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TENSIOMETERS-----

A tool to help control...

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TENSIOMETERS.....a tool to help control irrigation water

By Paul E. Fischbach and Paul E. Schleusener[1/]

INTRODUCTION

The penetration of irrigation water into the soil must be controlled to insure high yields.

If too much water is applied, yields may be reduced because the nitrates are carried below the depth of crop root penetration. Too much water may displace the soil air for too long a time causing reduced yields because of lack of oxygen.

Too little water in the root zone of the soil will also reduce crop yields.

Use tensiometers to find out how deep the irrigation water has penetrated. Tensiometers also help you decide when to start irrigating and whether the stream size in the furrows is large enough to get uniform water application on the upper and lower end of the irrigation run.

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WHAT IS A TENSIOMETER?

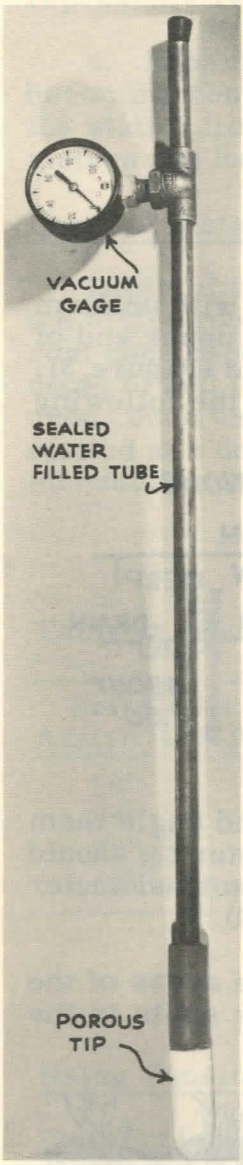


FIG. 1

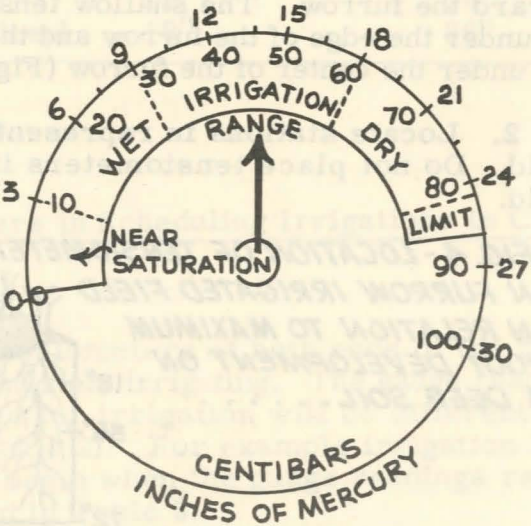
A tensiometer consists of a sealed, water-filled tube equipped with a vacuum gauge on the upper end and a porous ceramic tip on the lower end (Figure 1). Tensiometers show "soil moisture tension" or "soil suction."

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 (Figure 2).

When rainfall or irrigation renews the soil water supply, water will enter the tensiometer tube causing the gauge reading to lower (Figure 2).

Since the tensiometer measures actual moisture condition of the soil it is an excellent tool for helping you decide when to start and when to stop irrigating.

FIG. 2 - TENSIOMETER DIAL



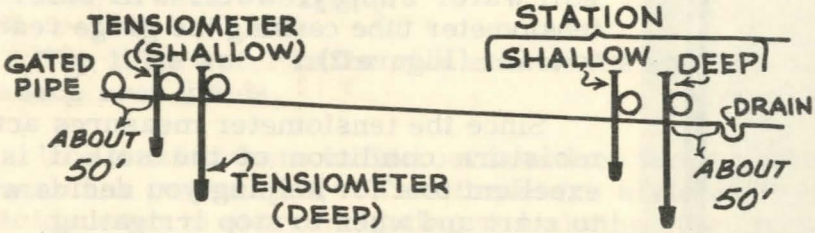
TENSIOMETER STATIONS

Tensiometer controlled irrigation is based on "stations" which set up a zone of moisture control in the soil. A "station" consists of two or more tensiometers of different lengths placed near one another, usually in the crop row.

Where to Place Tensiometers

Two stations may be enough in a field with uniform soil and slope. Put one station near the upper end of the field and the other near the lower end (Figure 3). When placing tensiometers keep in mind the following suggestions:

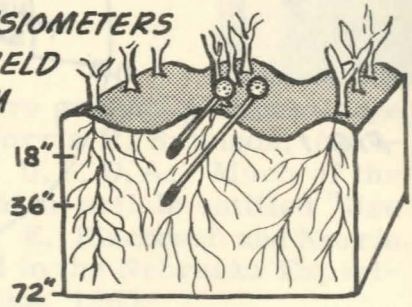
FIG. 3 - LOCATION OF TENSIOMETER STATIONS...



1. Place tensiometers in the row and angle them toward the furrow. The shallow tensiometer tip should be under the edge of the furrow and the deep tensiometer tip under the center of the furrow (Figure 4).

2. Locate stations in representative areas of the field. Do not place tensiometers in low spots in the field.

FIG. 4 - LOCATION OF TENSIOMETERS IN FURROW IRRIGATED FIELD IN RELATION TO MAXIMUM ROOT DEVELOPMENT ON A DEEP SOIL.....



3. Select a station where the plant population is representative of the field.

4. Keep the soil around the tensiometer station from becoming compacted when taking readings. Approach the station from a row other than the one in which tensiometers are located.

Depth of Installation

Depth of tensiometer installation is determined by the active root zone of the crop (Figure 4). This active root zone depends upon the crop, stage of growth, and depth of soil (Table 1). For example, for a deep rooted crop, such as corn, on a deep soil, tensiometers installed at a depth of 18 inches and 36 inches are recommended for each station.

Table 1. Recommended Depth of Setting Tensiometers

Soil Depth or Active Root Zone	Shallow Tensiometer	Deep Tensiometers
18"	8"	12"
24"	12"	18"
36"	12"	24"
48" or more (deep)	18"	36"

Using Tensiometers in Scheduling Irrigations in Corn

Start Irrigation

The shallow tensiometers at both ends of the field will tell you when to start irrigating. The gauge reading that indicates need for irrigation will be different for different soils (Table 2). For example irrigation in a corn field should begin when the gauge readings reach the point indicated in Table 3.

Table 2. Interpretation of Tensiometer Readings

Dial Reading			Interpretation
	Inches of Mercury	Centi-bars	
Nearly Saturated	0 3	10	Near saturated soil often occurs for a day or two following irrigation. Danger of water-logged soils, a high water table, poor soil aeration, or the tensiometer may have broken tension, if readings persist.
Field Capacity	6 9	11 20 30	Field capacity. Irrigations discontinued in this range to prevent waste by deep percolation and leaching of nutrients below the root zone. Sandy soils will be at field capacity, in the lower range with clay soil at field capacity in the upper range.
Irrigation Range	12 15 18	40 50 60	Usual range for starting irrigations. Soil aeration is assured in this range. In general, irrigations start at readings of 30-40 in sandy textured soils (loamy sands & sandy loams). Irrigations usually start from 40-50 on loamy soils, (very fine sandy loams & silt loams). On clay soils (silty clay loams, silty clays & etc.) irrigations usually start from 50-60. Starting irrigations in this range insures maintaining readily available soil moisture at all times.

Dry	21	70	This is the stress range. However, crop not necessarily damaged or yield reduced. Some soil moisture is readily available to the plant but is getting dangerously low for maximum production.
	24	80	Top range of accuracy of tensiometer, readings above this are possible but the tensiometer will break tension between 80 to 85 centibars.

Table 3. Tensiometer Readings For Starting Irrigation of Corn

Soil	Gauge Readings	
	Centibars	Inches of Mercury
Loamy sands sandy loams	40	12
Very fine sandy loams silt loams	50	15
Clay loams silty clay loams	60	18

For a soil at least 6-feet deep the shallow and deep tensiometers should be 18 and 36 inches long, respectively. For shallower soils see Table 1.

Stop Irrigation

The first irrigation should be stopped when the gauge reading drops to 10 centibars or 3 inches of mercury, or less, on the shallow tensiometers. On later irrigations, if the gauge readings on the deep tensiometers have increased to the values in Table 3 before irrigation, stop irrigating when the gauge readings are lowered on the deep tensiometers. If the gauge readings

on the deep tensiometers are less than those in Table 3 before irrigation - then stop irrigating when the gauge readings are lowered on the shallow tensiometer.

Uniform Water Distribution

An example of good water penetration pattern on a uniform slope and soil is 24 inches deep on the upper end of the run, 21 inches in the middle of the run, and 18 inches on the lower end of the run. Such a pattern can be obtained if the water reaches the end of the row in about 1/4 the time required to penetrate 18 inches.

Tensiometers can be used to determine whether the proper stream size was used. If the gauge readings were lowered on both tensiometers on the upper end of the run, but only on the shallow tensiometer on the lower end - the stream size was too small. On the next irrigation increase stream size so that water will flow from one end of the field to the other in less time.

CAUTION - do not use too large a stream, or serious erosion will occur. It may be necessary to reduce the length of run.