

AGRICULTURAL METEOROLOGY

1) What do you mean by Agricultural Meteorology? Explain its scope and importance in Agriculture?

2) Agricultural Meteorology :- It is the science related to the atmosphere and its phenomena, especially to weather and its effects on the Agriculture.

Scope and Importance of Agricultural Meteorology

- * All the living organisms totally depend on the plants to fulfill their needs of food.
- * As, the growth, development, yield of the crop are decided by the weather and climate the knowledge of Meteorology are of great importance.

Scope of Agricultural Meteorology

1) Characterisation of Agricultural climate :-

Solar Radiation, air, Temperature, Rainfall, wind, Humidity etc are climatic parameters which determine the growth, yield, and development of crop. Knowledge of Meteorology helps in Maximisation of crop yield.

2) Climatic Crop planning for stability in production :-

Meteorological information regarding the Effective rainfall, Soil moisture pattern, Soil type, Soil depth, Rooting characteristics helps us in the selection of the type of crop for a Particular type of climate.

3) Crop management :- It involves all the farm operations like Harvesting, Fertilizer applications, Tillage practices etc. by the information provided through Meteorological analysis.

4) Crop monitoring :- It includes understanding climatic conditions, use of forecasts, Monitoring Systems to monitor the growth and development of crop.

5) Crop modeling and yield forecasting :- It is a simplified representation of more complex reality in crop productive system.

6) Crop-climatic Relationship :- It is used to solve the complexities of plant activities concern to its microclimate.

7) Climatic extremities :- Adverse effect of climatic extremities can be avoided if we mitigate their intensity.

8) For Biodiversity Conservation.

9) For efficient use of plant and animal genetic material.

10) For promoting geographical information.

2) Define Weather and Climate? Differentiate between weather and climate.

A) Weather :- The condition of atmosphere in a particular place at a particular time.

Climate :- The average weather conditions of a region

(or)

The generalised weather conditions of a region.

<u>WEATHER</u>	<u>CLIMATE</u>
<p>1) It changes from place to place.</p> <p>2) It is typical physical conditions of atmosphere.</p> <p>3) Regions with same numerical values have same weather.</p> <p>4) It provides Meteorological information.</p> <p>5) crop growth, development and yield are decided by weather in a given region.</p> <p>6) weather can be categorised as fair, unfair, excellent etc.</p> <p>7) weather is measured in observatory.</p> <p>8) Adverse weather conditions results in the crop failures, losses and thereby yield.</p>	<p>1) It varies from Region to Region.</p> <p>2) Generalised weather conditions.</p> <p>3) Regions with same numerical values may have different climates.</p> <p>4) It constitutes geographical information in respect to weather.</p> <p>5) crop selection for suitable places is decided by the climatic conditions of the region.</p> <p>6) climate can be classified as Arid, Tropical, Temperate etc.</p> <p>7) This is derived information on Regional basis.</p> <p>8) climate is considered in long term agricultural planning.</p>

3) Define Atmosphere? Describe the Physical structure of atmosphere with a neat diagram.

a) Atmosphere :- It is the gaseous envelope surrounding the earth.

Structure of Atmosphere :- a) Lower atmosphere.

1) Troposphere :-

- a) Lower layer of atmosphere extending to a height of 8-18 km above earth's surface.
- b) All the weather changes takes place in this zone. So called as "seat of weather phenomena".
- c) Temperature decreases with the increasing of height called lapse rate = $6.5^{\circ}\text{C per km}$.
- d) Tropopause is a layer lying between the Troposphere and stratosphere acts as boundary.
- e) Temperature is -60°C .

2) Stratosphere :-

- a) Altitude of 50-55 km above Tropopause. Earth's surface.
- b) Stratosphere is called as "seat of photochemical Reaction".
- c) Ozone layer is present in this phase.
- d) Temperature decreases with decreasing height and vice-versa.
- e) Outer layer surrounding stratosphere is called as "stratopause".
- f) Temperature at stratopause is 90°C .

b) Upper Atmosphere

3) Mesosphere

a) Altitude 80km above Earth's surface.

b) Also called as "Chemosphere"

c) Temperature decreases as height increases.

d) Outer layer called as Mesopause.

e) Temperature at mesopause is -90°C to -90°C .

4) Ionosphere (Thermosphere)

a) Altitude 500km above Earth's surface.

b) Temperature decreases with height.

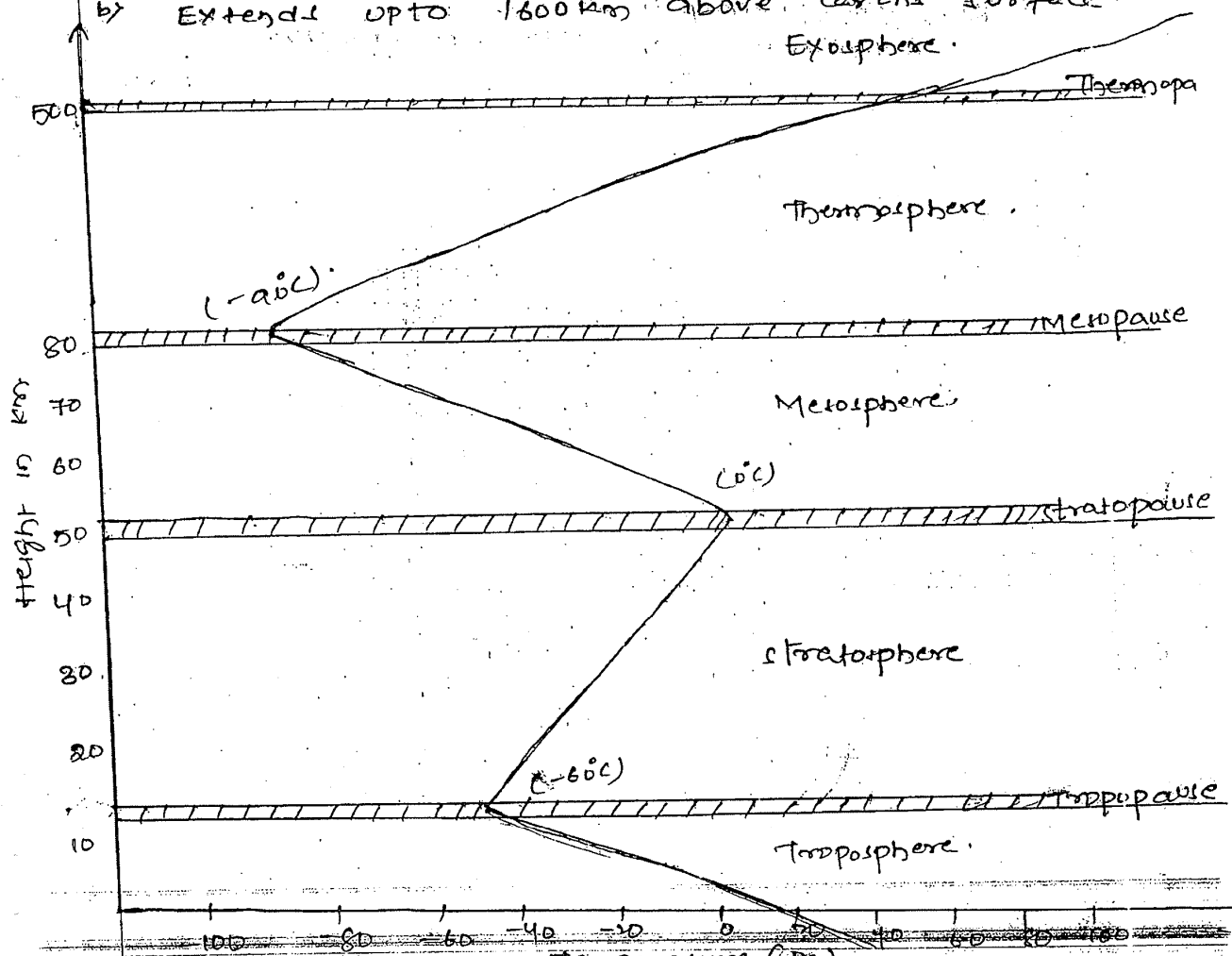
c) Outer layer is called as 'Thermopause'.

d) Temperature at Thermopause is 1000°C .

5) Exosphere

a) Outermost layer of Atmosphere.

b) Extends upto 1600km above Earth's surface.



4.3)

Define Solar Radiation? Explain the Radiation balance Sheet and Effect of solar radiation on agriculture?

a)

Solar Radiation :- The incoming of solar insolation is called as Solar Radiation (or)

Amount of heat energy received from the sun is called as Solar Radiation.

Energy balance / Heat balance / Radiation balance sheet

* The net radiation is the difference between the total downward and upward radiation fluxes and is a measure of energy available at the ground surface.

* It is used for various kinds of activities such as photosynthesis, Respiration etc. and is fundamental quantity of energy.

* If we consider (338 Wm^{-2}) 100% radiation reaching annually. Then out of this

1) Reflected by -
a) clouds - 19%
b) Atmosphere - 06%
c) Earth's surface - 03%

28%

2) Radiation absorbed by -
a) clouds - 05%
b) Atmosphere - 20%

25%

$\therefore \text{Net radiation} = 100 - (28 + 25) = 47\%$

Total net radiation = 47%

Role of Radiation in Agriculture.

pg no:- 4.

- a) It is the main source of energy for plant and animal life.
- b) plays important role in photosynthesis
- c) Governs the distribution of temperature and crops.
- d) It influences the growth stages of plant.
- e) Influences the nutrient assimilation etc.
- f) Growth, development, and yield of the crop are influenced.
- g) Accelerates flowering in short duration plants.
- h) Light intensity mostly affects the amount of nutrient synthesis and type of nutrients.

5) Define temperature? what are the factors affecting air temperature?

A) Temperature:- The degree of hotness (or) coldness is called as Temperature.

Factors affecting temperature

- 1) Latitude :- \rightarrow Temperature decreases as we move from equator to poles.
- 2) Altitude :- \rightarrow Temperature decreases with increase altitude from mean sea level.
- 3) Distribution of land and water :- \rightarrow water bodies generally cool the temperature.
- 4) Ocean currents :- \rightarrow Hot and cold ocean currents affect temperature.
- 5) Prevailing winds :- \rightarrow winds moderate the surface temperature.

6) Cloudiness :- \rightarrow clouds act as barriers to the incoming radiation.

7) Mountain barriers :- They obstruct the hot and cold winds.

8) Nature of surface :- Perpendicular Rays impart more heat.

9) Relief :- Direction and degree of slope may affect the temperature.

10) Convection and turbulence :- This process also takes place in heating of atmosphere.

6) Explain the vertical distribution of temperatures

1) Troposphere :- Temperature decreases from 15°C to -60°C .

2) Stratosphere :- Temperature increases from -60°C to 9°C .

3) Mesosphere :- Temperature decreases from 9°C to -90°C .

4) Thermosphere :- Temperature increases from

7) write the importance of soil temperature and factors influencing the soil temperature?

a) Importance :-

* It affects the seed germination, growth, development and upto harvesting of crop.

* It regulates the water uptake by plant.

* It affects the rate of transpiration by crops.

* Increases the microbial activity in soil and the optimum soil temperature for better plant growth is $18-30^{\circ}\text{C}$.

* Soil temperature affects the Physical and Chemical Properties of soil.

* Increases the nutrient uptake by crops.

Factors affecting temperature

A. External factors :-

1) Solar Radiation :- It is directly proportional to Soil temperature.

2) Wind :- Wind heats up the soil by conduction.

3) Evaporation and Condensation :- Greater rate of Evaporation more the soil is cooled.

4) Rainfall :- cools the soil temperature.

5) Mulching :- Influences soil temperature due to surface changes.

6) Humidity :- Decreases temperature.

7) Tillage :- Reduces heat flow.

B. Internal factors

1) Aspect and slope :- Southern slopes receive more insolation.

2) Soil Texture :- Fine texture soil absorbs more heat.

3) Soil moisture :- Soil moisture decreases soil temperature.

4) Soil Colour :- Black soils warm up faster than any other soils.

5) Organic matter :- Addition of organic matter to soil reduces soil temperature.

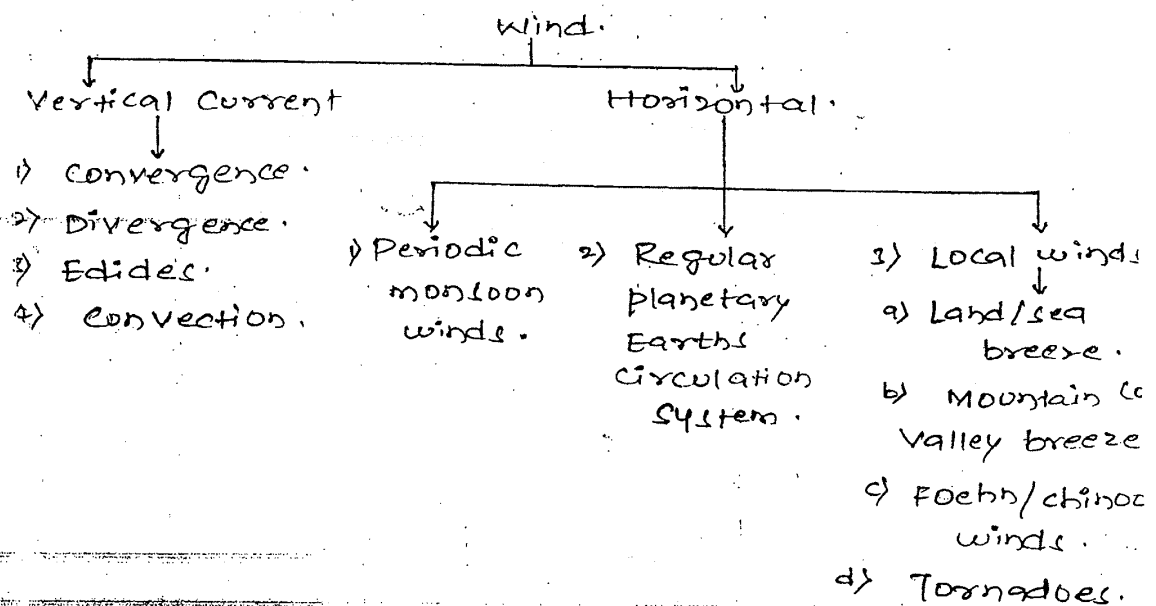
8) Define wind? Explain the importance of wind in Agriculture? classify the types of winds?

9) wind :- Horizontal flow of air over the earth's surface is called as wind.

Importance of wind in Agriculture

- a) wind velocity and direction are important weather elements influences the configuration and distribution of plants.
- b) Affects both mechanically and physically, the rate of transpiration increases with increasing winds, at high winds it becomes zero.
- c) Transports heat in either sensible / latent form.
- d) Increases turbulence in atmosphere.
- e) Helps in pollination and seed dispersal.
- f) Alters the balance of hormones.
- g) strong winds causes lodging effects, branches breakage, flower falling etc.
- h) winds cause soil erosion.
- i) winds prevent frost by disturbing atmospheric inversion.

classification of winds:-



Q) Define Condensation? Explain the forms of Condensation?

1) Condensation :- The process in which water vapour is converted into liquid.

Forms of Condensation:-

1) Dew :- Dew forms when a surface cools to the temperature which is colder than the air next dewpoint of air next to the surface.

2) Frost :- It is formed by freezing dew and by the process of sublimation of water vapour moving directly to a solid form.

3) Fog :- It is made up of a large amount of tiny suspended water droplets near the ground.

4) Mist :- Mist is a less dense fog.

5) Rime :- These are the supercooled drops in fog / cloud that freeze on the objects on the ground.

6) Smog :- It is the combined effect of smoke and fog.

7) Haze :- The large faint particles in air released by smoke, dust etc.

It is of two types.

a) Dry Haze. b) wet haze.

10) Define Precipitation and Explain Forms of Precipitation.

Q) Precipitation :- The Earthward falling of tiny water droplets (or) Ice crystals due to Condensation is termed as Precipitation.

Forms of Precipitation

1) In liquid form

a) Rain :- An earthward falling drops of water having diameter greater than 0.5mm is called as Rain.

b) Drizzle :- Drizzles are falling droplets less than 0.5mm diameter.

c) Shower :- Rain for a short time with intermittent time is called shower.

2) In solid form

a) Snow :- Precipitation of water in solid form of small or large sized crystals.

b) Hail :- Hail is precipitation of solid ice. Hails may achieve even the size of a cricket ball.

3) Mixed form

a) Sleet :- Simultaneous mixture of rain and snow is called sleet.

b) Hailstorm :- Rainfall associated with hail stone is called hailstorm.

11) Define cloud? classify clouds in detail?

A) Cloud :- "An aggregation of minute drops of water suspended in the air at higher altitudes."

Basic types of clouds :-

- 1) Cirrus (ci) :- Meaning 'curl' as fibrous (or) feathery form. Highest cloud type. 7-12 km in altitude.
- 2) Cumulus (cu) :- Meaning 'heap' is woolly, bumpy cloud with rounded top and flat base.
- 3) Stratus (st) :- Sheet type of cloud without any form to distinguish it. Lower than Cumulus.
- 4) Nimbus (nb) :- Dark and ragged cloud and form which precipitation occurs.

WMO classified clouds into 10 categories with four basic groups:-

- 1) Above 6km height :-
 - a) cirrus (ci)
 - b) cirrocumulus (cci)
 - c) cirrostratus (cs)
- 2) Between 2-6 km height :-
 - a) Alto cumulus (Ac)
 - b) Altostratus (As)
- 3) From ground to 2km :-
 - a) stratocumulus (sc)
 - b) stratus (st)
 - c) Nimbostratus (N)
- 4) Vertical development :-
from 0.5 to 16km
 - a) cumulus (cu)
 - b) cumulonimbus (cb)

12) Define Drought? classify Drought in detail?

A) Drought :- It is defined as the condition when the soil moisture deficits, which results when the amount of water available in soil is not sufficient to meet the potential evapotranspiration.
(or)

Drought is a period of inadequate (or) no rainfall over extended time creating soil moisture deficit and hydrological imbalances.

Classification of Drought

A. Based on medium:-

- 1) Soil drought :- A condition where soil moisture depletes.
- 2) Atmosphere drought :- It occurs due to low humidity, dry hot winds.

B. Based on water source :-

- 1) Meteorological drought :- occurs when actual rainfall falls below 75% of normal rainfall.
- 2) Hydrological drought :- occurs when all water sources like wells, lakes, rivers etc dry up.
- 3) Agricultural drought :- Due to inadequate rainfall during peak water requirement by the crop.

C. Based on time of occurrence :-

- 1) permanent drought :- occurs in deserts, arid region
- 2) Seasonal drought :- Due to large scale seasonal variations.
- 3) Contingent drought :- Due to irregular and variability in rainfall.

13) write in brief about the strategies to mitigate drought?

- A)
 - a) To retain maximum moisture in soil by many practices.
 - b) Need to increase the proportion of total dry matter going to grain.
 - c) use of drought escaping, resisting and avoiding plants.
 - d) Suitable Cropping Patterns.
 - e) Proper fertilizer management.
 - f) selection of short duration crops.
 - g) In situ conservation technologies.
 - h) Thinning of foliage to reduce evapotranspiration.
 - i) Agronomic practices such as mulching, weeding, antitranspirants usage to reduce

~~Evapotranspiration~~

3) Multidisciplinary approaches to reduce transpiration.

14) Define weather forecasting? Explain the types of weather forecasting.

a) Weather forecasting:- Any advance information about the probable weather in future, which is obtained by evaluating present and past meteorological conditions is called weather forecasting.

Types of weather forecasting

- 1) Now casting:- For few hours 6 to 24 hrs.
- 2) Short Range:- valid for 3 days, twice a day.
- 3) Medium Ranges:- valid for 3-10 days.
- 4) Long Range:- valid for more than 10 days.

15) write short notes on the following

- a) Green house effect b) Remote sensing.
- c) Crop modeling d) Types of Rains.

a) Green house effect:- The progressive warming up of earth's surface due to blanketing effect of atmospheric gases like CO_2 , CH_4 , CFCs , N_2O etc for the reflected rays is termed as Green house effect (a) Global warming.

Effects:- 1) Melting of ice at Glaciers.

2) Raising the Earth's temperature.

3) Effects Agriculture and other flora and fauna.

b) Remote sensing :- Acquisition of physical data of an object without touch or contact is defined as Remote sensing.

- * This acquisition is done through computers and sensor systems.
- * Sensors include Electromagnetic Radiations, (EMR) Audio range, etc.
- * Remote sensing is of two types a) Active type.
b) Passive type.

c) Crop modeling :- It can be defined as simplified representation of the physical, chemical and physiological mechanisms underlying plant growth process.

• Crop model :- It is representation of a crop through mathematical equations explaining the crop interaction with both above ground and below ground environment.

Types of Models :-

- A. Empirical or Descriptive models.
- B. Mechanistic or Explanatory models.

d) Types of Rains :-

1) Convictional Rains :- Mostly occur in summer season due to the convection currents in air caused by solar radiation.

2) Orographic Rains :- Mountain ranges acts as barrier to the flow of air which raises the air to move up, cool the clouds and responsible for Orographic rains. They occur during monsoon season.

3) Cyclonic Rains :- Rains as a result from a cyclone formation termed as cyclonic Rains. They occur from April - May and Oct - Nov.

Definitions:

1) Microclimate :- Microclimate is the climate in which plants and animals live upto 2m height.

2) write a note on Cyclone and Anticyclone?

A system of close isobars with low pressure at center.

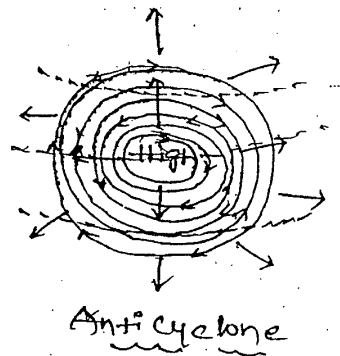
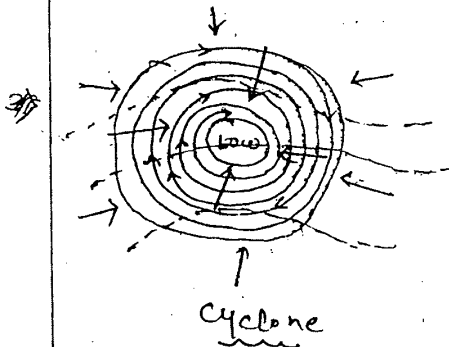
Cyclone :- (i) It is a system of wind blowing around the center of low pressure area and the movement of wind directed towards Centre is termed as cyclone and also called as lows or depressions.

* The wind flow is anticlockwise in the Northern hemisphere.

* wind speed is above 34 knots.

Anticyclone :- A system of close isobars with high pressure at the centre is known as Anticyclone and also called as "high".

* The wind flow is clockwise in northern hemisphere.



3) Relative humidity :- It is the ratio of actual quantity of water vapour present in given air volume to the maximum amount of water vapour that it can hold at same volume of air.

$$RH = \frac{\text{Actual quantity of w.v in given Vol. of air}}{\text{Maximum amount of water vapour it can hold at same volume of air}} \times 100$$

- 4) Specific humidity :- weight of water vapour per unit weight of moist air. units :- g/kg .
- 5) Pressure Gradient :- The rate of decrease of pressure in space at a given time.
- 6) Isobars :- Imaginary lines drawn on the map to join places of equal atmospheric pressure.
- 7) Specific heat :- Amount of heat required to raise the temperature of $1kg$ of soil through $1^{\circ}C$ (or) $1K$. It is called specific heat / Mass specific heat.
units = J/kgK .
- Volume specific heat :- Amount of heat required to raise the temp. of unit volume of soil through $1^{\circ}C$ (or) $1K$.
units = J/LK .
- 8) DALR :- Dry adiabatic lapse rate -
when a parcel of unsaturated air is displaced it becomes diminished equal to that of new environment and its volume increases.
- 9) SALR :- Saturated adiabatic lapse rate :-
when a parcel of saturated air is displaced upward its temperature decreases by adiabatic process.
- 10) Lapse Rate :- It is the rate at which the temperature decreases with increasing height.
units :- $^{\circ}C/km$.
- 11) Albedo :- Solar radiation reflected back to atmosphere without any change in its quantity called as Albedo.