TEMPERATUR POINTS

Temperature is a measure of the hotness of a body. If a water vessel is kept on flame and we monítor the state of water by dipping our fingers, we first feel mild warmth, then warmth and then heat. A stage comes further when we cannot measure hotness through our fingers if the water vessel continued to be on flame. It means something flows to water from flame, which is nothing but heat flow. In other words, heat flow results change in temperature, which can be measured by a device known as thermometer.

DIURNAL AND MONTHLY VARIATIONS OF SURFACE AIR TEMPERATURE

The minimum air temperature occurs at about sunrise, after which there is a constant rise till it reaches the maximum level. The maximum air temperature is recorded between 1300 hr and 1400 hr although the maximum solar radiation level is attained at noon. A steady fall in temperature till sunset is noticed after it attains the maximum. Thus the daily march displays one maximum and one minimum.

The difference between the two is called the diurnal range of air temperature, the diurnal range of air temperature is more on clear days, while cloudy weather sharply reduces daily amplitudes. The diurnal range temperature is also influenced by soils and their coverage in addition seasons, Addition of daily maximum and minimum temperature divided by two is nothing but daily mean or average temperature. That is

$$\text{Daily mean temperature} = \frac{\text{Daily maximum temperature} + \text{Daily minimum temperature}}{2}$$

SOIL TEMPERATURE

Soil temperature varies among different soil types depending upon the soil structure received is the same. It plays a major role in seed germination. The root zone of any crop is a function of soil temperature and soil moisture if other environmental factors are homogeneous. The surface of the earth gets heated up during the day and gets cooled during the night causing significant diurnal changes in top layers of the soil. For example at 0800 hr, the soil temperature was 28.5°C at 5 cm depth, followed by 29.9°C at 10 cm depth and 31.2°C at 15 cm depth. On the same day at noon (1300 hr), the soil temperature was 44.4°C, 39.7°C and 36.7°C at 5 cm, 10 cm and 15 cm depth respectively. It showed that the top soil is a heat source during the day and sub-surface soil during night and early morning hours.

VEGETATION AND AIR TEMPERATURE

Natural vegetation or crop cover has considerable influence on the distribution of temperature in the layer of air near the soil. If the ground surface is totally or partially covered by crops during its maximum growth stage, the incoming solar radiation is intercepted due to their canopy and the amount received at the ground surface is relatively less, the crop surface itself acts as an active surface just like the ground surface, the temperature profile is changed within the crop surface, and it is different from the thermal structure in the open, very near the ground. In daytime the temperature of the plant cover is higher, and lower at night when compared to that of the surrounding The temperature of plant cover depends on the height of the plant, the stand density and the solar elevation.

AIR TEMPERATURE AND CROPS

The surface air temperature is one of the important variables, which influences all stages of crop during its growth, development and reproductive phase. A short-duration crop becomes medium or long duration crop depending upon its environmental temperature under which it is grown. Most of the crops

have upper and lower limits of temperature, below or above which they may not come up. Also, the crop productivity is related to temperature if other crop-related environmental factors are not limiting.

CARDINAL TEMPERATURE POINTS

Every physiological plant process undergoes a well-defined range of limits of temperatures. There must be at least a minimum essential temperature to the initiation of activity; the activity will proceed at the highest rate when the optimum temperature is reached; eventually activity will come to a close at the maximum temperature point. These three points are known as the cardinal temperature points. They may vary widely with the age or stage of development of the plant, and they vary considerably for different species. Wilsie (1962) gave a table of cardinal temperature points for germination of crop seeds (based on data collected by Haberlandt and reported by Graphe) which provides some idea of the differences among crops as to their temperature requirements.

THERMOPERIODISM

The response of plants to diurnal or seasonal fluctuation in temperature is known as thermoperiodism. A number of physiological processes, including germination, stem elongation, fruiting, floral development and increase in frost-hardiness may proceed most satisfactorily under a rhythm of alternating temperatures.

- Cold temperature < 10°C
- Optimum temperature 11-24°C
- High temperature > 25°C

Growing Degree Days (GDD)

The concepts of growing degree days, heat unit and thermal unit won developed assuming that there is a direct and linear relationship between crop growth and temperature. The assumption was that the growth of plants is

dependent on the total amount of heat to which it is subjected during its lifetime. The heat unit or growing degree days are defined as follows:

$$\mathbf{GDD = [(Tmax + Tmin/2] - T_t}$$

where, T is the maximum temperature in °C, T is the minimum temperature in °C and T, is minimum threshold or base temperature.

The minimum threshold temperature is the temperature below which no growth takes place. It varies from 4.5 to 12.5°C for different crops: It is 5°C for rice, 8°C for millets, 10°C for maize, 14-15°C for cotton and 13°C for coconut. The degree days' concept can be used for forecasting the duration of crop and its harvest dates. The crop yields also could be predicted based on crop-specific thermal units.

UNITS

Temperature is measured in different temperature units across the world. Mostly, degrees Celsius (°C) is commonly used. The same is practiced in India also. However, Fahrenheit scale is also used in the U.K. In literature on heat and temperature, we often come across the Fahrenheit scale. The Reaumer scale is used in Russia for household purposes.

Degrees Celsius is same as degrees Centigrade. The melting point of ice s taken as 0 in Celsius scale and Reaumer scale while 32 in Fahrenheit scale. The boiling point of water is taken as 100, 212 and 80 in Celsius, Fahrenheit and Reaumer scales, respectively.