APPLICATION OF SOIL MOISTURE SENSORS IN AGRICULTURE

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SOIL MOISTURE SENSOR

The soil moisture sensor (SMS) is a sensor connected to an irrigation system controller that measures soil moisture content in the active root zone before each scheduled irrigation event and bypasses the cycle if soil moisture is above a user defined set point. Soil moisture sensors, like rain sensors, are considered rain shut off devices, but while rain sensors measure evapotranspiration rates, soil moisture sensors measure real time soil moisture. Measuring soil moisture is important for agricultural applications to help farmers manage their irrigation systems more efficiently. Knowing the exact soil moisture conditions on their fields, not only are farmer's able to generally use less water to grow a crop, they are also able to increase yields and the quality of the crop by improved management of soil moisture during critical plant growth stages. Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content.

DIFFERENT TYPES OF SENSORS

There are numerous types of sensors available today, each having variable performances. Some measure soil moisture content while other measure soil water potential and dielectric constant (volumetric content). Although there are numerous techniques available for soil moisture sensing, but in this review the soil water tension based sensors (Granular matrix sensors) and soil water content based sensors (TDR, FDR and TDT) are discussed. The nuclear scattering and gamma ray attenuation techniques have not been discussed here as they use radioactive material which may prove to be hazardous.

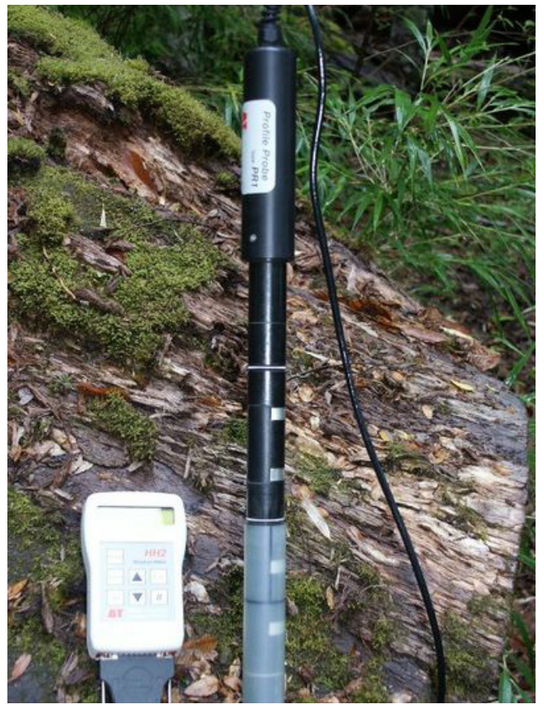
1. FREQUENCY DOMAIN REFLECTOMETRY (FDR):

This sensor uses the soil as a capacitor, which stores part of an electric charge that is run through two or more electrodes inserted into soil. Changes in frequency of the wave as it passes through the soil are related to this capacitance and its dielectric properties of the soil (i.e., the greater the frequency, the more soil moisture). It's principle is similar to TDR sensor.

Advantages

•With FDR, measurements can be made at several depths at the same location.

•Can be used in saline soils beyond the range of the TDR.
•High resolution signal (less noise than TDR).
•FDRs tend to be less expensive than TDRs.

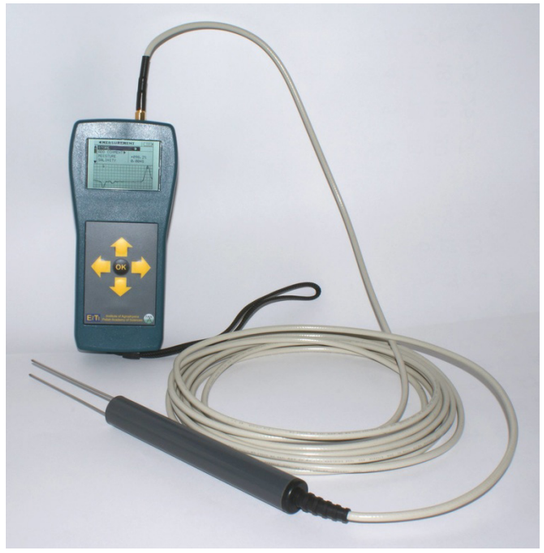


2. TIME DOMAIN REFLECTOMETRY (TDR):

In time domain reflectrometry, a pulse of radio frequency energy is injected into a transmission line and its velocity is measured by detecting the reflected pulse from the end of the line. The dielectric constant of a certain volume element around the sensor is obtained by measuring the speed of propagation.

Advantages

•TDR respond quickly to varying soil moistures.
•Soil moisture from multiple depths can be obtained from a single probe.
•There is little or no disturbance to the test site during the testing process.
•Minimal soil disturbance.



3. AMPLITUDE DOMAIN REFLECTOMETER

This sensor consists of two metal rods arranged in a circle around a central rod that acts as the transmission line. The sensor measures impedance of a signal from the transmission probe to the receiving probes. Impedance contains two parts: the dielectric constant and the soil electrical conductivity. The latter is minimized by signal selection, thus leaving the dielectric constant, which is proportional to soil moisture

Advantage

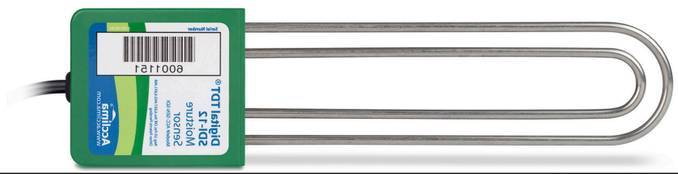
•Can be used in highly saline soils.
•Inexpensive and Minimal soil disturbance.
•Temperature does not interfere with signal.

4. TIME DOMAIN TRANSMISSION (TDT)

This sensor operates similarly to a TDR, however the rod is connected to the electrical source at both the beginning and end of the rod. The TDT measures the travel time of the wave propagation between the rods.

Advantage:

•Large sensing volume (≈30 in 3) and Inexpensive.

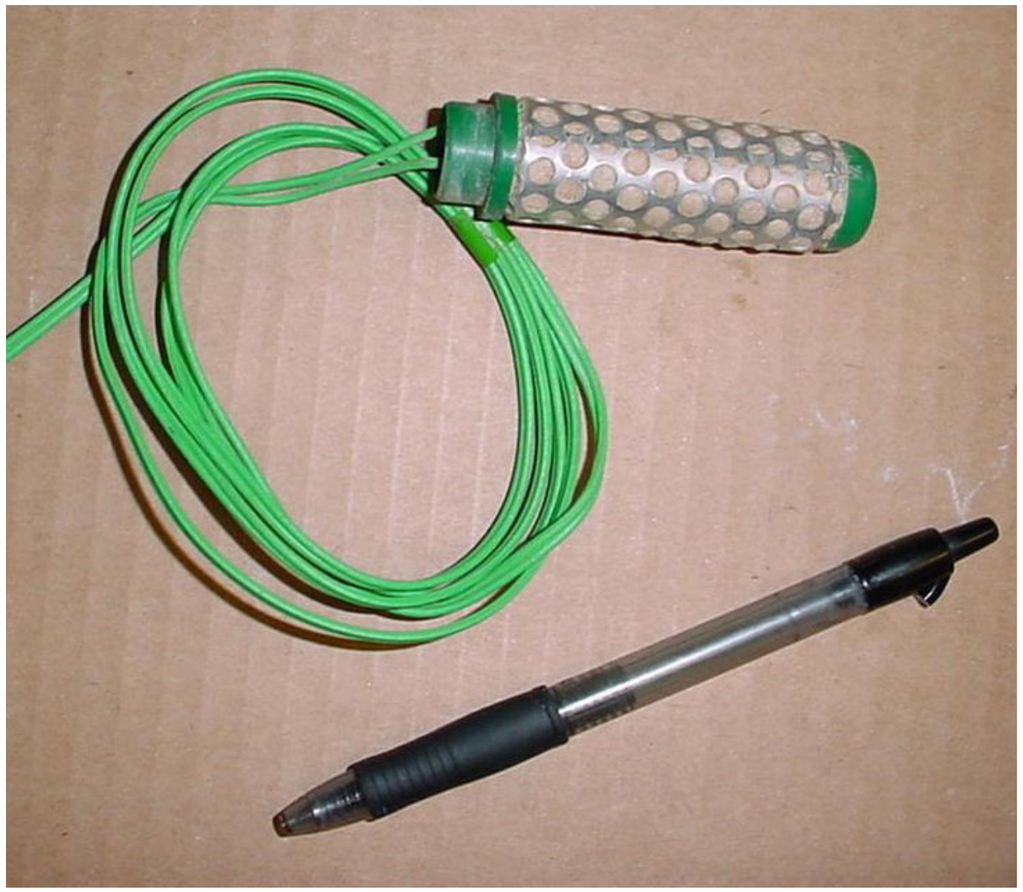


5. GRANULAR MATRIX SENSOR (GMS)

The granular matrix sensor is made of a porous ceramic external shell with an internal matrix structure containing two electrodes. The electrodes inside the GMS are imbedded in the granular fill material above the gypsum wafer. The water conditions in the granular matrix change with variation in corresponding water conditions in the soil and these changes are continuously indicated by difference in electrical resistance between two electrodes in the sensor. This resistance between the electrodes is inversely related to soil water.

Advantage

- Can measure a large area (8-inch diameter).
- Can be used in moderately saline soils.
- Can be used to sense wet or dry soil moisture readings for irrigation.
- If soil does not dry out, little maintenance is required.



CONCLUSION:

Soil moisture sensor (SMS) is good irrigation management. Good irrigation management gives better crops, uses fewer inputs, and increases profitability. Soil moisture sensors help irrigators to understand what is happening in the root zone of a crop.