

## **Measurement of matric potential using gauge and mercury type tensiometer**

### **Aim:**

To Install and know the working principle of tensiometer in crop field.

### **Materials required**

1. Tensiometer
2. Water
3. Screw auger or coring tool
4. Aluminum moisture box
5. Spade
6. Bucket

### **Introduction**

The tensiometer is an instrument designed to provide a continuous indication of the soil moisture tension. As the water potential in tensiometer comes in equilibrium with the soil water, the tensiometer represents the matric potential of the soil. The available soil moisture range is upto 15 atm. This device typically consists of a glass or plastic tube with a porous ceramic cup, and is filled with water. This device typically consists of a glass or plastic tube with a porous ceramic cup, and is filled with water. The top of the tube has either a built-in vacuum gauge or a rubber cap used with a portable puncture tensiometer instrument, which uses a hypodermic needle (sharp and hollow needle) to measure the pressure inside the tensiometer.

### **Working principle**

When buried in the soil the ceramic tip of the tensiometer allows water to move freely in or out of the tube. As the soil dries out, water is sucked out through the porous ceramic tip, creating a partial vacuum inside the tensiometer which is read on the vacuum gauge. When the soil is wetted by sufficient rainfall or irrigation, water flows back into the tensiometer, the vacuum decreases and the gauge reading is lowered.

Tensiometer measures how tightly water is held to the soil particles and not how much water is

left in the soil. A sandy soil will reach a high tension sooner than a clay loam because sandy soils cannot supply as much water to the plant and it is used up more quickly. As soil moisture is depleted by plant uptake, or as it is replenished by rainfall or irrigation, corresponding readings on the tensiometer vacuum gauge occurs.

Tensiometers do not operate in dry soil because the pores in the ceramic tip drain and air is sucked in through them breaking the vacuum seal between the soil and the gauge on top of the tensiometer. Such tensiometers are used in irrigation scheduling to help farmers and other irrigation managers to determine when to water. In conjunction with a water retention curve, tensiometers can be used to determine how much to water. Soil tensiometers can also be used in the scientific study of soils and plants.

## **Procedure**

1. Select a representative spot in the cropped field, usually between plants within a row for convenience during Intercultural operations.
2. Make a vertical hole equal to the cup diameter to the desired depth using a screw auger or a coring tool.
3. Carefully remove the auger, making sure no rocks fall back in to the hole. Sometime pouring water along the driving shaft helps in easy coring of the hole,
4. Collect the soil in an aluminum box. Prepare thick slurry of the collected soil and pour it in to the hole.
5. Prepare the tensiometer for installation. Fill the tensiometer with distilled water. Observe for any air gaps/air bubbles in the tube.
6. Hitting the top of the tensiometer with an open palm will also dislodge any air bubbles from the side of the tensiometer.
7. Replace the cap, twisting until the stopper reaches the bottom of the reservoir. You do not need to turn it too hard.
8. Place the cup of the tensiometer in the mouth of the cored hole. Force the cup into the hole by pushing directly down on the cap. Do not wobble or rotate the tensiometer shaft and do not push on the gauge. After properly positioning the cup of the tensiometer maintain at least 3 cm between the bottom of the gauge and the soil surface.
9. After positioning the cup properly, place a small amount of water into the bottom of the hole

and allow it to soak in. This ensures proper contact of ceramic cup with the soil.

10. Build a mound around the tensiometer to prevent water from running directly down the side of the tensiometer
11. Allow the tensiometer to attain equilibrium and start monitoring the soil water tension reading in the vacuum gauge.
12. Record the soil water tension readings in the vacuum gauge at the same time each day, in the early morning.
13. From the soil moisture characteristic curve estimate the soil water content with respect to the soil moisture tension measured by tensiometer.

**Draw a neat sketch showing the working principle of tensiometer**

### **Tensiometer Observations**

<b>Depth of soil (cm)</b>	<b>Vaccum guaze reading (centibar)</b>	<b>Soil moisture content (%)</b>	<b>Remark</b>
<b>30 cm</b>			
<b>45 cm</b>			
<b>60 cm</b>			

## Calibration of Tensiometer

The relation between tensiometer and soil moisture percentage is given by the following equation:

$$Y=c+b\log X$$

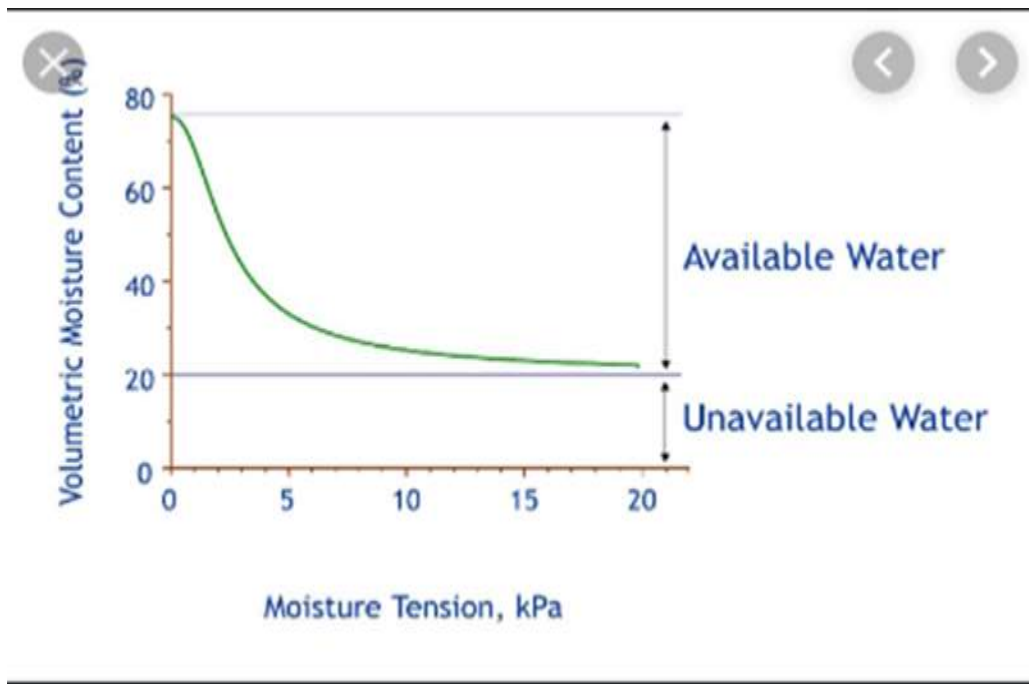
Where, Y, is the moisture percentage,

b & c are constants and

X, is the tensiometer reading.

The best way of tensiometer calibration against moisture percentage is by installing in field then recording tension readings and soil moisture content by Gravimetric method. Data are plotted of graph paper and their corresponding soil moisture readings on oven dry basis and thus, a curve prepared for guidance.

## Draw soil moisture content graph



## Precautions

Before tensiometers are buried in the soil, the ceramic tip and tube must be placed in a container of water for 24 hours or atleast 12 hours to ensure that the tip is fully wet. Tensiometers must remain in the container of water until installed.

The tensiometer tube must be filled with water to the top before installation and at each reading the water level in the tensiometer must be checked.

### **Practical significance**

Tensiometer provides soil moisture tension readings rapidly in-situ. The instrument is relatively simple and robust. The soil moisture tension is a measure of the tenacity with which water is retained in the soil and is related to the amount of water in the soil that is available to plants. It reflects the force per unit area that must be exerted by plant roots to extract water from the soil. Further scheduling irrigations based on tensiometric readings maximizes irrigation efficiency by minimizing runoff and percolation losses. This often results in lower energy and water use and optimum crop yields.

### **Conclusion**

**Signature of Faculty In-charge**