## Section 686.14

### (a) Tensiometers

(1) Tensiometers are used to measure soil water suction. A tensiometer consists of a sealed water-filled tube equipped with a vacuum gauge on the upper end and a porous ceramic tip on the lower end. The face of a typical tensiometer gauge is shown in Figure 686-7. Tension readings should be correlated with the soil water content for a specific soil. Tensiometers can be used to schedule irrigations and to determine the amount of water to apply. The main disadvantage of the tensiometer is that it is limited in operation to less than 100 centibars of suction. Normally, tensiometers operate from 0 to 80 centibars. This makes them best suited for coarse textured soils. When the suction exceeds 80 centibars, tension is broken and the dial will read zero. The tensiometer will then need recharging before it will work.

(2) The suction generated when the crop roots remove water from the soil draws water from the tensiometer tube through the porous tip and causes the gauge to register a vacuum. The drier the soil, the higher the reading.

(3) When irrigation or rain water renews the soil water supply, water is sucked into the tensiometer tube thus causing the gauge to read lower.

(4) Tensiometers are set at a station setting up a zone of soil water control in the soil. A "station" consists of two or more tensiometers of different lengths placed near one another.

(5) Two stations may be enough in a field with uniform soil and slope. One station should be near the upper end of the field and the other near the lower end. More tensiometers may be needed in areas where the soils or slopes vary from representative soils or slopes in the field. When placing tensiometers, the following suggestions should be kept in mind.

a. In row crops, the tensiometers should be placed in the crop row. The shallow tensiometer tip should be under the edge of the furrow, and the deep tensiometer tip under the center of the furrow.

b. For orchards, the tensiometers should be located within the drip line and 3 to 6 feet from the tree trunk and on the sunny side.

c. Measuring stations should be in representative soil areas of the field. Tensiometers should not be placed in low spots in the field,

d. Stations should be at points where the plant population is representative of the field.

e. The soil around the tensiometer station should not be compacted. The station should be approached from a row other than the one in which the tensiometers are located.

f. Tensiometers should be placed after the last freeze in the spring and should be removed before the first freeze in the fall. As an alternative where ground frost is minimal, the tensiometers can be buried under a deep cover of soil or manure.

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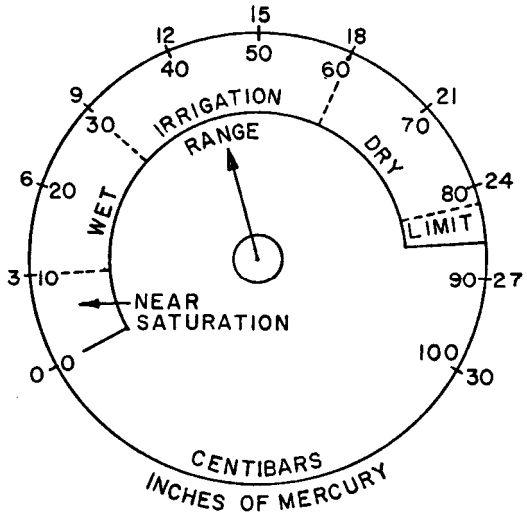


Figure 686-7, Tensiometer Dial

Table 686-1 Recommended Depth for Setting Tensiometers

| Irrigation Depth of Active Root Zone | Shallow Tensiometer | Deep Tensiometer |
|---|---|---|
| Inches | Inches | Inches |
| 18 | 8 | 12 |
| 24 | 12 | 18 |
| 36 | 12 | 24 |
| 48 or more (deep) | 18 | 36 |

6. Depth of tensiometer installation is determined by the active root zone of the crop. This active root zone depends upon the crop, stage of growth, and depth of soil. For example: for a crop such as alfalfa on a deep soil, tensiometers installed at a depth of 18 inches and 36 inches are recommended for each station. Recommended depths for setting tensiometers are given in Table 686-1. Tensiometers should not be installed in a fine textured soil at the shallow root depth because soil suction will exceed 100 centibars before the management allowed deficiency is reached.

7. The tensiometer may be installed in a probe hole for a squeeze fit or in a hole large enough to permit backfilling. The cup should be pushed into the soil at the bottom of the hole, if it is soft enough. If the soil is too hard, it may be softened by water; or a small hole can be made to receive the cup. The hole should be refilled in layers and compacted around the tensiometer tube. A special tool supplied by the manufacturer may be used to install the tensiometer. It is important to get good soil contact.

8. The above-ground parts of the tensiometer should be shielded from the sun to avoid a "thermometer" effect.

9. Readings should be examined carefully to detect the effect of a leak. A leaky tensiometer can give misleading results. The tensiometer should be kept filled with de-aired (boiled) water or serviced regularly with de-airing equipment.

10. Tensiometers readings should be correlated with the total soil water content in the soil profile at each station. This can be done by using the gravimetric method in Section 686.12. Gravimetric measurements should be made for several different tensiometer readings and plotted on a graph. Figure 686-8 shows an example of tensiometer readings versus soil water content in the root zone.

11. To schedule irrigation, it is necessary to know which tensiometers should be used at a given site. The greatest soil suction will occur near the soil surface where the roots are most active. This may cause the activity of the soil water to decrease so rapidly that the range of operation of the tensiometer will be exceeded. This will cause air to enter the instrument.

a. In sandy soils, tensiometers in the active root zone should be used to schedule irrigation.

b. For clayey soils, the soil suction will usually exceed the operating range of the instrument before it is necessary to irrigate. It takes about 2.0 bars (200 centibars) of suction to reach MAD percent water depletion level for a clay. At 0.8 bar or 80 centibars the water depletion level would he about 50 percent MAD. This makes it necessary to use the lower tensiometers in the root zone to schedule irrigation.

c. Soil suction values that indicate need for irrigation will differ for the different soils. A guide for interpreting tensiometer readings is given in Table 636-2.

12 To determine when and how much water to apply requires the development of a relationship between soil suction and soil water content for the root zone. An example of the development of this relationship and use is given on page 686-10. The following procedure should be used to collect data for the development of the soil suction--soil water content relationship.

a. Select a tensiometer which will not lose its suction. Generally, the tension in the second or third quarter should be used.

b. Measure the soil water content in the root zone. Record the tensiometer readings at time of soil water content measurement.

c. Make a number of measurements at different tensiometer readings.

d. Plot the data on graph paper.