WHAT'S A LEACHING FRACTION?

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A Leaching Fraction is: a) a percent of your total wealth in your wallet that one of your family members can extract; b) a symbol seen on a paper placemat at a local Chinese restaurant; c) the sum you arrive at after helping your third grader with a math assignment; d) the amount of blood you have left after falling in a creek that had a high population of blood sucking worms; e) all of the above except a, b. c. d.

If you still are not sure what a Leaching Fraction is and really *want* to know, keep reading.

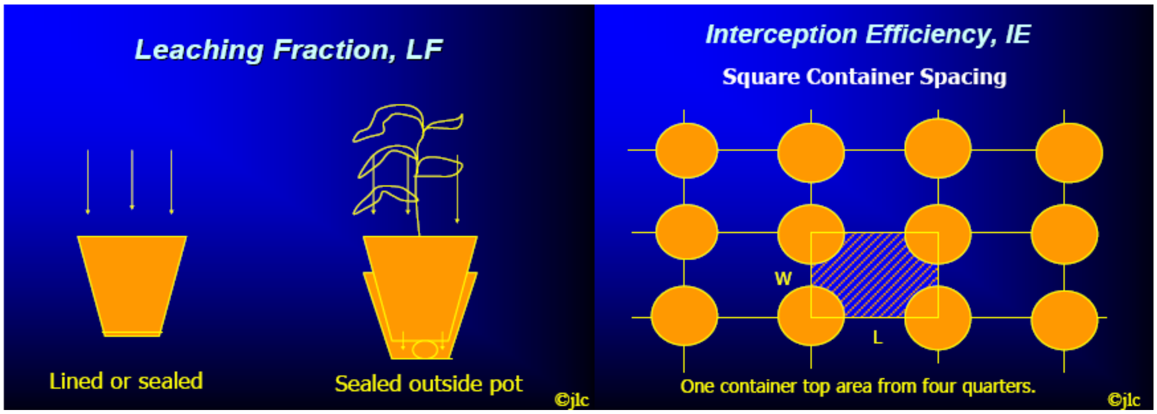
Leaching fraction actually is proposed as one way for a nursery to determine if they are operating their irrigation system for the appropriate length of time to adequately water the crop without over watering. Over watering in a container irrigation zone may cause an excessive amount of water to flow out of the bottom of the container. High percentages of leachate leaving containers removes nutrients from the container and results in a larger volume of runoff than is necessary for irrigation that must be collected in detention or retention structures or filtered by landscape vegetative features at the nursery before leaving nursery properties.

The procedure for determining irrigation leaching fractions in container irrigation zones follows a protocol used in Maryland for developing nutrient management plans for container nurseries using overhead sprinkler irrigation. The protocol is outlined on a University of Maryland website developed by Dr.John Lea-Cox, Nursery Extension Specialist. The figures used in this article (seen below) were also provided by Dr. John Lea-Cox. The URL for the Webpage is http://www.nursery.umd.edu/extension/water.pdf

To collect information related to Leaching Fraction (LF) nurseries need to set up a method to collect water leached from plant containers (LF) and from empty containers located next to plant containers at the same spacing used in the growing blocks. The method we have used has been to place containers in buckets that tightly fit around the circumference of the container. We place empty pots and pots with plants in buckets before an irrigation event. This method will work for automated irrigation systems or for manual irrigation valves. After the last irrigation (for multiple cycles), the volume of water collected in plant containers is divided by the volume of water collected from empty containers. The percent leaching fraction of volume collected in plant pots divided by the empty containers should be 20% (0.2) or less to avoid over watering. If the percent leaching fraction is above 20%, irrigation run time should be reduced. This method also works to determine how long to irrigate zones during the growing season. In most cases, irrigation run time will need to be increased as plants grow and require more water as they grow and need more water. However, in some cases, irrigation run time may actually need to be reduced as plants develop larger canopies. Some plants have canopies that act as a funnel and actually capture water beyond the top diameter of the container. A study conducted at N.C. State in 2004 resulted in some crops such as Vitex and Gardenia that have a funnel type architecture gathered as much as 2.5% more water than was collected in empty containers.

Another piece of data called Irrigation Efficiency (IE) can also be calculated using the volume of water collected in empty containers. The area of the top of the container can be used to calculate the volume of water falling between containers (See the second figure shown below). More information on Irrigation Efficiency is included at the end of this article.

The Figure below describes the Leaching Fraction (LF) and Irrigation Efficiency (IE) procedure:



Leaching Fraction Calculation

Leaching Fraction (LF) is the proportion of applied water that leaches from a container after an irrigation event.

LF (%) = leachate volume (ml) / Total irrigation volume (ml) x 100

Since nitrate and orthophosphate are soluble in most soil-less substrates, low leaching fractions increase the residence time of soluble nutrients in the root zone. Leaching fraction calculations integrate a number of key attributes, including substrate porosity, gravitational potential (influenced by container height) and irrigation duration. It therefore measures the sum of these factors, which are especially important when fertigation (the application of soluble fertilizers in irrigation water) is used in plant production.

Collecting the Data

Leave the plant occupied containers to drain for at least an hour. After this time, separate the plant-occupied container from the tight fitting bucket. Carefully pour the water collected into a measuring cylinder or a clean bottle. Weigh or measure the volume of leachate and record the value. Then weigh or measure the volume of water in the other empty, plastic-lined. Location in the growing bed may influence the amount of water received. An average for leaching fraction or irrigation efficiency can be determined if multiple buckets and containers are used to collect water in an irrigation zone. Growers can actually determine variability in an irrigation zone by placing containers in a diagonal line across an irrigation zone. Variability may be due to wind but often is due to irrigation design related to location of risers or variation or wear in orifices of nozzles. Growers may need to consider replacing nozzles or worn out orifices and in some cases growers may need to consider re-designing irrigation in some zones. These considerations would be appropriate if leaching fraction and irrigation efficiencies varied by large percentages such as 50% difference of water collected in empty pots or pots containing plants.

Calculating the Leaching Fraction

Calculate the leaching fraction of each pot by dividing the leachate volume of the plant-occupied container by the amount of irrigation water captured by the nearby empty container. This figure multiplied by 100% equals the percentage of water leachate (i.e. the leaching fraction).

Average at least five (or number of replicates) to get a more accurate value from the entire irrigated area. This represents your average leaching fraction for that container size, irrigation duration and substrate type. If any of these factors differ markedly in other container production areas, repeat the procedure to calculate those leaching fractions.

Example

Management Unit –(Examples in the table below are for 3 gallon containers)
Substrate- 6 Pine Bark- 1 Builders Sand

Container	#1	#2	#3	#4	#5	Average
Plant Container	250 ml	225	160	275	210	224
Empty Container	775ml	740	770	870	760	783
Leaching Fraction	32%	30%	21%	31%	28%	29%

Goal for Leaching Fraction
The goal is to minimize the measured leaching fraction. Values under 20% are good. You can also monitor the electrical conductivity (EC) of container leachates to prevent a build up of salts. These practices could provide a means for growers to manage irrigation based up the EC value to avoid over leaching and low EC's or avoid high EC's that could potential damage crops. Reducing leachate reduces the nutrients being lost from the container.

<u>INTERCEPTION EFFICIENCY (IE)</u>

Interception Efficiency (IE) is a measure of the amount of applied water that is captured by the container during an overhead irrigation event. Interception efficiency is usually expressed as a percentage of the applied water, but can be calculated theoretically in terms of area. Interception efficiency is defined as the container top surface area divided by the ground area allotted to a single container, and is expressed as a percentage value (see Figure above). Interception efficiency integrates plant density, container size (volume) and irrigation method.

The interception efficiency (IE) of a container is the percentage of water captured by a container compared to the amount applied to the container and the open space around the container. When overhead irrigation methods are used and containers are spaced apart, a percentage of water enters the containers. When low volume irrigation is used, all the water enters the container and IE is 100%.

When containers are spaced out, they may be in a consistent square pattern or in a diagonal pattern. The spacing is container center to center some distance (L) down the house or bed and some distance (W) apart across the house or bed.

Draw a rectangle connecting the centers to show this relationship. (See figure above). Note that four quarters of a container are in the rectangle to represent one container top area. The rectangle area (L x W) is the ground area allotted to each container. The container top area is simply the area of a circle or 0.785 x diameter x diameter.

The interception efficiency (%) is (container top area/ area allotted to each container) x 100. The percentage of overhead-applied water that misses the container is (100-IE). For a diagonal container spacing, the width (Wd) is the distance between the centerlines of containers running down the house or bed.

Irrigation water volume collected buckets under plant containers represent the leaching fraction volume during an irrigation cycle. Water volume collected in empty containers represents the total water volume applied. To determine leaching fraction (LF) divide the volume of water collected in buckets below plant containers by the volume of water collected in empty buckets.