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For Timely Irrigation... Tensiometers

Cooperative Extension South Dakota State University

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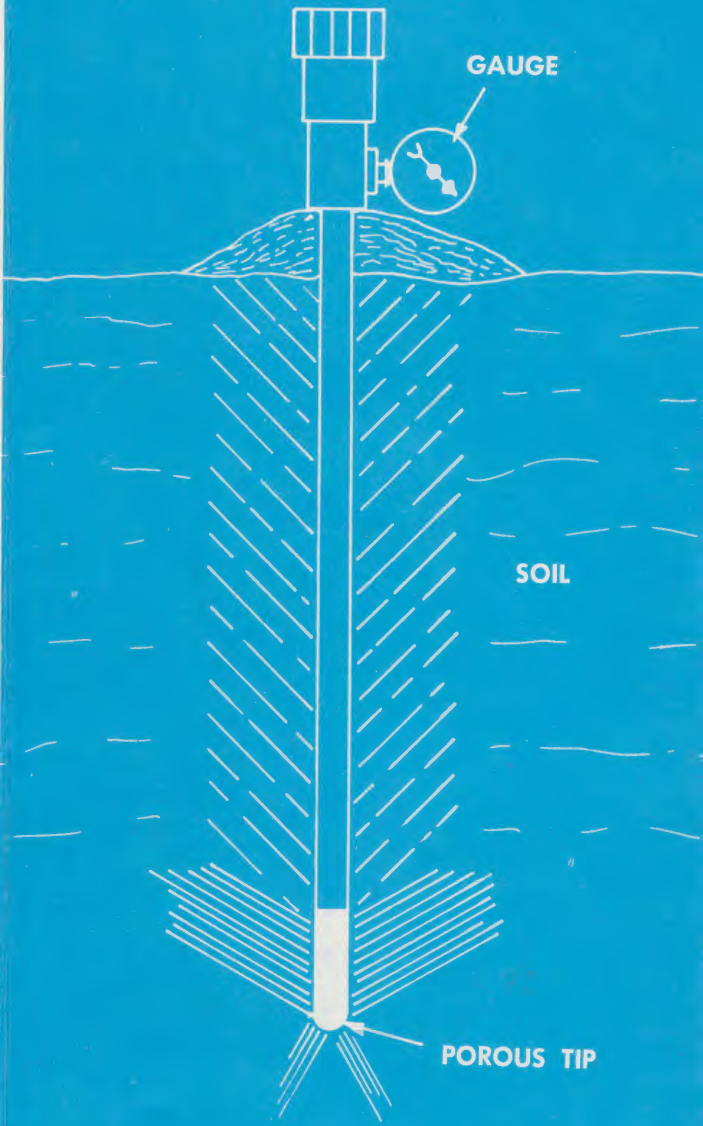
tensiometers



Cooperative Extension Service
South Dakota State University, Brookings
U. S. Department of Agriculture

For timely irrigation . . .

tensiometers

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"When should I irrigate?" is a question confronting every irrigator.

Even though a well-designed irrigation system will be capable of supplying the water needs of a crop on a given soil type, irrigation must start before a soil moisture deficiency develops. If irrigation does not begin before a plant moisture stress exists across the whole field, the last area of the field to be irrigated may suffer from a moisture deficiency since it takes several days to irrigate most fields.

"Available" moisture is that part of the *"total"* moisture which is available to the plant. The amount of available moisture present in the soil at any time depends on the type and depth of soil, rate of transpiration, rate of evaporation, and the depth of application and period of time since the last irrigation or rainfall.

There is no substitute for experience in estimating soil moisture levels. However, standardization of procedures and use of available instruments can assist the irrigator in correctly evaluating available moisture in his soil.

The use of *tensiometers* is the most common field method for determining available soil moisture. They do not measure the effects of salts on the availability of moisture. Other moisture measuring instruments are presently being tested and evaluated.

Tensiometer—"Mechanical Root"

The tensiometer is a relatively inexpensive instrument capable of measuring the force or suction which a plant root must overcome to extract moisture from the soil. It is a sensitive "mechanical root" that indicates, without prior calibration, the availability of water in the root zone. It does not measure the quantity of water directly.

COVER DRAWING—**Figure 1. A tensiometer as placed in the soil.**

A tensiometer consists of a sealed, water-filled tube with a porous ceramic tip on the lower end and a vacuum gauge on the upper end (Figure 2).

The tensiometer gauge (Figure 3) indicates soil moisture tension or soil suction. It does not indicate moisture percentage. This suction, generated as moisture is removed from the soil by the crop, draws water from the tensiometer tube through the porous tip causing the vacuum created to be registered on the gauge. *The drier the soil, the higher the vacuum.*

INSTALLATION

1. Prepare tensiometer for installation according to specific instructions of the manufacturer. This involves filling the instrument with solution and removing air from the gauge and the pores of the ceramic tip.
2. Prepare the hole in the soil with a regular soil probe. Probe to three-quarters of the desired depth of the instrument.
3. Prepare remaining one-quarter of desired depth with a ¾-inch rod (or the exact size of ceramic tip). Good contact between lower portion of tensiometer and soil is essential.
4. Bank some soil at the surface around the upper portion of the tube to provide good drainage.
5. Place a flag or tall marker at each station for easy location.
6. Avoid soil compaction in immediate area of tensiometer. Always approach station on row other than where instrument is located.

LOCATION AND DEPTH

Two Tensiometers Per Station

Tensiometer control of irrigation is based on "stations" set up to give a good indication of the available moisture throughout a specific field. A "station" should consist of two tensiometers of different lengths (see Table 1) installed in the same proximity, usually in the crop row. Each station should fully evaluate

Figure 2. Tensiometer.

the surface moisture conditions and will indicate when irrigation should begin. The deeper tensiometer will evaluate penetration. This deeper tensiometer should be used for controlling irrigation in a situation where several small rains are sufficient to keep the top foot of soil adequately watered but when dry conditions may exist in the lower part of the profile.

Stations With One Tensiometer

When only one tensiometer is used per location, water may be required in the plant root zone early in the season before the tensiometer indicates moisture is needed. Later on in the season, light rains or light applications of water may result in indications of high or sufficient soil moisture conditions in the upper portion of the root zone while in the lower portion soil moisture might actually be low. In these cases, where only one tensiometer is used, soil samples should be taken with a soil probe to check moisture levels in all areas of the root zone. The use of two instruments per station is highly recommended in preference to only one instrument per station.

Recommended Depth of Setting Tensiometer
(1 tensiometer per station)

Crop	Depth of tensiometer (inches)
Potatoes	12
Corn and grass	18
Alfalfa	24

Station locations should be selected which represent the average field conditions of soil type, slope and plant population. Do not place tensiometer in high or low spots in the field. Locate stations according to the following general guidelines:

Table 1. Recommended depths of setting tensiometers.

Crop	Soil depth or active root zone (inches)	Shallow tensiometer (inches)	Deep tensiometer (inches)
Garden	18	8	12
Potatoes	24	12	18
Corn and Grass	36	12	24
Alfalfa	48 or more	18	36

Gravity Irrigation (for furrows or borders). Place tensiometer in first set with a station one-third the distance from the end of the run in the same crop row. Place a second station in the last irrigation set. Do not dike the ends of the furrows.

Sprinkler Irrigation (for tow lines, side move, booms, or big gun systems). Locate stations parallel to main line and about 50 feet into the crop. Select the area covered by one lateral in the first and last set in the field.

Stations in the first and last sets will help to determine when to start irrigating again should a rain disrupt the irrigation schedule.

Locate the station about a third of the distance from the center. When only one instrument is used, water penetration to the lower reaches of the root zone is often inadequate.

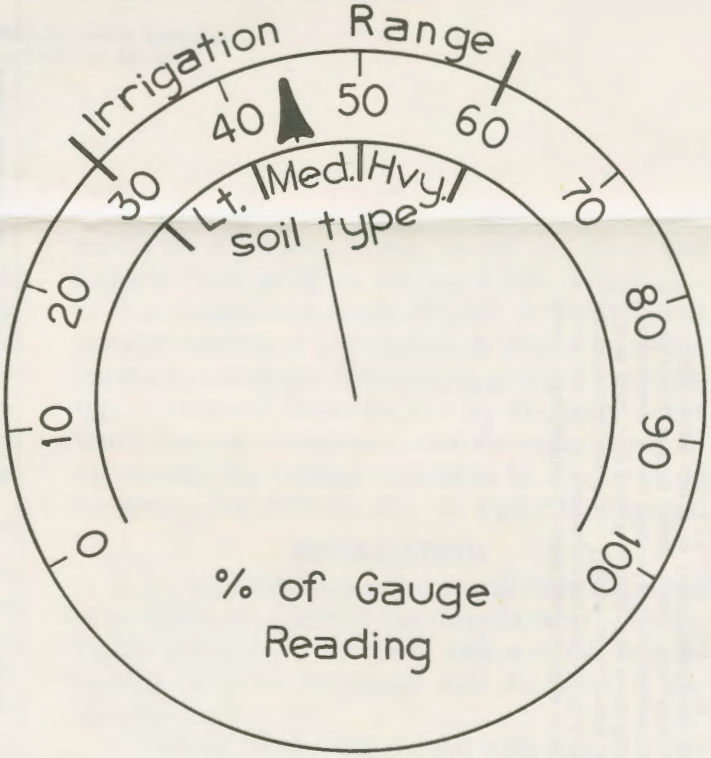
Interpretation of Readings

Tensiometers measure the availability rather than quantity of soil moisture; however, the operator's experience on his specific soil and area is very important in interpreting tensiometer readings. Figure 3 illustrates some general guides for interpreting tensiometer readings.

Service

Service the tensiometers in the field according to recommendations of the manufacturer. In the process of removing water from the tensiometer when the soil is dry and adding water when the soil moisture content increases, air is drawn up in the tube and collects at the top. Displace this air periodically by adding water when needed.

Figure 3. Tensiometer gauge.



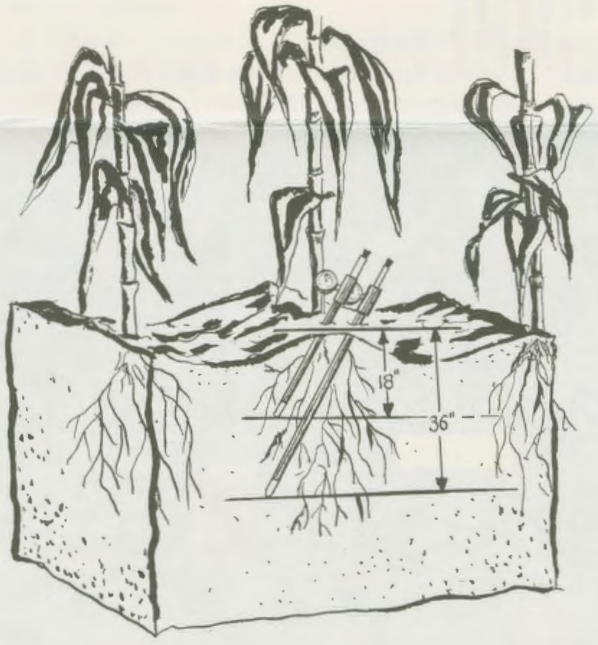


Figure 4. Tensiometer location for furrow irrigation.

TENSIOMETER TROUBLE SHOOTING

Problem	Cause	Remedy
Zero reading on gauge	Soil permitted to become too dry	Recharge instrument with water, making sure all air has been removed. Review manufacturer's instructions.
	Poor contact between porous tip and soil, forcing instrument to break tension.	Reset tensiometer making sure soil and tip fit perfectly. Recharge instrument
Little or no fluctuations on gauge reading	Damaged gauge	Check gauge. If faulty, replace.
	Porous tip may not be functioning properly	Remove instrument and follow manufacturer's recommendations for service. Tip may require light sanding with emery cloth to remove sealent.
Continuous high reading on gauge	Poor contact between porous tip and soil permitting high losses of water from instrument	Reset tensiometer assuring good contact between soil and tip.

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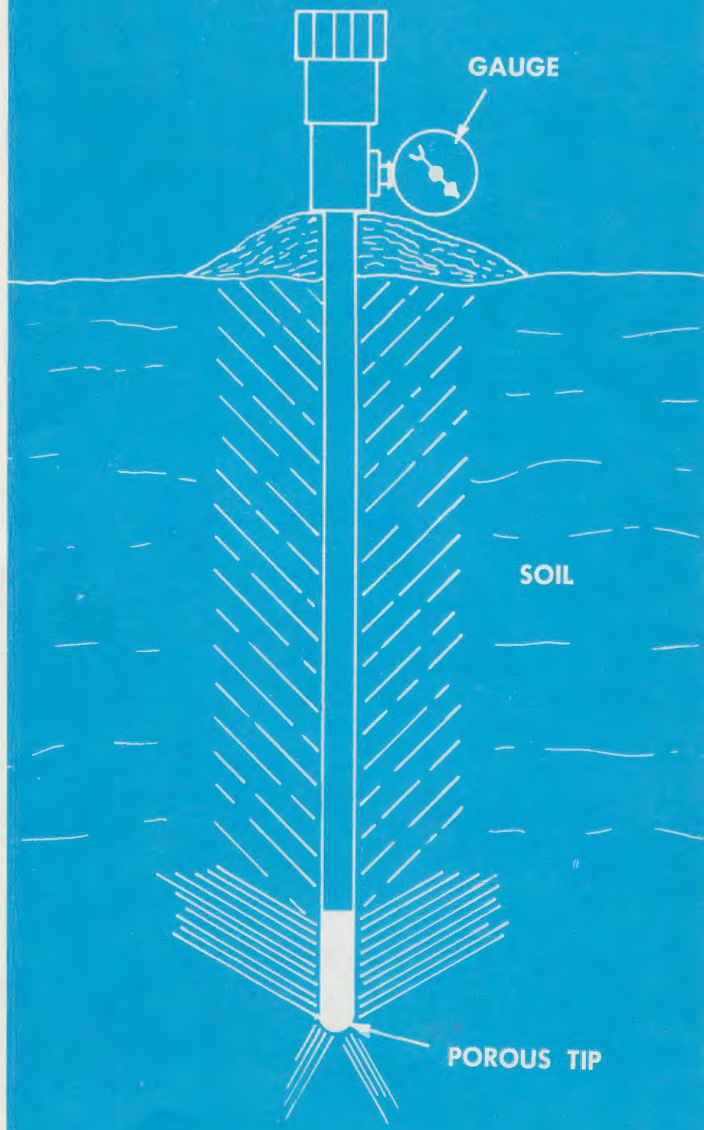

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