

AIR TEMPERATURE

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Temperature is defined as, “The measure of speed per molecule of all the molecules of a body”. Where as heat is, “the energy arising from random motion of all the molecules of a body’. (Degree of molecular activity). It is the intensity aspect of heat energy.

Conduction

Heat transfer when two bodies of unequal temperatures come into contact. Heat passes from point to point by means of adjacent molecules.

Convection

Transfer through movement of particles (part of mass) in fluids and gasses. These are able to circulate internally and distribute heated part of the mass.

Radiation

It is the process of transmission of energy by electromagnetic waves between two bodies without the necessary aid of an intervening material medium

Factors affecting air temperature

1. Latitude

The time of occurrence of maximum monthly mean temperature and minimum monthly mean temperature also depends on latitude of a place. (eg.) The coldest month is January in northern regions of India while December in the south. Similarly, the warmest month is May in the south while June in the north across the country.

2. Altitude

The surface air temperature decreases with increasing altitude from the mean sea level as the density of air decreases. Since the density of air is less at higher altitudes, the absorbing capacity of air is relatively less with reference to earth's longwave radiation.

3. Distribution of land and water

Land and water surfaces react differently to the insolation. Because of the great contrasts between land and water surfaces their capacity for heating the atmosphere varies. Variations in air temperature are much greater over the land than over the water. The differential heating process between land and sea surfaces are due to their properties. It is one of the reasons for Indian monsoon.

4. Ocean currents

The energy received over the ocean surface carried away by the ocean currents from the warm areas to cool areas. This results in temperature contrast between the equator and poles. The occurrence of El-Nino is due to change in sea surface temperature between two oceanic regions over the globe.

5. Prevailing winds

Winds can moderate the surface temperature of the continents and oceans. In the absence of winds, we feel warm in hot climates. At the same time, the weather is pleasant if wind blows.

6. Cloudiness

The amount of cloudiness affects the temperature of the earth's surface and the atmosphere. A thick cloud reduces the amount of insolation received at a particular place and thus the day time temperature is low. At the same time, the lower layers in the

atmosphere absorb earth's radiation. This results in increasing atmospheric temperature during night. That is why, cloudy nights are warmer. This is common in the humid tropical climates.

7. Mountain barriers

Air at the top of the mountain makes little contact with the ground and is therefore cold while in the valley at the foothills makes a great deal of contact and is therefore warm. That is, the lower region of the earth's atmosphere is relatively warmer when compared to hillocks.

Diurnal and seasonal variation of air temperature

- The minimum air temperature occurs at about sunrise, after which there is a constant rise till it reaches to maximum.
- The maximum air temperature is recorded between 1300 hrs and 1400 hrs although the maximum solar radiation is reaches at the noon.
- A steady fall in temperature till sunrise is noticed after is attains 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 of temperature is also influenced by soils and their coverage in addition to seasons.

Horizontal air temperature distribution

- The lines connecting points of equal temperature is called as **isotherm**
- It is largely depends latitude. A general decrease in temperature from equator towards poles is one of the most fundamental factors of climatology.
- Irregular distribution of land and water on earth's surface breaks the latitudinal variation in temperature.
- Land areas warm and cool rapidly than water bodies
- Mountain barriers influence horizontal distribution of temperature by restricting movement of air masses.
- On local scale topographic relief exerts an influence on temperature distribution.

Temperature inversion

- Occasionally at some altitude the temperature abruptly increases instead of decreasing. This condition in which this abrupt rise instead of fall in temperature occurs in the air is known as the temperature inversion. This may occur under the following conditions.
- When the air near the ground cools off faster than the overlying layer, because of heat loss during cooling nights.
- When an actual warm layer passing over a lower cold layer.
- Cold air from hill tops and slopes tend to flow downward and replaced by warm air.

Heat Units

- It is a measure of relative warmth of growing season of a given length. Normally it is indicated as Growing Degree Days (GDD). A heat unit is the departure from the mean daily temperature above the minimum threshold temperature.
- The minimum threshold temperature is the temperature below which no growth takes place.
- Usually ranges from 4.5 to 12.5 °C for different crops (Most commonly used value is 6.0°C)

Degree Day

A degree day is obtained by subtracting the threshold temperature from daily mean temperature. Summation of the daily values over the growth period gives degree days of the crops.

$$\text{GDD} = \sum \frac{T^{\max} + T^{\min}}{2} - T^b$$

Where

T^{\max} – Maximum air temperature of the day

T^{\min} – Minimum air temperature of the day

T^b - Base temperature of the crop

The base temperature is the threshold temperature.

Advantages / Importance of growing degree Day Concept

1. In guiding the agricultural operations and planting land use.
2. To forecast crop harvest dates, yield and quality
3. In forecasting labour required for agricultural operations
4. Introduction of new crops and new varieties in new areas
5. In predicting the likelihood of successful growth of a crop in an area.

HEAT INJURIES

‘Thermal death point’ – the temperature at which the plant cell gets killed when the temperature ranges from 50-60°C. This varies with plant species. The aquatic and shade loving plants are killed at comparatively lower temperature (40°C).

High temperature

- results in desiccation of plants
- disturbs the physiological activities like photosynthesis and respiration
- increases respiration leading to rapid depletion of reserve food.

Sun clad

Injury caused on the barks of stem by high temperature during day time and low temperature during the night time.

Stem griddle

The stem at ground level scorches around due to high soil temperature. It causes death of plant by destroying conductive tissues. Eg. This type of injury is very common in young seedlings of cotton in sandy soil when soil temperature exceeds 60°C.

COLD INJURY

(i) Chilling injury

Plants which are adapted to hot climate, if exposed to low temperature for sometime, are found to be killed or severely injured or development of chlorotic condition (yellowing) (eg.) chlorotic bands on the leaves of sugarcane, sorghum and maize in winter months when the night temperature is below 20°C.

(ii) Freezing injury

This type of injury is commonly observed in plants of temperate regions. When the plants are exposed to very low temperature, water freezes into ice crystals in the intercellular spaces of plants. The protoplasm of cell is dehydrated resulting in the death of cells. (eg.) Frost damage in potato, tea etc.

(iii) Suffocation

In temperate regions, usually during the winter season, the ice or snow forms a thick cover on the soil surface. As a result, the entry of oxygen is prevented and crop suffers for want of oxygen. Ice coming in contact with the root prevents the diffusion of CO₂ outside the root zone. This prevents the respiratory activities of roots leading to accumulation of harmful substances.

(iv) Heaving

This is a kind of injury caused by lifting up of the plants along with soil from its normal position. This type of injury is commonly seen in temperate regions. The presence of ice crystals increases the volume of soil. This causes mechanical lifting of the soil.

Role of temperature in crop production:

1. Temperature influences distribution of crop plants and vegetation.
2. The surface air temperature is one of the important variables, which influences all stages of crop during its growth development and reproductive phase.
3. Air temperature affects leaf production, expansion and flowering.
4. The diffusion rates of gases and liquid changes with temperature.
5. Solubility of different substances is dependent on temperature.
6. Biochemical reactions in crops (double or more with each 10°C rise) are influenced by air temperature.
7. Equilibrium of various systems and compounds is a function of temperature.
8. Temperature affects the stability of enzymatic systems in the plants.
10. At high temperature and high humidity, most of the crop plants are affected by pests and diseases.
9. High night temperature increases respiration and metabolism.
10. A short duration crop becomes medium duration or long duration crop depending upon its environmental temperature under which it is grown.

Cardinal temperatures

- Most of the crops have upper and lower limits of temperature below or above which, they may not come up and an optimum temperature when the crop growth is maximum. These are known as cardinal temperatures and different crops have different temperatures.