Monitoring Irrigation Efficiency

Monitoring irrigation efficiency is an important consideration when using CIRRIG's **ET zone type**. This is because irrigation output for ET zone type is based on estimating ET and CF with plant model functions. It is strongly recommended that accuracy of CIRRIG output be monitored with leaching fraction tests. This is particularly important for sprinkler-irrigated plants in small containers as large container-grown plants on micro-irrigation would typically use a LF zone type.

A leaching fraction test (LF) is a simple procedure that provides a snapshot of how efficient the irrigation was on a given day. LF is the amount of leachate (drainage) collected out of the bottom of the container relative to the total amount of irrigation water entering the container and can be determined by weighing before and after irrigation. In general, it is desirable for LF<15%. If the LF was found to be >15%, then CIRRIG was overestimating the irrigation requirement. Similarly, if no leachate was collected during LF testing, then CIRRIG was underestimating the irrigation requirement. The irrigation output from CIRRIG can be adjusted by using the irrigation uniformity parameter. Decrease the percent uniformity value to increase irrigation rates and increase the percent uniformity value to decrease irrigation.

Equipment needed for LF, ET and CF testing: portable bench scale with range of 0-30 kg and a precision of at least 0.01 kg handles most situations. Approx. cost: $500.

A portable bench scale is needed to weigh containers in the nursery for determining water loss and gain for LF, ET and CF measurements. Weight change relates directly to volume of water: 1 kg water = 1000 cm^3 and 1 g water = 1 cm^3.

Leaching Fraction (LF) Procedure for Sprinkler Crops

1. Select and label representative containers.
2. Place each container in a pail so that the container will be suspended in the pail leaving enough headroom to collect leachate without reabsorption. It is important that irrigation water not enter the pail directly.
3. Weigh the pail and container together and record the pre-irrigation dry weight.
4. Put containers back in production area in normal arrangement
5. After irrigation and drainage, weigh the pail and container together and record the post-irrigation wet weight. The increase in weight is equivalent to the total water applied to container.
6. Remove the container, and record weight of leachate in pail.

Calculations:

a) Irrigation water applied to container (cm^3) = [wet weight (kg) – dry weight (kg)]*1000 cm^3/kg

b) LF = leachate volume (cm^3)/total water applied (cm^3)

Example LF calculations

Data dry weight = 10.65 kg
wet weight =11.73 kg
leachate = 0.35 kg

Calculations

a) irrigation water applied (cm^3) = 11.73 - 10.65 kg = 1.08 kg

b) LF = 0.35/1.08= **32%**

Procedures for Measuring Container ET

1. Select and label representative containers.
2. Weigh containers early at dawn after irrigation but before appreciable water loss has occurred (record wet weight). It is important that containers are well-watered in the morning so that ET during the day is not limited.
3. Put containers back in production area in normal arrangement for the rest of the day.
4. At dusk reweigh same containers (record dry weight).
5. Container ET is equal to the weight loss during the day converted to depth of water for sprinkler irrigated crops.

Calculations

a. Container top area (cm^2) = πr^2 = 3.14159 *container radius^2

b. Container ET (cm^3) = wet weight (kg) – dry weight (kg) *1000 cm^3/kg

c. Container ET (cm) = container ET (cm^3)/container top area (cm^2)

Example Container ET Calculation - Sprinkler

Data wet weight = 11.45 kg/container

dry weight = 10.30 kg/container

container diameter = 11 inch = 11 x 2.54 = 27.94 cm

container radius = 27.94 /2 = 13.97 cm

Calculations

a. Container top area (cm^2) = πr^2 = 3.14159*13.97 ^{2}=613

b. Container ET (cm^3) = (11.45-10.30 kg)*1000=1150 cm^3

c. Container ET (cm) = 1150/613=1.88 cm = **0.74 inch**

Example Container ET Calculation - Micro

Data wet weight = 31.45 kg/container

dry weight = 27.20 kg/container

Calculations

a. Container ET (cm^3) = (31.45-27.20 kg) = 4.25 kg = 4.25 L = 1.12 gal

Fig. 2. Irrigation cups are placed above the canopy in the vicinity of test plants to determine irrigation rate applied during CF testing.

Procedures for Determining CF

1. Follow the same steps as for LF plus the following
2. Place gauges (cups or pails) in the vicinity of test containers to determine the irrigation rate (Fig. 2).
3. After irrigation, measure the volume of water in each irrigation cup (cm^3)

Calculations

a) irrigation gauge area (cm^2) = πr^2

b) depth of irrigation applied (cm) = volume collected (cm^3)/gauge area (cm^2)

c) area of container (cm^2) = πr^2

d) irrigation water captured (cm^3) = [wet weight (kg)- dry weight (kg)]*1000 cm^3/kg

e) depth of water captured (cm) = water captured (cm^3)/container area (cm^2)

f) CF = depth of irrigation captured (cm)/depth of irrigation (cm)

Example CF calculations

Data
dry weight = 10.65 kg
wet weight =11.80 kg
container diameter = 11 inch = 27.94 cm; radius = 13.97
irrigation cup diameter = 9 cm; radius = 4.5 cm
average volume of water collected in irrigation cups = 894 cm^3

Calculate irrigation water applied

a) irrigation cup area (cm^2) = πr^2 = 3.14159 *4.5^2= 63.6 cm^2

b) depth of irrigation (cm) = 84 cm^3/63.6 cm^2 = 1.32 cm

c) container top area = πr^2 = 3.14159 *13.97^2= 613 cm^2

d) irrigation water captured (cm^3) = 11.80 - 10.65 = 1.15 kg =1.15 x 1000cm^3/kg = 1150 cm^3

e) depth of irrigation captured (cm) = 1150 cm^3/616 cm^2 = 1.87 cm

f) CF = depth of irrigation captured/depth irrigation applied = 1.87 cm/1.32 cm = **1.42**

Note: In this example CF=1.42 indicates that the container with plant is capturing 42% more water than a container without a plant.