Unit No-1

Syllabus: Effect of Locality Factors: Climatic factors : Light, temperature, frost, precipitation, dew, humidity, wind; Physiographic factors : altitude, aspect, topography, microclimate, geology and soil, geology and forests, soil conditions; Biotic factors.

: Maintain INTRO-BODY-CONCLUSION format when possible
: Use Heading and Subheading for answer clarity (better presentation and understanding)
: Stick to the Keywords (what the question demands?)
: Use Maps / diagrams/ flowcharts to enhance the quality of content.
: You must practice writing in timely and economical manner

- **10 Marks: 150 words**
- **20 Marks: 250 -300 words**

: Use paragraph style of writing instead of bullet form
: Note: The model answers may exceed the word limit sometime. Thus, whenever you are writing you can shorten the answers through writing crisp answers (eliminating detailed explanation). Otherwise, you can use map, diagram or chart to explain the same answers in short.

1. **Define "locality factor" and discuss the different locality factors? Describe how the growth of the tree is affected by light? (20 marks)**

Ans-

As one moves from one locality to another, one can easily discern the change in the nature andcomposition of forests borne on such localities. Forests in Darjeeling hills are different from those in the lateritic tracts of south-west Bengal. Again, forests in the plains of north Bengal will be altogether different from the estuarine forests in the Sundarbans down in the south. That is, with change in locality, the nature of forests changes. Such changes manifest in flora and fauna, and their characteristic features like species, relative abundance of species, composition of vegetation in different stories, ground vegetation etc. This happens because forests and its biota (flora and fauna) in a particular locality are governed by the climate, soil, topography and biotic factors prevailing in that locality. In other words, it is not a matter of chance that a forest of a specific nature and composition gets established in a locality or site, rather forest of a locality is the result of complex influence of the climatic, edaphic, topographic, and biotic factors of the locality.

The factors of the locality are thus defined as the effective climatic, edaphic, topographic and biotic conditions of a site, which influence the vegetation of the locality. These factors are also referred to as site or habitat factors. Factors of locality are broadly classified into four categories, namely,

1. Climatic factors
2. Topographic factors
3. Edaphic factors, and
4. Biotic factors

The site factors interact among themselves to yield the inputs like light, heat, water, nutrientsetc. that are directly available and used by the plants.

Light

Light is an important locality factor as it has the following effects on trees and other vegetations

1. **Chlorophyll formation**- Light is an essential factor responsible for chlorophyll formation.
2. **Functioning of stomata**- Light influences the opening and closing of stomata, thus effecting respiration andphotosynthesis.
3. **Photosynthesis**- Photosynthesis, the process by which plants produce food, cannot takeplace in absence of light. Plants actually use only a small part of the total light falling onthe leaves. The leaf allows only a portion of incident light to be absorbed; and most of the light energy absorbed is used up in raising leaf's temperature and is lost as heat or consumed in transpiration. Since Chlorophyll is green, green foliage reflects a higher percentage of green lights than the blue- violet or the longer yellow- red wavelengths. Thus the blue- violet and the yellow – red coloured light get absorbed instead of being reflected, and have relatively greater influence on photosynthesis.
4. **Growth**-The most obvious importance of light to forest vegetation lies in the dependence of tree-growth on Photosynthesis and latter's dependence, in turn, on light. The influence of light on tree growth depends on the wavelength, duration and intensity.
    a. The wavelength or colour of the light influences the height and shape of the plants.
    b. Duration of light or the length of exposure to day light influences the growth of plants. The response of plants to the timing of light and darkness, called Photoperiodism, is a biological clock enabling plants to adjust their metabolism to certain seasonal fluctuations. Photoperiod

largely controls the entrance into dormancy of many woody plants. Photoperiod is particularly important in higher altitudes where seasonal differences are very much pronounced.

c. Before we describe effect of intensity of light, let us define a couple of terms. Light Irradiance is the amount of radiation received per unit area in the visible spectral brand. The Light Compensation point is the light intensity at which carbon gain from photosynthesis equals carbon loss from respiration. When the irradiance is increased above the compensation point, photosynthesis is increased proportionately. It has been observed by scientists that in the range of 1 to 15 % of full sunlight, photosynthesis is directly proportional to irradiance, if other factors are favourable. The increase in photosynthesis will continue until other factors combine to bring growth to halt. At very high irradiance, factors like high respiration, water deficit causing stomatal closing, and over-accumulation of photosynthate may result in decreased photosynthesis.

5. **Form and quality of trees** – Growing axes of trees elongate mainly between sunset andsunrise in low irradiation. That is why trees growing in shade are usually taller than those of the same age growing in open provided other growth factors are not restricted.Light also influences the form of trees. In congested forest crop, lower branches of treesdie and fall off due to deficiency of light caused by upper story resulting in long clear boles. Continued competition for space restricts development of crown and tends to produce stem of more cylindrical shape. Exposure to light favours formation of relativelylarge crown and consequently, rapid growth. That is why, towards the end of rotation, forests are opened up to allow the selected trees to put on rapid diameter growth.
6. **Species stratification, size and structure of Leaves** – The intensity of light in a typical forest varies widely along vertical heights from top canopy to forest floor. The top canopy receives the full light. However, the intensity of incident light reduces as light gets filtered down through the canopies and foliage. Ultimately, light that reaches forestfloor is of very low intensity. This variation of light intensity down the heights results instratification of species in different canopies, according to requirement of light. Light also affects the size and structure of leaves. In typical forest trees, shade leaves are thinner, and less deeply lobed. Shade leaves have a larger surface per unit weight and fewer stomata than comparable sun leaves off the same tree.

Light requirement of species

Light required by a species for growth and establishment varies from species to

species. Based on tolerance to light intensity, species are classified into following categories –

1. **Light Demander** – requires abundant light for its bestdevelopment
2. **Shade bearer** – is capable of persisting and developing undershade
3. **Shade demander** – requires, at least in its early stage, some shade for normaldevelopment.

In practice, however, all species cannot be categorized rigidly under the above classification, because plants may respond to light intensity differently under different growing conditions, and at different stages of growth. For example, *Shorea robusta* (Sal), known to be light demander, requires shade at the early (seedling) stage. However, based on broad observation, some examples of classifications are givenbelow.

Light Demander - *Bombax ceiba* (Simul), *Terminalia alata* (Pacasaj),Eucalyptus etc.

Shade bearer – *Quercus dilatata* (Katus), *Cupressus torulosa*, *Toona celiata* (Toon), *Pongamia pinnata* (Karanj), *Schima wallichii* (Chilauni)etc.

Shade demander – *Taxus baccata, Xylia dolabriformis* (Lohakath),

Mallotus philippinensis (Sindure), *Litsea glutinosa* (Leda) etc.

2. Describe how the edaphic factor affects the growth of the plant. (20 marks)

Ans-

Edaphic factors are those related to the soil in which the plants grow.
Among the primary resources that plants need for their growth and development, soil provides three major ones, namely, water, mineral nutrients and a porous medium for physical support. Thus edaphic factors, that is, soil characteristics which form the root environment are very crucial for plantsand forest vegetation.

Soil

Soil may be defined as a porous medium consisting of minerals, organic matter, water and gases. It is very diverse in nature. It is influenced by the local climate, the parent material or landform on which it develops and the plants that grow on it.

Soil physical properties

a. Horizonation

Soil "horizons" are discrete layers that make up a soil profile. They are typically parallel with the ground surface. In some soils, they show evidence of the actions of the soil forming processes.

O horizons are dominated by organic material. Some are saturated with water for long periods or were once saturated but are now artificially drained; others have never been saturated.

A horizons are mineral layers that formed at the surface or below an O horizon, that exhibit obliteration of all or much of the original rock structure, and that show one or both of the following:

1. an accumulation of humified organic matter intimately mixed with the mineral fraction and not dominated by properties characteristic of E or B horizons
2. modification as a result of the actions of cultivation, pasturing, or similar kinds of disturbance

E horizons are mineral layers that exhibit the loss of silicate clay, iron, aluminum, humus, or some combination of these, leaving a concentration of sand and silt particles. These horizons exhibit obliteration of all or much of the original rock structure.

B horizons are mineral layers that typically form below an A, E, or O horizon and are dominated by obliteration of all or much of the original rock structure and show one or more of the following:

1. illuvial concentration of silicate clay, iron, aluminum, humus, carbonate, gypsum, or silica, alone or in combination
2. evidence of removal of carbonates
3. residual concentration of sesquioxides
4. coatings of sesquioxides that make the horizon conspicuously lower in value, higher in chroma, or redder in hue than overlying horizons without apparent illuviation of iron
5. alteration that forms silicate clay or liberates oxides or both and that forms granular, blocky, or prismatic structure if volume changes accompany changes in moisture content; or brittleness

C horizons are mineral layers which are not bedrock and are little affected by pedogenic processes and lack properties of O, A, E or B horizons. The material of C layers may be either like or unlike that from which the overlying soil horizons presumably formed. The C horizon may have been modified even if there is no evidence of pedogenesis.

R horizons are layers of hard bedrock.

Transitional horizons are dominated by properties of one master horizon, but have subordinate properties of another. AB and B/C are examples of transitional horizon designations.

b. Soil Color

In well aerated soils, oxidized or ferric (Fe+3) iron compounds are responsible for the brown, yellow, and red colors you see in the soil.

When iron is reduced to the ferrous (Fe+2) form, it becomes mobile, and can be removed from certain areas of the soil. When the iron is removed, a gray color remains, or the reduced iron color persists in shades of green or blue.

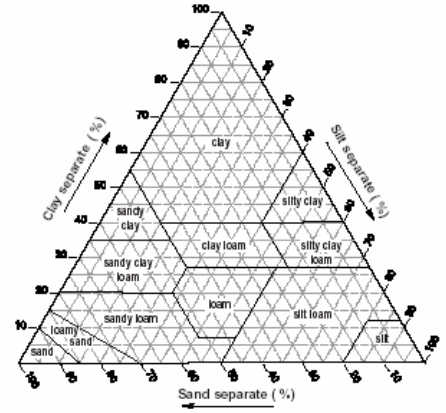
Upon aeration, reduced iron can be reoxidized and redeposited, sometimes in the same horizon, resulting in a variegated or mottled color pattern. These soil color patterns resulting from saturation, called "redoximorphic features", can indicate the duration of the anaerobic state, ranging from brown with a few mottles, to complete gray or "gleization" of the soil.

Soils that are dominantly gray with brown or yellow mottles immediately below the surface horizon are usually hydric.

Soil color is typically described using some form of color reference chart, such as the ***Munsell Color Chart***. Using the Munsell system, color is described in reference to the color's "hue", "value", and "chroma". Hue describes where in the color spectrum the soil color exists, which for soils includes the colors yellow, red, blue, green, and gray. Value describes the lightness of the color. Chroma indicates the strength of the color. In a Munsell notation, the color is written in the order hue-value-chroma. The color "5YR 4/3" is an example of a Munsell notation, where 5YR is the hue, 4 is the value, and 3 is the chroma.

c. Soil Texture

Soil texture refers to the proportion of the soil "separates" that make up the mineral component of soil. These separates are called sand, silt, and clay. These soil separates have the following size ranges:



1. Sand = <2 to 0.05 mm
2. Silt = 0.05 to 0.002 mm
3. Clay = <0.002 mm

Sand and silt are the "inactive" part of the soil matrix, because they do not contribute to a soil's ability to retain soil water or nutrients. These separates are commonly comprised of quartz or some other inactive mineral.

Because of its small size and sheet-like structure, clay has a large amount of surface area per unit mass, and its surface charge attracts ions and water. Because of this, clay is the "active" portion of the soil matrix.

For all mineral soils, the proportion of sand, silt, and clay always adds up to 100 percent. These percentages are grouped into soil texture "classes", which have been organized into a "textural triangle".

Soil texture can affect the amount of pore space within a soil. Sand-sized soil particles fit together in a way that creates large pores; however, overall there is a relatively small amount of total pore space. Clay-sized soil particles fit together in a way that creates small pores; however, overall there are more pores present. Therefore, a soil made of clay-sized particles will have more total pore space than a will a soil made of sand-sized particles. Consequently, clayey soils will generally have lower bulk densities than sandy soils.

Collectively, the soil separates of sand, silt, and clay are called the "fine-earth fraction", and represent inorganic soil particles less than 2mm in diameter. Inorganic soil particles 2mm and larger are called "rock fragments".

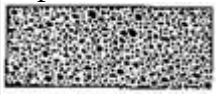
When the organic matter content of a soil exceeds 20 to 35% (on a dry weight basis) it is considered organic soil material, and the soil is called an organic soil. As this material is mostly devoid of mineral soil material, they cannot be described in terms of soil texture. However, the following "in lieu of" texture terms can be used to describe organic soils:

1. "peat"; organic material in which the plant parts are still recognizable
2. "muck"; highly decomposed organic material in which no plant parts are recognizable
3. "mucky peat"; decomposition is intermediate between muck and peat

d. Soil Structure

The soil separates can become aggregated together into discrete structural units called "peds". These peds are organized into a repeating pattern that is referred to as soil structure. Between the peds are cracks called "pores" through which soil air and water are conducted. Soil structure is most commonly described in terms of the shape of the individual peds that occur within a soil horizon.

Types of Soil Structure	
Graphic Example	**Description of Structure Shape**
	**Granular** – roughly spherical, like grape nuts. Usually 1-10 mm in diameter. Most common in A horizons, where plant roots, microorganisms, and sticky products of organic matter decomposition bind soil grains into granular aggregates
	**Platy** – flat peds that lie horizontally in the soil. Platy structure can be found in A, B and C horizons. It commonly occurs in an A horizon as the result of compaction.
	**Blocky** – roughly cube-shaped, with more or less flat surfaces. If edges and corners remain sharp, we call it angular blocky. If they are rounded, we call it subangular blocky. Sizes commonly range from 5-50 mm across. Blocky structures are typical of B horizons, especially those with a high clay content. They form by repeated expansion and contraction of clay minerals.
	**Prismatic** – larger, vertically elongated blocks, often with five sides. Sizes are commonly 10-100Mm across. Prismatic structures commonly occur in fragipans.
	**Columnar** – the units are similar to prisms and are bounded by flat or slightly rounded vertical faces. The tops of columns, in contrast to those of prisms, are very distinct and normally rounded.

"Structureless" Soil Types	
Graphic Example	**Description of Structure Shape**
	**Massive** – compact, coherent soil not separated into peds of any kind. Massive structures in clayey soils usually have very small pores, slow permeability, and poor aeration.
<span  </span	**Single grain** – in some very sandy soils, every grain acts independently, and there is no binding agent to hold the grains together into peds. Permeability is rapid, but fertility and water holding capacity are low.

e. Soil Consistence

Soil consistence refers to the ease with which an individual ped can be crushed by the fingers. Soil consistence, and its description, depends on soil moisture content. Terms commonly used to describe consistence are:

Moist soil:

1. loose – noncoherent when dry or moist; does not hold together in a mass
2. friable – when moist, crushed easily under gentle pressure between thumb and forefinger and can be pressed together into a lump
3. firm – when moist crushed under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable

Wet soil:

1. plastic – when wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger
2. sticky – when wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material

Dry Soil:

1. soft – when dry, breaks into powder or individual grains under very slight pressure
2. hard – when dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger

f. Bulk Density

Bulk density is the proportion of the weight of a soil relative to its volume. It is expressed as a unit of weight per volume, and is commonly measured in units of grams per cubic centimeters (g/cc).

Bulk density is an indicator of the amount of pore space available within individual soil horizons, as it is inversely proportional to pore space:

Pore space = 1 – bulk density/particle density

For example, at a bulk density of 1.60 g/cc, pore space equals 0.40 or 40%. At a bulk density of 1.06 g/cc, pore space equals 0.60 or 60%.

The addition of even a small percentage of organic soil material to a mineral soil can affect the bulk density of that soil. Compare the two soil samples below:

Soil "A": 100% mineral soil material; bulk density = 1.33 g/cc

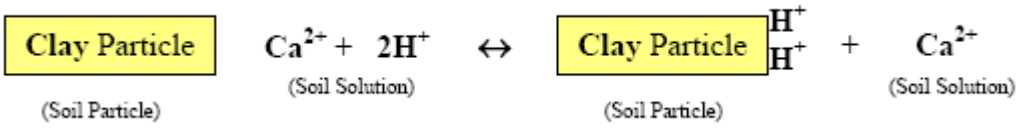
Soil "B": 95% mineral soil material and 5% organic soil material; bulk density = 1.26 g/cc

The difference in bulk density relates to a difference in "particle density" of mineral soil material versus organic soil material. The average particle density of mineral soil material is 2.65 g/cc, which approximates the density of quartz. Conversely, the average particle density of organic soil material is 1.25 g/cc. Organic soil material weighs less than mineral soil material, so it will lower the bulk density of a mineral soil when added, as it reduces the overall weight of the soil.

Soil chemical properties

a. Cation Exchange Capacity (CEC)

Some plant nutrients and metals exist as positively charged ions, or "cations", in the soil environment. Among the more common cations found in soils are hydrogen (H+), aluminum (AL+3), calcium (Ca+2), magnesium (Mg+2), and potassium (K+). Most heavy metals also exist as cations in the soil environment. Clay and organic matter particles are predominantly negatively charged (anions), and have the ability to hold cations from being "leached" or washed away. The adsorbed cations are subject to replacement by other cations in a rapid, reversible process called "cation exchange".



Cations leaving the exchange sites enter the soil solution, where they can be taken up by plants, react with other soil constituents, or be carried away with drainage water.

The "cation exchange capacity", or "CEC", of a soil is a measurement of the magnitude of the negative charge per unit weight of soil, or the amount of cations a particular sample of soil can hold in an exchangeable form. The greater the clay and organic matter content, the greater the CEC should be, although different types of clay minerals and organic matter can vary in CEC.

Cation exchange is an important mechanism in soils for retaining and supplying plant nutrients, and for adsorbing contaminants. It plays an important role in wastewater treatment in soils. Sandy soils with a low CEC are generally unsuited for septic systems since they have little adsorptive ability and there is potential for groundwater.

b. Soil Reaction (pH)

By definition, "pH" is a measure of the active hydrogen ion (H+) concentration. It is an indication of the acidity or alkalinity of a soil, and also known as "soil reaction".

The pH scale ranges from 0 to 14, with values below 7.0 acidic, and values above 7.0 alkaline. A pH value of 7 is considered neutral, where H+ and OH- are equal, both at a concentration of 10-7 moles/liter. A pH of 4.0 is ten times more acidic than a pH of 5.0.

The most important effect of pH in the soil is on ion solubility, which in turn affects microbial and plant growth. A pH range of 6.0 to 6.8 is ideal for most crops because it coincides with optimum solubility of the most important plant nutrients. Some minor elements (e.g., iron) and most heavy metals are more soluble at lower pH. This makes pH management important in controlling movement of heavy metals (and potential groundwater contamination) in soil.

In acid soils, hydrogen and aluminium are the dominant exchangeable cations. The latter is soluble under acid conditions, and its reactivity with water (hydrolysis) produces hydrogen ions. Calcium and magnesium are basic cations; as their amounts increase, the relative amount of acidic cations will decrease.

Factors that affect soil pH include parent material, vegetation, and climate. Some rocks and sediments produce soils that are more acidic than others: quartz-rich sandstone is acidic; limestone is alkaline. Some types of vegetation, particularly conifers, produce organic acids, which can contribute to lower soil pH values. In humid areas such as the eastern US, soils tend to become more acidic over time because rainfall washes away basic cations and replaces them with hydrogen. Addition of certain fertilizers to soil can also produce hydrogen ions. Liming the soil adds calcium, which replaces exchangeable and solution H+ and raises soil pH.

Lime requirement, or the amount of liming material needed to raise the soil pH to a certain level, increases with CEC. To decrease the soil pH, sulphur can be added, which produces sulfuric acid.

c. Calcariousness

Calcareous soils have often more than 15% $CaCO_3$ in the soil that may occur in various forms (powdery, nodules, crusts). Soils with high $CaCO_3$ belong to the Calcisols and

related calcic subgroups of other soils. They are relatively widespread in the drier areas of the earth.

The potential productivity of calcareous soils is high where adequate water and nutrients can be supplied. The high calcium saturation tends to keep the calcareous soils in well aggregated form and good physical condition. However, where soils contain an impermeable hard pan (petricalcic horizon) they should be deeply ploughed in order to break the pan. This should be followed by the establishment of an efficient drainage system. Furrow irrigation is better than basin irrigation on slaking calcareous soils. On undulating lands, contour and sprinkler irrigations are better options than flood irrigation. Drip irrigation may also be practiced. Calcareous soils generally have low organic matter content and lack nitrogen. Nitrogen fertilizer may be applied any time from just before planting up to the time the plant is well established. Application of nitrogen through side-dressing to the growing crop is an efficient way of nitrogen application. Care should be exercised so as not to apply nitrogen close to the seed as it may prevent germination. Ammoniac sources of nitrogen and urea should not be left on the surface of calcareous soils, since considerable loss of ammonia through volatilization may occur, and they should be incorporated in the soil instead.

Phosphorous is often lacking in calcareous soils. Amounts to apply depend on how deficient the soil is and the crop requirements. Excess applied phosphorus may lead to deficiency of zinc or iron. To be effective on calcareous soils, applied phosphorus fertilizer should be in water soluble form. Band application of phosphate is more effective as compared to broadcast application. Application at the time of seeding has been found to be most appropriate since phosphorus is required mostly during the younger stages of plant growth.

Calcareous soils usually suffer from a lack of micronutrients, especially zinc and iron. Zinc deficiency is most pronounced in maize, especially under high yield intensive cultivation systems. Zinc sulphate is an effective zinc source and is the most popular form in use. For soil application, zinc sulphate is broadcast and incorporated in soil. A single application lasts for several years. Foliar applications of zinc are used on fruit trees. Heavy applications of animal manure are helpful in preventing deficiency of iron and zinc.

3. Explain how the biotic factor affects the growth of the plant in forest. (20 marks)

Ans-

The biotic factors include the influence of living organisms, both plants and animals upon the vegetation. Any activity of the living organism which may cause marked effects upon vegetation in any way is referred to as biotic effect.

The biotic effect may be both direct and indirect. It may be beneficial to the plants in some respects but detrimental in other respects.

The plants live together in a community and influence one another. In the forest there are many plant communities, such as trees, shrubs, herbs, mosses, lichens. These communities interact with one another and adjust according to environmental conditions. Trees cast their shadow on many shade-loving plants which grow around or beneath them. The micro-organisms, such as bacteria, algae, fungi, and viruses affect the life of plants of a given area in many ways.

Besides these, the decomposition of dead parts of plant bodies causes significant addition of organic compounds and humus to soil. In this way, vegetation modifies the habitat to a considerable extent. Similarly, animals which are in close association with plants also affect the plant life in one or several ways. Many animals use plants as their food and for shelter as well. Besides animals, the man is most significant agent for modifying the vegetation.

The biotic effects modifying the vegetation can be discussed in the following heads:
(1) Interactions between the plants and local animals and man.

(2) Interaction among plants growing in a community.

(3) Interaction between plants and soil micro-organisms.

1. Interaction between Plants and Local Animals and Man:
These can be described under the following heads:
(i) Effects of grazing and browsing by animals.

(ii) Role of animals in the pollination.

(iii) Role of animals in the dispersal of seeds and fruits.

(iv) Insects and carnivorous plants.

(v) Effects of human activities on vegetation.

(vi) Myremecophily.

(vii) Miscellaneous effects.

(i) Effects of grazing and browsing:

Grazing means eating away of un-harvested herbs as forage by animals , as for example, eating away of grasses by goats whereas browsing refers to a similar use of shrubs or trees by animals , as for example, eating away of leaves and small twigs of Neem by camels.

The animals destroy a large part of Vegetation by grazing and browsing. Some animals prefer to graze and browse on some particular plant species they show selective grazing and browsing, e.g., sheep normally prefer forbs, horses and cattle prefer grasses and goats and deer prefer woody and leafy Parts of plant. Small annual plants become uprooted and disappear after being grazed. In browsing, taller plants such as trees and shrubs are little affected.

Various other effects of grazing and browsing are summarized briefly in the following points:

(a) The grazing and browsing adversely affect the aeration of soil and make it compact and hard and finally render the soil unfit for the growth of trees and shrubs. Forests open to cattle are changed first into shrubby vegetation's and finally into grasslands. Excessive grazing and browsing may thus change the pattern of vegetation and finally lead the area to develop into desert.

(b) The grazing and browsing reduce greatly the frequency of photosynthetic organs (leaves and apical green parts of stem) and thus curtail the assimilation.

(c) The grazing and browsing reduce the vegetation from the surface of earth to a considerable extent and thus expose the soil for erosion.

(d) The most important effect of grazing and browsing is the trampling. In the trampling complete destruction of small and weak annual herbs is caused by the hoofs, paws and feet of animals, but the shrubs and trees are little affected. Usually trampled area becomes inhabited by special type of plants which can withstand the mechanical effect of trampling. These plants propagate vegetatively and are not dependent upon the seed for their propagation.

(e) In grazed pasture and meadows, dung avoiding (coprophobic) plants disappear giving place for the colonization of non-coprophilous vegetation.

(ii) Role of animals in pollination:

A large number of plants depend on insects, birds and a number of animals for their pollination. These plants develop coloured flowers. The flowers possess scents, nectar, sap, edible pollens and many other characteristic structures for attracting insects towards them. Insects, birds and other pollinators visit the flowers in search of honey and edible pollens. Flowers in the families Rosaceae, Compositae, Leguminosae, Rutaceae, Umbelliferae, Euphorbiaceae, Cruciferae, Ranunculaceae are pollinated by insects.

Some plants are specialized in their pollination by particular type of animals, for example, Rafflesia is pollinated by elephants and birds, bilipped flowers of Salvia are pollinated by bees, entomophilous flowers of orchids, Ficus and Calotropis are pollinated characteristically by insects.

It is observed that different types of flowers and their pollinators generally live together in the same biotic communities and affect each other's life.

Besides insects, birds, bats and some other animals, man too is taking active part in pollinating artificially one plant with the pollen of some other plant species. The artificial pollination is being used by man for the production of high yielding and disease resistant plant varieties.

(iii) Role of animals in the dispersal of fruits and seeds:

Many animals, such as birds, bats, monkeys, act as important agents for disseminating the seeds, fruits and spores and thus they play important role in the migration of plants. The seeds of many plants are very hard. Such seeds along with fleshy parts of fruits are swallowed by animals. While passing through the elementary canals of animals hard seeds are not affected by digestive juices.

When the animals leave faecal matter, the uninjured seeds present in it germinate. Passing of seeds through the digestive tracts sometimes facilitates their germination in certain cases. The seeds of tomato, tobacco, guava and many other plants are dispersed in this way.

The hairy, spiny, hooked and sticky fruits and seeds of some plants get entangled with the bodies of birds and other animals and with the clothes of man and are brought to distant places. When the animals clean their bodies at some places the seeds are dropped there. Seeds and fruits of Xanthium, Andropogon, Plumbago, Aegle marmelos are dispersed in this way. Ants are good agents for transporting oily seeds and small grains of cereals.

(iv) Insects and Carnivorous plants:

Semi-autotrophic insectivorous plants, as for example, pitcher plant, Drosera, Aldrovanda, Dionaea, bladderwort, etc., grow in the habitats which are deficient in nitrogenous compounds. These plants have some specialized organs and mechanisms for trapping and assimilating the preys.

Pitcher plants have leaf pitchers containing liquid and enzymes inside. When the insects are trapped down in the pitcher they are digested and assimilated by it. In Drosera spathulate leaves are covered with sensitive glandular hairs which shine in the sunlight and attract insects and small flies. When the insects are entangled in the glandular hairs of leaves, digestive enzymes are secreted immediately which kill and digest the bodies of insects. The digested parts of insects are absorbed by the surface cells of the leaves.

(v) Effects of human activities on vegetation:

Man affects vegetation in the following ways:

(a) By cutting, felling and replanting the forest trees.

(b) Cultivation:

Besides the old methods of cultivation, man has adopted a number of advanced methods for cultivation of plants. Cutting, budding, grafting and other methods used by man are proved beneficial for certain plants. Now at various research stations men are performing cross breeding experiments to evolve new varieties of plants that give high yields and are disease resistant. In cultivation, the destruction of weeds by man

eliminates the competition among the plants. Proper spacing of plants during cultivation also checks the competition among them for food.

(c) Fire:
Fire is a biological factor rather than a physical factor because it is mostly caused by man's activity. Lightning initiated fires have destroyed plants and animals since their early appearance on earth. In some countries, especially America and Africa, a lot of work has been done on the effects of fire on different ecosystems. A large body of information has developed on the effects of fire on grasslands and forests as well as on the use of fire in land management.

The branch of ecology which deals with the effects of fire on ecosystem is called "Fire ecology" or Ecopyrology. Plants having ability to withstand fire with little or no damage are referred to as Pyropliytes. A number of pyrophytes are known to occur in Siwalik hills. Important examples of pyrophytes are Cochlospermum religiosa, Combretum nanum, Grewia sapida etc. These small plants are supposed to have become permanently dwarf by annual jungle fires. Pyrophytes are mostly woody plants with thick bark.

Fires caused by man's activity are responsible for complete destruction of vegetation at certain places resulting in temporary or permanent alterations in the characters of vegetation's. In some parts of tropics and subtropics, especially in Africa, the burning of grassland has been a regular practice for the last many centuries.

Generally, in fires the aerial parts of plants are destroyed completely but their roots, rhizomes or other underground parts may sometimes remain unaffected which under favourable conditions may grow and produce new plants. Fire generally makes the area suitable for the growth of grasses and thus improves the quality of forage. Post-bum plants are preferred by herbivores. Animals grazing on burnt grasslands are found to gain weight more rapidly than those grazing on un-bunt grasslands. Fire removes harmful plant and animal parasites and pests.

Litter accumulations physically prevent the healthy production and growth of some plant species in grassland. Fire not only removes the choking litter accumulation but also reduces the organic debris to ash. It affects the productivity by stimulating both the above and below ground growth, increases flowering in forbs and seed production in grasses, increases certain species like legupies and improves nutrient contents of the grassland species.

Burning in normal course does not affect the grassland soils adversely and generally improves them. Mineral salts of calcium, magnesium, potassium and phosphorus increase with burning. Excessive burning may reduce the humus content and the fertility of the soil. Soil acidity increases and erosion is accelerated. Annual burning coupled with continuous heavy-grazing will have detrimental effects on the health of grassland.

(d) Man also clears the vegetation for making houses, roads, etc.

(e) In ancient times many human invasions took place in India which caused great destruction of vegetation. Alexander (330 B.C.), Muslim invasion after 850 A.D. Gori and Gaznavi, and Rajput invasions destroyed dense forests and converted them into deserts. Mohenjo-Daro and Harappa are examples which are supposed to have become deserted as a result of human invasions. The excavations of Mohenjo-Daro and Harappa indicate that shrubby plants were abundant in the desert areas of Punjab and Sindh.

(vi) Myremecophily:

Sometimes ants take their abode or shelter on some trees such as Mango, Litchi, Jamun, South American Acacia (Acacia sphaerocephala) (Fig. 2.18) and so on. These ants act as body guards of the plants against any disturbing agent. In lieu of this defence, the plants provide food and shelter to these ants. This phenomenon is known as myremecophily.

(vii) Miscellaneous effects:

The animals also affect the plant life in many other ways. Some animals, as for example, barkeater, rodents may kill a large number of trees. Juice sucking insects, woodpeckers, bud eating birds, sparrow, squirrel and other animals cause great harm to the vegetation. Elephants detach the branches of the trees and sometimes uproot the gigantic trees. The insects, birds, squirrels, mice and rodents eat abundant seeds. Some animals eat and destroy seeds at the sowing time. Fishes, ducks and other aquatic animals depend upon aquatic plants for food and shelter.

2. Interaction among Plants Growing in a Community:

Various plants in a community react with one another in several ways for:

(i) Water,

(ii) Essential minerals and organic compounds, and

(iii) Light and air.

The taller plants modify the habitat for the plants growing around and underneath them by casting shadow, protecting them from injuries by strong wind, by increasing the atmospheric humidity, and by determining the humus content of the soil.

The two main problems of interaction among plants are:

(a) Maximum absorption of water from the atmosphere and from the bark surface of the supporting plant and

(b) Maximum economy in the water consumption. These plants develop two types of roots, namely the aerial and clinging roots.

The aerial roots are thick and have special thin walled porous absorptive tissue, the 'velamen' on their surface. These roots absorb rain water and moisture from the atmosphere. The clinging roots fix the epiphytes on the surface of supporting plants. Because the epiphytes are autotrophic, they do not affect the supporting plants to any considerable extent.

(iii) Effects of parasitic plants. Some plants are heterotrophic and are dependent on other plants for their food requirements. They are called parasites.

These are of the following two types:
(i) Ectoparasites (external parasite); and

(ii) Endoparasites (internal parasites).

The endoparasites are more destructive than the ectoparasites. Because the parasites take their food from host plants, they check the growth and ultimately cause the death of their hosts. Cuscuta, Loranthus, Orobanche, Rafflesia, and sandal wood tree (Santalum album) are important parasitic angiosperms which may grow either on roots or on stems and sometime even on the leaves of the higher plants. The parasites may be either obligate or facultative.

Cuscuta is an obligate stem parasite on Acacia, Zizyphus and a number of other angiospermic plants. Loranthus is a partial stem parasite on mango. Orobanche grows very commonly on the roots of crucifers and solanaceous plants as obligate roots parasite. Other important parasites are Rafflesia on the roots of Vitis Viscum album on coniferous trees. Striga, one of the smallest angiospermic parasites grows on the grasses. Arceuthobium minutissimum, an interesting smallest parasitic dicot, is an obligate stem parasite of Pinus excelsa.

3. Interaction between Plants and Microorganisms:
Various kinds of bacteria, protozoa, algae, fungi, worms, nematodes and other soil microbes act as important agents which alter the physical and chemical properties of the soils and increase or decrease their fertility. These changes in the soil properties have great impact on the nature and growth of vegetation.

Very often soil microbes, such as nematodes, bacteria and fungi cause many diseases in the underground parts of plants. Viruses too cause several mosaic and other diseases in many plants, as for example, the curling of tomato leaves, mosaic patterns in papaya and lady's finger (bhindi), bean mosaic, tobacco mosaic, etc. Some microbes secrete growth stimulating substances in the soil which induce the growth of plants.

Besides above effects, the soil microorganisms show symbiotic activities and many soil fungi form mycorrhizal association with the roots of higher plants.

4. Explain different topographic factors and how it affects the growth of the plant in different topography. (20 marks)

Ans-

Topographic factors

Topography or physiography is the surface features, their form and substance, of a given regional or local area. Topographic factors may be defined as those relating to land form or configuration, e.g altitude, slope, aspect etc. Among the major ecosystem components, topography or physiography is the most stable component and least affected by human or natural disturbances. The topographic factors markedly influence the ecosystem functioning asthey control local climate, soil formation process, soil moisture and soil nutrients which in turninfluence the vegetation. We now discuss the various topographic factors.

Landform or configuration

A landform is defined as any physiographic feature on the earth's surface, such as a plain, valley, and hill etc., caused by erosion, sedimentation, or movement. Land configuration or land surficial shapes and their parent materials modify the fluxes of solar radiation, soil water and nutrients and thus regulate establishment, distribution, growth and productivity of plants. For example, let us consider a newly exposed landform which offers different local climates on its sunny or shaded slopes. Based on their compatibility with temperature, humidity and soil, different plant communities colonize these different slopes. The plants in turn select the fauna that adapt with the microclimate of the different slopes. Further soils develop over time through interactions of land forms, local climate and biota. Interactions of all components through time result into similar ecosystem on similar landforms.

Altitude or Elevation

Altitude or elevation of a specific landform is important as it is a rough indicator of climatic factors affecting plants. It should be, however, borne in mind that climatic factors at a given altitude depend on latitude and many other factors that may have greater influence than elevation.

1. **Solar radiation** – Solar radiation passes through lesser turbid atmosphere to reach places of higher altitude. Therefore, solar radiation increases with altitude.
2. **Temperature** – With increasing altitude, air becomes rarer and progressively loses its capacity of absorbing and retaining heat. As a result, temperature drops with increase in altitude. Generally up to 1500 m, there is a fall of 1^0C in the mean temperature for a riseof 270m in the hills, but beyond 1500 m, the fall in temperature is more rapid. (L S Khanna 1999). Based on their response to temperature, various plant communities thrive at different altitudes. This results in altitudinal zonation in vegetation in hills.
3. **Rainfall** – It has been estimated that half the water vapour in the air lies below 2000 maltitude and three quarters below 4000 m. A high mountain range acts as a barrier and moves the humid air to ascend and get cooled. Cooling brings about condensation and results in precipitation. On a high mountain range the rainfall is more on the windward side. That is why, southern slopes of outer ranges of Himalayas receives heavy rainfall, whereas there is much less rainfall

on the interior ranges of Himalayas. On the windward side of a mountain range, condensation starts at a certain level and continues up to an altitude beyond which air contains little water vapour to condense. Along the altitude there is a zone of maximum precipitation which is normally below the top of the ridge. On the Himalayas the zone of maximum precipitation is at an altitude of about 1220 m above sea level. Rainfall increases with altitude upto this height and then beginsto decline.

Slope

The slope gradient or the angle of repose of geologic material is expressed in degrees or in terms of percentage. The greater the slope, the greater is the surface per hectare or other unit area which is measured horizontally. That is why, good forest sites of moderate slope contain more trees and produce more yields per hectare than do comparable level sites (Burton.V barnes et.al 1998).

Compared to a site of gentle slope –

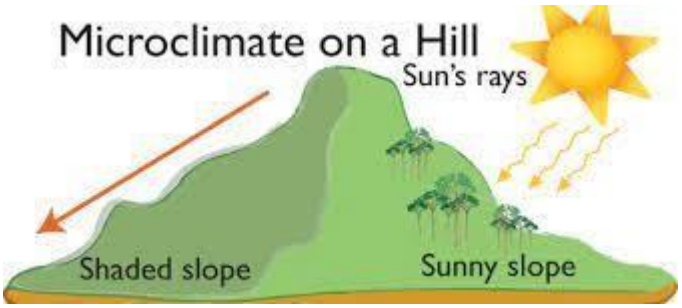
1. A steep slope allows more rapid movement of water and snow, that is, greater runoff.
2. A steep slope exhibits better drainage.
3. A steep slope is fraught with greater danger of soil erosion, avalanche and mass soilmovement.
4. In general, have less soil depth and less humus content in the soil.

Aspect

Aspect is the orientation of the slope with regard to the sun's position. It determines the amount of insolation received by a hill slope. At any given latitude the hottest and the driest sites are those that most nearly face the sun's angle during the middle of the summer day, that is, receive more intense sunlight than any other. In India, all southerly aspects receive more sunlight than northern slopes and are therefore warmer. This is true in general in northern hemisphere, where north slopes receive less sunlight and are cooler and moister. The situationis of course reversed in the southern hemisphere. The difference in temperature on southerly and northerly aspects gives rise to different vegetation on such aspects in high altitudes. East and west slopes also exhibit variation in temperature, but the degree of variation is less extreme. East facing slopes are exposed to direct sunlight during the morning when the air temperature has not sufficiently warmed up, and are normally somewhat cooler and moister than west-facing slopes.

5. **A. Microclimate**

A microclimate (or micro-climate) is a local set of atmospheric conditions that differ from those in the surrounding areas, often with a slight difference but sometimes with a substantial one. The term may refer to areas as small as a few square meters or square feet (for example a garden bed or a cave) or as large as many square kilometers or square miles. Because climate is statistical, which implies spatial and temporal variation of the mean values of the describing parameters, within a region there can occur and persist over time sets of statistically distinct conditions, that is, microclimates. Microclimates can be found in most places.



Not only climate influences the living plant but the opposite effect of the interaction of plants on their environment can also take place, and is known as plant climate. This effect has important consequences for forests in the midst of a continent; indeed, if forests were not creating their own clouds and water cycle with their efficient evapo-transpiration activity, there would be no forest far away from coasts, as statistically, without any other influence, rainfall occurrence would decrease from the coast towards inland. Planting trees to fight drought has also been proposed in the context of afforestation.

The type of soil found in an area can also affect microclimates. For example, soils heavy in clay can act like pavement, moderating the near ground temperature. On the other hand, if soil has many air pockets, then the heat could be trapped underneath the topsoil, resulting in the increased possibility of frost at ground level.

The microclimates of a region are defined by the moisture, temperature, and winds of the atmosphere near the ground, the vegetation, soil, and the latitude, elevation, and season. Weather is also influenced by microclimatic conditions. Wet ground, for example, promotes evaporation and increases atmospheric humidity. The drying of bare soil, on the other hand, creates a surface crust that inhibits ground moisture from diffusing upward, which promotes the persistence of the dry atmosphere. Microclimates control evaporation and transpiration from surfaces and influence precipitation, and so are important to the hydrologic cycle, the processes involved in the circulation of the Earth's waters.

B. Frost

Frost means chilling of air below the freezing point (0 degree Celsius). On the basis of mode of formation, frost is classified into following categories.

1. **Radiation frost** – It occurs at night on account of loss of heat by radiation. On clear winter nights air near the ground undergoes rapid cooling and when temperature falls below freezing point, water vapour gets transformed into ice crystals that form on soil,

ground vegetation or other object surfaces near the ground. It is called **ground frost** or **hoar frost**. It is not only the surface air but also soil air that gets chilled.

2. **Pool frost** – It occurs in a place when convection current of cold air of considerable depth flows into natural depressions from adjoining areas. It is more damaging than ground frost as cooling effect extends to a considerable height of the vegetation.

3. **Advection frost** – Advection frosts occur when cold air blows into an area to replace warmer air that was present before the weather change. It is associated with cloudy conditions, moderate to strong winds, no temperature inversion and low humidity. Often temperatures will drop below the melting point (0 °C) and will stay there all Day.

Injuries due to frost

Injury to young plants – Ground frost which occurs at night freezes the soil moisture. In the morning young plants get exposed to sunlight and undergo heavy transpiration. The loss of water in the plant body due to transpiration is not replenished as the roots cannot supply water from the soil moisture which is frozen. As a result, the young seedlings suffer mortality.

Cell Injury - Direct frost damage occurs when ice crystals form inside the protoplasm of cells, whereas indirect damage can occur when ice forms inside the plants but outside of the cells. It is not cold temperature but ice formation that actually injures the plants. It is believed that intracellular ice formation causes a "mechanical disruption of the protoplasmic structure". The extent of damage due to intracellular freezing depends mainly on how fast the temperature drops and to what level it supercools before freezing. As a result of extracellular ice formation, water will evaporate from the liquid water inside the cells and will pass through the semipermeable cell membranes and deposit on the ice crystals outside of the cells. As ice continues to grow, the cells become more desiccated. Typically, in injured plants, the extracellular ice crystals are much larger than the surrounding dead cells, which have collapsed because of desiccation. Therefore, the main cause of frost damage to plants in nature is extracellular ice crystal formation that causes secondary water stress to the surrounding cells.

Injury to crown – The pool frost or the cold waves generally kill back saplings and poles to the ground level.

Frost cracks – Under frost attack, stems of the trees develop longitudinal cracks, called frost cracks. These fissures close later and get covered with growth of callus.

Canker – When a branch dies due to frost, callus forms at the base of the branch. The callus gets killed due to subsequent frost attack. As the process recurs the wound point becomes vulnerable to attack by fungi resulting in formation of canker.

Protection measures

In Nursery

Shades at night – The nursery beds may be covered with shades at night. The shades should be slanted so that leaves of the seedlings do not get exposed to direct sunlight

in the morning. When during the day the soil temperature has risen up, the shades may be removed so that soil receives direct sunlight.
Watering – Watering the nursery beds in the morning during frosty season is advised. Watering melts the ice crystals formed on the ground, provides water to the roots and thus lessens the chilling effect of frost.
Smoking – Sometimes brushwood and grass are burnt around nursery at night to create a smoke screen over the nursery. This prevents radiation frost in the night.
In Plantation
Nurse crop – Raising of nurse crop [example: *Cajanus* (Arahar)*, Ricinus communis* (castor oil plant)] in the interspaces reduces the frost damage to the desired species.
Retention of frost protection shelterwood – When planting of frost tender species is planned in frosty localities, the area in question is clear felled except that healthy, a number of young and middle aged trees, evenly distributed, are suitably selected from the existing stock and retained as shelterwood as a frost cover.
Regulation of weeding **–** It is advisable not to do weeding during winter so that weeds may act as frost cover to the plants.

In natural Regeneration Areas
Shelerwood or Selection System – While trying to obtain natural regeneration in frosty localities, it is advisable to avoid clear felling system. Shelterwood or selection system will be an appropriate option to provide frost cover to regeneration.

C. Moisture

Moisture is the water or other liquid diffused in a small quantity as vapour, within a solid, or condensed on a surface. Water and its availability across the surface of the earth, in the soil, and atmosphere havean enormous influence on the biota. Water is essential for various physiological activities of plants and for soil formation. Major storages of water on earth are ocean and atmosphere. Water is also stored in ground water, water bodies and plants. Atmosphere stores large amounts of moisture, most of which is in the form of vapour, and is referred to as **humidity.** Warm air is capable of holding more water than cold air. **Water holding capacity** is the amount of water that can be held by air, that is, the stage of humidity at saturation. **Relative humidity** is the percentage of water vapour to the total water holding capacity.

Essential Role of Moisture

1. Water is a major constituent of plant cell. It constitutes about 80% of protoplasmwhich forms the basis of plant life.
2. Water is present in cell vacuoles as cell sap and influences plant growth.
3. Water is an essential material for photosynthesis.
4. Water carries soil minerals to the plants and is essential for translocation of food.
5. It is necessary for essential physiological functions of respiration and transpiration

6. It is an important factor for germination and viability of seeds.
7. Water is necessary for both physical and chemical weathering of rocks and minerals in the process of forming soil. Rocks and minerals undergo physical weathering and breakdown through heat, water, ice and pressure. Chemical weathering involves processes like acidification and dissolution in which water plays an important role.

As water plays a vital role in the physiological processes of plant life and formation of soil, it has a significant influence on vegetation. Spatial humidity pattern coupled with soil water may play a major role in determining regional vegetation patterns. Trees tend to have leaf shapes, stomatal distributions, and stomatal characteristics that are suitable for the environments in which they grow. Water thus determines the tree species of a region, their density and growth, as well as those of other vegetation.

D. Temperature

Temperature is a physical quantity that expresses hot and cold. It is the manifestation of thermal energy, present in all matter, which is the source of the occurrence of heat, a flow of energy, when a body is in contact with another that is colder or hotter.

Solar radiation is the source of heat that governs the temperature of the earth surface. The mean annual temperature at any given spot of earth surface is basically controlled by the incoming solar insolation and by secondary heat transfer owing to terrestrial radiation and air movement. Temperature at various places on earth varies and is affected by the following factors

1. **Latitude –** It is the angular distance north or south from the equator of a point on the earth's surface, measured on the meridian of the point. As one moves to north or south from the equator, the temperature decreases with increasing latitude. In the Indo-Gangetic plain, the normal fall in the main temperature is estimated to be roughly 0.55° C for increase of each degree in latitude.
2. **Altitude –** Temperature is also a function of altitude. As altitude rises, there is fall in temperature.
3. **Distance from the sea-** Sea has a moderating affect on temperature. The ranges of diurnal and seasonal variation of temperature become wider, as the distance of a place from the sea increases.
4. **Winds-** The winds, particularly when blowing from the sea, affect the temperature. In India the south west monsoon brings rain and lowers the atmospheric temperature.
5. **Mountains** - The location and orientation of mountain ranges interact with winds and rainfall and thus influence the temperature. The windward slopes of a mountain have lower temperature than the leeward side.
6. **Forest Vegetation –** A forest with light crown cover and trees without foliage(Deciduous trees during the leafless season) allows the solar radiation to penetrate, but tend to reduce air movement relative to outside the forest.

Under such condition the mean air temperature within the forest may be higher than the outside. On the other hand when trees are in full foliage, the extremes within the forest are generally less than outside, and the diminution of radiation within the forest may result in lower mean annual air temperatures.

Effect of temperature

Atmospheric temperature influences the activities of shoots of plants, while soil temperature influences those of their roots.

Air temperature

Solar radiation provides heat to the plant body. However, plants regulate their temperature by dissipating part of the energy they absorb by three mechanisms namely, re-radiation, transpiration and convection. Through such adaptations, the plant maintains a heat balance with its environment.

Effect on growth – As temperature increases, plant activities increase up to an optimum temperature and then decrease until, at very high temperatures, the plant dies. (Burton V Barnes et.al 1998 Forest Ecology). Temperature influences strongly the following growth processes –

1. Activity of enzymes that catalyze biochemical reactions, especially, Photosynthesis and respiration
2. Solubility of CO_2 and Oxygen in plant cells
3. Transpiration
4. Ability of roots to absorb water and minerals from the soil,and
5. Membrane permeability

Since various growth processes demand different optimum temperatures, it is difficult to characterize the total growth or biomass production of a species by a certain optimum temperature.

1. **Effect on microbial activity** - Increase in air temperature facilitates microbiological activity on soil surface, and consequently enhances decomposition of organic matter and release of nutrients to be available to trees.
2. **Effect of germination of seeds –** Temperature is essential for germination of seeds.

Soil Temperature

Soil temperature has the following effects on vegetation

1. Absorption of soil moisture by plants increases markedly with rise in temperature upto a certain limit. When soil temperature grows above 35^{o} C absorption of moisture starts declining. Again, when soil temperature falls below 27^{0} C, water absorption is greatly reduced till at 0^{o}C it becomesinsignificant.
2. In temperate climate, soil temperature influences cambial activity.

Effect of excessively low temperature

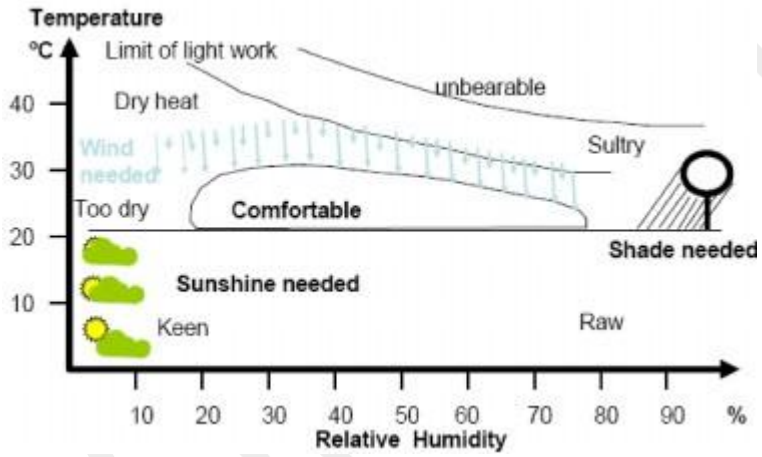
In tropical region, temperature below 5^{o} C may cause chilling injury to plants. Such

low temperature causes the injury by upsetting the carbon and water balance of plants. At very low temperature, loss of water by transpiration exceeds gain by absorption, and loss of carbon by respiration exceeds carbon gain by photosynthesis. Further fall in temperature results in frost and snow, which cause injury to trees and forest vegetation. Rapid freezing may cause death of plant tissues, particularly of actively growing plants and succulent tissues. Rapid thawing is also very harmful, causing certain changes that disrupt cell membranes.

E. Bioclimate

A climate, as it influences, and is influenced by, biological organisms. A climate or climatic zone considered or defined in relation to living organisms and their distribution is known as Bioclimate.

Various climate factors influence the vegetation collectively but not individually or separately. Thus the vegetation of a place is result of various climatic factors acting together.
The variables like annual mean temperature (Temp) and annual precipitation (Prec), as these are key drivers of ecosystem processes, vegetation structure , and species richness .



While affecting vegetation collectively, these factors modify the influence of each other to certain extent. Therefore, each climatic factor has to be modified or adjusted in such a way that it may describe the influence of collective complex climatic factors on plant life. The climate defined by these modified or adjusted climatic factors is called bioclimate. For example, the total rainfall of a place has certain effect on vegetation. But the effect of rainfall is modified by number of rainy days. A certain amount of total rainfall with a larger number of rainy days will result in a different vegetation than the same total rainfall and number of rainy days. The effect of total rainfall and number of rainy days is further modified by the amount of evaporation taking place in that locality. Therefore, in order to describe the correct effect of rainfall as a climatic factor, the total rainfall will have to be modified by the number of rainy days and evaporation.