ABE326

Using Tensiometers for Vegetable Irrigation Scheduling in Miami-Dade County.[1]

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How the Tensiometer Works

A tensiometer is a simple and relatively inexpensive tool, which can be used for scheduling irrigation for vegetable crops grown in Miami-Dade County. Tensiometers continuously measure soil water potential or tension which is a measure of soil moisture status. This is expressed in centibars (cbar). If the tension of the soil is high, plants have to use more energy to extract soil water.

A typical tensiometer is a water-filled tube with a porous ceramic cup at the lower end. After installation in the soil, water moves from the tensiometer through the cup into the unsaturated soil. This process continues until the negative pressure inside the tensiometer equals the negative pressure in the surrounding soil. The pressure inside the tensiometer is then in equilibrium with the pressure in the soil and can be measured by reading a vacuum gauge on the tensiometer.

Tensiometer Selection

For vegetable crops grown in South Dade, a 6-inch long tensiometer will be suitable, since most of the plant roots are located in this zone. Reliable determination of the irrigation time and amount of water applied requires installation of a second, longer (10-12 inches) tensiometer to sense conditions below a root zone. Both high tension (0-100 cbar) and low tension (0-40 cbar) are available commercially and they are suitable for use in vegetable fields.

Calibration and Preparation

New tensiometers should be tested and calibrated before installation. The Miami-Dade Cooperative Extension Service provides pro bono testing and calibration services to all vegetable growers in South Florida. To schedule this service please call Miami-Dade Cooperative Extension Service at 305-248-3311.

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Site Selection

Sites selected for tensiometer installation should be representative of the soil types and crop conditions in the field. If soil types vary considerably within the field, each of the soil types should have a separate set of tensiometers. For example, if you have marl and Krome gravelly soils in the same field, one set of tensiometers should be installed for each soil type.

If two different crops are planted in the same field, at least one set of tensiometers should be installed for each crop. Tensiometers should be located in the active root area in the wetting zone of the irrigation system. For vegetables grown on beds with drip irrigation, the tensiometers should be located in the plant row, between two plants in the wetting zone of the drip tape.

Installation

Proper installation is critical to assure effective contact between the ceramic cup of the tensiometer and the surrounding soil. Installation should proceed as follows. First a small area should be cleared to remove weeds and plant residues. A 22-24 inch pointed steel rod, 7/8-1 inch diameter, may be used to drill a hole deep enough to accommodate the entire length of the tensiometer. The diameter of the hole should be slightly larger than the diameter of the tensiometer to avoid a damage of the ceramic cup.

In very coarse soils, like the rocky calcareous soils of southern Florida, installation requires the use of a heavy hammer. Prepare a thick slurry by mixing soil, collected from the surrounding area and sieved through a 1/8 inch screen, with water. After placing some of the slurry in the bottom of the hole and carefully placing the tensiometer in the hole, the rest of the slurry should be added around the ceramic cup and the plastic tube of the tensiometer. Add enough slurry until it overflows. Gently move the tensiometer back and forth a few times to assure that good contact with soil has been achieved.

Taking and Recording Tensiometer Readings

The readings should be taken at the same time each day, ideally in the early morning before irrigation. The readings should be recorded in a notebook along with the rainfall and irrigation amounts and dates. The location of each tensiometer station should be identified by recording the site number, the depth of the tensiometer being read, and the date and time of the reading.

Irrigation Scheduling

In general the following guidelines should be used to interpret tensiometer readings to schedule vegetable irrigation in gravelly or sandy soils.

1. **Readings of 0-5 cbar:** Soils are saturated or nearly saturated as a result of irrigation or rain. Discontinue irrigation to prevent wasting water and leaching nutrients from the root zone.
2. **Readings 10-15 cbar:** Crops should be irrigated as soon as possible. Irrigation should be initiated at 10 cbar during the flowering and fruit set and at 15 cbar for the rest of the growing season.
3. **Readings 25 cbar and higher**: Plants probably show symptoms of water stress. Irrigate immediately! The tensiometers may soon lose vacuum and require servicing to restore accurate performance.

The duration of irrigation can be determined by using a longer (10-12 inch) tensiometer in addition to a 6 inch tensiometer. If the readings from the longer tensiometer drops 1-2 cbar after irrigation, then shorten the time of the irrigation event until the irrigation no longer registers on the gauge of the longer tensiometer. If the readings obtained from the longer tensiometer are persistently 20 cbar or higher, increase the length of the irrigation.

Maintenance

Tensiometers are simple instruments, but they require regular maintenance to provide proper readings of soil water status. During the growing

season, all tensiometers should be refilled with water periodically (especially after longer periods without irrigation or rain) to prevent losing suction due to a low water level in the plastic tube. All tensiometers should be removed from the soil every 3-4 months or at the end of the growing season and washed to remove soil, algae, bacteria and other debris from inside and outside the ceramic cup and the plastic tube. A mild household detergent and a small bottle brush can be used for cleaning. The ceramic cup should be soaked in a chlorine solution (1/4 cup of household bleach in a gallon of water) to kill bacterial growth. After cleaning, fill the instrument with clean water and add a mild biocide such as a solution supplied by the manufacturer or some chlorine bleach to prevent algal growth. A hand-held vacuum pump should be used to remove excess air before reinstallation in the field.

Trouble-Shooting

1. Tensiometer gauge always reads zero.

If correct, a zero reading means that the soil is saturated from irrigation, heavy rainfall or very poor drainage.

Possible problems:

1. No water in the tensiometer, or lost suction due to a low water level. **Solution:** Service the tensiometer and refill with water.

2. The gauge is faulty: **Solution:** Check and replace the gauge.

3. A connection is leaking: **Solution:** Check the general assembly including ceramic cup and O-ring seals.

2. Tensiometer does not seem to record the true soil moisture content.

Possible problems:

1. Poor contact between the ceramic cup and the surrounding soil. **Solution:** Re-install correctly.

2. The gauge is faulty. **Solution:** Check and replace the gauge.

3. Tensiometer needs frequent refilling with water.

Possible problems:

1. Ceramic cup or seal is leaking. **Solution:** Replace the seal or cup. Check other seals for leaks.

4. Tensiometer responds too slowly to irrigation.

Possible problems:

Water is slow to infiltrate between the ceramic cup and the soil.

1. The ceramic cup may be clogged by salts or algae. **Solution:** Clean or replace the cup.

2. The gauge sticks (from minor damage). **Solution:** tap to test, and replace the gauge if faulty.