

LIGHT – EFFECT OF LIGHT INTENSITY, QUALITY, DIRECTION AND DURATION ON CROP PRODUCTION – AIR TEMPERATURE – FACTORS AFFECTING TEMPERATURE

Light:

Light is the visible portion of the solar spectrum with wavelength range is from 0.39 to 0.76 μ .

- Light is one of the important climatic factors for many vital functions of the plant.
- It is essential for the synthesis of the most important pigment ie. Chlorophyll, Chlorophyll absorbs
- The radiant energy and converts it into potential energy of carbohydrate.
- The carbohydrate thus formed is the connecting link between solar energy and living world.
- In addition, it regulates the important physiological functions.
- The characteristics of light viz. intensity, quality, duration and direction are important for crops.

Light intensity

The intensity of light is measured by comparing with a standard candle. The amount of light received at a distance of one metre from a standard candle is known as “Metre candle or Lux”. The light intensity at one foot from a standard candle is called „foot candle“ or 10.764 luxes and the instrument used is called as lux metre.

- About one percent of the light energy is converted into biochemical energy.
 - Very low light intensity reduces the rate of photosynthesis resulting in reduced growth.
 - Similarly, very high intensity is detrimental to plant in many ways as below.
1. It increases the rate of respiration.
 2. It also causes rapid loss of water (ie) increases the transpiration rate of water from the plants.

3. The most harmful effect of high intensity light is that it oxidises the cell contents which is termed as „Solarisation“. This oxidation is different from respiration and is called as photooxidation.

- Under field conditions the light is not spread evenly over the crop canopy but commonly passed by reflection and transmission through several layers of leaves.
- The intensity of light falls at exponential rate with path length through absorbing layers according to Beer's law. ie the relative radiation intensity decreases exponentially with increasing leaf area.
- At ground level the light intensity is below the light compensation point (The light intensity at which the gas exchange resulting from photosynthesis is equal to that resulting from respiration)

Based on the response to light intensities the plants are classified as follows.

(i) Sciophytes (shade loving plants): The plants grow better under partially shaded conditions. (eg) Betel vine, buck wheat etc.

(ii) Hetrophytes (Sun loving): Many species of plants produce maximum dry matter under high light intensities when the moisture is available at the optimum level. (eg) Maize, sorghum, rice etc.

Quality of Light

When a beam of white light is passed through a prism, it is dispersed into wavelengths of different colours. This is called the visible part of the solar spectrum. The different colours and their wave length are as follows:

Violet 400 – 435 m μ Blue 435 – 490 m μ

Green 490 – 574 m μ Yellow 574 – 595 m μ

Orange 595 – 626 m μ Red 626 – 750 m μ

- The principal wavelength absorbed and used in photosynthesis are in the violet – blue and the orange - red regions.
- Among this, short rays beyond violet such as X rays, gamma rays and larger rays beyond red such as infrared, are detrimental to plant growth.
- Red light is the most favorable light for growth followed by violet – blue.
- Ultra – violet and shorter wave lengths kill bacteria and many fungi.

Duration of light:

- The duration of light has greater influence than the intensity for canopy development and final yield.
- It has a considerable importance in the selection of crop varieties.
- The response of plants to the relative length of the day and night is known as photoperiodism. The plants are classified based on the extent of response to day length which is as follows.

(i) Long day plants: The plants which develop and produce normally when the photoperiod is greater than the critical minimum (greater than 12 hours). e.g. Potato, Sugar beet, Wheat, Barley etc.

(ii) Short day plants: The plants which develop normally when the photoperiod is less than the critical maximum (less than 12 hours). Rice, Sorghum, cotton, Sunflower

(iii) Day neutral plants / Indeterminate: Those plants which are not affected by photoperiod. (eg) Tomato, Maize

The photoperiodism influences the plant character such as floral initiation or development, bulb and rhizome production etc. In long day plant, during periods of short days, the growth of internodes are shortened and flowering is delayed till the long days come in the season. Similarly when short day plants are subjected to long day periods, there will be abnormal vegetative growth and there may not be any floral initiation.

Direction of light

- The direction of sunlight has a greater effect on the orientation of roots and leaves.
- In temperate regions, the southern slopes plants produce better growth than the northern slopes due to higher contribution of sunlight in the southern side.
- The change of position or orientation of organs of plants caused by light is usually called as phototropism the leaves are oriented at right angles to incidence of light to receive maximum light radiation.

Photo morphogenesis: Change in the morphology of plants due to light. This is mainly due to U.V and violet ray of the sun.

Air Temperature

Temperature is defined as, “The measure of speed per molecule of all the molecules of a body”. Whereas 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

- i. Latitude
- ii. Altitude
- iii. Distribution of land and water
- iv. Ocean currents
- v. Prevailing winds
- vi. Cloudiness
- vii. Mountain barriers