

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 $< 10^{\circ}\text{C}$
- Optimum temperature $11\text{-}24^{\circ}\text{C}$
- High temperature $> 25^{\circ}\text{C}$

Growing Degree Days (GDD)

The concepts of growing degree days, heat unit and thermal unit were 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:

$$\text{GDD} = [(T_{\text{max}} + T_{\text{min}}/2) - T_t]$$

where, T is the maximum temperature in $^{\circ}\text{C}$, T is the minimum temperature in $^{\circ}\text{C}$ and T_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 $^{\circ}\text{C}$ for different crops: It is 5 $^{\circ}\text{C}$ for rice, 8 $^{\circ}\text{C}$ for millets, 10 $^{\circ}\text{C}$ for maize, 14-15 $^{\circ}\text{C}$ for cotton and 13 $^{\circ}\text{C}$ 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 ($^{\circ}\text{C}$) 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 is 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.

INSTRUMENTS

The instruments used for measuring temperature are as follows:

1. Single Stevenson Screen
2. Maximum Thermometer
3. Minimum Thermometer
4. Dry Bulb Thermometer
5. Wet Bulb Thermometer
6. Infrared Thermometer
7. Double Stevenson Screen
8. Thermograph
9. Grass Minimum Thermometer
10. Soil Thermometer