The University of Arizona
Cooperative Extension

Leaching for Reclamation

Problem Description

When salts build up in soil, they have to be removed to allow for plant growth except in the few cases of very salt tolerant plants. The amount of water required to accomplish this task depends upon the method of water application, the initial salinity of the soil, the final soil salinity desired, and the quality of the irrigation water. Presumably the quality of the water will be the same as that which will be used for irrigation for crop production later. Further, in many cases, the soil became saline as the result of inadequate leaching during crop production using the same water as available for use at present. If the water or soil is sodic, then care must be taken to use an appropriate soil or water amendment to provide the addition of calcium to prevent the development of sodic soil or the worsening of a sodic condition. If a sodic condition is a problem or a potential problem, plan for its solution prior to initiating the leaching process.

In the evaluation and diagnosis of saline and / or sodic soil conditions, it is important to understand and make the distinction between the two. Management steps for remediation or maintenance are distinctly different for each case. For example, the use of soil or water amendments appropriate for reclaiming a sodic soil condition in a situation where a soil is actually saline and non-sodic can be very costly and inefficient. To determine whether you have a soil with a sodium induced problem, the "Sodium Adsorption Ratio" (SAR) of the soil saturation extract should be determined by a laboratory. Fine textured soils may have reduced water infiltration when the SAR is greater than 5 or 6. The sandier the soil, the higher the SAR can become before infiltration rates are reduced. Sodic soils require the replacement of sodium with calcium or magnesium through the use of an amendment, such as gympsum, prior to leaching. In contrast, saline soils are made more saline by the application of many amendments.

Soil and Water Analyses

From a soil test, determine the present soil salinity. Sample deep enough and in enough increments so you can determine if the surface is significantly higher or lower in salinity that most of the root zone. (This will not usually be the case unless a high water table or a perched water table existed for a substantial period of time). One very rough rule of thumb has been to apply one acre foot of good quality irrigation water to reclaim one acre foot of soil. If water costs are high and irrigation uniformity and efficiency are good, applying only the amount needed to reclaim the portion of the soil with the salinity problem makes good economic sense. If, for example, only the top foot of soil needs reclaimed but a grower would normally plan to leach to *"reclaim"* the most of the root zone, even at $15 per acre foot of water, the water savings from one acre of land would pay for the needed soil samples to make the determination.

A soil test allows for a more accurate approach to leaching for reclamation which is represented by graphs **(Figures 1 & 2)**. To use the figures, divide the

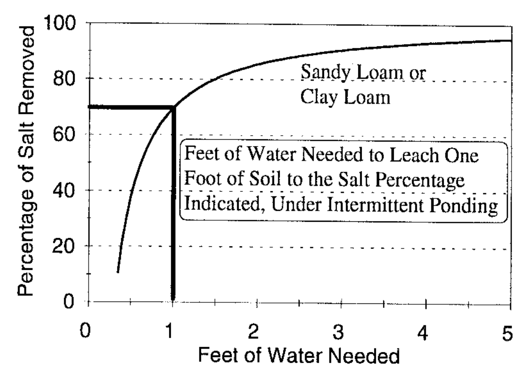

Figure 1

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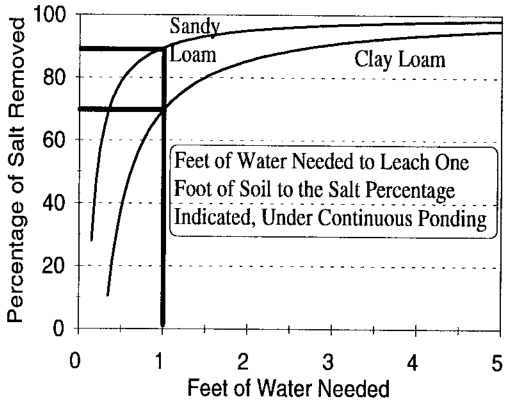

Figure 2

desired EC_e by the soil test EC_e, then multiply by 100%, to obtain the percentage on the left hand axis of the graph. You may want to use a slightly larger fraction to provide a margin of safety, but unless the condition is extreme or the irrigation system is very efficient, this shouldn't be necessary. From the bottom axis of the graph select the depth of water applied per foot of soil to be reclaimed.

Multiply the fraction from the bottom axis by the depth of soil to be reclaimed (in feet) and multiply this by the number of acres to be reclaimed. The result is the number of acre feet of water required. Remember, the EC of the water used for leaching should also be checked by a lab, to ensure that the soil salinity levels will be sufficiently lowered by the leaching.

Problems that can arise during this operation include nonuniform water infiltration, perched water tables, and crop injury. Crop injury results from attempting to carry out the reclamation leaching when a crop is in the field. Scalding of alfalfa in the summer and oxygen depletion in roots of actively growing fruit trees are two examples. ***PLANNING AHEAD AND MAINTAINING PROPER GROWING CONDITIONS ARE MUCH BETTER THAN TRYING TO CORRECT A PROBLEM AFTER IT'S TOO LATE!***

Notice from the steeper curve depicted in **figure 1** as contrasted with the clay loam soil curve of **figure 2,** that the amount of irrigation water required for reclamation leaching may be much less if the application method is intermittent flood irrigation or sprinkler irrigation, as contrasted with continuous flooding.

Because of the geometry of the soil surface when buried drip irrigation or furrow irrigation is employed, leaching recommendations are not so easily made. This has not been a problem historically, since more than enough water has generally been available for leaching with furrow irrigation and reclamation leaching is frequently conducted using border flooding even when the crop is to be grown using furrow irrigation. Particular care must be taken with buried drip irrigation, since attempting reclamation leaching with the buried drip lines may create a greater salinity hazard in the soil directly above the drip tubing. This will be particularly true during times of high evaporative demand. Moral of the story; perform reclamation leaching using intermittent border flood irrigation or sprinkler irrigation prior to the installation or use of a buried drip irrigation system.

Since use of the graph requires knowledge of the initial soil salinity level and of the final desired soil salinity, a soil test is necessary. Further, the type of crop to be grown needs to be known to determine the final desirable soil salinity. Once the crop is known, the desirable soil salinity level is usually equal to or less than the maximum level which will still allow maximum crop growth. That salinity level, represented by EC_e, is given in, *Interpreting Soil Salinity Analyses*, University of Arizona, Cooperative Extension Bulletin No. 8557.

Another consideration is whether the opportunity will exist to move the salt front, during later irrigation events, to depths deeper than it moved during the reclamation leaching. Often, the salt front will move to a depth of about TWO or THREE times the depth of the water applied. The actual depth depends upon the drainage characteristics of the soil, including non-uniformity, the presence of layers, the soil porosity and it's so called *"field capacity."*

If the amount of water applied is expected to move the salt front below the root zone, then no yield loss is expected from the concentration of salts in the leaching front. However, a salt sensitive crop like lettuce is usually overirrigated to assure adequate leaching during the plant establishment phase. Often the overirrigation is considerable. When this is the case, the wicking of water and salts back toward the soil surface shouldn't be a problem unless overirrigation has resulted in a water table within 18-24 inches of the soil surface, and the downward rate of water movement is nearly zero. Extra care in considering your particular situation and in planning the reclamation will pay dividends in the future by preventing further aggravation of a salinity problem.

Evaluation of the economic benefits gained, costs incurred, and the potential for the creation of secondary problems (e.g. nitrate or pesticide losses to the groundwater, creation of *"perched"* water tables, etc.) should be carried out prior to applying leaching water for salinity removal.