



Do you know ?

- Which are the different cropping seasons in Maharashtra? How they are identified ?
- What is the difference between weather and climate?
- What is the role of meteorological department in farming?
- What do you mean by meteorology, agrometrology and atmosphere ?



Remember this

The success or failure of crops is intimately related to weather condition during the crop growth period. People often confuse weather with climate, but both are not the same. Between these two, climate is of prime importance. It is often rightly said that 50% of the variation in crop yields are due to climatic condition alone. Weather has significant influence on every phase of agricultural activity from preparatory tillage to harvesting. Climate is a factor which is beyond the control of farmer. Therefore, a sound knowledge of weather and climate with their elements is essential for successful agriculture.

2.1 Definition : Weather and climate

2.1.1 Weather :

Weather may be defined as follows.

- Weather is the condition of the atmosphere at a particular place over a short period of time.
- Weather refers to every day changes in the behaviour of atmosphere at the given place and a given time.

- Weather pertains to smaller area like village, city or even district and smaller duration of time i.e part of a day e.g. rainy day, hot day or cloudy weather, etc. It always differs from time to time.

2.1.2 Climate : Climate may be defined as follows.

- Climate pertains to average weather condition over a period of time or season.
- Climate is the weather conditions related to longer periods like month, season or year and is described by normal and average e.g. cold season, tropical, subtropical climate. It is more or less stable and differs from 'region to region'.

Atmosphere : The earth has a thick layer of air called as the atmosphere.

It is colourless, tasteless and odourless mixture of gases that surrounds the earth. The atmosphere is present within a height of 32km from the earth surface.

Composition of Air

According to NASA the gases in earth's atmosphere include.

Composition :

1. 78% Nitrogen
2. 21% Oxygen
3. 0.03% Carbon di-oxide
4. 0.93% Argon



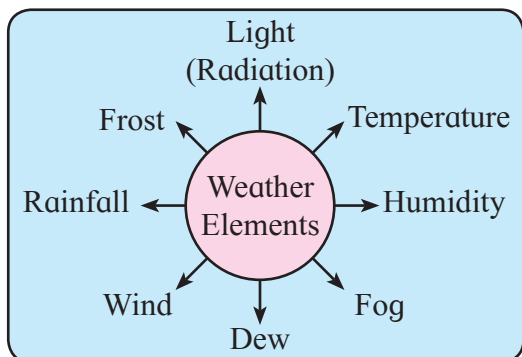
Can you imagine?

Why particular crop is grown in specific region and season ?

2.2 Weather elements and their effect on crop growth.

2.2.1 Temperature: Temperature is the degree of hotness or coldness of a substance. Solar radiation is the main source of heat energy through which the atmosphere is indirectly heated up.

The rotation of earth cause the change in temprature during day and night. Temprature is measured by thermometer calibrated in the scale of celsius (°C), fahrenheit (°F) andkelvin (°K).



Try this

Observe the thermometer and convert the reading from

Celsius into Fahrenheit $^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$

Fahrenheit into Celsius $^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$

Celsius into Kelvin $^{\circ}\text{K} = ^{\circ}\text{C} + 273$

Effect of temperature: Temperature has great influence on the existence of plants. Each plant species has maximum and minimum limits of temperature for growth. Optimum temperature is essential for better growth and development of plants. Most of the crop plants make their best growth and development between 7°C to 32°C. Optimum temperature is necessary for seed germination, vegetative growth, flowering, fruiting, maturity and higher yields. Photosynthesis and respiration rate increases in high temperature. It also reduce sugar content, increase water requirements. Low temperature causes chilling/ freezing injuries.

2.2.2 Rainfall : Rainfall is precipitation in the form of liquid drops larger than 0.5 mm in diameter falling on earth. Ordinary rain drop varies from 0.5 to 4 mm in diameter.

Effect of rainfall : Rainfall has beneficial as well as harmful effects on crop growth.

It is the main sources of water for plant growth. Water performs number of vital functions in crop growth. Quantity of rainfall is not only important but its even distribution increases crop yield. Rainfall pattern determines cropping system. It reduces salt, maintains pH and nutrient availability.

Heavy and excess rain results in flood and waterlogged condition in the field. Flood causes soil erosion and damage to the crops on river banks. Water logging affects soil aeration and root function. Heavy rain affect pollination and fertilization. Long dry spell affect growth and yield of the crop. Heavy and continuous rains during harvesting period result in prolonged harvesting time. There may be mouldy grain formation on earhead, which reduce quality of entire produce.

2.2.3 Sunlight (Solar radiation) : Sun is the prime source of energy injected into the atmosphere. Solar radiation is received in the form of electromagnetic waves. It consist of stream or flow of particles. These particles are called quanta or photon.

Effect of sunlight : Growth of crop is favoured by sufficient sunlight and retarded by lack of sunlight. Quantity, duration and intensity of solar radiation influences plant development and plant processes. It is necessary for photosynthesis, the process in which green plant prepare their own food material. The life process of many plants is influenced by the length of day which is called photoperiodism. On the basis of photoperiod required for flowering plants are classified as short day and long day plants. Red and blue colour light stimulate plant growth, flowering, while green light has minimum effect. Insufficient light produces weak plants which are susceptible to diseases.



Practice this

Conversion of figures from

- mm into cm.
- cm into inch.
- inch into mm.

2.2.4 Humidity: Humidity refers to the water vapour content of the atmosphere. Liquid water is converted into water vapour by evaporation. The amount of water vapour in the atmosphere depends upon wind and temperature.

Humidity are of two types (a) **Specific humidity (relative)**. It means weight of water vapour per unit weight of air (including water vapour). (b) **Absolute humidity** - It is actual quantity of water vapour by weight present in a given volume of air.



Do this

Distribute different agronomic crops as short day and long day crop on the basis of photoperiod. Also distribute crops which are grown as irrigated and rainfed.



Try this

Calculate absolute humidity (g/m^3) when 2 cubic metres of air contains 10 g of water vapour.

Use formula - Absolute humidity (g/m^3)

$$= \frac{\text{Weight of water vapour}}{\text{Volume of air}}$$

Effect of humidity : Relative humidity directly influences water relations of plants and affects crop growth. High humidity reduce transpiration and evaporation losses of soil water. Low humidity increases the water requirements of the crop and affect the growth and yield of crop. Atmospheric humidity affects pollination, photosynthesis, flowering, fruiting, etc.

Leaf enlargement is more in humid condition. High humidity increases the attack of pest and diseases.

2.2.5 Wind : Wind is the horizontal flow of gases from high pressure area to a low pressure area. The natural movement of air, especially in the form of current air blowing from particular direction. Lee ward - from which it blows and wind ward - where it blows.

Effect of wind : Wind increases crop water requirements by increasing evaporation. It is useful for pollination in cross pollinated crops. It helps to increase supply of carbon dioxide for photosynthesis. Wind alters balance of hormones. Wind helps in winnowing operation. Tall crops during high wind velocity lodge which adversely affect quality as well as quantity of yield. It also causes shedding of flowers and fruits, damages shoot, increases rate of evaporation and transpiration, reduces soil moisture, causes soil erosion.

2.2.6 Dew : Dew is water in the form of droplets that appears on thin object in the morning or evening due to condensation. The temperature at which condensation occurs is called the dew point. It is the form of direct condensation of water vapour to liquid drops. It occurs on grass cover, leaves, metallic surface, paper, window glasses, etc.

Effect of dew : It occurs in winter season during morning hours and useful for dry rabi crops like wheat, gram, etc. Foliar absorption of dew is an important factor in survival of natural vegetation in arid region. Dew reduces transpiration losses of water and minimizes crop water requirements. Dew formation increases humidity which increase incidence of pest and diseases.

2.2.7 Fog : Fog is a visible aerosol consisting tiny water droplets or ice crystals suspended in the air at or near the earth surface.

It can be considered as a type of low-laying cloud. Fog commonly occurs in the early morning hours during winter season. It is formed when air temperature near ground falls below dew point temperature, wind is calm and relative humidity is more than 75%.

Effect of fog : Prolonged foggy weather has adverse effect on vegetables and cause discolouration of leaves. It increases soil water availability and reduces physiological activities.

2.2.8 Frost : When the dew point is below 0°C , moisture passes directly from gaseous to solid state resulting in the formation of ice crystals called as 'Frost'. It mostly occur in the valleys of the mountains.

Effect of frost : It affects the pollination and seed setting in most crops. It may cause cracking of fruits and bad effect on quality of fruits. It causes freezing injury to plants by extra cellular ice formation and cellular dehydration.



Try this

Visit to a meteorological observatory and observe how different weather parameters are measured.

2.3 Instruments of measuring weather elements :

The different instruments and the units used for measuring of weather parameters are as follows

2.3.1 Stevenson Screen : It is a wooden box, that made up of a double layer screens and is used to shield meteorological instruments. It shelters meteorological instrument against rainfall and direct heat radiation. However, it allows air to circulate free around them. It is painted with white colour to reflect sun radiations.



Fig. 2.1 : Stevenson screen

2.3.2 Thermometer : The thermometer is a device used for measuring atmospheric temperature.

The thermometer have two important parts i.e. sensor or bulb and a tube having visible scale. The unit used to record the readings are degree Celsius, degree Fahrenheit and degree Kelvin.

The thermometers are widely used in industry, meteorology, medicine and in scientific research. In meteorology it is used to record minimum - maximum, atmospheric i.e. air and soil temperature. Thermograph is a mechanical device which records air temperature and graphs continuously.



Fig 2.2 : Minimum and maximum thermometer

2.3.3 Rain guage : The instrument used for measuring the amount of rainfall is called as rain gauge. The rainfall is measured in terms of depths of rain water in millimetre, centimetre and inch.



(i) Non recording rain gauge

(ii) Self recording rain gauge

Fig. 2.3 : Rain gauge

There are two types of rain gauge.

- (i) Non-recording or ordinary rain gauge.
- (ii) Self recording or automatic siphon rain gauge.

2.3.4 Pyranometer : The instrument used to record total incoming radiation is called as 'Pyranometer'.

Solar radiations are expressed in terms of watts per square meter.

2.3.5 Sunshine recorder (Heliograph) : It is the instrument used to record the duration of bright sunshine during the day time.



Fig 2.4 : Sunshine recorder

2.3.6 Anemometer and wind vane : The speed at which wind is flowing is called as wind velocity. The wind velocity i.e. wind speed is recorded in knots (nautical miles per hour), meter per second (mps), kilometre per hour (kmph) and miles per hour (mph).

The 'anemometer' is a device that is used to measure wind speed or wind velocity. Where as 'wind vane' is used to detect the direction of wind. The wind vane points the direction of wind.

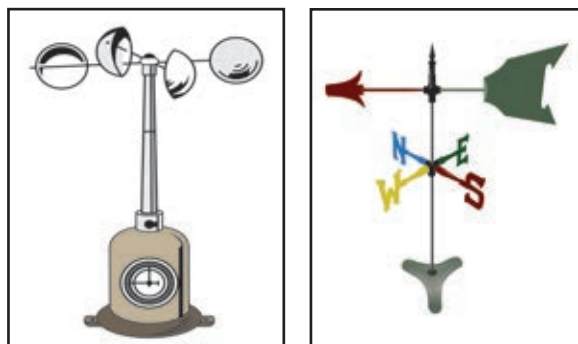


Fig 2.5 : Anemometer Fig 2.6 : Wind vane

2.3.7 Psychrometer / Hygrometer : Relative humidity is the amount of water vapours present in the air. It is expressed in percentage of the amount needed for saturation at the same temperature.

The instrument used for measuring relative humidity is called as 'hygrometer' or psychrometer. Psychrometer consist of two bulbs with thermometer i.e. wet bulb and dry bulb and reads humidity based on the differences between two.

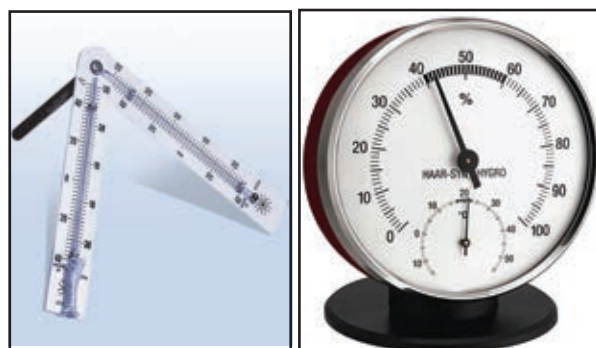


Fig 2.7 : Psychrometer Fig 2.8 : Hygrometer

2.3.8 Dew gauge : The droplets of water that forms on the ground and other surfaces outside during the morning and evening is called as 'dew'. It is recorded by using the instrument called as dew gauge. The unit of measurement is mm.

Table 2.1 : Weather elements, instruments and their units.

Sr.No.	Weather element	Instrument for measurement	Unit
1.	Temperature	Thermometer Thermograph	Degree Fahrenheit, Celsius and Kelvin
2.	Rainfall	Ordinary rain gauge Automatic siphon rain gauge	Millimeter, centimeter, inch
3.	(a) Solar radiation (b) Light	Pyranometer Sunshine recorder (Heliograph)	Watts per square meter Duration of bright sunshine
4.	(a) Wind velocity (b) Wind direction	Anemometer Wind vane	Knots, meter/sec, km/hr., miles/hr. East-west, North - south
5.	Relative humidity	Psychrometer or Hygrometer	Per cent (%)
6.	Dew	Dew gauge	mm

2.4 Weather forecasting

2.4.1 Meaning

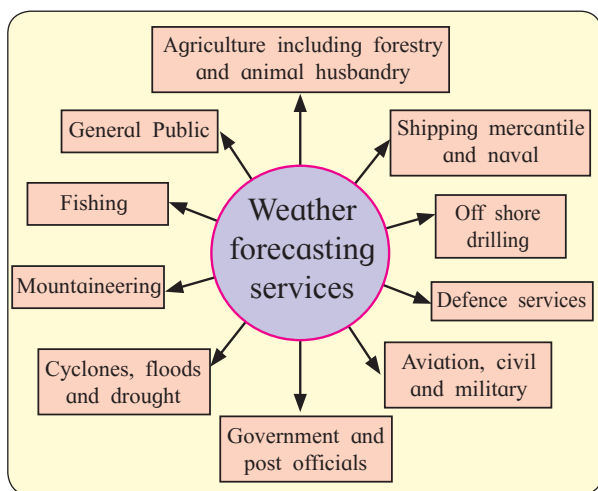
Weather forecasting is defined as prediction of state of the atmosphere for a given location. Weather forecasts are important as they are issued to protect life and property, to save crops and to tell us what to expect in our atmospheric environment.

As crop growth and its yield is highly influenced by weather elements or adverse climatic condition; the producer have to face huge losses of their crop.

Generally people have attempted to predict the weather from thousands of year ago, but scientifically it is done since 19th century. In the agriculture based country like India where, about 70% of farming is depending on rainfall, accurate weather forecast should have to be made available for farmers well in advance to minimize crop losses.

Accurate weather forecasting that is made well in advance can help the farmers in planning of timely land preparation, selection of crop, time of sowing, method and time of fertilizer application, other interculture operations and finally harvesting of his crop. Indian Meteorological Department (IMD) is established in 1875 with headquarter at Pune. Agricultural Meteorological Division is started in 1932 to conduct research on crop and weather relationships.

For this purpose a major step was taken to set up specialized meteorological observatories in a crop environment to inculcate weather consciousness among farmers. This has resulted in steady growth of observatories in all over India, which at present numbers about 125.



Weather forecasting services for different purposes normally practiced in India

However, the weather reports are prepared by five regional forecasting centres which are situated at Chennai, Nagpur, Mumbai, Delhi and Kolkata.

2.4.2 Importance of forecast

Accurate weather forecasting helps the farmers in realising economic yields by minimising the crop losses by -

- (1) Planning for necessary inputs during the season.
- (2) Timely land preparation to take advantage of earliest rain.
- (3) Selection of crops and cultivation.
- (4) Efficient use of fertilizers.
- (5) Predicting pest and disease incidence.
- (6) Timing of weeds, pests and diseases control.
- (7) Reducing adverse effects of weather hazards.
- (8) Timely crop harvesting.

2.4.3 Types of weather forecasting

Based on time or duration of forecasting period, the weather forecasting can be divided into three types : (1) short range forecasting (2) medium range forecasting (3) long range forecasting

- (1) **Short range forecasting** : These forecasts are for a day or two. These daily forecasts are useful to irrigation engineers, mariners, aviation engineers and farmers.
- (2) **Medium range forecasting** : These forecasts are for a period of three to ten days.
- (3) **Long range forecasting** : These forecasts are for periods of more than four weeks. The long range forecasts are useful for choosing cropping pattern. These forecasts are issued thrice in a year.



Internet my friend

1. Collect information about agro climatic zones of Maharashtra.

2.4.4 Methods of forecasting : There are three methods of weather forecasting.

1. Conventional or synoptic method : Synoptic method involves detailed analysis of current weather reports, over a large area. The current patterns are related with the past analogous situations and forecasts are prepared on the assumption that a current situation matching with the past analogous situations and forecasts are prepared on the assumption that a current situation will behave on the lines of the past. This method is useful for short range forecast.

2. Statistical method : Regression and correlation equations or other sophisticated relationships are established between weather elements and resulting climates. Normally selection of predictors or weather parameters is based on a possible relationship with the predictant. These techniques are useful for short as well as long range forecasting.

3. Numerical weather prediction technique : In this technique, the behaviour of atmosphere is represented by a set of equations based on physical laws governing air movement, pressure and other information. This technique is found suitable for medium forecasts.



Fig 2.9 : Meteorological field laboratory

Exercise

Q. 1 A. Fill in the blanks.

1. Wind velocity is measured by using instrument.
2. Weather refers to changes in the atmosphere at given place.
3. Ordinary rain drop varies from mm in diameter.
4. The prediction of weather situation that is likely to develop is called
5. The mechanical device used to record air temperature continuously is

3. Stevenson screen is used to shield meteorological instruments.
4. Thermograph is used to record duration of sunshine.
5. High humidity reduces transpiration rate in plants.

B. Make the pairs.

'A' Group

1. Light
2. Wind
3. Humidity

'B' Group

- a. Anemometer
- b. Hygrometer
- c. Thermometer
- d. Pyranometer
- e. Rain gauge

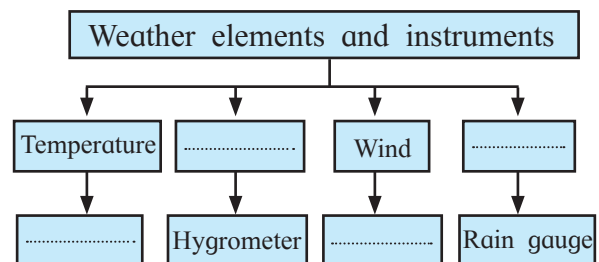
OR. B. Find the odd out.

1. wind/ temperature / humidity / atmosphere / light
2. dew / climate / fog / rainfall / frost
3. thermometer / hygrometer / tensiometer / anemometer / rain gauge
4. thermometer / anemometer / hygrometer / lactometer / pyranometer

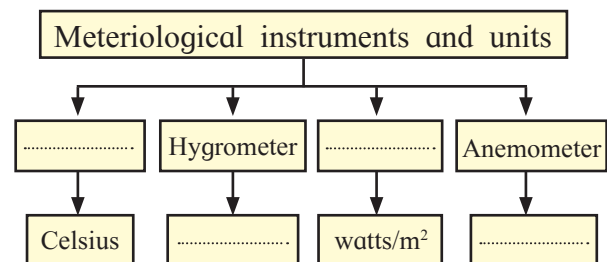
C. State true or false.

1. Hygrometer is used for measuring rainfall.
2. Short range forecasting is predicted for more than four weeks period.

Q. 2 Answer in brief.



1. Write a note on temperature.
2. What is weather forecasting?



3. Complete the following chart.
4. What are the types of weather forecasting?
5. Complete the charts.

Q. 3 Answer the following questions.

1. Explain effect of rainfall on crop growth.
2. Explain effect of humidity and sunlight on crop growth.
3. Differentiate weather from climate.

4. Convert the following from celsius into Fahrenheit.
 - (a) 35°C (b) 10°C
 - (c) 25°C (d) 37°C
3. Describe the methods of weather forecasting.

2. Explain the importance of weather forecasting for farmers ?
3. Write in detail about the services where forecasting is important.
4. Explain effects of rainfall, wind and fog on the growth of crop.
5. Give information about different instruments used for measuring weather elements with their unit?

Q.4 Answer in detail.

1. Complete the chart.

No.	Weather elements	Instrument of measurement	Unit
1.	Temperature	.....	(a) (b)
2.	.....	Rain gauge	(a) (b)
3.	Wind	.....	.....
4.	.....	Hygrometer	.....

Activity :

Record different weather elements by using respective meteorological instruments.



Courtesy : Indian Meteorological Department, Pune