

Results showed:

1) Significant differences in soil solution concentrations after tap water and fertilizer solution leaching.
2) The irrigation system influenced salt content and distribution.
3) Salt content varied in the soil profile. This last result is perhaps most significant because it indicates that we cannot reliably use the electrical conductivity of the drainage water from a pot as a measure of the salt content within the pot.

C. **Leaching Carnation Benches:** Special raised benches were constructed for this leaching experiment which enabled us to collect and analyze the drainage water. One plot was set up with gates irrigation and the other with Chapin trickle irrigation. These plots were salinized with a solution of sodium bicarbonate (25meq/l) and magnesium sulfate (25 meq/l), and then leached with tap water (less than 100 μmhos/cm). We found that, in the first 1.5 quarts per sq.ft. of drainage, the gates system removed about 25% more salt than the Chapin system. However, as drainage continued to 3 quarts per sq.ft., the amount of salt removed by the Chapin system was not significantly different from the gates system. Furthermore, beyond 3 quarts per sq.ft., the Chapin system actually removed more salt per unit volume of water than the gates system. In other words, the gates system accomplished most of its salt removal in the first 1.5 quarts per sq.ft of drainage, but the Chapin system showed a steady rate of salt removal. The shape of the leaching curve was characteristic of the irrigation system used, and further analysis of this data will yield more information and recommendations.

Current Experiment

Soil Columns: In this experiment, the particle size distribution of growing medium will be varied in order to determine the effect of pore size distribution, porosity, percolation rate, and moisture holding capacity on the efficiency of leaching. This will enable one to relate specific characteristics of a growing medium to ease of salt removal. From this work, recommendations can be made on how to alter growing medium to reduce salt problems.

The theory behind this experiment is as follows: the major factor in determining how easily soil salts are controlled is how readily and completely the existing soil solution is replaced by the leaching water. This is determined, in part, by the pore size distribution of the medium. If a medium has many large pores, then the leaching water will just run down through these large pores, leaving the salts behind in the smaller pores which do not conduct water. When the rate that water moves through the soil is decreased, either by slowing the rate of water application or by changing the medium so as to decrease the rate that water moves through it, then the amount of salt that can be removed from the growing medium will increase. This is because more mixing takes place between the leaching water and the soil solution and because the leaching water needs extra time in the soil so that the salts can get out of the small pores and into the large ones which conduct water. It is like the man on the street corner waiting for an RTD bus. If the bus slows down enough, he can jump on. If it does not slow down he will be left at the bus stop. From this experiment one should find the right speed for the bus.