PART II GEOGRAPHY HONS.
(1+1+1 SYSTEM)

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CHERNOZEM SOIL

Literally translated the Russian word Chernozem means *black earth*. Chernozem represents a process of soil formation in the Steppe region where the climate may be referred to as semiarid-subhumid. Chernozem however stands for more than just black.

Geographic Distribution :

In Europe, the Chernozem extends according to the map of Glinka, as published by Prasolov in a belt running southwest to northeast through northern Bulgaria, Hungary, Galicia, Rumania & Russia. In the western part, it is found approximately at the parallel 45^0N latitude and in the eastern part, at the parallel 57^0N latitude.

In Asia, the chernozem belt is an extension of the European belt and terminates approximately at the meridian 93^0Longitude east of Greenwich. A few scattered area of chernozem and chernozem like soils are found in northern China.

In North America, the Chernozem belt runs from North to South between the parallels 50^0 and 27^0 north latitude. In the United States, it occupies approximately three-fourth of North Dakota, one-half of South Dakota & Nebraska, three-fourths of Kansas, one-half of Oklahama & Texas. To these we have to add the Prairies soils of Minnesota, Iowa, Illinois, Missouri, Kanasas, Oklahama & Texas. Some chernozem and prairie soils are to be found in Idaho, Oregon& Washington. The chernozem soils occupy an area of 280,000 sq. miles and the Prairie soils 283,500 sq. miles.

In South America and Meridional belt there is a definite process of soil formation which is observed between the meridians 55^0 & 65^0 longitude west of Greenwich. The chernozeem and chernozem like soil is located between parallels 26^0 and 38^0 south latitudes. The nature of these soils has not been clarified. It appears that they are of the southern variety of chernozem.

Climate :

The general features of the climate in the Chernozem zone has been elucidated by Dokuchaev. They are continentality, deficiency of rainfall, low humidity, hot summer, cold summers and short fluctuations in temperature (the annual average for Russia being 5^0c. The rainfall deficiency is caused not so much by the low rainfall as by the character of fall 7 seasonal distribution. In the Steppe regions, the rain comes frequently in downpours, resulting in considerable runoff. The highest fall comes during the summer. Because of the high temperatures, low humidity and high evaporation, less moisture is available for percolation and leaching. In Siberia, precipitation is in places as low as 300mm.

Parent Material:

Chernozem is found in a great variety of soil textures, mostly of the heavy types-the loams. The principal parent material of the vast region of Chernozem in Russia is loess. Large areas of Chernozom are located on lime marks, limestone, basalt, granite, sandstones and others. In the United States, the typical Chernozem soils, the Barnes series(North Dakota, South Dakota and Western Minnesota)have originated on glacial drift, of the Boyd series-on Cretaceous Shales, the Holt series on Tertiary sandstones. Some of the Prarie soils have developed on cherty limestone, calcareous glacial drift, fine grained sandstone, limestone and many types of rocks of various geologic ages. Vast areas of Chernozem soils lie on loess.

Natural Vegetation :

Long and small grasses are typical in chernozem region. But in some transitional areas , woody temperate deciduous forests are attached with it.

Topography :

Almost plain or slightly undulating type of topography helps to form chernozem. It is absent in steep slopes.

Drainage :

The areas with good aeration system helps in the permeability of water which favours chernozem formation. Chernozem has many more suborders. Profile characteristics for the suborder are rather well defined. With increasing precipitation, they become more pronounced as follows :

1. The colour of the surface soil changes from dark brown to black due to the greater accumulation of organic matter.

2. The thickness of horizons increases, especially the A horizon and the effect of organic matter on profile colour extends to greater depths in the profile.

3. Structure becomes more apparent, crumb or granular in the A and block or prismatic in the B horizon. Textural profiles, probably due to development of clay in place, do occur.

4. The depth to a lime layer increases until, in the Prairie soils, the layer disappears. Only traces of soluble salts are found. Calcium & magnesium dominate and exchange complex.

5. The reaction of the surface soil varies from near neutral in the drier zones to slightly acid in the prairie soils.

Profile of Chernozem :

A typical Chernozem profile possesses the following morphological characteristics :

A_0 - A mat of dead grasses and stems, stunted with the surface of the sod and generally 0.5 to 1 inch thick.

A_1- Dark brown to black depending on effective precipitation. The colour being more pronounced when wet 12-24 inches and more in depth. Organic matter content is high from 4% - 15% decreasing gradually with depth. The increase of depth is more rapid in the cooler climates where organic matter is not oxidized so readily. Structure ranges from granular to crumby. The aggregates are more stable and do not shake even when subjected to heavy rains. Aeration and water intake are ideal under structural conditions.

A_2- Similar to A in colour and depth. The organic matter content is still appreciable even at the bottom of the horizon. The structure is granular to crumby in the upper layer and blocky to cloddy in the lower one. In some cases specially in the regions close to the chestnut brown soils this horizon frequently contains free lime.

B – Pale reddish in colour and 15-25 inches deep. Structure is well defined and may vary from lumpy to powdery and sometimes magnesium carbonates in the form of speck veins and some layers are abundant. In some soils spots are apparent. These are designated by Russians as being white spots in southern variety. In Chernozem of Russia, gypsum is sometimes found in the lower layers of the horizon.

C – Loess is the usual parent material of Chernozem. This fact does not ensure the formation of Chernozem on other parent materials such as granite, basalt, limestones and other rocks. There is however one condition that parent material must fulfill before it can form Chernozem namely it must contain calcium sandstone . Parent material rich or lacking in Ca does not form Chernozem even in the midst of the Chernozem zones.

Formation :

1. **Transportation of basic materials through Leaching-**

During the onset of spring and winter the amount of rainfall increases and the accumulated salt which occurs during summer washed downward. After during dry summer, the rate of humification and mineralization increases. The soil organisms remain dormant during winter to onset of spring. Thus the infiltrated water remain as free H_2Co_3.But in wet spring and summer, these react with organic matter and form carbonic acid which transforms Ca into $Ca(HCO_3)_2$.Like this it goes downward and accumulated in the lower part of 'A' or 'B' horizon as carbonates. Again sometimes calcium and magnesium as upward by capillary action and stay in some parts of the profile.

$$H_2CO_3 + Ca \longrightarrow Ca(HCO_3)_2$$

$$Ca(HCO_3)_2 \xrightarrow[CO_2]{heat} CaCO_3 + H_2O + C$$

During winter the upper layer is covered with snow and the temperature, soil air is more than the temperature of the upper air. Thus the vapour pressure of soil increases. So the soil vapour increases to the upper part. But condensation due to cooling effect helps to become water gain and comes downward. This some amount becomes washed.

Among basic materials Sodium and Potassium are totally removed. But some amount of sodium and some amount of Potassium are fixed by rich complex. Some amount of phosphorus accumulated and no transportation occurs case and sesquioxides.

2.Accumulation of Organic Matter :

The amount of organic matter in chernozem profile is more in 'A' horizon and decreases towards downward. From spring to summer the grasses are developed. Their dead bodies add organic material to the soil. But these are readily decomposed due to lack of humus. Again organic colloids become stabilized. Thus chernozem soils have more organic matter in their upper layers.

According to Ivanov, Ca has a great role to play in accumulation of cation. They help in coagulation of organic colloids. Thus chernozem has a special granular situ. Due to this the soil becomes dry upto a great depth and the organisms becomes almost dormant and accumulation of organic matter occur.

3.Humates & Sesquioxides

In areas with high pH the aluminium and iron silicates are hydrolysed i.e. the silicate ions are replaced by hydroxide ions. Thus lot of silica becomes free. The soil becomes rich with silica and some amount remain as silicic acid. But due to less precipitation, some bases are there in the soil & a soluble compound is formed. These compounds coagulate the negative colloids. Again humanates attract Ca^{++}& Mg^{++}ions. Thus they become stabilized after saturation due to positive ions.

4.Soluble Organic Matter

These have very low amount of soluble organic matter but it is 55%. Those are soluble gases downward and accumulate some organic matter transported.

Agricultural Productivity :

Chernozem soils are known in the world over for their productivity. They contain large quantities of organic matter and abumdant supply of mineral nutrients. Wheat and other foodgrains are the principal crops in all the parts of chernozem belts.