Leaching Requirements of Pecan and Fruit Trees

Guide H-644

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This publication is scheduled to be updated and reissued 2/05.

Irrigation water contains dissolved salts that can accumulate in the root zone as evapotranspiration (*Et*) removes irrigation water and leaves the salts behind. As excess quantities of soluble salt accumulate in the root zone, trees have difficulty in extracting water from the salty soil water solution, and transpiration and the resulting growth are reduced.

Excessive salinity build-up can be controlled by applying an additional amount of irrigation water often referred to as the "leaching requirement."

THE LEACHING REQUIREMENT

The leaching requirement (*LR*) is the extra water needed for leaching expressed as a fraction or percentage (leaching percentage) of the total water penetrating the soil (*DD*). It has been defined by the U.S. Salinity Laboratory as the fraction of the irrigation water (*DI*) that must penetrate below the root zone to maintain salinity at a specified level.

$$LR = \frac{DD}{DI}$$

LR varies with the salinity tolerance of the crop and the salinity of the irrigation water. For general use, it is based on quantitative salinity measurements, although leaching requirements for specific salts may also be computed. The sodium content of some irrigation waters may impose serious limitations on its use on certain soils and must be considered in an overall leaching program.

Slow soil permeability, shallow water tables, or restricted subsurface drainages may interfere with adequate leaching. Where these conditions exist, drainage must be improved before soil salinity can be reduced by leaching. In fact, poor drainage often causes excessive accumulations of salt in soil even when relatively good-quality water is used.

THE LR EQUATION

LR can also be calculated by dividing the electrical conductivity of the irrigation water (*ECiw*) by the electrical conductivity of water draining from the bottom of the root zone (*FCdw*). In practice, the *ECdw* value is not readily available, and the U.S. Salinity

Laboratory recommends using the average electrical conductivity of the soil solution extract (*ECe*) and the *ECiw* to determine *LR*.

$$LR = \frac{ECiw}{5(ECe) - EC\ iw}$$

Fig. 1 shows the relationship between the salinity of the applied water and the salinity of the soil water saturation extract for different *LR*s.

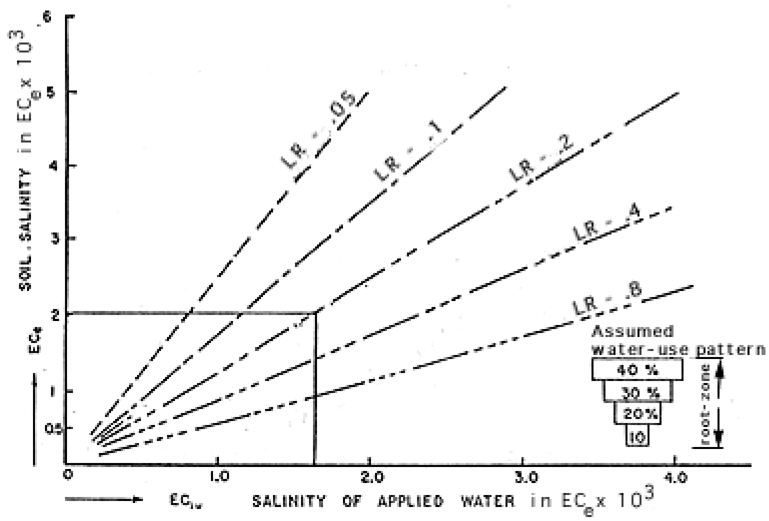

Fig.

Growth reduction does not occur in a tree until a threshold level of salinity is reached, and then growth decreases in a linear amount with increasing salinity. Relative growth rate (RGR) reduction for selected soil salinity levels in trees is presented in table 1.

Table 1. Salinity (measured as electrical conductivity) tolerance of trees as a function of (*EC* x 10 (3rd power)) in soil saturation extract.

Representative species	Conductivity of medium (μS/m)(to the (a) power)			
	0% RGR	10% RGR	25% RGR	50% RGR
Apricot	1.6	2.0	2.6	3.7
Peach	1.7	2.2	2.9	4.1
Almond	1.5	2.0	2.8	4.1
Plum	1.5	2.1	2.9	4.3
Pecans	2.0	3.0	4.5	7.0
Grapes	1.5	2.6	4.1	6.7

(a) power = Electrical conductivity of a saturation extract (*ECe*) of the growing medium, measured in microSiemens per centimeter (= micronhos per centimeter).
Source: modified from Ayers (1977) and Handreck and Black (1984).

APPLYING THE LR CONCEPT

To compute the *LR*, the salinity of the irrigation water and the salinity tolerance of the crop must be known. These values are furnished by the NMSU Cooperative Extension Service Soil and Water Testing Laboratory as *EC* x 10 (6th power). These values should be divided by 1,000 to be equivalent units, with values for *ECe* normally given as *EC* x 10 (3rd power) (table 1).

Example: To grow pecans irrigated with well water with an electrical conductivity of 1,700 x 10 (-6th power) mhos:

$$EC \times 10^{6} \text{ of irrigation water} = 1{,}700.$$

To convert to

$$EC_{iw} \times 10^{3} = \frac{1{,}700}{1{,}000}$$

$$= 1.7 \text{ irrigation water}$$

$$EC \times 10^{3} = 2.0 \text{ soil (from table 1).}$$

From fig. 1, the leaching fraction should be 0.2. Therefore, in addition to the water supplied for consumptive use (*Et*) (the amount of water absorbed by the plants and lost by evaporation), an additional amount equal to 0.2 *Et* should be applied for leaching.

Assuming uniform water application, if the irrigation efficiency (the water stored in the root zone divided by the applied water) is greater than (1 - *LR*), then the *LR* should be used to calculate depth of irrigation water. If the application efficiency is less than (1 - *LR*), then the *LR* is already being satisfied.

Assuming an irrigation efficiency greater than (1 - *LR*), the depth of irrigation water (*Diw*) to maintain a steady-state salt balance is

$$Diw = \frac{Et - Dr}{1 - LR},$$

where *Dr* is runoff of applied irrigation water. It is assumed that all of the *LR* will be satisfied by irrigation water exclusive of any leaching by rainfall. If the value of *Dr* is assumed to be 0 and the intended *Et* for this irrigation is 3.0", then the depth of irrigation water is

$$3.75'' = (3.0 - 0) / (1 - 0.2)$$

This amount of water must be applied to the portion of the field receiving the smallest water application amount so that the *LR* over the rest of the field is 0.2 or more.

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Reprinted February 2000
Electronic Distribution August 2000