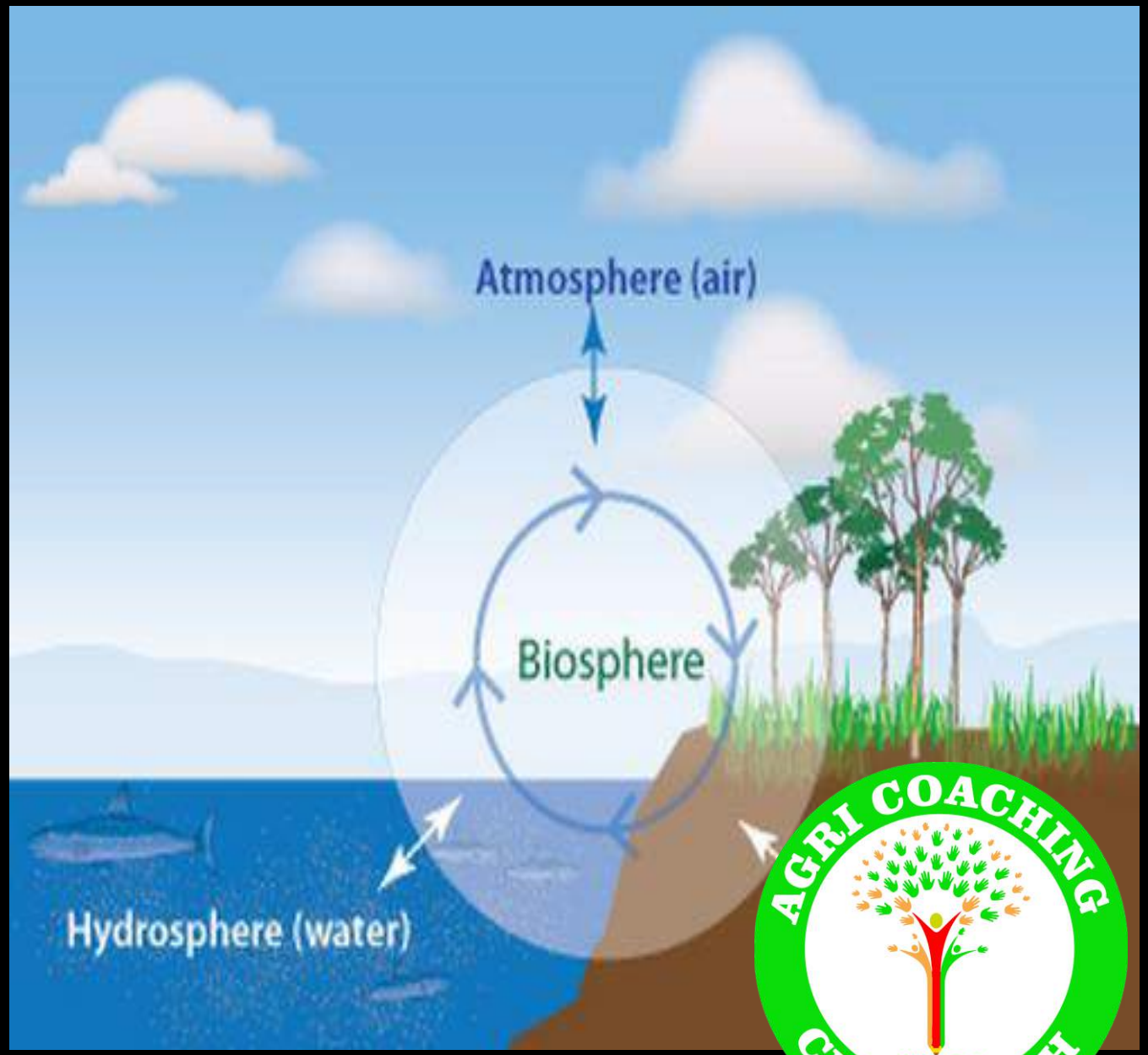
Soil Science

AGRI COACHING
SINCE 2016
CHANDIGARH

- Three spheres, corresponding to the three states of matter **(solid, liquid and gas)** constitute the earth.
- The solid zone is **lithosphere**
- Land which is covered by water forming seas and oceans is the **hydrosphere**
- The gaseous envelope over the earth’s surface is the **atmosphere**.



- **Pedology:** Formation, chemistry, morphology and classification of soil)
- **Edaphology:** Influence of soil on organisms, especially plants.

What is Land & Soil?

Land is broadly defined as total natural environment of the areas of the earth not covered by water.

In addition to soil, its attributes include all the living organisms, the air and water bodies with in or on it and rocks below.

Solum which means floor or ground. A soil scientist call **soil**, a geologist may call **fragmented Rock** And Engineering may call **earth** and economic may call **land**.

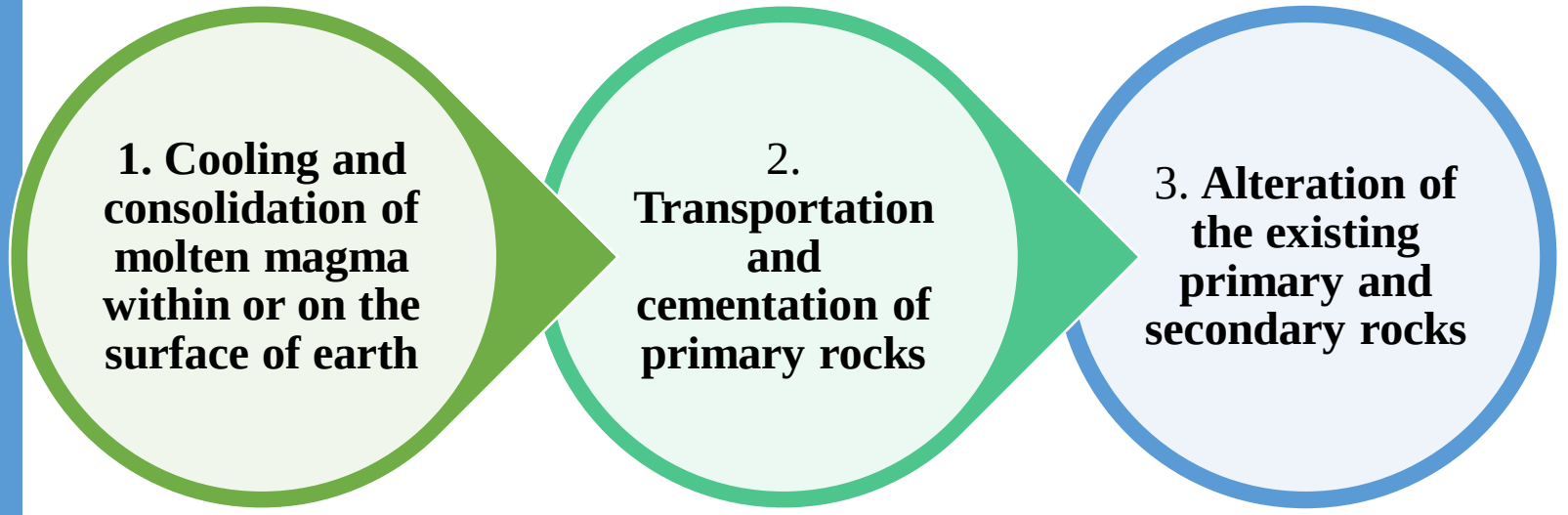
Concept of Land and Soil

Component of Soil

Rocks

- The rocks are generally composed of two or more minerals.
- Petrology Greek, *petra* means *rock, logos* means *science*) deals with science of rocks. It consists of:
- i) ***Petrography*** which deals with description of rocks
- ii) ***Petrogenesis*** which is the study of the origin of rocks.

Formation of rocks



Geologists have classified rocks into three major groups

- Igneous
- Sedimentary
- Metamorphic

TYPES OF ROCKS

IGNEOUS

Granite

Scoria

Pumice

Obsidian

SEDIMENTARY

Sandstone

Limestone

Shale

Conglomerate

Gypsum

METAMORPHIC

Marble

Slate

Quartzite

Gneiss

Weathering

- **Weathering is the process of transformation of solid rocks into parent material or Regolith.**

Weathering happens through three major ways, namely:

- Physical Weathering
- Chemical weathering
- Biological Weathering

Soil Forming Factors

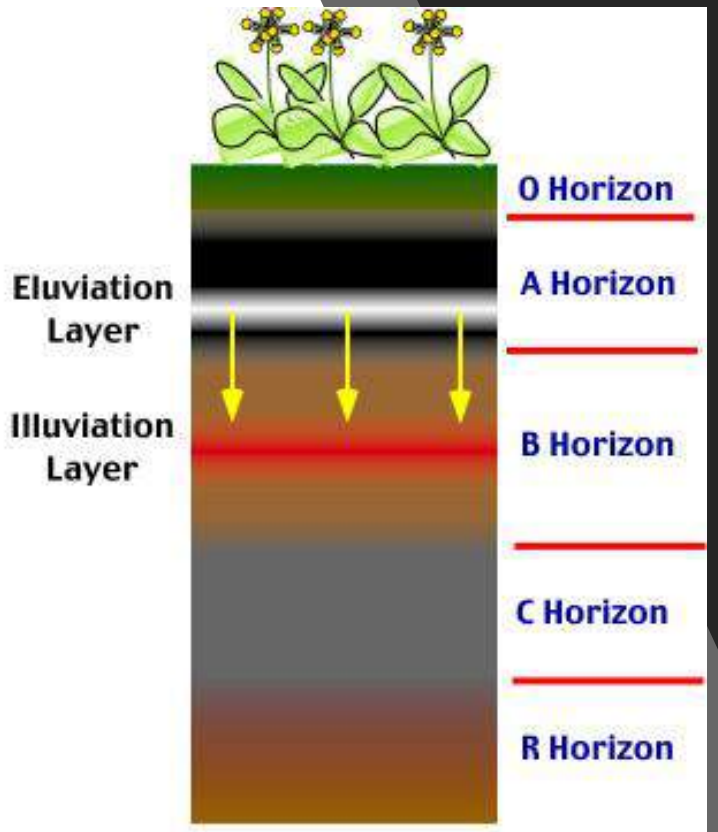
The soil formation is the process of two consecutive stages.

1. The weathering of rock (R) into Regolith

2. The formation of true soil from Regolith

Fundamental Soil forming Processes

- **Eluviation**: It is the mobilization and translocation of certain minerals in the soil.
- **Eluviation** means washing out. It is the process of removal of constituents in suspension or solution by the percolating water from the upper to lower layers. **(RRB SO-2019)**



- **Illuviation:** The process of deposition of soil materials (removed from the eluvial horizon) in the lower layer (or horizon of gains having the property of stabilizing translocated clay materials) is termed as Illuviation.
- B horizon refers to the zone of illuviation.**(AFO-2020)**

The minerals in the soil are classified into two categories:

Primary Minerals in soil

Secondary Minerals in soil

Table . : Primary and secondary minerals found in soils.

Primary Minerals		Secondary Minerals	
Name	**Formula**	**Name**	**Formula**
Quartz	(SiO_2)	Geothite	(FeOOH)
Muscovite	$[KAl_3Si_3O_{10}(OH)_2]$	Hemactite	(Fe_2O_3)
Orthoclase	$[KAlSi_3O_8]$	Gibbsite	$(Al_2O_3.3H_2O)$
Biotite	$[KAl(Mg,Fe)_3Si_3O_{10}(OH)_2]$	Clay minerals	Aluminium silicates
Alibite	$[NaAlSi_3O_8]$	Dolomite	$[CaMg(CO_3)_2]$
Hornblende	$[Ca_2Al_2Mg_2Fe_3Si_6O_{22}(OH)_2]$	Calcite	$CaCO_3$
Augite	$[Ca_2(Al,Fe)_4(Mg\ ,\ Fe)_4Si_6O_{24}]$	Gypsum	$CaSO_4.2H_2O$
Anorthite	$[Ca\ Al_2Si_2O_8]$		
Olivine	$[(Mg,\ Fe)_2SiO_4]$		
Mica	$[K_2(Si_6Al_2)Al_4O_{20}(OH)_2]$		

Important Soil Properties

- Infiltration
- Drainage
- Depth
- Available Water Holding Capacity
- Reaction
- Cation Exchange Capacity
- Landscape Position

Soil texture

- **Soil texture** refers to the **relative proportion of particles or it is the relative percentage** by weight of the three soil separates viz., **sand, silt and clay.**
- The proportion of each size group in a given soil (the texture) **cannot be easily altered** and it is considered as a basic property of a soil.

Size of The Particles (In Soil Texture)

- Particle size is determined by the diameter of individual soil fragments.

According to the International system of soil classification ,size of different particle are as follows

Soil	Size
Clay	less than 0.002 mm
Slits	0.002mm to 0.02mm
Sand	0.02mm to 2.0mm
Gravel	larger than 2.0 mm

Classification by USDA

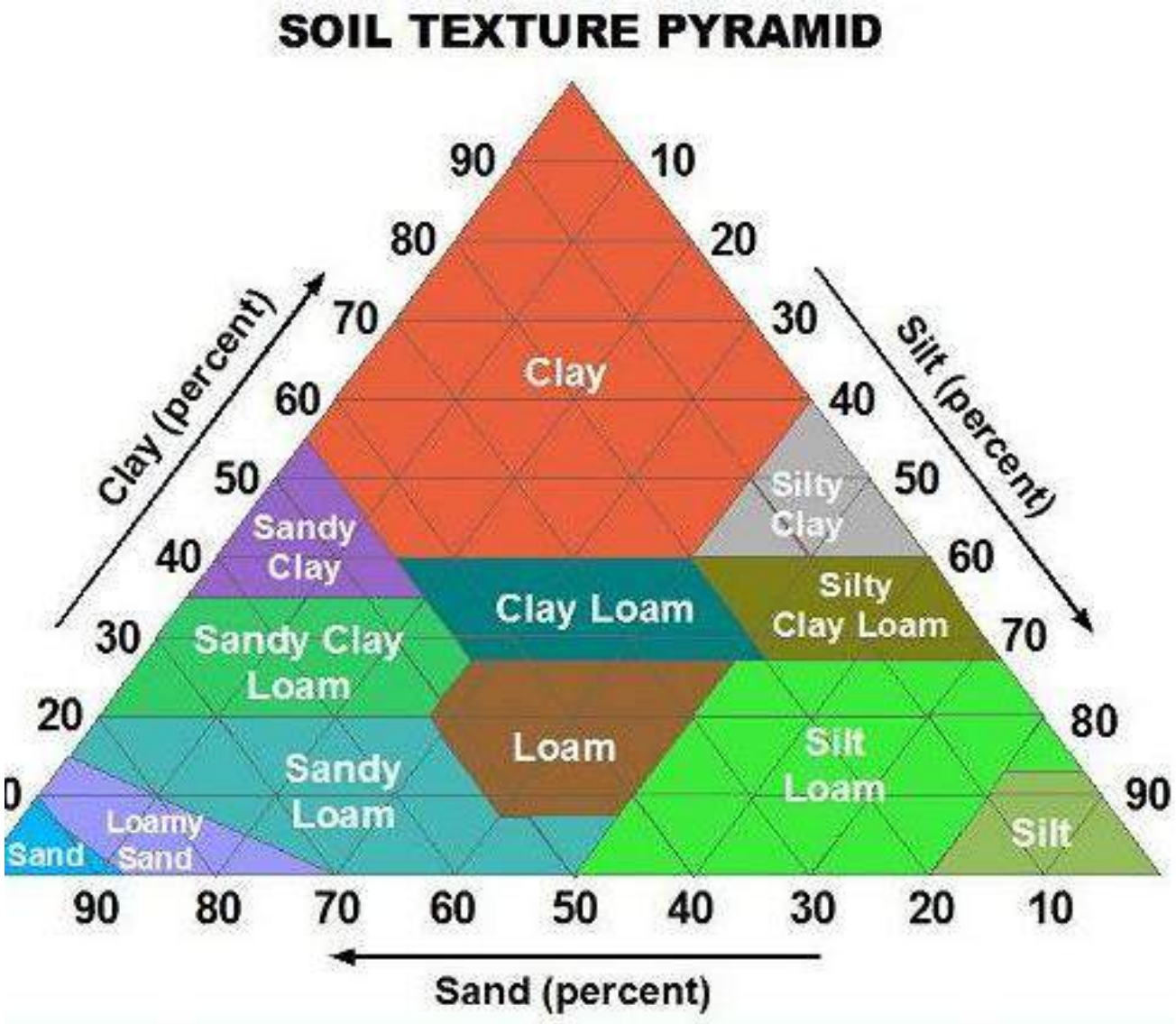
Soil Separates	Diameter (mm)
Clay	<0.002
Silt	0.002-0.05
Very Fine Sand	0.05-0.10
Fine Sand	0.10-0.25
Medium Sand	0.25-0.50
Coarse Sand	0.50-1.00
Very Coarse Sand	1.00-2.00

Classification by ISSS

Soil Separates	Diameter (mm)
Clay	<0.002
Silt	0.002-0.02
Fine Sand	0.02-0.2
Coarse Sand	0.2-2.0

Soil textural classes

- To convey an idea of the textural make up of soils and to give an indication of their physical properties, soil textural class names are used.



SERIAL NUMBER	SOIL CLASSES OR TEXTURAL NAMES	RANGE IN RELATIVE PERCENTAGE OF SOIL SEPARATES		
		SAND	SILT	CLAY
1	Sandy soil	85-100	0-15	0-10
2	Loamy sand	70-90	0-30	0-15
3	Sandy loam	43-80	0-50	0-20
4	Loam	23-52	28-50	7-27
5	Silt loam	0-50	50-88	0-27
6	Silt	0-20	40-100	0-12
7	Sandy clay loam	45-80	0-28	20-35
8	Clay loam	20-45	15-53	27-40
9	Silty clay loam	0-20	40-73	27-40
10	Sandy clay	45-65	0-20	35-45
11	Silt clay	0-20	40-60	40-60
12	Clay	0-45	0-40	40-100

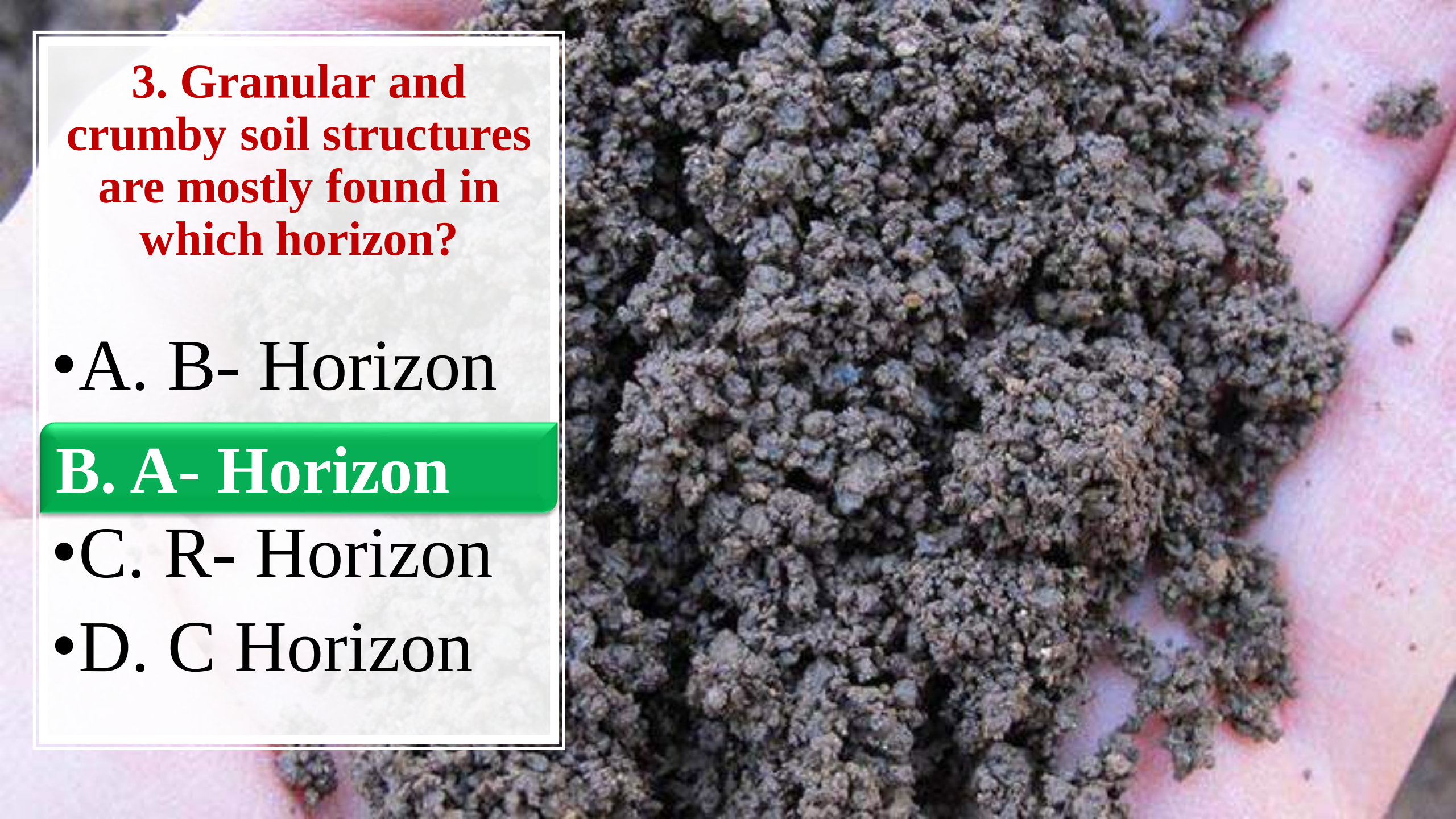
From This data question was asked in NABARD-2019

Soil structure

- The **arrangement and organization of primary and secondary particles** in a soil mass is known as **soil structure**.
- **Soil conditions** and characteristics such as water movement, heat transfer, aeration, and porosity are much influenced by structure.

3. Granular and crumby soil structures are mostly found in which horizon?

- A. B- Horizon
- **B. A- Horizon**
- C. R- Horizon
- D. C Horizon



Effect of Soil Structure on other Physical Properties

Porosity

Temperature

Consistence

Colour

Root penetration

The role of soil structure in relation to plant growth

- **Soil structure** influences the amount and nature of porosity.
- Structure controls the amount of water and air present in the soil. Not only the amount of water and air dependent on soil structure, but their movement and circulation are also controlled by soil structure.
- **It affects tillage practices.**
- **Structure controls runoff and erosion.**
- **Platy structure** normally hinders free drainage whereas sphere like structure (granular and crumby) helps in drainage.
- **Crumby** and granular structure provides optimum infiltration, water holding capacity, aeration and drainage. It also provides good habitat for microorganisms and supply of nutrients.

4. What is the particle density of silt soil?

- A. 2.655
- B. 2.837
- **C. 2.798**
- D. 2.659

Consistence

- **Soil consistence** is defined as “the resistance of a soil at various moisture contents to mechanical stresses or manipulations”
- It combines both the ‘**cohesive**’ and ‘**adhesive**’ forces, which determine the ease with which a soil can be reshaped or ruptures.

Consistence

Plasticity is the degree to which a reworked soil can be permanently deformed without rupturing. Plasticity is evaluated by forming a roll (wire) of soil that is 4 cm long.

The plasticity index (PI) is a measure of the plasticity of a soil.

Bulk density and particle density of soils & porosity

- **Particle Density:** The weight per unit volume of the solid portion of soil is called particle density.
- Generally particle density of normal soils is 2.65 grams per cubic centimeter.
- The particle density is higher if large amount of heavy minerals such as magnetite, limonite and hematite are present in the soil.
- Particle density is also termed as true density.

Textural classes	Particle density (g/ cm3)
Coarse sand	2.655
Fine sand	2.659
Silt	2.798
Clay	2.837

Important data

Bulk Density

- The **oven dry weight** of a unit volume of soil inclusive of pore spaces is called **bulk density**.
- **The bulk density of a soil is always smaller than its particle density.**
- As a rule of, most rocks have a density of 2.65 g/cm3 so ideally, a silt loam soil has **50% pore space** and a bulk density of **1.33 g/cm3.**
- The bulk density of sandy soil is about **1.6 g / cm3**, whereas that of organic matter is about **0.5.**
- Bulk density normally decreases, as mineral soils become finer in texture.

- The **bulk density** varies indirectly with the total pore space present in the soil and gives a good estimate of the porosity of the soil.
- **Bulk density** is of greater importance than particle density in understanding the physical behavior of the soil.
- Generally soils with low bulk densities have favorable physical conditions.

Bulk density of different textural classes

Textural class	Bulk density (g/cc)	Pore space (%)
Sandy soil	1.6	40
Loam	1.4	47
Silt loam	1.3	50
Clay	1.1	58

Porosity

- **Soil porosity** refers to that **part of a soil volume that is not occupied by soil particles or organic matter.**
- In sandy soils, the particles are arranged closely and the pore space is low. In clay soils, the particles are arranged as well aggregates and the pore space is high.
- **Presence of organic matter increases** the pore space.
- **Virgin soils** have more pore space
- Conservation tillage and no tillage reduces porosity than conventional tillage

Size of pores

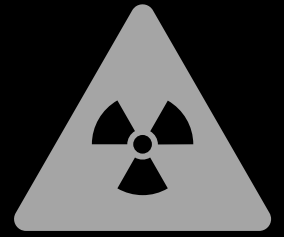
- **1. Macro pores (non-capillary pores) :** diameter >0.05 mm
- **2. Micro pores (capillary pores) :** diameter < 0.05 mm
- In macro pores, air and water moves freely due to gravitation and mass flow. In micro pores, the movement of air and water is very slow and restricted to capillary movement and diffusion.
- **Sandy soil have more macro pores** and clay soils have more micro pores.
- So in sandy soils, water and air movement is rapid due to macro pores though the pore space is higher and in clay soils the air and water is slower due to micro pores though the total pore space is higher.

Calculate the % porosity

- A soil sample has a weight of 0.7 kg. Bulk density is 1.33 g/cc and particle density is 2.659 g/cm3.

Formula to calculate Porosity

% porosity =



100 - (bulk density / particle density) x 100

Which soil shows the characteristic of shrink swell Potential?

A. Black soil

- B. Red Soil
- C. Alluvial soil
- D. Dessert soil

Shrink-swell Potential

- **Shrink-swell potential** is a measurement of the amount of volume change that can occur when a soil wets and dries.
- Most of this **volume change is due to the clay fraction of the soil.**
- **Clays swell when wet and shrink when dry.**
- **Montmorillonite tend to have high shrink-swell potentials.**
- And **kaolinite tend to have low shrink-swell potentials.**

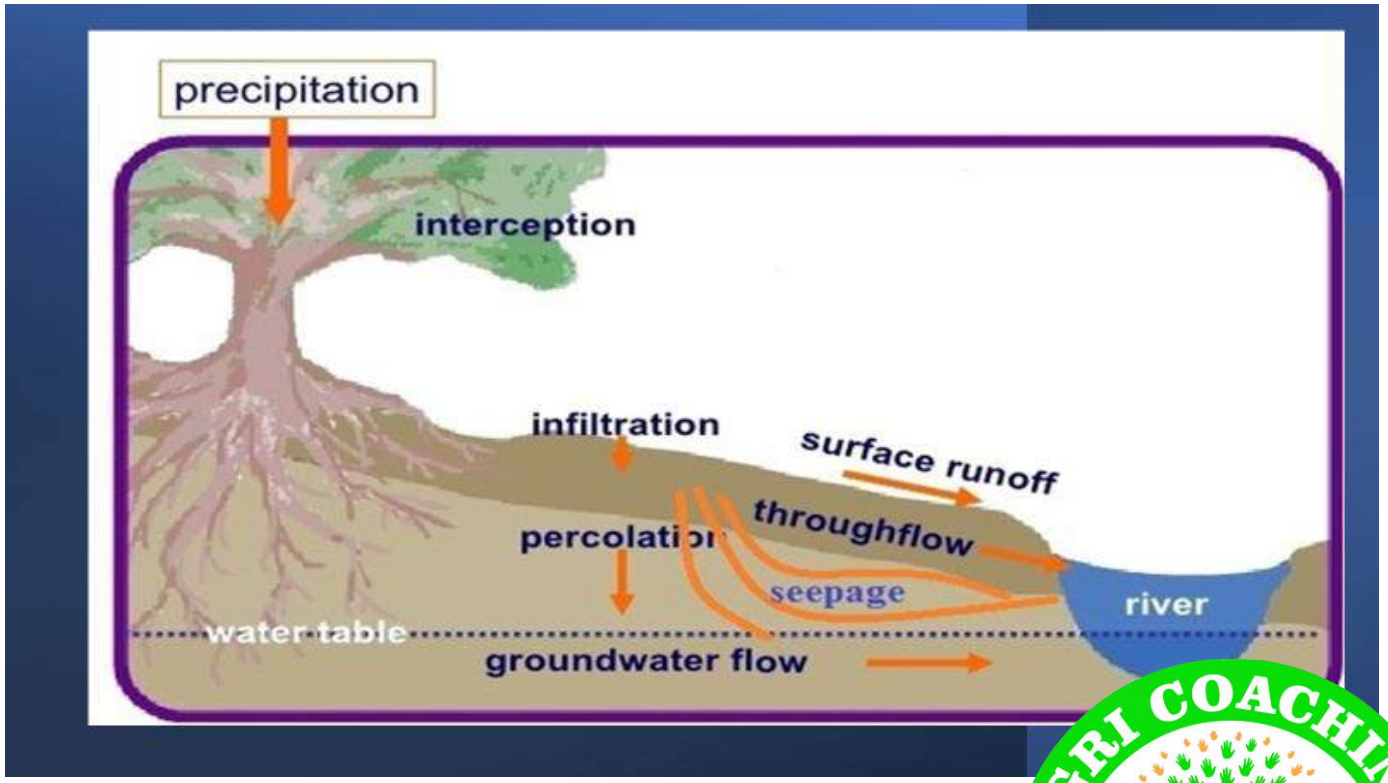
Shrink-swell Potential

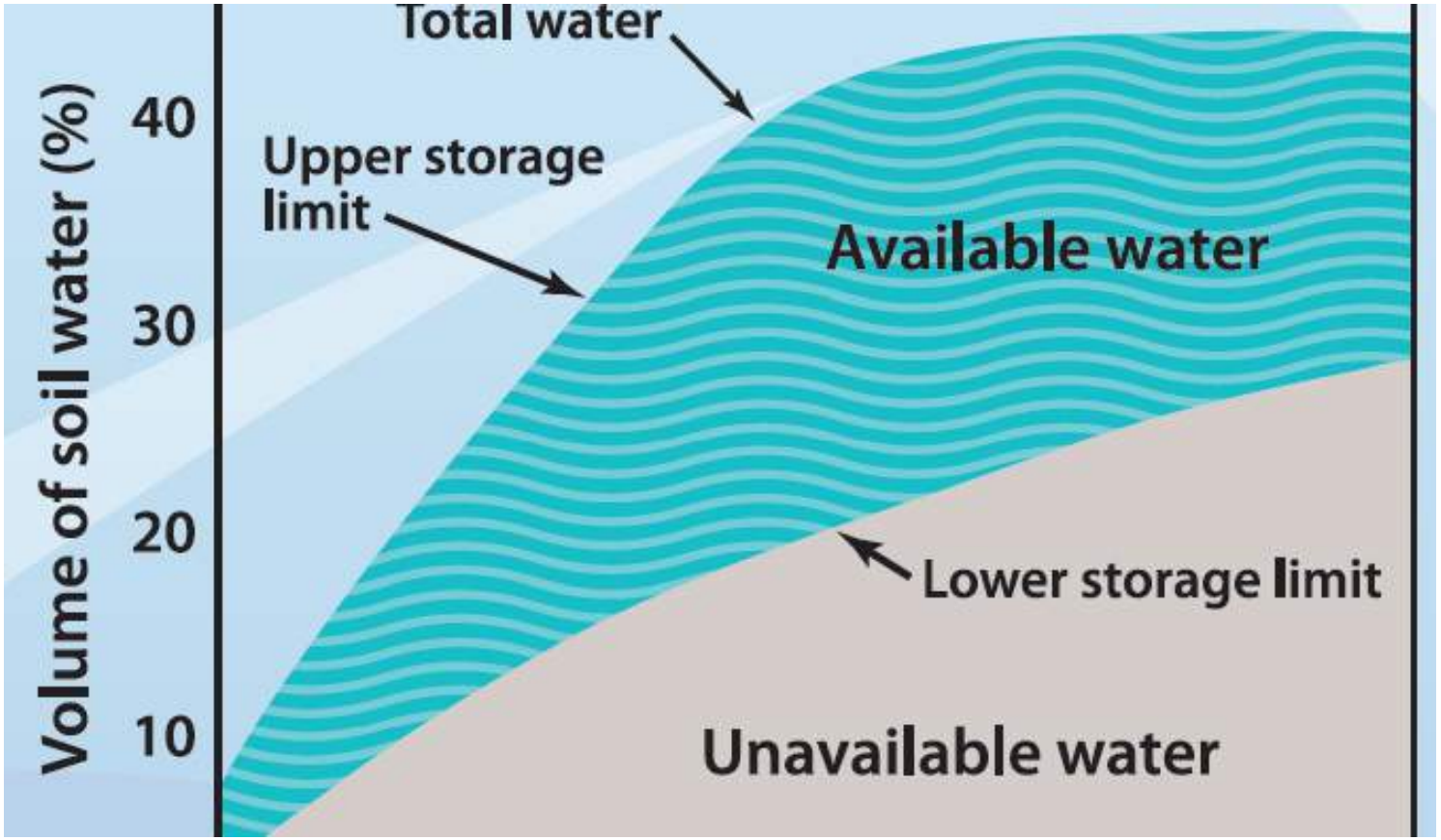
Drainage

- **Drainage** refers to the **frequency and duration of periods of saturation or partial saturation.**
- Internal soil drainage is important because of its effect on land use and management decisions.

Entry of Water into Soil

- The movement and filtration of water through soils and permeable rock is termed as Percolation **(AFO-2016, 2017)**





Available Water Holding Capacity

- The capacity of soils to hold water available for use by most plants.
- It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point.

Classes and availability of soil water

Gravitational water:	Capillary water:	Hygroscopic water:	Hygroscopic coefficient
Water moves freely in response to gravity.	Water held by surface tension in the pore spaces.	Water held tightly to the surface of the grains by adsorption.	Soil moisture decreased to wilting point water held tightly by soil particles (AFO-2020)

Gravitational <0.3 ATM or -1/3 bar

Capillary Water:

0.3-31 ATM (0.3-15 ATM) or -1/3 to -31 bars

Hygroscopic: >31 ATM (31-10000 ATM) or -10,000 bars

1 atm = 1.01325 bar

Soil moisture constants and range of tension

Moisture class	Tension (atm)	pF
Hygroscopic	31 to 10,000	4.50 to 7.00
Hygroscopic coefficient	31	4.50
Wilting point	15	4.20
Capillary	1/3 to 31	2.54 to 4.50
Field capacity	1/3	2.54
Gravitational	Zero or less than 1/3	<2.54

ASSESSMENT OF IRRIGATION WATER QUALITY

Based on soil salinity

Water Class	EC (dS m^{-1})	Remarks
C1 - Low salinity	0-0.25	Can be used safely
C2 - Medium salinity	0.25-0.75	Can be used with moderate leaching
C3 - High salinity	0.75-2.25	Can be used for irrigation purposes with some management practices.
C4 - Very high	2.25-5.00	Cannot be used for irrigation purposes

SODICITY HAZARD (RRB SO-2018)

Water Class	SAR	Remarks
S1: low sodium hazard	0-10	Little or no hazard
S2: medium sodium hazard	10-18	Appreciable hazard but can be used with appropriate management
S3: High sodium hazard	18-26	Unsatisfactory for most of the crops
S4: Very high sodium hazard	>26	Unsatisfactory for most of the crops

Types of soil in India

Major classification of Indian soils

Alluvial soil [43%]	Red soil [18.5%]	Black / regur soil [15%]	Arid / desert soil
Laterite soil (12%)	Saline soil	Peaty / marshy soil	Forest soil

Major soils of India and their orders

Soil	Order
Alluvial Soil	Entisol, Inceptisols and Alfisols
Black Soil	Vertisol (Max in Maharashtra) **(AFO-2020,RRB SO-2019)**
Red Soil	Alfisols
Laterite Soil	Ultisols
Desert Soil	Aridisol

Alluvial soil

- It is the **most important** type of soil found in India.
- Alluvial soils are **deficient in nitrogen and humus** and **phosphorus** therefore it requires **fertilizers**.
- Widespread in **northern plains and river valleys**.
- Highly fertile.
- **Indus-Ganga-Brahmaputra plain**, Narmada-Tapi plain etc are example.

- **They are depositional soil** – transported and deposited by rivers, streams etc.
- **New alluvium** is termed as **Khadar is sandy, light colour and less Kankar nodules.**
- **Old alluvium** is termed as **Bhangar full of clay, dark colour and more Kankar nodules.**
- The **khadar soil is more fertile** but less organic matter.
- The **bhangar soil** is less fertile but high in organic matter.

- **Rich in:** Potash.
- **Colour:** Light Grey to Ash Grey.
- **Texture:** Sandy to silty loam or clay
- Alluvial soils are **suitable for** production of crops of **rice, wheat, maize, sugar cane, tobacco, cotton, jute, oilseeds etc.**

Red soil

Red Soil

- **Seen mainly** in low **rainfall area, semi-arid areas**
- The pH values of most red soils (water extracted) range from **4.5-6.5.** The pH value of soils is influenced by parent materials. Soils formed in **limestone are normally higher than 5.5, but those from shale and slate lower than 5.0.**
- **Also Called Early soil.**
- **Low cation exchange capacity** and **low water holding capacity.**

- Red soil is always in **acidic nature.**
- Highly suitable for **groundnut crop cultivation.**
- **Texture:** Sandy to clay and loamy.
- Crops like **millets, pulses, oil seeds (ground nut, gingelly, castor) and tuber crops like cassava** are commonly cultivated

Black soil / regur soil

Black soil

- Regur means **cotton** – best soil for cotton cultivation, Not suitable for young plants before transplanting. **(RRB-2019)**

➢ **Mature soil, Also Called as Late Soil.**

➢ Dark-grey in colour due to clay-humus complex.

➢ The soil is rich in clay (montmorillonite) particles and has neutral to alkaline reaction.

- Horticulture nursery soil should be well drained, Black cotton soil type of soil is not suitable for nursery **(RRB SO-2018)**
- Typical characteristics of this black soil are **swelling (during wet period) and shrinkage (dry period)**
- **Self-ploughing** is a characteristic of the black soil as it develops wide cracks when dried.
- **Colour:** Deep black to light black.
- **Crops Grown:** Cotton, Bengal gram, mustard, millets, pulses, oil seeds (sunflower, safflower)
- **Texture:** Clayey.

Laterite soil

Laterite soil

- Laterite soils are formed due to the process of laterization. i.e., leaching of all cations leaving Fe and Al oxides.
- Lateritic soil is maximum in hills and gigantic plans. **(AFO-2017)**
- **Self-ploughing is characteristics like black soil (Shrink well potential)**
- Name from **Latin word 'Later'** which **means Brick.**
- **pH- 5-6**

- Seen in the areas of **high temperature and high rainfall.**
- **Rich in**: Iron and Aluminum
- **Deficient in**: Nitrogen, Potash, Phosphorous, Lime, Humus
- **Colour**: Red color due to iron oxide.
- Acid loving crops (Plantation crops) and fruits (pineapple, avocado) are more cultivated.
- **Tea, rubber, pepper, spices** are cultivated.

Peaty / marshy soil

- Peaty soil found in **Kerala** called as **kari**
- These are marshy soils and are a result of water logging and anaerobic conditions (which leads to partial decomposition of organic matter).
- These soils are characterized by a **rich humus and organic content.**
- **Areas of heavy rainfall and high humidity.**
- **Heavy soil** with **black color.**
- These are generally submerged during the rainy season and utilized for the cultivation of rice.

Soil Erosion

Soil erosion is the displacement of the upper layer of soil, one form of soil degradation.

A low level of erosion of soil is a naturally occurring process on all land.

Types of Erosion

Splash Erosion

Rill Erosion: minute finger like structures are formed if not taken care **(AFO-2020)**

Gully erosion

Ravine erosion

Valley Erosion

Sheet Erosion (occurs frequently during cloud bursts)

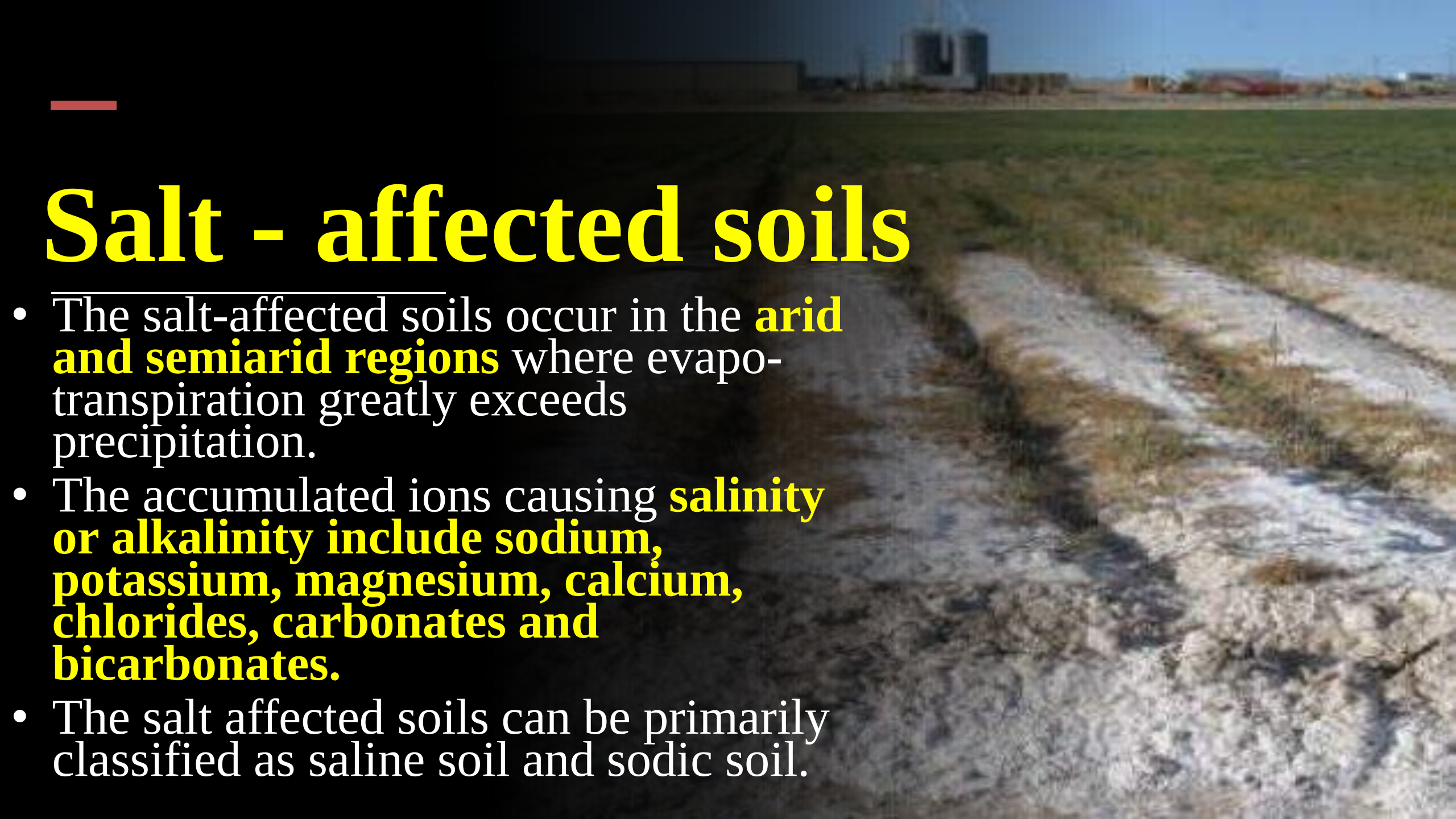
Wind erosion

Problematic soil

- **Acidic soil, Alkaline soil, Soil crusting, Hard Pan** are some of the major problem of the soil.

Salt - affected soils

- The salt-affected soils occur in the **arid and semiarid regions** where evapo-transpiration greatly exceeds precipitation.
- The accumulated ions causing **salinity or alkalinity include sodium, potassium, magnesium, calcium, chlorides, carbonates and bicarbonates.**
- The salt affected soils can be primarily classified as saline soil and sodic soil.



Extent and distribution of salt affected soils in India (AFO-2018)

Sr. No.	State	Saline soils (ha)	Alkali soils (ha)	Coastal saline soil (ha)	Total (ha)
1	Andhra Pradesh	0	196609	77598	274207
2	A & N islands	0	0	77000	77000
3	Bihar	47301	105852	0	153153
4	Gujarat	1218255	541430	462315	2222000
5	Haryana	49157	183399	0	232556
6	J & K*	0	17500	0	17500
7	Karnataka	1307	148136	586	150029
8	Kerala	0	0	20000	20000
9	Maharashtra	177093	422670	6996	606759
10	Madhya Pradesh	0	139720	0	139720
11	Orissa	0	0	147138	147138
12	Punjab	0	151717	0	151717
13	Rajasthan	195571	179371	0	374942
14	Tamil Nadu	0	354784	13231	368015
15	Uttar Pradesh	21989	1346971	0	1368960
16	West Bengal	0	0	441272	441272
	Total	1710673	3788159	1246136	6744968

Distribution of salt affected soils in Agro-climatic Zones

- **Highest:** Gujarat Plain and Hills Region> East Coast Plains and Hills Region> Upper Gangetic Plains Region.
- **Lowest:** Eastern Plateau & Hills Region> West Coast Plains and Hills Region> Island Region

Saline soil/White alkali-

- **Formation :** Common in arid and semi – arid regions having **annual rainfall less than 55cm.**
- Formerly these soils were called **white alkali soils** because of surface crust of white salts.

Reclamation of saline soil

- **Flooding** or **leaching** of soluble salts by good irrigation water.
- **Removal of excess salts** to a desired level in the **root zone**.
- **Use of FYM** for saline soil.

The relative salt tolerance of different crops is given in the table

From this data question was asked in AFO-2018, AICL-2018, NABARD-2019

Plant species	Threshold salinity (dS m-1)
Field crops	
Cotton	7.7
Sugar beet	7.0
Sorghum	6.8
Wheat	6.0
Soybean	5.0
Groundnut	3.2
Rice	3.0
Maize	1.7
Sugarcane	1.7

Alkaline soil /Sodic soil

- Dominant in mean **annual rainfall 55-90 cm** and relatively low lying areas with insufficient drainage.
- Alkali or sodic soil is defined as a **soil having a conductivity of the saturation extract less than 4 dS m^{-1} and an exchangeable sodium percentage greater than 15.**

Reclamation of Alkaline soil

- **Gypsum (CaSO4. 2H2O)(AFO 2015)** used for reclamation of **sodic or alkali soil**.
- **Iron pyrite** can be used for amendments of alkali soil.
- **Green manuring** should be adopted.
- **Cultivation of salt tolerant crop.**
- In case of saline soils **Gypsum shouldn't** be recommended because sulphate also increases salt concentration .

Saline-alkali/ sodic soils

- Saline-alkali / sodic soil is defined as a soil having a **conductivity of the saturation extract greater than 4 dS m-1** and an **exchangeable sodium percentage greater than 15.**
- The **pH is variable and usually above 8.5** depending on the relative amounts of exchangeable sodium and soluble salts.
- When soils dominated by **exchangeable sodium, the pH will be more than 8.5** and when soils dominated by soluble salts, the **pH will be less than 8.5.**

Parameters of different problematic soil

From This data 3 question was asked in AFO-2015,2018

Soil	pH	EC (dS /m)	ESP
Saline	< 8.5	> 4	< 15
Alkaline	> 8.5	< 4	> 15
Saline-Alkaline	> 8.5	> 4	> 15

Acidic soil

- Highest acidic soil found in **West Bengal**. (In Area)
- Acidity due to absorption of **Al^{+3}, Fe^{+2}, Mn** on soil colloids.
- In acid soil regions (ASR) precipitation exceeds the evapotranspiration and hence leaching is predominant causing loss of bases from the soil.

Production constraints

- **Increased** solubility and toxicity of **Al, Mn and Fe**
- **Deficiency of Ca and Mg**.
- Reduced availability of P and Mo.

Manures

- Manures are the **organic materials derived from animal, human and plant residues** which contain **plant nutrients in complex organic forms.**
- Manures with **low nutrient**, content per unit quantity have **longer residual effect** besides improving soil physical properties compared to fertilizer with high nutrient content.

Classification of organic manures

Manures

Bulky organic manures
-FYM
-Compost
-Night soil
-Green manures etc.

Concentrated organic manures
-Edible oil cake (Ground nut cake)
-Non edible oil cake (Neem, Castor etc.)
-Blood meal

Green Manure

Green Manure Crops

Green Leaf Manure

Nutrient content of Green Manure Crops

Plant	Scientific name	Nutrient content (%) on air dry basis		
		N	P2O5	K
Sunhemp	*Crotalaria juncea*	2.30	0.50	1.80
Dhaincha	***Sesbania aculeata***	**3.50**	**0.60**	**1.20**
Sesbania	*Sesbania speciosa*	2.71	0.53	2.21

Biomass production and N accumulation of green manure crops

Crop	Age (Days)	Dry matter (t/ha)	N accumulated
Sesbania aculeata	60	23.2	133
Sunhemp	60	30.6	134
Cow pea	60	23.2	74

Concentrated Organic Manures

- Concentrated organic manures have **higher nutrient content than bulky organic manure.**
- The important concentrated organic manures are **oilcakes, blood meal, fish manure etc.** These are also known as organic nitrogen fertilizer.

Fertilizers

- Fertilizer is any material of **synthetic origin** **added to the soil to supply one or more plant nutrients.**

Classification of Fertilizers

- Straight Fertilizers
- Complex Fertilizers
- Mixed Fertilizers

Classification Based on Nutrient

- Nitrogenous Fertilizers
- Phosphatic Fertilizers
- Potassic Fertilizers

The nitrogen content of different nitrogenous fertilizers (RRB SO-2018)

Name of the Fertilizer	N content (%)	Form of Nitrogen
Sodium Nitrate	16	Nitrate (NO_3)
Potassium Nitrate	12.5-13.5	Nitrate
Ammonium Sulphate	20.6	Ammonia (NH_4)
Ammonium Chloride	26	Ammonia (NH_4)
Ammonium Nitrate	33	NH4-16.5 NO3- 16.5

Name of the Fertilizer	N content (%)	Form of Nitrogen
Ammonium sulphate Nitrate	25.6	NH4-19.5 NO3- 6.6
CAN fertilizer is known as Kisan Khad	25 %	(AFO-2015,2019)
Urea	46	Amide
Calcium Cyanamide	20.6	Amide

Potassic fertilizers

- **Potassium chloride (KCI):** containing 60.0 per cent K2O.
- **Potassium sulphate (K_2S0_4):** contains 48 per cent K2O and 17.5 percent Sulphur.
- **Potassium Nitrate:** It contain 44% K2O, 13 % Nitrogen

Phosphatic Fertilizers

- **Single Super phosphate ($Ca(H_2PO_4)_2$):** It contains 16 Per cent P2O5, 19 Per cent Ca & 12 per cent S in available form.
- **Di-Ammonium phosphate:** It contain 18 percent nitrogen & 46 percent P2O5
- **MAP: Mono-ammonium phosphate**: It contain 12 % Nitrogen and 48 % P2O5
- **Basic slag**: It contain 14-18 P2O5
- **DCP:** Citrate soluble fertilizer but water insoluble **(RRB SO-2019)**

Bio Fertilizers

- “Biofertilizers are **substances that contain microorganisms,** which when added to the soil **increase its fertility and promotes plant growth.**”

Types of Biofertilizers

- Symbiotic Nitrogen Fixing Bacteria
- Loose Association of Nitrogen-Fixing Bacteria
- Symbiotic Nitrogen-Fixing Cyanobacteria
- Free-Living Nitrogen-Fixing Bacteria

Nitrogen Fixers (AFO-2020,RRB SO-2019)

Type	Particulars
Free living	**Aerobic** – Azotobacter , Beijerinckia, Anabaena **Anaerobic** – Clostridium (grows well in waterlogged soil)**(AFO-2015)** **Facultative anaerobic** – Klebsiella
Symbiotic	Rhizobium, Frankia, Anabaena azollae
Associative symbiotic	Azospirillum

Phosphorus mobilizers

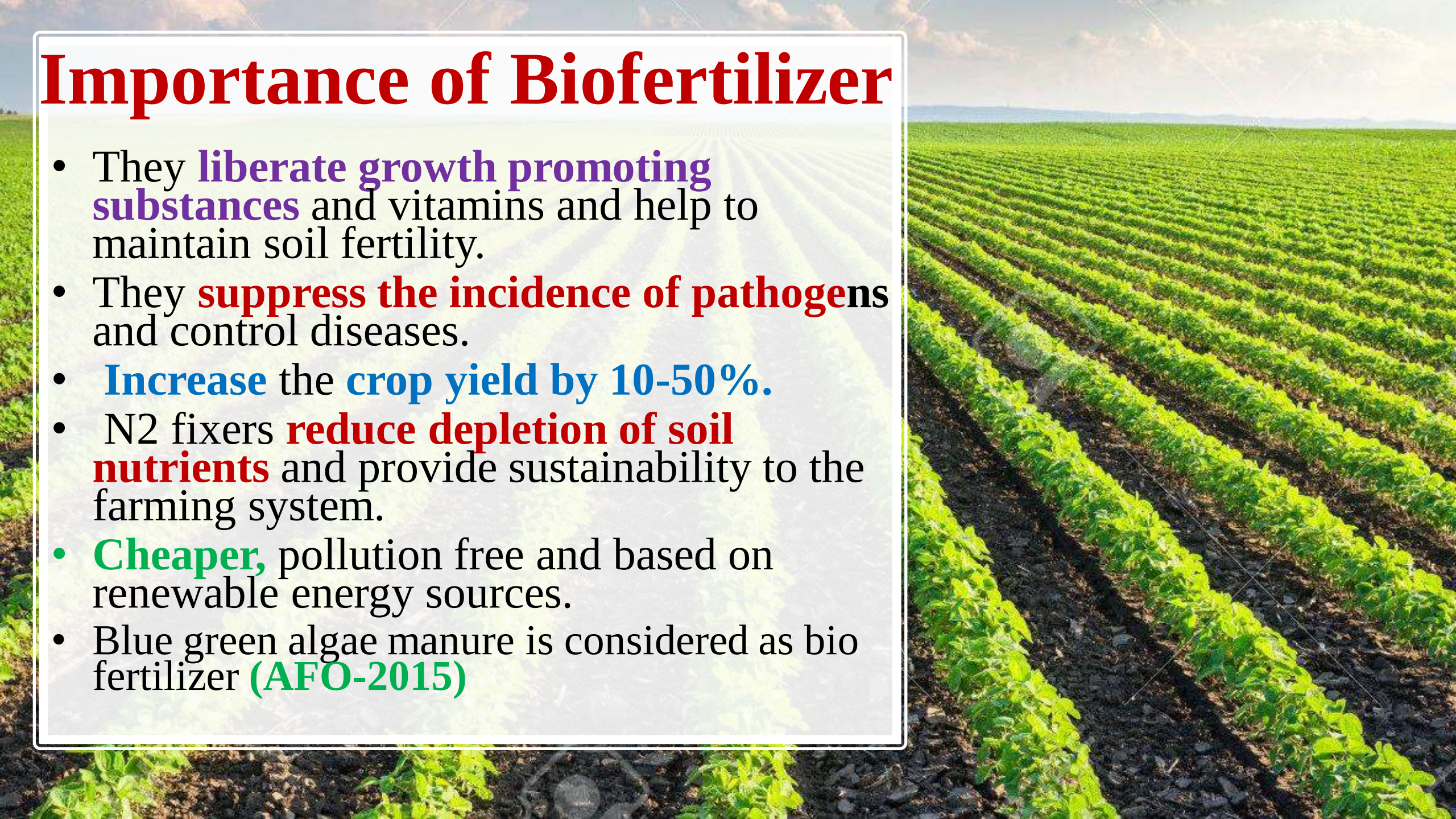
Types	Examples
Arbuscular mycorrhiza fungi	Glomus sp.,Gigaspora sp.,Acaulospora sp., Scutellospora sp. & Sclerocystis sp.
Ectomycorrhizal fungi	Laccaria sp., Pisolithus sp., Boletus sp., Amanita sp.
Ericoid Mycorrhiza	Pezizella ericae
Orchid mycorrhiza	Rhizoctonia solani

Silicate and Zinc solubilizers: Bacillus sp,

Plant growth promoting Rhizobacteria: Pseudomans spp.

Importance of Biofertilizer

- They **liberate growth promoting substances** and vitamins and help to maintain soil fertility.
- They **suppress the incidence of pathogens** and control diseases.
- **Increase** the **crop yield by 10-50%.**
- N2 fixers **reduce depletion of soil nutrients** and provide sustainability to the farming system.
- **Cheaper,** pollution free and based on renewable energy sources.
- Blue green algae manure is considered as bio fertilizer **(AFO-2015)**




FACTS

1. **Salt index** of irrigation water is **positive, it indicates Water is harmful for irrigation. (Raj Pre-Pg-2019)**
2. **pF value 4.18** indicates: **Wilting Point**
3. The bacteria which solubilize the insoluble phosphate: **Bacillus megaterium**
4. The capacity of a soil to resist appreciable change in pH value is called: **Buffering capacity**
5. **Black cotton soil** covers the largest area in **Madhya Pradesh**.
6. **Non-essential** but useful elements for plants would be: **Vanadium and sodium**
7. **Dominant mineral** in Vertisol: **Smectite (Montmorillonite)**
8. Calcium content in **gypsum:29.4%**
9. **Optimum time of application of farmyard manure** of crop is one month before sowing of Crop **(Rajasthan agriculture service prelims general agriculture 2010)**
10. Under waterlogged condition which nutrient occurs in toxic condition is **iron (Gujarat public service commission 2013)**

1. Soil having **more than 30% organic matter** is place in **histosols (Gujarat public service commission 2013)**

2. Biogas slurry also used as -: **Bulky organic manure (MCAER-2015) & (MCAER-2017)**

3.Sulphur containing amino acids -: **Cystine (MCAER-2019)**

4. Which biofertilizer used in sugarcane -: **Azotobacter (MCAER-2018)**

5. Press mud is one of the byproduct of -: **Sugarcane industry (MCAER-2015) & (MCAER-2017)**

6. Natural aggregates which vary in their water stability are- **Peds**

7. Most important **natural oxidant** is - **vitamin K**

8. The **inherent property of soil** to provide available nutrient - **soil fertility**

9. Property of toughness and capacity of soil to be moulded is **– plasticity**

10. Which of the following does not influence the soil structure**:** **base exchange**

1. For most of the mineral soil particle density ranges: **2.6-2.75mg/m3**
2. The zinc % in Zn-EDTA is **12% (BHU PG 2013)**
3. **Wilting point** in most soils in the region of **field capacity is -50%**
4. The **low content of organic carbon** in the Indian soil has been attributed to-**excessive tillage, Burning crop residue**
5. Which type of soil fix more phosphate –**acidic soil**
6. **PF** value for field capacity is **2.4**
7. **Bulk density** for organic matter is **0.5**
8. Which is major soil order in India **Alluvial soil (43%).**
9. **Khadar and Bhangar** terms are related to **Alluvial soil.**
10. Tensiometer are not suitable for which soil - **Clay soil (JRF, UPCATET)**

1. The harmful ingredients in bricks earth-**iron pyrites**

2. Which soils are ideal for most of crops because of inadequate nutrient and water availability and well drain condition –**Loamy soil**

3. Which soil occurs mainly soil crust **problems-silt clay soil**

4. Which one of the following irrigation method is best suited for an **undulating topography Sprinkler irrigation. (M.Sc. NOTES)**

5. The size of the clay particle in soil falls in one of the ranges: **<0.002mm.**

6. The **availability of molybdenum** is more at: **pH – 9.0.**

7. If the quantity of organic matter is **more than 50% is called peat soil**

8. Which fertilizer have highest equivalent acidity **Anhydrous ammonia (148meq/100g).**

9. Saline alkaline soil having **EC more than 4 ds/ m.**

10. Which state having **highest area under total problematic** soil **Kerala.**


Thank
You