



BSc Horticulture Notes (6th Dean Committee Syllabus)

Course No.: SSAC-231 (New)
Course Title: Fundamentals of Soil Science

- All the notes provided in this file are based on the new 6th Dean Committee Syllabus.
- Students are required to take a print of this file to study for Semester End Examination.
- Join our Telegram Channel: [@AgroMind](#) (Click the Blue link to join the Channel.)

Lecture 1 & 2

Composition of earth's crust Soil as a natural body- major components

COMPOSITION OF EARTH'S CRUST

Write down the composition of earth's crust. Average composition of earth's crust.

Sr.No.	Element	Percentage
1)	O	46.6
2)	Si	27.7
3)	Al	8.1
4)	Fe	5.0
5)	Ca	3.6
6)	Na	2.8
7)	K	2.6
8)	Mg	2.1
9)	Others	1.5

Element	Percentage
O	46.6
Si	27.7
Al	8.1
Fe	5.0
Ca	3.6
Na	2.8
K	2.6
Mg	2.1
Others	1.5

Trick to remember O Si Al Fe Ca Na K Mg Others

[CLICK HERE to Join AgroMind Telegram Channel](#)

- 1) **Oxygen** is the most abundant element found in earth crust.
- 2) **Oxygen** is the most abundant non-metal element found in earth crust.
- 3) The Earth's crust is mainly composed of **oxygen** and **silicon** elements.
- 4) **Aluminium** is the most abundant metallic element found in earth crust.
- 5) Together, oxygen and silicon make up about **75%** of the Earth's crust.
- 6) The second most abundant element in the crust is **silicon**, a metalloid, contributing about 27.7%.

History and Development of Soil Science, its Scope and Importance Soil as a Natural Body, Pedological and Edaphological Concepts of Soil



- Most great civilizations have depended on good soils.
- The ancient dynasty of Nile, Indus etc. were possible by the food producing capacity of the fertile soils of the river valley and its irrigation system.
- The soil destruction or mismanagement was also responsible for their downfall.

Early Scientific Investigations on Soil Productivity



Jan Baptist van Helmont, Flemish Chemist

- He grew a willow tree and measured the amount of soil, the weight of the tree and the water he added.
- After five years the plant had gained about 74 kg.
- Since the amount of soil was basically the same as it had been when he started his experiment, he realized that the tree's weight gain had come from water.



Théodore de Saussure

- He also showed that plants require mineral nutrients, which they take up from the soil.



John Woodward, an English Researcher

- Found that muddy water produced more plant growth than rainwater or river water, and



- He concluded that the fine earth was the “Principle” of growth.

Boussingault J.B., French Agriculturist (1834)

- Proved that air and rain water were the primary sources of carbon, hydrogen and oxygen in plant tissues.



- His investigations were largely disregarded until 1840.

Justus von Liebig, German Chemist

- Find that crop yields were increased by adding minerals or inorganic elements to the soil
- He gave the principle of “Law of minimum”

Lawes and Gilbert (by 1855 at Rothamsted Experiment Station in England)

- Proved that for cereals, nitrogen did not come from the air, but from the soil and nitrogen containing chemicals added to the soil.

Way J.T. (in 1856)

- Discovered that ammonium compounds were changed to nitrates in soils.



Hilgard E.W. (in 1860)

- Developed relationship among climate, vegetation, rock materials and the kinds of soils that develop. **Dokuchaiev V.V.**, Russian Scientist



- Invented concepts of soil classification based on field soil characteristics.

- Called as “Father of Soil Science”.



C. F. Marbut

Marbut C.F., of U.S.National Soil Survey Programme

- Developed a nationwide soil classification system based to a great extent on the Russian concepts.



H. Jenny

Hens Jenny (1941)

- Formulated relationship between any soil properties and soil forming factors.



Leather J.W.

- Regarded as Father of Soil Science and Agril. Chemistry in India.
- He developed indigenous mode of characterizing the soils of India.
- He worked on a variety of agricultural production and chemistry related issues in India.

Write Functions of soils :

- 1) It gives mechanical support to erect plant on surface of soil.
- 2) It provides all essential nutrients for growth of plant.
- 3) It provides moisture and air to the plant growth.
- 4) It serves as a media for different biological activity, which supports to plant growth.

Define Soil.

Soil may be defined as a dynamic natural body on the surface of the earth composed of minerals and organic matter, in which plants can grow.

Define Soil Science

The science dealing with soil as a natural resource on the surface of the earth including Pedology and physical, chemical and biological properties of soil in relation of their management for crop production.

Write the scope of soil science. OR What are the disciplines / branches of soil science ?

The Soil Science has the following six well defined discipline / branches :

The soil science has six well defined and developed disciplines. Scope of soil science is reflected through these disciplines.

- 1) **Soil Fertility** : It is the ability of soil to supply nutrients to the plants necessary for its growth.
- 2) **Soil Chemistry** : It is the study of chemical composition, chemical processes taking place in the soil and chemical properties of soil.
- 3) **Soil Physics** : It is the study of physical properties of soil viz., density, texture, structure etc.
- 4) **Soil Micro-biology** : It is the study of micro-organisms and their role in biological transformations in the soil.
- 5) **Soil Conservation** : It is the study of management of soil against physical loss by erosion or chemical deterioration with the purpose of producing high yields and protecting from degradation.
- 6) **Pedology** : The science dealing with the genesis, survey and classification and the laws of geographic distribution of soils as a body in nature.

Discipline/ branches of Soil Science	Soil Fertility	ability of soil to supply nutrients
	Soil Chemistry	study of chemical composition, processes and properties of soil
	Soil Physics	study of physical properties of soil
	Soil Micro-biology	study of micro-organisms
	Soil Conservation	management of soil against physical loss by erosion
	Pedology	Study of soil genesis, survey and classification

What are the two approaches/concepts of soil?

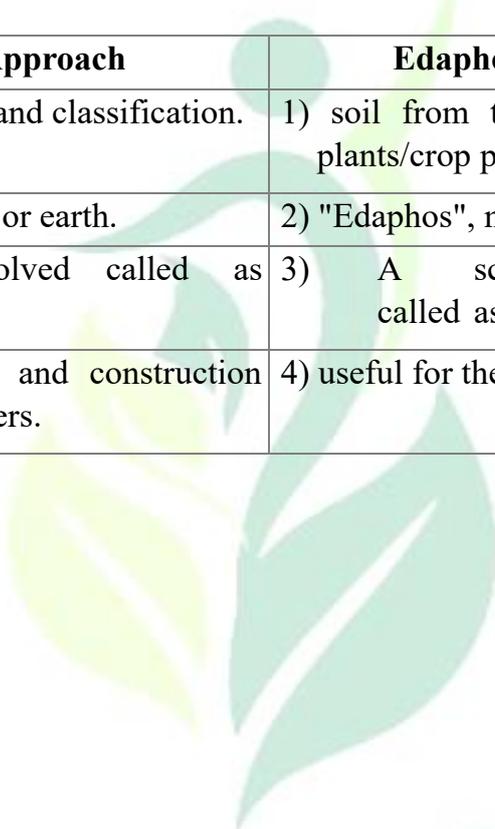
There are two approaches given below that can be used in studying soil.

1) ***Pedological Approach*** and 2) ***Edaphological Approach***

Pedological Approach	Edaphological Approach
1) Pedology is the study of <u>soil as a natural body in relation to its genesis, survey and classification.</u>	1) Edaphology is the study of <u>soil from the stand point of higher plants/crop production.</u>

2) Pedology term is derived from the Greek word " Pedon ", which means soil or earth.	2) Edaphology term is derived from the Greek word " Edaphos ", which also means soil or ground.
3) A scientist involved in the study of soil as a natural body in relation to its genesis, survey and classification is called as Pedologist .	3) A scientist involved in the study of soil from the stand point of higher plants is called as Edaphologist .
4) This data is <u>useful to highway and construction engineers</u> as to farmers.	4) This data is <u>useful for the production of food and fibre</u> .

Pedological Approach	Edaphological Approach
1) soil genesis, survey and classification.	1) soil from the stand point of higher plants/crop production.
2) "Pedon", means soil or earth.	2) "Edaphos", means soil or ground.
3) A scientist involved called as Pedologist.	3) A scientist involved called as Edaphologist.
4) useful to highway and construction engineers as to farmers.	4) useful for the production of food.



AgroMind

Lecture 3, 4 & 5

Rock and Minerals Classification

The branch of science concerned with the origin, structure and composition of rocks is called as **Petrology**.

Define rock and classify in brief.

A rock may be defined as an *aggregate* or *hard mass* of one or more minerals.

Classification of rocks

On the basis of mode of formation, the rocks are divided into the following three main classes :

- 1) **Igneous rock** or Primary rock
- 2) **Sedimentary rock** or Secondary rock or Stratified rock
- 3) **Metamorphic rock**

Igneous rock	Sedimentary rock	Metamorphic rock
Formed by the cooling and crystallization of molten magma	Formed from sediments derived from the breaking down of pre-existing rock (i.e. igneous rock)	Rocks which have undergone some chemical or physical changes due to action of water, heat or pressure
e.g. Basalt, Granite	e.g. Sandstone, Limestone	e.g. Shale → Slate

1) **Igneous rock** :-

- ✓ The igneous rocks are formed by the cooling and crystallization of molten magma on or beneath the surface of earth.
- ✓ They make up 95% of the earth's crust and are a source of parent material for other rocks.

Classification

1) On the basis of mode of formation, igneous rocks are divided into two groups.

- 1) **Volcanic rock** and
- 2) **Plutonic rock**

Volcanic rock	Plutonic rock
1) The rocks that are formed by <u>cooling of molten magma poured out on the surface</u> of the earth are called Volcanic rocks. e.g. Basalt, Rhyolite	1) The rocks that are formed by the <u>cooling of the original magma below the surface</u> are called Plutonic rocks. e.g. Granite, Gabbro
2) Volcanic rocks are also called as ' Extrusive rocks '.	2) Plutonic rocks are also called as ' Intrusive rocks '.

- The rocks contain **gas cavities or vesicles** are known as '*Vesicular rocks*'.
- When the **vesicles are filled with some minerals** are known as '*Amygdaloidal rocks*'.

- The rocks **consolidated in vertical cracks** and formed wall like masses are known as '*Dykes*'.
- The rocks **consolidated in horizontal cracks** or planes are known '*Sills*'.
- The rocks **consolidated in irregular and narrow cracks** or fissures are known as '*Vein*'.

2) On the basis of *chemical composition or silica content, igneous rocks* are divided into three groups.

1) *Acid rocks*, 2) *Intermediate rocks* a) *Sub-Acid*, b) *Sub-Basic* and 3) *Sub-Basic*

Igneous rocks			
Acid rocks	Intermediate rocks		Basic rocks
SiO ₂ > 65%	Sub-Acid	Sub-Basic	SiO ₂ < 55%
e.g. Granite	SiO ₂ 60 to 65%	SiO ₂ 55 to 60%	e.g. Basalt
	e.g. Syenite	e.g. Diorite	

Sedimentary rocks :

- The sedimentary rocks are formed from sediments derived from the breaking down of pre-existing rock.
- The sediments are transported to new places and deposited in new arrangements and cemented to form secondary rocks.

Based on rocks formed through a chemical reaction, sedimentary rocks are formed into following types :

	Types	Description	Example
1)	Arenaceous rocks	Rocks formed by the deposition of coarse grained particles	Sandstone
2)	Argillaceous rocks	Rocks formed by the deposition of fine particles	Shale, Mudstone
3)	Calcareous rocks	Rocks consists of carbonate of lime or lime and magnesia	Limestone, Dolomite
4)	Carbonaceous rocks	Rocks formed from decomposing vegetation under anaerobic condition	Coal, Lignite
5)	Siliceous rocks	Rocks consists mainly SiO₂ derived from plants and animals	Diatomaceous earth
6)	Precipitated rocks	Rocks consists deposits formed as rock masses either by cooling, evaporation or by direct chemical precipitation	Rock phosphate, Gypsum, Bouxite

Metamorphic rocks :

The word metamorphic means 'change in form' and metamorphism is used as a general term for all those changes that alter more or less completely the original characters of rocks.

Metamorphic rocks are those which have undergone some chemical or physical changes due to action of water, heat or pressure.

Classification :

Hydro-metamorphic Rocks	Thermo--metamorphic rocks	Dynamo--metamorphic rocks
These rocks are formed due to the changes brought about by <i>water</i> .	These rocks are formed due to the changes brought about by <i>heat</i>	These rocks are formed due to the changes brought about by <i>pressure</i>
The action of water tends to remove some material or introduce new materials in the existing rocks.	The action of heat hardens the rocks and often develops new crystals in it.	The action of pressure tends to change the structure of the rocks.
e.g. Sandstone → Quartzite Basalt → Laterite	e.g. limestone → Marble	e.g. Shale → Slate

Minerals

It is a **naturally occurring inorganic substance** having **definite chemical composition** and **distinct physical properties**. e.g. Magnetite, Haematite
Properties of minerals :-

- | | | |
|-------------------------|---------------------|--------------------------------|
| 1) Colour | 2) Luster | 3) Light transmission |
| 4) Streak | 5) Hardness | 6) Specific gravity or Density |
| 7) Cleavage | 8) Fracture | 9) Tenacity |
| 10) Forms and structure | 11) Chemical nature | |

1) **Colour** :- The colour of mineral depends on reflection of certain colour vibration, which are exhibited by ordinary light.

e.g. Orthoclase – Pink, Iron pyrite - Yellow

2) **Luster** :- It is the general appearance of a mineral in reflected light.

Types of luster

Metallic non-metals	Non-Metallic luster	Luster like metal	like
Luster like diamond	1) Adamantine luster	Luster resembling diamond	
ex. Iron	2) Vitreous luster	Luster like ordinary glass	Rock Quartz
Pyrite,	3) Sub-vitreous luster	Luster like milky glass	Milk Quartz
Graphite,	4) Resinous luster	Luster like resin	Talc

[CLICK HERE to Join AgroMind Telegram Channel](#)

Gold,	5) Pearly luster	Luster like pearly	Zeolite
Copper	6) Earthy luster	Luster like earthy	Gypsum
	7) Waxy luster	Luster like wax	Asbestos
		Luster like silk	8) Silky luster

3) **Light transmission** :- It is the degree of penetration of light through a mineral. Based on light passes through mineral, minerals are grouped into following three types.

Light transmission

Transparent	Translucent	Opaque
Clear penetration of light through a mineral	Unclear penetration of light through the mineral	No light pass through light through a mineral
e.g. Rock crystal	e.g. Milk quartz	e.g. Iron pyrite

4) **Streak** :- It is the colour of the powder of a mineral.

Mineral	Colour of mineral	Streak
Orthoclase	Pink	White
Iron pyrite	Yellow	Green

5) **Hardness** :- It is the resistance of mineral to scratch/cut.

Hardness is expressed in Mohr's scale and indicated by number 1 to 10.

Mohr's scale	Mineral	Remark
1	Talc	Softest
10	Diamond	Hardest

6) **Specific gravity or Density** :- It is the ratio between the weight of mineral to the weight of an equal volume of water.

$$\text{Specific gravity} = \frac{\text{Wt. of mineral}}{\text{Wt. of equal volume of water displaced}}$$

Based on specific gravity, minerals are classified into two groups

Based on specific gravity, minerals are classified into two groups

Type of mineral	Specific gravity	Example
1) Light mineral	< 2.85	Feldspar 2.65
2) Heavy mineral	> 2.85	Haematite 5.3

7) **Cleavage** :- It is the property of mineral to split / break along the planes smoothly (perfect) or roughly (imperfect) related to their molecular structure. e.g. Perfect cleavage - Diamond

8) **Fracture** :- It is the property of mineral to break along an irregular surface.

Fractures are of three types.

1) **Even fracture** - development of smooth and plane surface

2) **Uneven fracture** - development of rough surface

3) **Conchoidal fracture** - development of more or less curved surface

9) **Tenacity** :- The resistance of mineral to break, crush or bend is known as tenacity.

Tenacity are of three types.

1) **Brittle** - Mineral falls to powder during cutting

2) **Flexible** - Mineral can be easily bent

3) **Malleable** - Mineral flatten under a hammer

10) **Forms and structure :-**

Forms - Arrangement of atoms in mineral Minerals have various forms.

1) Crystalline form		2) Massive or Amorphous form	
Specific atomic arrangement of mineral		No specific atomic arrangement of mineral	
Types of crystalline form			
	Type	Detail	Example
a)	Monometric	Three axis are equal in length & at right angle (90 ⁰)	Halide
b)	Dimetric	Two axis are equal, one unequal & at right angle	Zircon
c)	Trimetric	Three axis are unequal & at right angle	Sulphur
d)	Monoclinic	Three axis are unequal & one right angle	Gypsum
e)	Triclinic	Three axis are unequal & none at right angle	Plagioclase
f)	Hexagonal	Three axis are equal at 120 ⁰ , one more forth axis of different length at 90 ⁰	Quartz

Structure - Arrangement of crystals

- Granular - Appear in fine grains
- Lamellar - Like plate or leaves
- Columnar or fibrous - Needle like reticulated or net like
- Stellated - radiating like a star
- Drusy - Minute crystal are implanted

11) **Chemical nature :-** It refers to the chemical nature of the minerals.

Based on chemical composition, minerals may be classified as follows :

- Element - e.g. Sulphur
- Oxide - e.g. Haematite
- Hydroxide - e.g. Gibbsite
- Sulphides - e.g. Iron pyrite
- Sulphates - e.g. Gypsum
- Carbonates - e.g. Calcite
- Phosphates - e.g. Apatite
- Silicates - e.g. Microcline

Classification of minerals

Based on			
Quantity	Mode of formation	Specific gravity	Chemical composition
(i) Essential Minerals :- Forms major part of the rocks - Occurs in quantities varying from 95-98% e.g. Calcite	(i) Primary Minerals :- - Formed from crystallization of magma e.g. Quartz	(i) Light Minerals :- having specific gravity < 2.85 e.g. Quartz 2.6	a) Native Element - e.g. Sulphur b) Oxide

<p>(ii) Accessory Minerals :- - Occurs in subsidiary amount (2-5%) e.g. Apatite, Magnetite</p>	<p>(ii) Secondary Minerals :- - Formed due to decomposition and/or alteration of primary minerals e.g. Serpentine</p>	<p>(ii) Heavy Minerals :- having specific gravity > 2.85 e.g. Hematite 5.3</p>	<p>- e.g. Haematite c) Hydroxide - e.g. Gibbsite d) Sulphides - e.g. Iron pyrite e) Sulphates - e.g. Gypsum f) Carbonates - e.g. Calcite g) Phosphates - e.g. Apatite h) Silicates - e.g. Microcline</p>
--	--	---	--



AgroMind

Lecture 6 & 7

Processes and Factors of Soils Formation

Define soil formation

The transformation of rocks into soil by the action of various soil forming factors and processes is called as **soil formation**.

Soil Forming Factors

Dokuchaiev (1889) was the first person who established the equation related to soil formation	Further, Jenny (1941) formulated the revised soil formation equation
$S = f(P, Cl, O)$ where S = Soil f = function of P = Parent material Cl = Climate O = Organisms	$S = f(Cl, b, r, p, t)$ where S = Soil f = function of Cl = Climate b = Biosphere r = Relief / Topography p = Parent material t = Time
P Cl O	Cli Bio Rel Par Ti
पिकलो	क्लि बायो रेल पार टी

Soil Forming Factors

Soil forming factors are grouped into two categories by **Joffee** (1949)

1) **Active** soil forming factors and 2) **Passive** soil forming factors

	Active soil forming factors (ASFF)	Passive soil forming factors (PSFF)
1)	ASFF are those which supply energy that acts on the mass for the purpose of soil formation	PSFF are those which provide a base on which active soil forming factors work or act for the development of soil
2)	Climate and biosphere are the active soil forming factors	Parent material, relief or topography and time are the passive soil forming factors

Active soil forming factors

1) Climate

- Climate includes rainfall, temperature, humidity and wind
- Water and heat directly react with parent material
- Water and heat indirectly affects through its action on vegetation
- Rainfall affects the profile development through erosion, percolation
- temperature affects the rate of chemical reactions, colour of soil, decomposition of organic matter and control the rate of chemical and biological reaction
- Wind acts as a transporting agent of dust particles

2) Biosphere

- The activities of living plants and animals and the decomposition of their organic waste and residues markedly influence the soil development
- Chemical composition of various plants exerts a profound influence on the type and speed of soil forming processes

- The burrow and channels made by burrowing animals like rodents, termites promote soil disintegration and mix the material of the lower layers with the upper layers
- Micro-organisms help the soil development by decomposing organic matter and forming weak acids that dissolve minerals faster than water

Passive soil forming factors 1)

Parent material

- Parent material is the mass of consolidated rock or unconsolidated material from which the soil has formed
- The nature of parent material influences the soil characteristics by their rate of weathering, nutrient content and particle size distribution

2) Relief or Topography

- The configuration of the land surface is known as topography or relief
- Topography influences the soil formation primarily through its effects on modifying water and temperature relation
- The soils on gentle slopes generally are deeper or thick, have more luxuriant vegetation and organic matter than in soils on similar materials on steep slopes
- Steepness of slope accelerates soil erosion and promotes drainage conditions in the hilly areas.

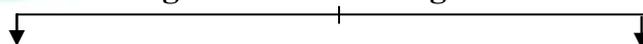
3) Time

- The period taken by a given soil from the stage of weathered rock upto the stage of maturity is considered as time
- Recent surface deposits show little soil development, whereas, land surface exposed for thousands of years may have well developed profiles □ Soil mature with time

Soil Forming Processes / Pedogenic Processes

- The pedogenic processes are extremely complex and dynamic
- Involving many chemical and biological reactions
- Usually operate simultaneously in a given area
- One process may counteract another or two different processes may work simultaneously to achieve the same result.

Soil Forming Processes / Pedogenic Processes



Fundamental soil forming processes

- 1) Humification
- 2) Eluviation
- 3) Illuviation
- 4) Horizonation

Specific soil forming processes

- 1) Calcification
- 2) De-calcification
- 3) Podzolization
- 4) Laterization
- 5) Gleization
- 6) Salinization
- 7) De-salinization
- 8) Alkalization / Solonization
- 9) De-alkalization / Solodization
- 10) Pedoturbation

Fundamental soil forming processes

1) **Humification** :- The process of decomposition of raw organic matter into humus is called as **humification**.

Humus : The well decomposed dark coloured substance produced by the decomposition of plant and animal material.

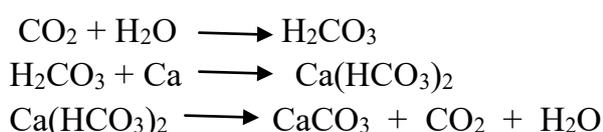
Humification helps in the formation of surface humus or organic layer.

Eluviation	Illuviation
It is the <u>removal of constituents</u> in suspension or solution by the percolating water from the upper to lower layers.	It is the process of <u>deposition of soil material</u> from the upper layer in the lower layer.
The horizons formed by the process of eluviation are termed as ' Eluvial horizon '	The horizons formed by the process of illuviation are termed as ' Illuvial horizon '
It is the process of mobilization and translocation of certain constituents like clay, salts	It is the process of immobilization and accumulation.
Eluviation means ' <u>Wash out</u> '	Illuviation means ' <u>Wash in</u> '
Formation of A or E horizon	Formation of B horizon

4) **Horizonation** :- It is the process of differentiation of soil in different horizons along the depth of the soil body.

Specific Soil Forming Processes

1) **Calcification** :- It is the process of precipitation and accumulation of calcium carbonate (CaCO₃) in some part of the profile.



2) **Decalcification** :- It is the process of removal of CaCO₃ or calcium ions from the soil by leaching.



3) **Podzolization** :-

(Russian term Pod = under and Zola = ash like)

- It is the process of removal of iron and aluminum (often as complex with humus) from the upper part (A or E horizon) and deposition at some depth (in B horizon).
- Silica is present in abundance.
- As the iron and aluminum move out, the A or E horizon gives a bleached grey or ashy appearance or ash like horizon.
- A cold and humid climate is most favourable for Podzolization.

4) **Laterization** :- (Later = Brick or Tile)

- It is the process of removal of silica from the upper layer and thereby leaving (or accumulation) of iron and aluminium oxide (sesquioxide).
- Laterization is also called as "Lotozation"
- Tropical rain forest having warm and humid climate are favourable for laterization.
- The high temperature, intense leaching and basic kind of parent material all favour of removal of silica and accumulation of sesquioxide.

5) **Gleization** :- (Russian term Glei = blue - grey / green clay)

It is the process of formation of bluish to greenish grey colour horizon in the lower part of the soil profile above the parent material due to poor drainage and water logged conditions (lack of oxygen) causing reduction of Fe. The soils are called hydromorphic soils.

6) **Salinization** :-It is the process of accumulation of salts such as sulphates, chlorides of Ca, Mg, Na and K in soils in the form of a salty horizon.

7) **De-salinization** :-It is the process of removal of excess soluble salts by leaching from the horizons.

8) **Alkalinization / Solonization** :- It is the process of accumulation of sodium ions on the exchange complex of the clay resulting in the formation of sodic soils.

9) **De-alkalinization / Solodization** :- It is the process of removal of Na⁺ from the exchange sites.

10) **Pedoturbation** :- It is the process of mixing of the soil.

Pedoturbation are of three types.

a)	Faunal Pedoturbation	It is the mixing of soil by animals like ants, earthworms, rodents, man.
b)	Floral Pedoturbation	It is the mixing of soil by plants as in tree tipping that forms pits and mounds.
c)	Argilli-Pedoturbation	It is the mixing of soil by churning process caused by swell-shrink clays.

Specific Soil Forming Processes in short

Calcification	:	accumulation of calcium carbonate (CaCO ₃) in some part of the profile
Decalcification	:	removal of CaCO ₃ or calcium ions from the soil by leaching.
Podzolization	:	removal of iron and aluminum from the upper part and deposition at some depth
Laterization	:	removal of silica from the upper layer and thereby leaving (or accumulation) of iron and aluminium oxide
Gleization	:	formation of bluish to greenish grey colour horizon in the lower part of the soil profile

Salinization	:	accumulation of salts such as sulphates, chlorides of Ca, Mg, Na and K in soils in the form of a salty horizon
De-salinization	:	removal of excess soluble salts by leaching from the horizons
Alkalization / Solonization	:	accumulation of sodium ions on the exchange complex of the clay resulting in the formation of sodic soils.
De-alkalization / Solodization	:	removal of Na ⁺ from the exchange sites
Pedoturbation	:	mixing of the soil

Development of Soil Profile

Soil Profile : It is defined as a vertical section of the soil through all its horizons and extending up to the parent material.

Soil Horizon : A layer of soil approximately parallel to the soil surface, differing in properties and characteristics from adjacent below or above it.

Solum : The upper and most weathered part of the soil profile includes A, E and B horizons.

Regolith : The disintegrated (and decomposed) mass of weathered rock and soil material above solid rock, in which soil develops.

Master Soil Horizons

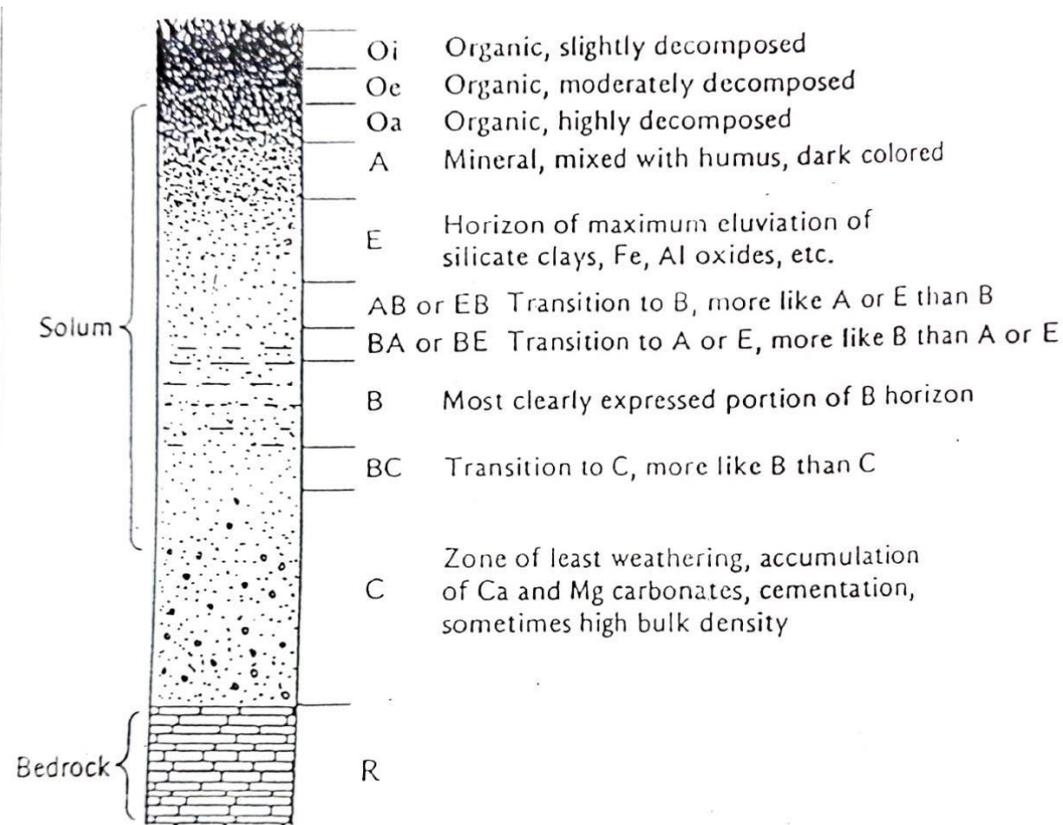
1)	O horizon	<ul style="list-style-type: none"> ➤ Comprised of organic horizons that form above the mineral soil ➤ They result from litter derived from dead plants and animals ➤ Usually occur in forested and are generally absent in grassland. The specific horizons are <p>Oi - <u>Slightly decomposed</u> plant and animal residue Oe - <u>Moderately decomposed</u> plant and animal residue Oa - <u>Highly decomposed</u> plant and animal residue</p>
2)	A horizon	<ul style="list-style-type: none"> ➤ <u>Topmost mineral horizon</u> ➤ Contain a strong mixture of partially decomposed organic matter ➤ Darker colour than the lower horizons
3)	E horizon	<ul style="list-style-type: none"> ➤ Generally lighter in colour than the A horizon ➤ Maximum leaching or <i>eluviation</i> of clay, iron and aluminium oxides
4)	B horizon	<ul style="list-style-type: none"> ➤ <i>Illuviation</i> or accumulation of material like iron and aluminium oxides, silicate clay, calcium carbonate, has takes place from above and even from below
5)	C horizon	<ul style="list-style-type: none"> ➤ Unconsolidated (Loosely arranged) material below solum ➤ Outside the zones of major biological activities ➤ Little affected by processes that formed the horizons above it.
	R Layer	Under lying consolidated rock, with little evidence of weathering

Transition Horizons :

- ❖ Transitional between the master horizons (O, A, E, B, and C)
- ❖ Dominated by properties of one horizon, but have prominent characteristics of another

1)	AB	Transition to B, more like A than B
2)	EB	Transition to B, more like E than B
3)	BA	Transition to A, more like B than A
4)	BE	Transition to E, more like B than E
5)	BC	Transition to C, more like B than C

[CLICK HERE to Join AgroMind Telegram Channel](#)



Hypothetical soil Profile

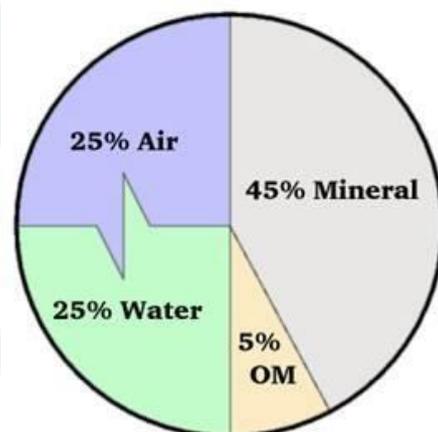
What are the components of soil ?

The soil consists of four major components i.e. mineral matter, organic matter, soil air and soil water. **Mineral matter :**

- ❖ Mineral matter is composed of small rock fragments and minerals of various kinds.

Organic matter :

- ❖ Organic matter consists of an accumulation of partially decayed and partially synthesized plant and animal residue.
- ❖ It plays significant role in supply of plant nutrient, maintenance of soil structure and activity of soil organisms



Soil water :

- ❖ Soil water containing dissolved salts in it, is called soil solution.
- ❖ Soil solution is an important medium for supply of nutrients to plants.

Soil air :

- ❖ Soil air occupies pores not filled with water.
- ❖ Soil air contains a higher concentration of carbon dioxide.

Fill in the blanks

- 1) Normal soil contents 45% mineral matter.

- 2) **Organic matter** content is approximately **5%** in normal inorganic soil.
- 3) Soils having **more than 20%** of **organic matter** designated as **organic soil**.
- 4) **Organic matter** is a store house of nutrients in soil.
- 5) When all the pores are completely filled with water or aqueous solution, the soil is said to be **saturated**.
- 6) The solid phase of soil is also called as **soil matrix**.

----- Three Phases of Soil Or Three Phase Soil System

- 1) **Solid Phase :-** The soil contain minerals and organic matter which is called as solid phase.
- 2) **Liquid Phase :-** The water filled in soil pores containing salts and some gases in solution is called as liquid phase.
- 3) **Gaseous Phase :-** The air filled pore spaces in the soil is called as gaseous phase.

----- Soils of India and Maharashtra Soils of India

Give the important characteristics of major soil groups in India.

Enlist major soil types of India. Explain in brief black soils.

Write short note on Soil types of India.

1) **Red soils :-**

- Formed under sub-humid climate from rocks like granite, shale etc
- Light textured, porous structured, absence of lime and low soluble salts
- Poor in fertility, low in N P K & Ca
- pH ranging from 7.0 to 7.5
- found in Tamil Nadu, Karnataka, part of Andhra Pradesh, M.P. Orissa and Bihar

2) **Lateritic soils :-**

- Formed under high rainfall area
- Light in texture open free drainage structure
- pH ranging from 5.0 to 6.0
- found in part of Maharashtra, Karnataka, Kerala, M.P. and Orissa

3) **Black soils :-**

- Developed from Basalt rock
- High base exchange capacity
- pH ranging from 7.5 to 8.5
- rich in K & Ca and low in N & P
- found in part of Maharashtra, Karnataka, Gujrat, M.P., U.P., A.P., Rajasthan and Orissa

4) **Alluvial soils :-**

- deep and gray or grayish brown colour
- pH ranging from 7.0 to 8.0
- very fertile soil
- found in part of Rajasthan, Punjab U.P., Bihar and West Bengal

5) **Desert soils :-**

- developed in arid region

- mostly sandy, contain large amount of soluble salts
 - high pH and very poor fertility
- 6) Saline and Alkaline soils :-**
- developed in arid and semi-arid region
 - basin shaped topography and poor drainage is also responsible
 - found in black soil region in south & west coastal region along west and east coast
- 7) Peaty and marshy soils :-**
- formed under sub-merged condition
 - developed in humid region as a result of accumulation of large quantity of organic matter
 - found in Kerala , north Bihar and north U.P.
- 8) Tarai soils :-**
- formed under wet regime and high water table condition
 - foot hill soil found in Jammu and Kashmir, U.P., Bihar and West Bengal
 - grass and trees are native vegetation
- 9) Brown hill soils :-** □ formed hill under forest
- acidic to neutral in reaction
 - mainly found in Himalaya on sandstone and shale
- 10) Sub mountain soils :-**
- formed in high rainfall regions of sub-Himalayan under coniferous forest
 - acidic in reaction
 - high organic matter
- 11) Mountain Meadow soils :-**
- formed in high elevation in Himalayan
 - shallow with grass vegetation

Soils of Maharashtra

1) Black soils :-

- Formed under semi-arid, dry sub-humid and moist sun-humid region at elevations of 300 to 900 meter above mean sea level with hot summer and mild winter
- Dark colour is due to the formation of clay-organic matter complex
- High water retention and high CEC make soils productive □ Fine texture, high bulk density, shrinkage cracks

Shallow black soils	Medium black soils	Deep black soils
<ul style="list-style-type: none"> ❖ Up to 22.5 cm depth ❖ Course texture ❖ Low fertility 	<ul style="list-style-type: none"> ❖ 22.5 to 90 cm depth ❖ More fertile than shallow black soils ❖ Base-rich with Ca as predominant exchangeable cation 	<ul style="list-style-type: none"> ❖ < 90 cm depth ❖ More fertile than medium black soils ❖ 40 to 60% clay

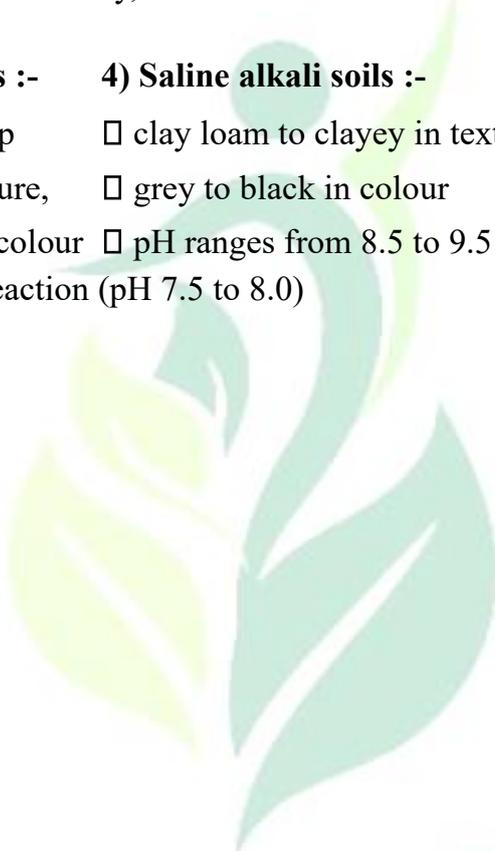
	❖ pH 7 to 9	
--	-------------	--

2) **Laterite and lateritic soils :-** □ Acidic in reaction (pH 5.0 to 6.5)

- Sandy clay loam to clayey in texture
- Sesquioxide constitute 95%
- Kaolinite is dominant clay, which sometimes associated with illite

3) **Coastal alluvial soils :-** 4) **Saline alkali soils :-**

- Derived from trap □ clay loam to clayey in texture
- clay loam in texture, □ grey to black in colour
- grayish black in colour □ pH ranges from 8.5 to 9.5
- and alkaline in reaction (pH 7.5 to 8.0)



AgroMind

Lecture 8, 9, 10, 11 & 12

Soil Physical Properties

Enlist different physical properties of soil.

1) Soil Texture	5) Soil Colour	9) Soil Plasticity
2) Soil Structure	6) Soil Density	10) Soil Consistency
3) Soil Air	7) Soil Porosity	
4) Soil Water	8) Soil Temperature	

Importance of physical properties

- Physical properties (mechanical behaviour) of a soil greatly influence its use and behaviour towards plant growth.
- The plant support, root penetration, drainage, aeration, retention of moisture, and plant nutrients are linked with the physical condition of the soil.
- Physical properties also influence the chemical and biological behaviour of soil.
- The physical properties of a soil depend on the amount, size, shape, arrangement and mineral composition of its particles.
- These properties also depend on organic matter content and pore spaces

SOIL TEXTURE

Define separates.

According to the size, the soil particles are grouped into gravel, sand, silt and clay, which are termed as “**soil separates**”.

Define mechanical analysis.

The process of determining the amounts of individual soil separates below 2 mm in diameter is called “**particle size analysis or mechanical analysis**”.

Write method of textural analysis.

- 1) **Feel method** :- the common field method of determining the textural class of a soil is by its feel. This is ascertained by rubbing a sample of the soil, usually in a moist to wet condition, between the thumb and fingers.
- 2) **Laboratory method or Mechanical method**
 - a) International Pipette method
 - b) Bouyoucos Hydrometer method

Explain Stokes' law with its formula. What are the assumptions of this law.

G.G. Stoke in 1851 determined the relationship between the size of the particles and their rate of falling in a liquid medium.

He stated that, the velocity of a falling particle is proportional to the radius square and not to its surface. According to formula

$$V = \frac{2}{9} \times \frac{g r^2 (d_p - d_f)}{\eta}$$

where, V = sedimentation velocity (cm/sec)
 g = acceleration due to gravity (cm/sec²)
 r = equivalent spherical radius of the particle (cm)
 ρ_p = density of particle (g/cm³) ρ_f = density of fluid (g/cm³)
 η (eta) = viscosity of suspending fluid (g/sec/cm³)

Therefore, as the size of the particle is decreased, the time taken by them to fall down the same depth increases.

Assumptions of Stokes' law

- Particles must be round and rigid/solid.
- Particles must be large in comparison with the molecules of the liquid.
- Fall must be unhindered/free.
- Particles must be of uniform density.
- The suspension must be unmoving/motionless

Limitations of Stokes' law

- Particles may not be round and rigid/solid.
- Change in fluid viscosity due to change in temp. cause a change in the rate of fall
- Particle density vary with mineralogical and chemical composition of the particle
- The continuous haphazard zig-zag motion of small particles suspended in liquid (so called Brownian Motion) can displace a settling particles

Define soil texture.

The relative proportion of sand, silt and clay is called “soil texture”.

Classify the soil separates or soil particles.

International Society of Soil Science (ISSS)			United State Department of Agriculture (USDA)		
Gravel	:	> 2.00 mm	Gravel	:	> 2.00 mm
Coarse Sand	:	2.00 to 0.2 mm	Very Coarse Sand	:	1.00 to 2.00 mm
Fine Sand	:	0.2 to 0.02 mm	Coarse Sand	:	0.5 to 1.00 mm
Silt	:	0.02 to 0.002 mm	Medium Sand	:	0.25 to 0.5 mm
Clay	:	< 0.002 mm	Fine Sand	:	0.10 to 0.25 mm
			Very Fine Sand	:	0.05 to 0.10 mm
			Silt	:	0.05 to 0.002
Clay	:	< 0.002 mm			

Common textural classes

Sands :- Sand at least 70 % or more & clay 15% or less	Silt :- Silt at least 80% & clay 12% or less	Clay :- Clays at least 35%	Loams :- Mixture of sand, silt and clay particles that exhibits equal properties of sand, silt and clay
---	---	--------------------------------------	---

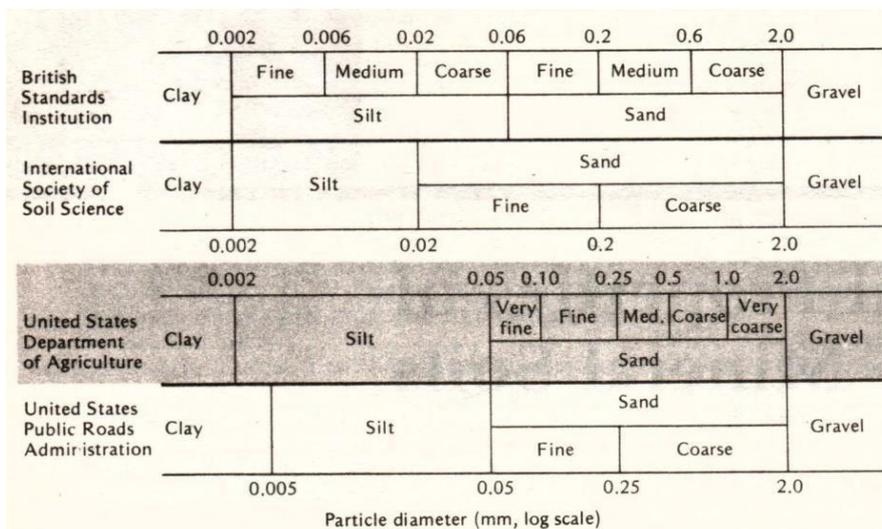


FIGURE 4.1
Classification of soil particles according to size by four systems. The U.S. Department of Agriculture system is used in this book.

Describe in details the textural classification of soil.

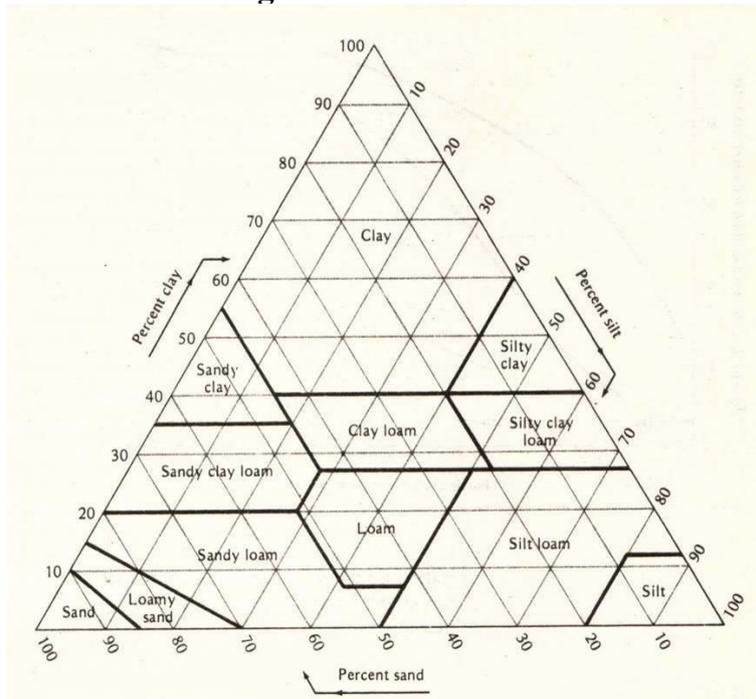
USDA classification system

Common name	Texture	Textural class
Sandy class	Coarse	Sands
		Loamy sands
Loamy class	Moderate coarse	Sandy loam
	Medium	Silty loam
		Loam
	Moderately fine	Sandy clay loam
		Silty clay loam
Clay loam		
Silty class	Medium	Silt
Clayey class	Fine	Sandy clay
		Silty clay
		Clay

Fill in the blanks

- 1) Silt and sand are called **skeleton of soil**.
- 2) Any mineral particle of soil having diameter greater than **2 mm** is not considered as soil separate.
- 3) According to ISSS, the diameter of the clay particle is **<0.002mm**.
- 4) The laboratory procedure used to determine the distribution of particles of soil is known as **Mechanical analysis**.
- 5) In mechanical analysis, silt and clay fraction of soil are estimated with the help of **Stokes' law**.
- 6) According to Stokes' law the rate of fall of particle in a fluid is **directly** proportional to the square of the radius of the particle and **inversely** proportional to the viscosity of the medium.
- 7) **Textural triangle** is used to determine the soil textural name after the percentage of sand, silt and clay are determined from the laboratory analysis.
- 8) In the field, the textural class of soil is commonly determined by **Feel method**.

Triangle for Textural classes



SOIL STRUCTURE

Define soil structure.

The arrangement of soil particles into stable aggregates is called as soil structure.

Classify the soil structure ?

The soil structure is classified under three categories.

- 1) **Type** (based on shape of peds)
- 2) **Class** (based on size of peds)
- 3) **Grade** (based on stability or durability of peds)

Types of soil structure : It is determined by the general shape and arrangement of peds. There are mainly four types of soil structure.

1) Plate like :-

The horizontal dimensions are much more developed than the vertical axis resulting a flattened, compressed or lens like appearance of peds.

When the units are **thick**, they are called **Platy**.

When the units are **thin**, they are called **Laminar**.

Platelike



2) Prism like :-

The vertical axis is more developed than horizontal, with flatted sides giving a pillar like shape.

When the units have **leveled tops**, they are called **Prismatic**.

When the units have **rounded tops**, they are called **Columnar**.

Usually found in B horizon, common in soils of arid and semi-arid regions.

Prismlike



Prismatic
(level tops)



Columnar
(rounded tops)

3) Block like :-

Aggregates have been reduced to blocks, irregularly six faced, with their three dimensions more or less equal.

When aggregate's **faces are flat and edges are sharp angular**, they are called as **Angular blocky**.

When aggregate's **faces and edges are rounded**, they are called as **Subangular blocky**.

4) Spheroidal or sphere like :-

These are rounded or spherical peds, small in size and are bounded by curved and irregular faces.

When peds are **less porous**, they are called as **Granular**.

When peds are **very porous**, they are called as **Crumb**.



Types of soil structure (in short)

Plate like		Prism like		Block like		Sphere like	
Platy	Laminar	Prismatic	Columnar	Angular blocky	Sub-angular blocky	Granular	Crumb
units are thick	units are thin	units have leveled tops	units have rounded tops	faces are flat & edges are sharp angular	faces and edges are rounded	peds are less porous	peds are very porous

Classes of soil structure : Each primary structural type of soil is differentiated into five size classes based on the size of the individual peds.

	Classes	Platy	Prismatic
1)	Very fine or Very thin	< 1 mm	< 10 mm
2)	Fine or Thin	1 to 2 mm	10 to 20 mm
3)	Medium	2 to 5 mm	20 to 50 mm
4)	Coarse or Thick	5 to 10 mm	50 to 100 mm
5)	Very coarse or Very thick	> 10 mm	> 100 mm

Grades of soil structure : Grades indicates the degree of distinctness or durability of the individual peds.

1) Structure-less :- there is no aggregation or orderly arrangement of primary particles.

Hence, these soils have no noticeable peds.

If the appearance is coherent as in compact clay, the term **Massive** is used.

If the appearance is non-coherent as in loose sand, the term **Single grain** is used.

2) Structured :

A) Weak :- Poorly formed, non-durable, indistinct peds

B) Moderate :- fairly durable and distinct

C) Strong :- Quite durable and distinct

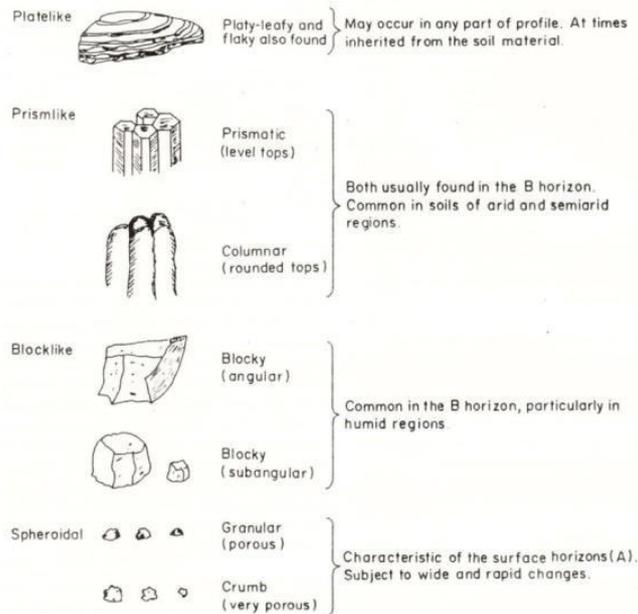


Figure 3. Various structural types found in soils (Source: Brady and Weil, 1996)

Importance of soil texture in relation to plant growth

- 1) It determine water holding capacity of soil
- 2) It determine the ease of tillage operation
- 3) It determine the aeration status
- 4) It determine drainage, percolation and water logging condition
- 5) It also influences the soil fertility as clay particles play an important role in soil fertility
- 6) It determine the nutrient retention and supply

Fill in the blank

- 1) Soil containing a large proportion of clay are called **heavy soil** or **heavy textured soil**.
- 2) Soil containing a large proportion of sand are called as **light soil** or **coarse textured soil**.

Soil bulk density and Particle density

Soil Density

$$\text{Density} = \frac{\text{Mass (M)}}{\text{Volume (V)}}$$

Soil is formed by mineral particles and pore spaces. So soil has two densities.

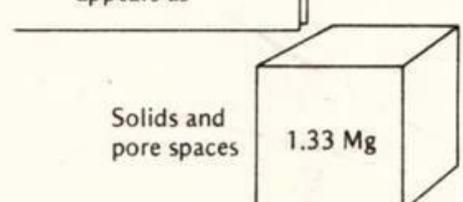
- 1) **Bulk density** and 2) **Particle density**

Write down the difference between particle density and bulk density.

Bulk density	Particle density
1) Defined as mass per unit volume including pore space	1) Defined as mass per unit volume of soil solids (excluding pore spaces)

2) Also called “ Apparent specific gravity ”.	2) Also called as “ Absolute ”, “ Real ” or “ True specific gravity ”.
3) Denoted by $D_b = M_s/V_t$	3) Denoted by $D_p = M_s/V_s$
4) Consist of soil solid <u>including pore spaces</u>	4) Consist of soil solid <u>excluding pore spaces</u>
5) <u>Affected by several factors</u> like texture, structure, organic matter etc.	5) <u>Not affected by organic matter</u>
6) Ranges from 1.10 to 1.50 Mg m⁻³ average 1.30 Mg m ⁻³	6) Ranges from 2.60 to 2.75 Mg m⁻³ average 2.65 Mg m ⁻³
7) Estimated by <u>clod or core method</u>	7) Estimated by <u>Pycnometer method</u>
8) Unstable/dynamic property	8) Stable/static property

In the field, one cubic meter of a certain soil appears as



Solids and pore spaces
1.33 Mg

To calculate bulk density of the soil:

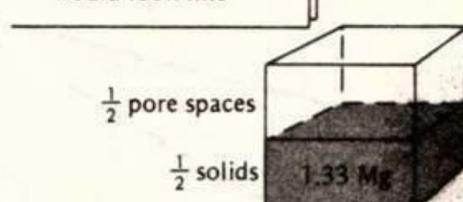
Volume = 1 m³ (solids + pores) Weight = 1.33 Mg (solids only)

$$\text{Bulk density} = \frac{\text{weight of oven dry soil}}{\text{volume of soil (solids + pores)}}$$

Therefore

$$\text{Bulk density, } D_b = \frac{1.33}{1} = 1.33 \text{ Mg/m}^3$$

If all the solids were compressed to the bottom, the cube would look like



$\frac{1}{2}$ pore spaces
 $\frac{1}{2}$ solids
1.33 Mg

To calculate solid particle density:

Volume = 0.5 m³ (solids only) Weight = 1.33 Mg (solids only)

$$\text{Solid particle density} = \frac{\text{weight of solids}}{\text{volume of solids}}$$

Therefore

$$\text{Solid particle density, } D_p = \frac{1.33}{0.5} = 2.66 \text{ Mg/m}^3$$

Factors affecting bulk density :-

1) Pore spaces :-

More pore space – low bulk density
Less pore space – high bulk density

2) Compactness:-

High compactness – high bulk density
Low compactness – low bulk density

3) Soil Texture :-

Fine texture (Clay, clay loam and silt loam) – low bulk density
Coarse texture (Sand, sandy loam) – high bulk density

4) Organic matter content :-

High organic matter – low bulk density
Low organic matter – high bulk density

5) Soil structure :-

Crumb soils – low bulk density
Platy soils – high bulk density

Factors affecting	bulk density
1) Pore spaces, 2) Compactness, 3) Soil texture	, 4) Organic matter, 5) Soil Structure

Explain factors affecting soil particle density.

The particle density depends on the chemical and mineralogical composition of soil. The particle density is higher if large amount of heavy minerals such as magnetite, limonite and hematite present in the soil.

With increase in organic matter of the soil, the particle density decreases.

Significance of soil density or bulk density

- ✓ It provides the engineer and the architect with a strong support for building foundation
- ✓ Low bulk density (1 to 1.5 g/cm³) indicates favourable physical condition of soil for plant growth. The soil has a good structure and many pore spaces for an optimum balance of air and water contents.
- ✓ High bulk density (1.8 to 2.0 g/cm³) indicates poor physical condition of soil for plant growth. These soils are usually compacted and contain relatively few pore spaces.

Soil porosity Percent.

Give the formula for porosity.

$$\text{Porosity (f)} = 1 - (\text{Db} / \text{Dp})$$

$$\text{Percent Porosity} = [1 - (\text{Db} / \text{Dp})] \times 100$$

where, Db = Bulk density, Dp = Particle density

Porosity or Pore Spaces

Write short notes on porosity or soil pore spaces.

- ❖ The pore spaces or porosity of soil is that portion of the total soil volume not occupied by solid particles, but occupied by air and water.
- ❖ It is normally expressed in percentage.
- ❖ It directly controls the amount of water and air in the soil and thus indirectly controls plant growth and crop production.
- ❖ Pore spaces in the soil are divided into macro pores and micro pores.

Differentiate between macro pores and micro pores

Macro pores		Micro pores	
1)	Relatively large size pores which allow ready movement of air and water as known as Macro pores	1)	Relatively small size pores which restrict (limit) the movement of air and water as known as Micro pores
2)	Macro pores are usually 0.08/0.06 mm or larger in diameter	2)	Macro pores are usually smaller than 0.08/0.06 mm in diameter
3)	Unable to hold water and mostly filled with air	3)	Hold water and mostly filled with water in moist condition

4)	It is also known as Non-capillary porosity	4)	It is also known as Capillary porosity
5)	If high macro pores, soil has adequate aeration, high infiltration, permeability, low retention of water	5)	If high micro pores, soil has inadequate aeration, low infiltration, permeability, high retention of water

State the factors affecting porosity of soil.

The following factors affecting porosity of soil.

1) Soil texture – Coarse textured soil – low total pore spaces Fine textured soil – high total pore spaces	2) Soil depth – Surface soil – high pore spaces Sub-surface soil – low pore spaces
3) Soil structure – Crumb structure – maximum pore spaces Plate like – minimum pore spaces	4) Compactness – Compacted soil – low pore spaces Non-compacted soil – high pore spaces
5) Organic matter – High organic matter - high porosity Low organic matter - low porosity	6) Cropping – Cropped soil - low/minimum porosity Uncropped soil-high/maximum porosity

Cropping tends to lower the total pore spaces in comparison to virgin or un-cropped soil.

Factors affecting porosity

1) Soil texture, 2) Soil structure, 3) Organic matter, 4) Soil Depth, 5) Compactness, 6) Cropping

Significance of porosity / pore spaces

- 1) Porosity directly controls the amount of water and air in the soil and therefore affects the growth of the plant
- 2) Aeration, drainage, permeability are influenced by porosity
- 3) For optimum growth, nearly equal amount of macro and micro spaces are required
- 4) Pore spaces affect internal soil temperature

Soil Consistency

The resistance of soil to mechanical stress or manipulation at various moisture content is termed as "**Soil Consistency**"

Forces causing/ responsible for soil consistency Two main forces are responsible for soil consistency are :

(i) Cohesion	(ii) Adhesion
Cohesion is the attraction of substance of like characteristics such as that of one water molecule for another.	Adhesion is the attraction of substance of unlike material for example attraction between soil and water molecule.

Forms of consistency :

	Consistency	Soil condition	Remarks
1)	Hard/Harsh	Occurs in dry soil	If ploughed, clods are formed

2)	Soft/friable	Moist soil	If ploughed, crumbs are formed
3)	Plastic	Fairly wet soil	If ploughed, easily puddled
4)	Sticky	Very wet soil	If ploughed, soils sticks to the plough
5)	Viscous	Saturated soil	Tillage by ordinary procedure is impossible because here soils run together with water

State the factors affecting soil consistency :

1) Soil water content :

Soil consistency is expressed with reference to water content of soil.

Thus, a soil may be **hard** when **dry**,

friable when **moist** and **plastic** when **wet**.

2) Soil texture : Soil consistency increases with increase in clay content.

Fine texture (clayey soils) – more consistency

Coarse texture (sandy soils) – less consistency **3)**

Types of clay :

Montmorillonite clay – more consistency

Kaolinite clay – less consistency **4)**

Organic matter :

More organic matter – more consistency

Less organic matter – low consistency **5)**

Soil structure :

Well aggregated soil – less consistency

Puddled soil – more consistency

Factors affecting soil consistency

- 1) Soil water content, 2) Soil texture, 3) Types of clay, 4) Organic matter, 5) Soil Structure

Significance of soil consistency

- 1) Different forms of soil consistency are important for developing tillage system and for construction purposes.
- 2) A distinct correlation exists between the different forms of consistency and the physical forms involved in tillage
- 3) Friable consistency is optimum condition for tillage and other agricultural operations
- 4) Plastic consistency is optimum condition for puddling.

Plasticity

Define plasticity.

- ❖ Plasticity is the capacity of being moulded or change its shape without cracking when stress is applied and after removing the stress it keeps the changed shape.
- ❖ Soils containing more than 15% clay exhibit plasticity.

Write about classes of plasticity.

Plasticity classes are described below :

1) Non-plastic :-

[CLICK HERE to Join AgroMind Telegram Channel](#)

A wire of 4 cm long and 6 mm thick that supports its own weight held on one end can not formed.

i.e. Wire of 4 cm long and 6 mm thick - not formed

2) Slightly plastic :-

Wire of 4 cm long and 6 mm thick – formed, but

Wire of 4 cm long and 4 mm thick - not formed

3) Moderately plastic :-

Wire of 4 cm long and 4 mm thick – formed, but

Wire of 4 cm long and 2 mm thick - not formed

4) Very plastic :-

Wire of 4 cm long and 2 mm thick – formed

Plasticity Indices

Lower Plastic Limit – is the lowest moisture content at which a soil can be deformed (bent/turned) without cracking

Upper Plastic Limit – is the moisture content at which a soil ceases (come to an end) to be plastic. It become semi-fluid and tends to flow like a liquid under an applied forces.

Plasticity Index – the difference in the moisture content between the upper and lower plastic limit is the range over which a soil remains plastic and is called plasticity index.

SOIL COLOUR

What is soil colour ?

- The colour of a soil is the result of light reflected from the soil.
- Colour is one of the most noticeable characteristics of a soil.
- Practically all colours occur in soils. This includes white, red, brown, gray, yellow and black; even bluish and greenish tinges occur.
- Colours of a soil inherited from its parent rock material, is referred as “**Lithochromic colour**”.
- The colour of soil as a result of soil forming process is termed as “**Acquired**” or “**Pedochromic colour**”.
- Frequently two or more colours occurs in patches are called **mottling**.
- It can be an indicator of the climatic condition under which a soil was developed or of its parent material and criteria for description and classification of soil.

What are the causes of soil colour ?

- The colour of soil has some relevance to soil constituents’ viz., parent material or mineral matter, organic matter, oxides of iron accompanied by weathering stage of soil, climatic conditions like temperature, rainfall etc.

Soil Colour	Colour due to presence of
Black to dark gray colour	Organic matter
Brown colour	Mixture of organic matter and iron oxide

- Colour indicates organic matter content of soil.
- Colour also indicates the degree of oxidation and reduction of iron and manganese compounds
- Colour of soils gives an idea about drainage of the soil
 - Well drained soils – red and yellow in colour due to oxidized Fe
 - Poorly drained soils – blue and gray in colour due to reduced Fe

Fill in the blanks

- 1) **Iron** (unhydrated ferric oxide) elements are responsible for imparting red colour to soil.
- 2) The three variables of Munsell colour system are **hue, value** and **chroma**.
- 3) **Hue** refers to the dominant spectral colour.
- 4) The notation for value extends from **0** for **pure black** to **10** for **pure white**.
- 5) The value of **chroma** increases with decreasing **grayness**.
- 6) In the colour notation 10YR 4/6, the symbol code **10YR** is **hue**, **4** is **value** and **6** is **chroma**.
- 7) Colours having **high chroma** throughout the profile are the symptom of **well drained** soils.
- 8) A **low chroma** colour indicates **poorly drained** soils.

State True or False

- 1) The colour of the soil gives an indication on content of organic matter - **True**
- 2) In Munsell colour chart, the purity of colour increases with increase in chroma number – **True**
- 3) The colour of the soil will be darker when moist than when dry – **True**
- 4) Gray colour soils are relatively less productive than brown colour soils – **True**
- 5) In tropical condition black colour of black soils are due to a combination of base status (Na,Ca), humus and montmorillonite clay minerals - **True**

AgroMind