Chernozem soil

The Russian meaning of chernozem is **black.** So, chernozem soil means **black soil.** Russians were the first who identified chernozem soil. Though chernozem type of soil is developed in other parts of the world, all such soils have been known by the name '**chernozem**'. In Europe this soil is developed in a belt

stretching from south-east to north-west. This belt extends up to Amur basin crossing Ural mountains. This type of soil is also developed in the central part of North America, south central part of South America and grasslands of Australia. Latitudinally it is developed within latitudinal limits from 35° – 50° in both the hemispheres.

Conditions of soil development : Climate : From the point of view of climate it is developed under semidesert and sub-humid parts of temperate regions. These areas are located mostly in the interior parts of the continents. So, climate is extreme in type. The range of temperature is very high. Winters are cold, temperature drops to below freezing point. Average summer temperature is moderate (18 – 25°C). Most of the rainfall occurs during summer. The average amount is 50 – 100 c.m. The regions get snow melt water by the start of the summer.

Natural vegetation : Under the prevailing extreme type of climate, herbaceous plants i. e. grasses are the only characteristic vegetation. Even within this region amount of rainfall varies. On the basis of the amount of rainfall the height of the grasses also varies. In areas of greater rainfall, the height of the grass is 1 – 2 metres. With the decrease in the amount of rainfall, the height of the grasses decreases and ultimately it becomes few centimetres only. Since the grasses are annuals, the amount of organic debris in the soil is adequate. Grasses are rich in mineral plant food. So, the soils are neutral or slightly alkaline in reaction. Roots of the grasses are fibrous. All these characteristics of the grasscs play an important role in the formation of soil.

Relief : The areas where chernozems are formed are generally plains or undulating plains. Since the chernozem areas are located very close to the deserts, soil particles are blown by the winds and have formed **loess** plains. Loess is a porus material. This porosity is an important characteristic of the soil.

Process of soil formation : Rainfall occurs during summer mostly. So, the effectivity of rainfall is less. Therefore, leaching process is less prominent. However, due to snow melt water by the start of the summer , the soils remain moist and helps the growth of grasses.The grasses dry up during, summer mostly. However the grasses grow rapidly during the periods of summer rain. During the periods of drought the grasses extend the roots very rapidly downwards. Although the decomposition process remains stagnant during dry summer days, the process starts by the end of summer when rain occurs and forms organic matter. Perolating water contained with organic material tends to form the soil structure or peds within the soil. Due to dryness in summers and freezing during winters, the peds become strong and stable. Content of organic matter is very high near the surface [illegible] between 3.5 – 15 percent.

In chernozems, calcium humates are formed in the A horizon. In wet conditions it is soluble. But during the dry season it is insoluble. During drying it forms a fine organic layer around the soil particles and develops soil structure . The structure is crumby (Fig- 40) which is considered to the best in type. It does not get destroyed even in the presence of water.

FIG : 40 CRUMB SOIL STRUCTURE

Chernozems are not only rich in organic matter. They are also rich in minerals. There is gradual decrease in organic matter from the top (Fig - 41). The colour of the soil in the A horizon is deep black. Besides, the type of clay mineral which is originated here is montmorillonitic in type. This can hold more moisture. The base exchange capacity is also high. The soidium and potassium that are derived during weathereing are partly mixed with ground water and partly remain in the A horizon.

Calcium and magnesium leach down and get deposited in the B horizon. They are present in the soil in the form of white streaks as veins and sub veins in the soil. Sometimes they are deposited as calcium and magnesium carbonates. In spite of the removal of calcium and magnesium from the A horizon, the pH of the A horizon remians

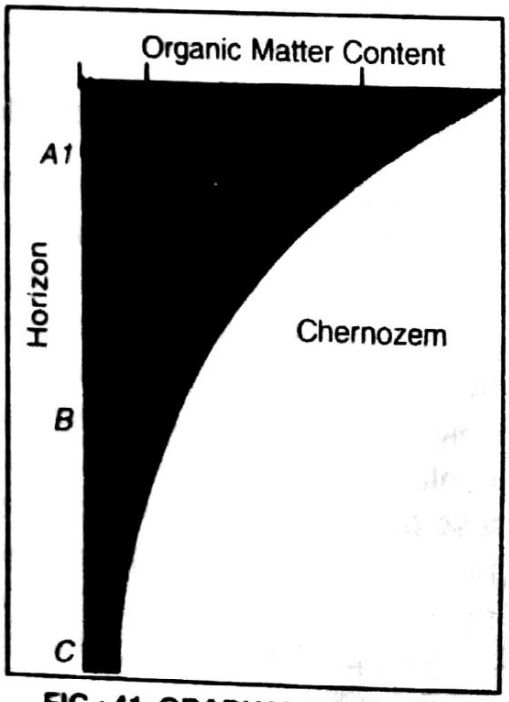

FIG : 41 GRADUAL DECREASE OF ORGANIC MATTER WITH INCREASE IN SOIL DEPTH

neutral or slightly alkaline because of the fact that the supply of minerals remains steady due to the release of minerals from mineralization. For this reason, the chernozem soils are rich from the point of view of organic matter and minerals and the soils are very fertile. The profile of a typical chernozem is as follows :

A_O : 1 – 2.5 c.m. deep. It is like a mat composed of dead grasses.

A_1 : 30 – 60 c.m. deep. Deep black to brown in colour. The percentage of organic matter is 4 – 15. The organic matter gradually decreases downwards. They are granular or crumby in structure. The structure is stable. Aeration is good.

A_2 : 30 – 60 c.m. deep. The colour is black to brown. Although the organic matter content is slightly less than the A horizon, it is pretty high, The structure is nutty. Lime remains in free form.

B : 40 – 60 c.m. deep. The colour is light yellow. No observable soil structure, dusty in nature. The deposition of calcium carbonate is observable. Sometimes, the deposition of gypsum is noted also.

C : Parent material is formed of loess. However, granites. basalts, limestones are also seen as parent material.

Use : Since the chernozem soils are developed over semidesert and sub-humid regions, the density of population is low. But the soils are very fertile. Provided water is available, it is suitable for the cultivation of wheat, cotton, corn etc. Wheat is a surplus crop. Animal rearing is an another occupation. In spite of low density of population, the number of towns and industries is pretty high.

Chestnut soil

rearing and herding are practised.

Laterite soil

In 1807 English soil scientist Bukhanon while working in the foothills of Malabar coast of Kerala found a type of soil, red in colour. The meaning of 'later' in Latin word is red. So he named that soil as '**Laterite**'. It is observed that iron, aluminium or magnesium oxides have deposited on the surface or at varying depths from the surface in a horizontal fashion. Most of the sands have been removed from the seats of their deposits and due to excess deposition of iron or magnesium oxides the soils are red in colour. That is, the process of soil formation in which there deposition of iron, aluminium or manganese oxides on the surface or at varying depths from the surface is called **Laterization** and the resultant soil is called **Laterite.**

Conditions of soils development : Laterite is formed under areas of uniformly high temperature and high rainfall. The average annual temperature near the equator is between 27 – 28° C. Away from the equator, the summer temperature remains to the extent of 35 – 40°C and winter temperature to the extent of 15 – 20°C. The equatorial area receives high amounts of rainfall which is to the extent of 200 c.m. It occurs throughout the year. In monsoon regions climate is hot and humid during summer and dry in winter. The amount of rainfall is 150 c.m.

Since the amounts of rainfall and temperature are uniformly high, dense forests have developed. Apart from trees there is **profuse** growth of lianas, creepers, epiphytes. parasites etc. In monsoon regions there is an admixture of evergreen and deciduous trees. Sometimes, there is abundance of evergreen trees. Due to various types of natural vegetation there are different types of animals, insects etc. Their number is innumerable.

The surface is mostly undulating. It has an important role to play in the soil development.

The process of soil formation : High temperature and high rainfall create such a condition where (a) The rate of chemical and biological decompositions are very high. It is so high that even the quartz which is considered to be one of the most resistant mineral gets solubilized. (b) Develops dense evergreen forest or dense deciduous forest. (c) The organic debris gets humified and mineralized quickly. (d) Since the organic debris is derived from

evergreen and deciduous species organic matter becomes relatively rich in minerals. (e) The soil reaction is either neutral or slightly acidic because of the release of minerals due to rapid rate of mineralization. (f) The neutral reaction helps the precipitation of metallic iron, aluminium and manganese elements. (g) Silicic acid is ionized and is removed as silica gel. (h) Calcium, magnesium, sodium, potassium etc. get leached and ultimately two chemical characteristics become important i.e. – (1) **removal of silica** and (2) **deposition of sesqui oxides** particularly iron and aluminum oxides. It has been found experimentally that the parent material in which the percentages of silica and iron were 42 and 7.84, after the process of laterization their corresponding percentages are 2 – 3 and 71.12.

Process of laterization : There are differences of opinion as to the process by which laterites are developed. Some are of the opinion that due to excessively high rainfall in the equatorial areas, the ground water level lies very close to the surface. Oxides of iron aluminium and magnesium are lost to the ground water through ages. So, the ground water becomes enriched with those oxides. If by any natural means the ground water level goes down vertically or the region vertically moves up, then that ground water gets opportunity to be dried and in contact with air those oxide - rich elements become hard which we call **Laterites.**

Others are of the opinion that laterite is an end product of weathering. According to them, under high rainfall and temperature, particularly due to high temperature, silica gets solubilized and lost to underground water. Same is the fate for other soluble minerals except iron, aluminium and magnesium. Because they are not mobilized due to less acidity of the soil. So, they exist as end products of weathering when others are lost. This is how an incrustation develops composed of iron and other oxides of metallic cations.

Laterites are generally developed at the top of the mountains or hills. These have been developed in Karnataka, Kerala, Madhya Pradesh, Chattisgarh, Eastern ghats, Malabar coastal region, Orissa, Jharkhand and western part of West Bengal. These are called **High level laterites.** Due to weathering and erosion those high level laterites are deposited as detritus at the foot hills and get hardened in course of time and become laterites. This type of laterites developed at the foot hill regions are called **Low level laterites.**

Classification of laterites : The laterites formed under ideal conditions possess less silica and more oxides. Generally if the

silica : sesqui oxide ratio is less than 1, then it is called **true laterite**. And if the ratio varies between 1 – 2, then that type of soil is called **lateritic.**

Characteristic features of laterites : Laterities have certain characteristics such as (a) Due to greater concentration of oxides of metallic elements, the colour of the soil is red. Sometimes it becomes brown or yellowish. (b) While lying below the surface, it is very soft and may be cut by knives. But as soon as they are exposed to air they become hard like stones. (c)The laterites seem to be composed of honeycomb cells. This is called **Vessicular structure**. (d) The clay which is originated under laterites is kaolinitic in type whose water holding and cation exchange capacities are low. (e) This soil is more resistant to erosion due to the presence of iron and other oxides. (f) Since most of the mineral plant foods are lost to underground water the soil is considered to be poor. (g) The organic matter content is less. (h) Generally the percentage of iron in this soil is 40 – 45. Sometimes it becomes 86 percent. (i) Horizons are not distinctly developed in laterites.

Use of the soil : Generally laterite soils are agriculturally poor, because most of plant nutrients like Ca, Mg, K, Na etc. are lost or leached down. Besides the slag-like material which is developed near the surface is so hard that it is difficult to cultivate. However, if that incrustation is removed, then the cultivation becomes possible. The yield is also good. However, this soil is suitable for plantation crops like cocoa, coffee, rubber, cashew nut, banana etc. In the river valleys paddy, maize, tobacco, oil seeds, cotton, hemp, jute, ground nut vegetables can be cultivated. Slag like materials are used for building materials and the ground laterites are used for roads.

Lateritic soils : Laterites and lateritic soils are developed between 30°N – 30° S. latitudes. The entire region is climatically hot. So, temperature remains high throughout the year. However, there is wide variation in rainfall. In spite of variations in rainfall, due high temperature there is deposition of oxides: So, the colour of the soil is red. Depending on the percentage of oxides and degree of hydration the colour may vary and various types of lateritic soils are developed such as **red-yellow podsolic soils, yellow-brown lateritic soil, reddish prairie soils, red-brown soil, reddish desertic soil** etc.

Answer the following questions

1) Differentiate between pedocal and pedalfer? (5)

2) Why are chernozem soils fertile? (5)

3) What are sesquioxides? (2)

4) What is vesicular structure? (2)

5) Why are laterite soils not fertile? (5)

6) What is meant by hard pan? In which type of soil are hard pans seen. (2)

7) Write 5 points of difference between podsol and chernozem soil. (10)