

# SOLAR RADIATION

## **Solar radiation**

- The flux of radiant energy from the sun is solar radiation.
- Heavenly bodies emit – short wave radiation
- Near surfaces including earth emit - long wave radiation

## **Radiation flux**

- The amount of radiant energy emitted, received, transmitted across a particular area is known as radiant flux.

## **Radiant flux density**

- The radiant flux divided by the area across which the radiation is transmitted is called radiant flux density.

## **Emissive power**

- The radiant flux density emitted by a source is called its emissive power.

# Spectrum of Radiation

Band	Spectrum	Wavelength ( $\mu$ )	Importance
Ultra	Cosmic rays	$< 0.005$	Shorter wave lengths of spectrum & Chemically active, unless filtered there is danger of life on earth
	Gamma rays and X-rays	$0.005 - 0.20$	
	Ultraviolet rays	$0.20 - 0.39$	
Visible	Violet	$0.39 - 0.42$	Visible spectrum known as Light essential for all plant processes
	Blue	$0.42 - 0.49$	
	Green	$0.49 - 0.54$	
	Yellow	$0.54 - 0.59$	
	Orange	$0.59 - 0.65$	
	Red	$0.65 - 0.76$	
Infra red	Infrared rays	$> 0.76$	Essential for thermal energy of the plant (Source of heat)

## **The functions of light are:**

1. All the plant parts are directly or indirectly influenced by light
2. Light of correct intensity, quality and duration is essential to normal plant development
3. Poor light availability causes abnormalities and disorders in plants
4. Light is indispensable to photosynthesis
5. Light governs the distribution of photosynthates among different organs of plants
6. Affects tiller production
7. Affects stability, strength and length of culms
8. Affects dry matter production
9. Affects the size of the leaves
10. Affects the root development
11. Affects the flowering and fruiting
12. Affects the dormancy of the seed

**Solar constant:** It is the energy falling in one minute on a surface of  $1 \text{ cm}^2$  at the outer boundary layer of the atmosphere, held normal to the sunlight at the mean distance of the earth from the sun. The units are  $\text{cal/cm}^2/\text{min}$ . " $\text{cal/cm}^2$ " is also known as "Langley". The estimated value of this constant is from 1.94 to 2.0 langely/min. The average value is 2 LY/mn.

## **Net radiation**

- The difference between the incoming radiation from the sun and the out going radiation from the earth is known as net radiation. The net radiation values become –ve after late evening hours to early morning hours. It is a conservative term and plays an importance role in the energy processes of the crops.

- **Albedo**
- It is the percentage of reflected radiation to the incident radiation. (Varies with colour and composition of the earth's surface, season, angle of the sun rays). Value is Highest in winter and at sunrise and sunset. Pure water – 5-20%, Vegetation 10-40%, Soils 15-50%, Earth 34-43% and clouds 55%. High albedo indicates that much of the incident solar radiation is reflected rather than absorbed.
- **Depends up on**
  1. Angle of incidence of radiation. Albedo increase with decreasing elevation of sun with minimum during noon.
  2. Physical characteristics of surface
  3. Season
  4. Time of the day

For plant community albedo depends upon

  1. Age of the crop
  2. Percentage of ground cover
  3. Colour and reflectivity of the foliage

# Radiation balance

As the insolation enters the atmosphere, a part of about 31% is reflected by clouds or scattered back to space. About 4% of insolation are lost by reflection from the earth. The ratio of the amount of radiation reflected to the amount received on a surface is termed as albedo. The earth's mean albedo is about 35%.

The ozone present in the upper layer of the atmosphere absorbs the harmful ultraviolet radiation. The gases in the atmosphere and dust particles absorb only 14% of the insolation. The remaining 51% [ $100 - (35 + 14)$ ] of the insolation reaches the earth's surface and heats it. The surface of the earth, in turn radiates heat in the form of relatively long waves. This is called as terrestrial radiation. Water vapour, CO<sub>2</sub> and other gases present in the atmosphere absorb 34 units of radiation. Remaining 17 units are radiated back to space without heating the atmosphere. Thus the earth's surface absorbs 51 units of insolation and radiates back the same amount. Hence, there is no net gain or loss between the earth and the atmosphere. The state of a balance or equilibrium between insolation reaching the earth surface and terrestrial radiation from the earth is known radiation balance.

# Energy balance or heat balance

The net radiation is the difference between total incoming and outgoing radiations and is a measure of the energy available at the ground surface. It is the energy available at the earth's surface to drive the processes of evaporation, air and soil heat fluxes as well as other smaller energy consuming processes such as photosynthesis and respiration. The net radiation over crop is as follows.

$$R_n = G + H + LE + PS + M$$

$R_n$  is net radiation,  $G$  is surface soil heat flux,  $H$  is sensible heat flux,  $LE$  is latent heat flux,  $PS$  and  $M$  are energy fixed in plants by photosynthesis and energy involved in respiration, respectively. The  $PS$  and  $M$  are assumed negligible due to their minor contribution (about 1-2% of  $R_n$ ). The net radiation is the basic source of energy for evapotranspiration ( $LE$ ), heating the air ( $H$ ) and soil ( $S$ ) and other miscellaneous  $M$  including photosynthesis.