



Study of Soil Temperature and Its Measurement

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Soil temperature is one of the important environmental factors for plant growth and development. About 47.9% of solar energy reaches the earth surface directly and is absorbed within a few centimeter depths. When the earth absorbs solar radiation, it not only heats up the air above but also the lower layers of the soil. The heat transfer into the soil is mainly take place conduction as compared to convection process. The heat flow into or out of the soil is called soil heat flux. The temperature of surface soil varies according to incident radiation during the day, increasing a peak value during noon and lowest just before sunrise. During the night also it falls but much more slowly than during the day. Soil temperature below the soil surface tends to follow the changes in surface but, the diurnal variation is reduced gradually. Diurnal amplitude also decreases considerably with depth. The exchange of the heat between the soil and its surface has pronounced effect on diurnal surface temperature variations. The nature and quantum of this exchange is primarily governed by the heat capacity per unit volume and thermal conductivity of the soil, both of which vary with the nature of soil surface and its moisture content. Moisture stimulates seeds to germinate, the time to emergence being temperature-dependent. The rate of growth of roots, stem and leaves depends on the rate of photosynthesis, which in turn depends on light, temperature, moisture. Soil provides the environment for plant roots and nutrients are stored, cycled in the soil and is released in forms available to organisms through chemical and biological processes. An example would be when water of an appreciably different temperature from the soil infiltrates, and the soil temperature changes as water fills soil pores.

Soil temperature is the direct manifestation of solar energy absorption. Soil acts as sink during day, time and as a source of heat during night time. Plants are most directly affected by soil temperature from germination. Its root system is entirely within the soil affecting growth, nutrient uptake, water uptake, organic matter decomposition etc. Soil temperature controls the intensity of biophysical, biochemical and microbiological processes that takes place within the soil. Therefore its measurement is necessary under climatic change situation for the study and we can manage the soil temperature by adaptation of certain management practices on the farm for the maintaining of optimum soil temperature under field conditions for the better crop production. Hence it is necessary to know the various instrument used for measurement of the soil temperature and standard procedure used for the measurement.

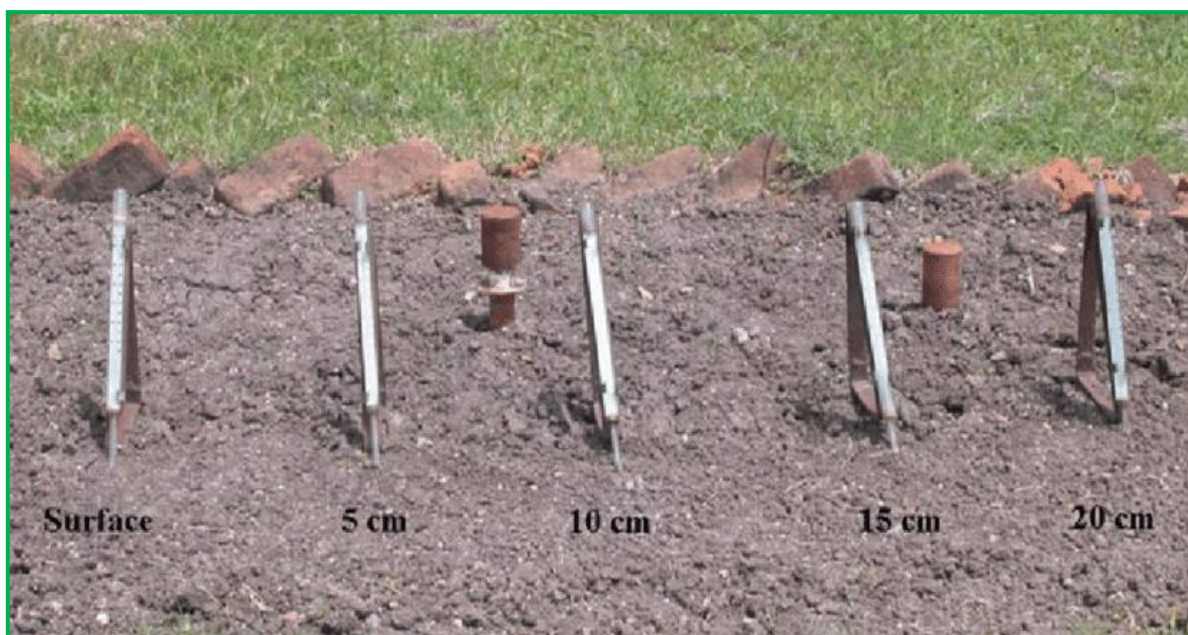
Following instruments are used to measure the soil temperature

1. Mercury in glass thermometer
2. Resistance thermometer
3. Thermocouple thermometer
4. Soil thermograph

Soil temperature is measured at various depths such as surface 1 cm, 2.5 cm, 5 cm, 10 cm, 15 cm, 20 cm, 30 cm, 50 cm, 100 cm and 150 cm. Soil thermometers generally of

mercury in glass type are used for shallow depths not exceeding 30 cm. Four thermometers to measure soil temperature on the surface and at the depths of 5, 10, 15 and 30 cm are installed. For exceeding 30 cm, Symon's pattern earth thermometers are used.

Soil Thermometers: - The soil thermometers are mercury in glass thermometers. The scale is enclosed inside the thermometers ranging from -5°C to $+70^{\circ}\text{C}$ and temperature can be read correctly up to 0.1°C , with eye observation. The stem of the thermometer is bent at 120° just above the bulb. This helps in keeping the bulb of the soil thermometers horizontally on the soil at the required depth and the scale or stem is inclined at 120° from the ground so that the scale can be read conveniently. Triangular iron stands are provided with thermometers. The iron stands are bent at 60° angles so that the thermometer when mounted makes an angle of 120° with the ground. The slopping side of the stand has two clips to hold the stem of the thermometers while its lower end is so shaped that it can be easily penetrated into the soil. Soil thermometers commonly used are of three depths 5, 15 and 30 cm. Thermometers should face south. In soil thermometers the graduation begins from the distance of 6.5 cm, 17.5 cm and 35.0 cm from the bulb for 5, 15 and 30 cm. depth soil thermometers, respectively. The soil thermometers are installed in a plot size of 2.5 m (E-W) x 1.5 m (N-S) direction. The plot should be divided into two equal halves breadth wise and on central line the thermometers are installed in ascending order from west to east by keeping 55 cm distance from east and west boundaries and 45 cm distance between two thermometers facing towards south. Before installation, carefully examine thermometers for defects if any (especially for the break in mercury column).



Soil thermometers

Installation: - From the middle of the bulb along the stem put up a black paint mark.

1. For 5 cm depth soil thermometer, remove the soil in layers of 0 to 2 cm, 2 to 4 cm and 4 to 5.5 cm.
2. For 10 cm depth soil thermometer, remove the soil in layers of 0 to 3 cm, 3 to 6 cm, 6 to 9 cm and 9 to 10.5 cm.
3. For 20 cm depth soil thermometer, remove the soil in layers of 3 cm thickness till reaching it up to 20.5 depths.

Care should be taken to keep each lot of soil separately and the iron stands need not be disturbed while removing the soil samples. Adjust the stands if necessary. Note that the sloping side must face towards south, Mark the ground level by a piece of string stretched

across the pit. Make sure that the vertical distance from the bed of the pit to ground level is about 5, 10 and 30 cm. respectively.

Slightly loosen the clips in the stand gently introduce the thermometer through the opening into the pit till the black mark on the stem of the thermometer is at a same level as the string. Also measure the depth of the thermometer bulb from the string. Adjust the position of the bulb till it is 5, 10 and 20 cm depth for respective thermometers. Now replace the soil in reverse order. See that there is no air pocket left around the bulb of the thermometer. Slightly press the soil, if necessary. Clamp the thermometer very carefully in the iron stand. Note the distance from the soil surface to the + 5⁰ mark. This distance is called as check distance.

Procedure for recording soil temperature: At the time of observation, sit sufficiently away from the thermometer so that no shadow would be cast on to the thermometer. Read thermometer correct to 0.1^oc soil temperature at 0700 hrs and 1400 hrs LMT in the order of 5, 15 and 30 cm depth. Avoid parallax error while reading the thermometer by keeping the line joining the eye of the observer and top of mercury column at right angle to the thermometer.

Precautions

1. If the rain water is collected in the soil thermometer plot, remove the same by digging drainage channels all around the plot.
2. Vegetation like weeds, grasses etc. should be removed from the plot at regular interval.
3. Soil thermometer should be installed facing towards the south direction.
4. Cracks developed in the soil furnace during summer or dry weather are filled in by loose soil and cracks are removed.
5. Check the check distance frequently and add soil if necessary.
6. Check any break in mercury column or collection of water in glass jacket.

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