PRACTICAL MANUAL

ON

Fundamentals of Soil Science

APS 118 3(2+1)

For B.Sc. Agriculture I Semester students

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2020

RANI LAKSHMI BAI CENTRAL AGRICULTURAL UNIVERSITY, JHANSI

Fundamentals of Soil Science APS 118 2(1+1)

Practical: Study of soil profile in field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Determination of soil density, moisture content and porosity. Determination of soil texture by feel and Bouyoucos Methods. Studies of capillary rise phenomenon of water in soil column and water movement in soil, Infiltration rate. Determination of soil pH and electrical conductivity. Determination of cation exchange capacity of soil. Study of soil map. Determination of soil colour. Demonstration of heat transfer in soil. Estimation of organic matter content of soil.

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Practical No. 1

Objective: Study of soil profile in field

Question: Complete a core profile description, identifying and describing master, transitional, and subordinate horizons. Provide a sketch of the soil profile using colored pencils – in addition to coloring, include horizon boundaries and structure in your drawing.

SOIL PROFILE	HORIZON	DESCRIPTION (color, texture, structure)
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Question 2: How does clay content change from the A horizon to the B horizon in each soil?

Practical No. 2

Objective: Collection of soil sample

Question 1: Write the scientific procedure for collection of representative soil sample, precautions etc.

Question 2: Write the information on labels during soil sample storage.

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Question 3: Draw different soil sampling tools.

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Practical No. 3

Objective: Assessment of soil Bulk density, Particle density and porosity.

Question: Calculate the following:

A. Bulk density

1. Diameter of the sampler (D)……..cm
2. Length of the sampler (L)……..……cm
3. Volume of the sample $V= \pi r^2 L$ ……..……cm^3
4. Weight of empty moisture box ……g
5. Oven dry weight of soil sample + moisture box ……..…….g
6. Oven dry weight of soil …… …..g

Bulk density ($g\ cm^{-3}$) =

B. Particle density

1. Volume of soil and water mixture……..…..cm^3
2. Volume of water used ……..……..cm^3
3. Volume of water displaced (volume of soil solids)…… cm^3
4. Weight of oven dry soil used ……g

Particle density ($g\ cm^{-3}$) =

Per cent pore space=

Results: The given soil sample has bulk density = ……..……, particle density = ……..… and porosity = ……

Question 1. Calculate the bulk density of a 400 cm^3 soil sample that weighs 575 g (oven dry weight).

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Question 2. Calculate the bulk density of a 400 cm^3 soil sample that weighs 600 g and that is 10% moisture.

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Question 3. Calculate the volume of a soil sample that is 12% moisture, weighs 650 g and has a bulk density of 1.3 g/cm^3.

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Question 4. Calculate the bulk density of a rectangular soil sample with dimensions 12 cm by 6 cm by 4 cm, that is 15% moisture content and weighs 320 g.

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Question 5. Calculate the oven dry weight of a 350 cm^3 soil sample with a bulk density of 1.42 g/cm^3.

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Question 6. Calculate the porosity of a soil sample that has a bulk density of 1.35 g/cm^3. Assume the particle density is 2.65 g/cm^3.

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Question 7. Calculate the porosity (n) of a 250 cm^3 clod that contains 140 cm^3 water when saturated.

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Question 8. Calculate the bulk density of a soil sample that has a porosity of 45%.

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Question 9. Calculate particle density of a soil sample that has a bulk density of 1.55 g/cm^3 and a porosity of 40%.

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Practical No. 4

Objective: Soil color interpretation using soil color chart.

Question 1. What affect does organic matter have on soil color?

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Question 2. Write the color of the soil according to Munsell notation. Find out the color of soil at both dry and moist condition. If soil is dry first note the color of dry soil. Then moist the clod with few drops of water and note down the color.

Sample No.	Dry soil					Moist soil				
	Munsell notation					Munsell notation				
	Hue	Value	Chroma	Comb-ination	Color name	Hue	Value	Chroma	Comb-ination	Color name
1.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..
2.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..
3.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..
4.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..
5.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..
6.	…..	…..	…..	……..	……..	…..	…..	…..	……..	……..

Result……

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Practical No. 5

Objective: Estimation of soil moisture content by Gravimetric method.

Question 1. Compute the following calculations:

A. Moisture box weight	…….	…….	…….
B. Moisture box weight + wet soil sample	…….	…….	…….
C. Moisture box + dry soil sample	…….	…….	…….
D. Wet sample weight (B – A)	…….	…….	…….
E. Dry soil weight (C – A)	…….	…….	…….
F. Moisture weight (D – E)	…….	…….	…….
G. Soil Moisture (%) = 100 x (F)/(E)	…….	…….	…….

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Practical No.6

Objective: Assessment of soil texture by feel and Bouyoucos method

Question 1. Write down procedure how feel method is used for texture determination in field.

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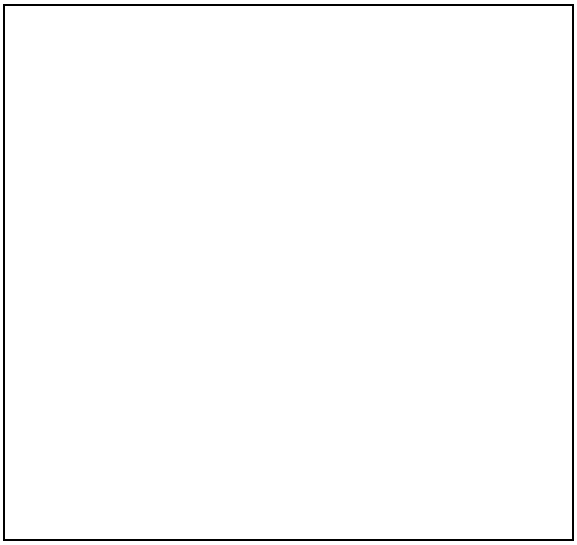
Question 2: Draw labeled diagramme of Bouyoucos hydrometer.



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Question 3: Write principles of Bouyoucos method

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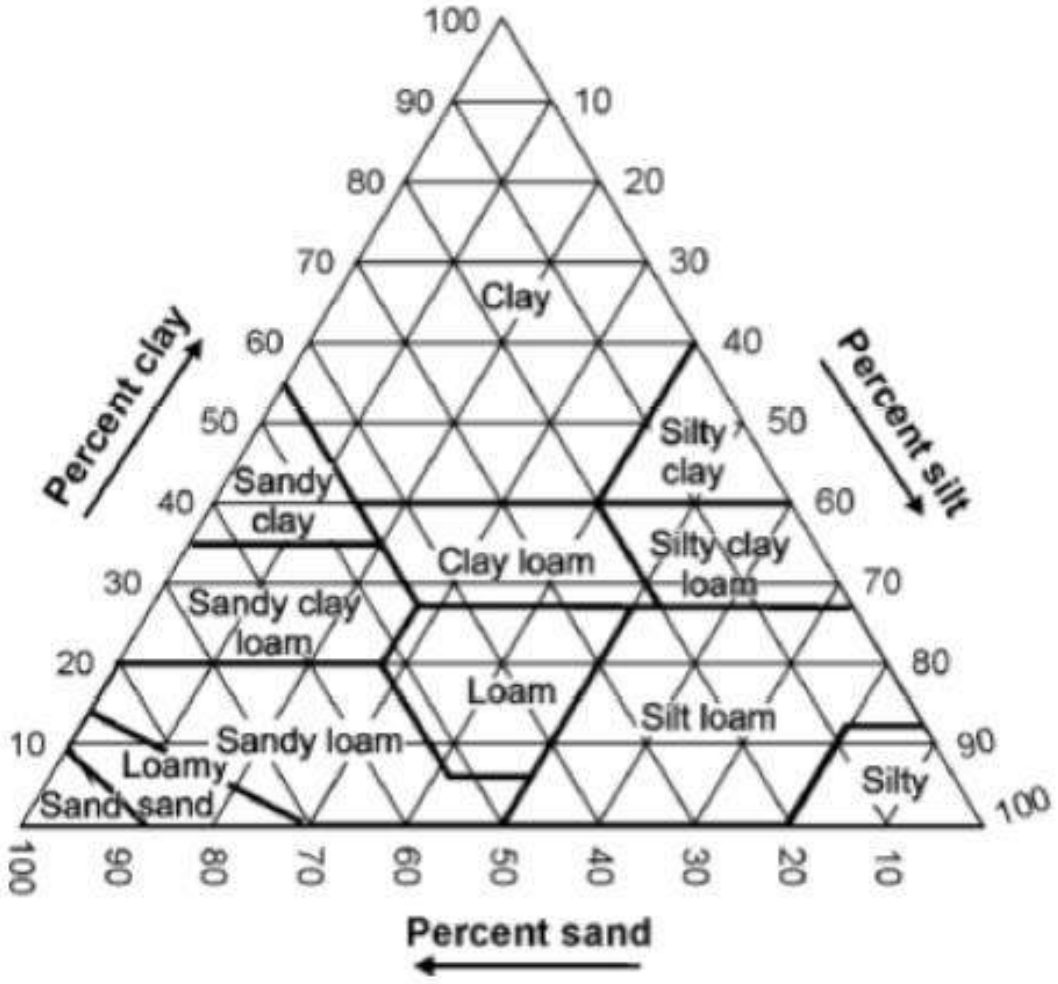
Question4: Write down and Stock's formula with symbols used in it.

The textural triangle and its use



Soil textural classes according to proportions of sand, silt and clay

Question 1. Use the soil textural triangle to determine the textural class of the following soil samples:

a. % Sand = 40, % Silt = 30, % Clay = 30 ……

b. % Sand = 10, % Silt = 55, % Clay = 35 ……

c. % Sand = 50, % Silt = 25, % Clay = 25 ……

d. % Sand = 25, % Silt = 30, % Clay = 45 ……

e. % Sand = 37, % Silt = 40, % Clay = 23 ……

d. % Sand = …., % Silt = …., % Clay = …. ……

f. % Sand = …., % Silt = …., % Clay = ….. ……

Question 2. What are redoximorphic features? What does gley mean?

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Question 3. Why is soil texture important?

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Question 5. Study the shape and relative size of sand, silt and clay samples provided to you by naked eye and under microscope. Note the color of the soil separates. How different soil separates feel between thumb and forefinger when rubbed in dry and moist conditions.

Observations

Soil Separates	Color	Feel	Shape	Relative Size

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Results: Soil Texture of present sample is……

Map unit name / Soil series: ……

States the soil is located in: ……

Practical No. 7

Objective: Assessment of soil structure using collected soil sample.

Question: Watch carefully and note down observations.

Sample No ID	Types of Soil Structure	Size of Soil Structure	Grade of Soil Structure
…………….........	……………...............	……………...............	……………...............
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Question 2: Draw different types of soil structure.

Practical No. 8

Objective: Estimation of capillary rise and water movement in soil.

Question 1: If the surface tension of water 0.06 N m^{-1}, then calculate the capillary rise in a tube of diameter 1 mm is (φ =0°).

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Question 2: Draw labeled figure of soil tensiometer.

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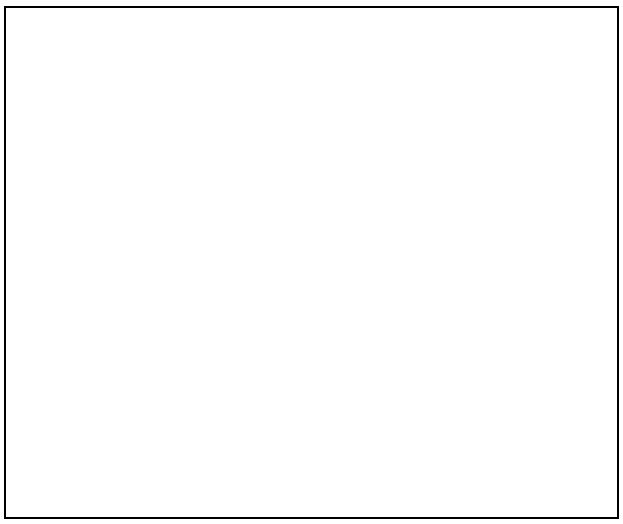
Practical No.9

Objective: Determination of Infiltration rate in soil

Question 1: Draw double ring infiltrometer apparatus and accessories.



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Question 2: Describe determination of infiltration rate of soil basic principle of double ring infiltration.

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Question3. Distinguish between infiltration and percolation.

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Question 4: Draw and state the relationship between
a. Cumulative infiltration and time
b. Infiltration rate and time

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Question 5: Describe factors affecting infiltration rate.

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Practical No.10

Objective: Determination of pH of unknown soil sample

Question 1: Find pH of following unknown soil samples and categorise its rating, and also interpret it.

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Question 2: Prepare Standard buffer solutions for pH measurement and calibrate pH meter.

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Practical No.11

Objective: Determination of Electrical Conductivity of unknown soil sample

Question 1: How to prepare standard potassium chloride (0.01 N) solution and calibrate EC meter?

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Question 2: Draw figure of reference electrode (combined).

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Question 3: Write principles of conductivity meter.

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Practical No. 12

Objective: Estimation of Cation Exchange Capacity (CEC) of soil.

Question 1: Describe procedure of Cation exchange capacity measurement of soils.

Practical No. 13

Objective: Estimation of Buffering Capacity of soil.

Question: Find out Buffering capacity of soil taking 1 g processed soil sample and Plot the data, with pH on ordinate and ml base added on the abscissa with following Observations.

S.No.	Volume of 0.01N NaOH added (ml)	pH readings	
		2:1 soil (Fine textured)	1:1 soil (Coarse-textured)
1.	0	.....	.....
2.	25	.....	.....
3.	50	.....	.....
4.	75	.....	.....
5.	100	.....	.....
6.	125	.....	.....
7.	150	.....	.....
8.	175	.....	.....
9.	200	.....	.....

Draw Graph

Conclusion: .....

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Result: Soil is weakly/ strongly buffered

Practical No. 14

Objective: Study of Soil Map.

Question 1: Give soil fertility map definition.

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Question 2: Define the following with measuring scales?

a. Village Patwari maps
b. Toposheets of Survey of India
c. Aerial photographs

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Question 3: How to read a soil map?

Practical No. 15

Objective: Demonstration of heat transfer in soils.

Observations

i. Air dry loam soil

Distance from the water tank (cm)	Temperature °C Time (minutes)					
	10	20	30	40	50	60
5						
10						
15						
ii. Loam soil wet to field capacity						
5						
10						
15						
iii. Air dry sand						
5						
10						
15						

Calculation Calculate heat capacity of the soil from equation (2) using your own data.

Result

2. Heat capacity of the soil……..
3. Put the temperature curves using time as abscissa and temperature as the ordinate

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Practical No. 16

Objective: Estimation of organic matter content in soils.

Question 1: Discuss the importance of organic matter in soils.

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Question 2: Prove that 1 meq $K_2Cr_2O_7$= 0.003 g Organic Carbon.

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Question 3: Give the role of the following reagents in determination of Organic carbon in soils:

1. Ag_2SO_4
2. H_3PO_4
3. NaF

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Question 4: Give the relation between (factors to convert) organic matter and total N.

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Question 5: Organic carbon content of soils is an Index of available N status of soils. How?

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Question 6: Perform soil organic carbon estimation taking 1 g processed soil sample and mention category.

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Result: The per cent organic matter of the soil is ---------- and it is rated as ----------

Practical No.17

Objective: Identification of fertilizers.

Question 1: Identify following fertilizer samples and write their nutrient content and properties.

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Question 2: Define the following terms:

a. Primary fertilizers……

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b. Straight fertilizers……

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c. Complex fertilizers……

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d. Fertilizer……

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e. Manure……

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Question 3: Give different organic plant nutrient sources in soil ?

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Practical No.18

Objective: Microscopic examination of soil microbes.

Observations

Slide No.	Treatment	Number of different cell colonies	Groups	Shape	Relation with soil particles
1.	Moist soil				
2.	Moist soil + wheat straw				
3.	Moist soil + soybean straw				
4.	Moist soil + KNO_3				
5.	Moist soil + soybean straw +KNO_3				

Result: The given soil contains ….....,…… & ……. group of microorganisms.

Question1: Write down your views about role of microorganisms present in cultivated soil and barren soil.

Cultivated Soil:……

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Barren Soil:……

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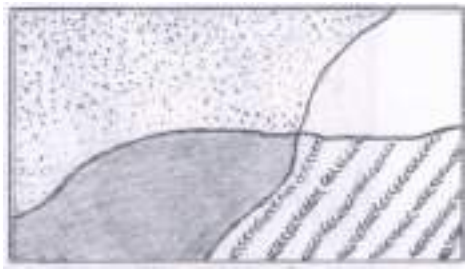
SOIL PROFILE

- **Soil Profile:** The soil profile is defined as a vertical section of the soil that is exposed when a soil pit, or hole, is dug from the surface of the soil to the underlying bedrock. It is generally made up of following **HORIZONTAL LAYERs** called Horizons.
- **Horizon O** Partially decomposed organic matter
- **Horizon A top soil** Contains humus living creatures and mineral matter from rocks
- **Horizon B subsoil** Rich in minerals and clay particles leached down from A. Roots of large plants are found here
- **Horizon C (partially weathered rock)** Parent material that is being weathered
- **Horizon D Bedrock** Parent material that has not been affected by weathering

COLLECTION OF SOIL SAMPLE

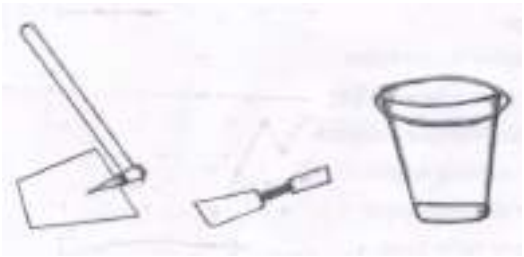
Materials required: Spade, Khurpi, Augers, Bucket, Scale, Wooden roller, Mortar and pestle, Sieve, Polythene/paper/cloth bags, Labels, Card-board cartons, Rack, Aluminium boxes.

Soil sampling procedure: Based on difference in soil type, color, crop growth or slope, divide the area in different homogenous units.



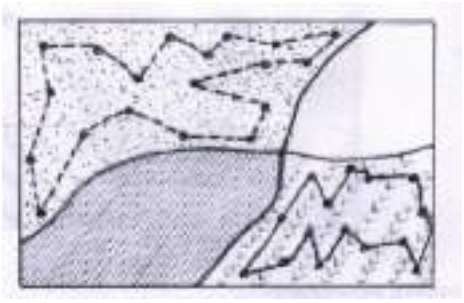
Division of area

Post-Hole Auger Screw Auger Closed Tube Auger

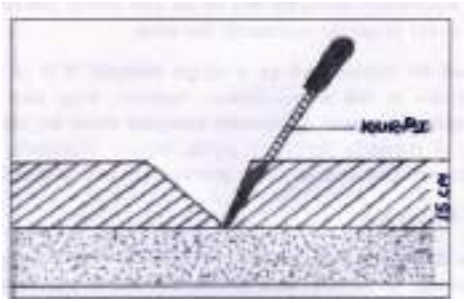


Spade Khurpi Bucket

Soil sampling tools



Collection of soil samples in Zig-Zag manner



Collection of soil sample by Khurpi.

SOIL BULK DENSITY, PARTICLE DENSITY AND POROSITY

Bulk density and particle density are methods of expressing soil weight. Bulk density is the ratio of the mass of water-free soil to its bulk volume. It is expressed in g/cc and is sometimes referred to as "apparent density". When expressed in g/cc, bulk density is numerically equal to apparent specific gravity or volume weight.

$$\text{Bulk density (g cm}^{-3}) = \frac{Weight\ of\ oven\ dry\ soil}{Volume\ of\ soil}$$

Particle density is the mass (weight) of a unit volume of soil solids and is expressed in metric units in grams per cubic centimeter. The particle density for most soil minerals varies 2.60-2.75 gcm^{-3} as the bulk of the soil consists of quarts, feldspar and colloidal silicates.

$$\text{Particle density (g cm}^{-3}) = \frac{Weight\ of\ oven\ dry\ soil}{Volume\ of\ soil\ solids}$$

Pore space of soil can be calculated from the values of bulk density and particle density using the simple formula.

$$\text{Per cent pore space} = \left[1 - \frac{Bulk\ density}{Particle\ density}\right] x\ 100$$

SOIL COLOR INTERPRETATION

The color of soil is due to organic matter, mineral matter and mixture of these two. Red, brown and yellow color of soil is mainly due to compounds of iron. Silica, lime and salts provide white or light color to the soil. Organic matter gives black, grey and brown and other dark color to the soil. Minerals of manganese and titanium also enhance dark coloration of the soil.

Munsell color chart is used for identifying color of the soil. This chart is a note book having cards of different color. Each card has chips of different color alongwith a hole below each chip. Hue, value and chroma are indicated on each card. These are three variables of a color.

Hue indicates (here 10YR) main color of spectrum and main wavelength of light. Value indicates relative blackness or whiteness of color (Numerator digit like 5 in 5/4). Chroma (Denominator digit like 4 in 5/4) indicates relative purity of color. The full notation of these color variables can be depicted as 10YR5/4) and color is Yellowish brown.

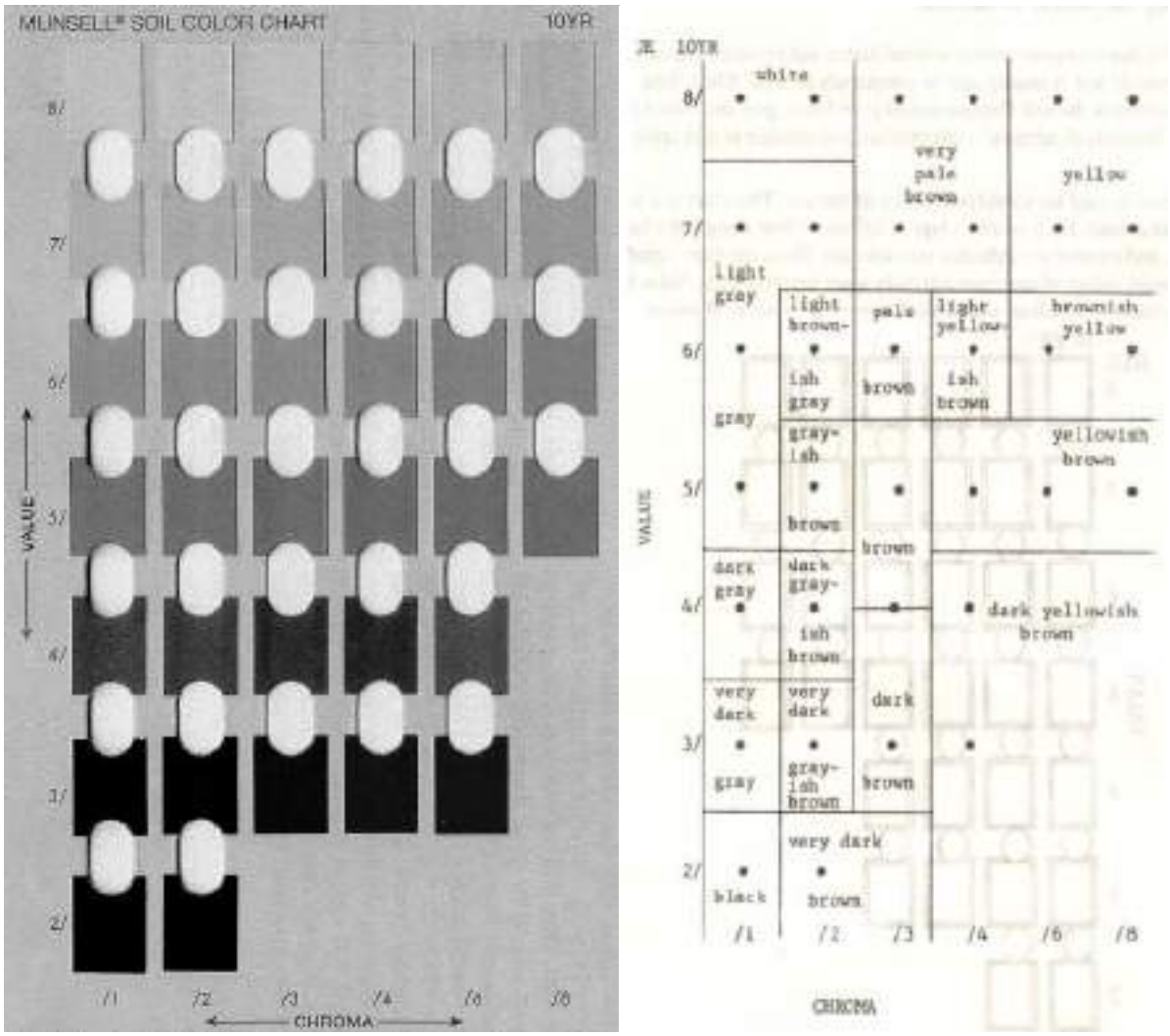


Fig: A sheet of Munsell color chart and their naming

SOIL MOISTURE MEASUREMENT

Gravimetric method of moisture estimation is most widely used where the soil sample is placed in an oven at 105°C and dried to a constant weight. The difference in weight is considered to be water present in the soil sample.

Moisture (%) = (Loss in weight/ Oven dry weight of the soil) x 100

Example:	**SAMPLE**
A. Moisture box weight	115.27 g
B. Moisture box weight + wet soil sample	177.57 g
C. Moisture box weight + dry soil sample	168.10 g
D. Wet sample weight (B – A)	62.30 g
E. Dry soil weight (C – A)	52.83 g
F. Moisture weight (D – E)	9.47 g
Soil Moisture (%) = 100 x (F)/(E)	**17.93%**

DETERMINATION OF TEXTURE BY FEEL METHOD

The relative amount or proportion of soil separates i.e. Sand, silt and clay in the soil is called as soil texture.

Soil texture	Feel of moist soil and stickiness	Ribbon formation
Sand	Very gritty, does not stick	No ribbon formation
Loamy sand	Very gritty, It dirties fingers slightly	No ribbon formation
Sandy loam	Moderately gritty, it dirties fingers	No ribbon formation
Silt loam	Smooth, stick on fingers	Weak ribbon
Loam	Slightly gritty, stick on fingers	Poor ribbons
Sandyclay loam	Slightly gritty and fairly smooth, stick on fingers	Moderate ribbons
Clay loam	Smooth, stick on fingers	Moderate ribbon of short length
Silty clay loam	Very smooth, stick tightly with flexibly	Good ribbons with slight longer length
Clay	Very smooth, stick very tightly and very flexibly	Very good long and flexible ribbons.

ASSESSMENT OF SOIL STRUCTURE USING COLLECTED SOIL SAMPLE

The arrangement of primary particles (sand, silt, clay) and their aggregates into a certain definite pattern is called soil structure.

			
PLATELIKE: • PLATY (Leafy and flaky also found) May occur in any part of profile. At times inherited from the soil material.	**PRISMLIKE:** • PRISMATIC (Level tops) • COLUMNAR (Rounded tops) Both usually subsoil manifestations. Common in soils of arid and semi arid regions.	**BLOCKLIKE** • BLOCKY (Cube like) • BLOCKY (Sub angular) Common in heavy sub soils, particularly those of humid regions.	**SPHEROIDAL** • GRANULAR(Porous) • CRUMB (Very porous) Characteristic of the furrow slice. Subject to wide and rapid changes.

Boyoucos hydrometer method is a very popular method that was devised for rapidly determining the content of sand, silt, and clay in a soil. In this hydrometer method a sample (usually 50 grams) of air-dry soil is mixed with a dispersing agent (such as a sodium pyrophosphate solution) for about 12 hours to promote dispersion. Then dispersed suspension is poured into a specially designed cylinder, and distilled water is added to bring the contents up to volume one Liter. **The soil particles settle in the water at a speed directly related to the square of their diameter and inversely related to the viscosity of the water.** A hand stirrer is used to suspend the soil particles thoroughly and the time is immediately noted. A specially designed hydrometer is carefully inserted into the suspension and two hydrometer readings are made. The sand settles in about 40 seconds and a hydrometer reading taken at 40 seconds determines the *grams* of silt and clay remaining in suspension. Subtraction of the 40-second reading from the sample weight gives the *grams* of sand. After about 8 hours, most of the silt has settled, and a hydrometer reading taken at 8 hours determines the grams of *clay* in the sample. The silt is calculated by difference: add the percentage of sand to the percentage of clay and subtract from 100 percent

ESTIMATION OF CAPILLARY RISE AND WATER MOVEMENT IN SOIL

Water is drawn into a capillary tube inserted into a beaker containing water. Liquid or water moves from its surface where the pressure is zero to a height h in a capillary.

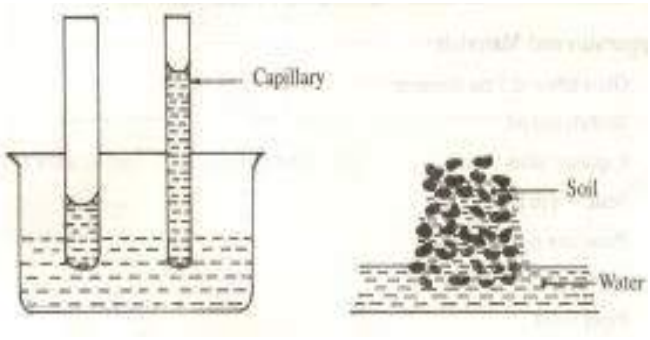


Fig: Capillary rise of water

The height to which the water will rise in the capillary is given by the following expressions:

$$h = \left[\frac{2T}{dgr}\right] \quad \text{..... (1)}$$

Where, h = height, cm
T = surface tension of water 72.8 dynes/cm^2
d = water density = 1.0 g cm^{-3}
g = Acceleration due to gravity = 980 g/sec^2
r = capillary radius, cm

Above the water table, 'h' is negative because water pressure in the capillary decreases with weight. Water pressure in the capillary can be calculated by rearranging the above equation as: 2T = dgh = pressure (dynes/cm^2)

ESTIMATION OF pH OF SOILS

The pH value is a measure of hydrogen ion concentration of the soil water system and expresses the acidity and alkalinity of soil. pH is very important property of soil as it determines the nutrient availability, microbial activity and physical condition of the soil. The concept of pH was given by Sorensen in 1901. pH value ranges from 0-14.

ESTIMATION OF EC OF SOILS

Principle: Amount of total soluble salt in a sample is generally expressed in terms of its electrical conductivity. It is measured with the help of electrical conductivity meter. The most common unit of EC being followed is dSm^{-1} (deci Siemens per meter). Which is equal to the older unit of milli mhos / cm.

Specific conductance or electrical conductivity is the conductance 1 cc of solution measured between two electrodes placed 1 cm apart. It is expressed in mho cm^{-1} or m mho cm^{-1} or dS m^{-1}.

1 dS m^{-1} x 10^2 = 1 milli Siemens m^{-1}

Percentage of soluble salts in soil = 0.064 x EC x SP/100
Where SP the saturation percentage of soil and EC is in d S m^{-1}.
Salt content in mg/L (ppm) = EC dSm^{-1} x 640

ESTIMATION OF CATION EXCHANGE CAPACITY (CEC) OF SOIL

The total number of exchangeable cations, a soil can hold is called cation exchange capacity (CEC).

Soil texture	Typical CEC Range (c mol kg^{-1})
Sand	2-6
Sandy Loam	3-8
Loam	7-15
Silt Loam	10-18
Clay and Clay Loam	15-30

Calculation: CEC (C mol P$^+$ kg^{-1}) $= \frac{(S-B)}{\text{weight of sample}}$ x N of H_2SO_4 x N of NaOH x 100

where,

S = Vol. of NaOH required for sample titration

B = Vol. of NaOH required for blank titration

ESTIMATION OF BUFFERING CAPACITY OF SOIL

Buffering capacity is a distinct resistance to a change in the pH of soil solution. This resistance to pH change is equally important in preventing a rapid lowering of the pH of soils. The buffering capacity of a soil depends on its cation exchange capacity. Higher the exchange capacity the greater will be the buffering capacity of the soil. This is because more reserve acidity must be neutralized to affect a given rise or lowering of percentage base saturation. That is why a fine textured (high CEC) acid soil requires more lime compared to a coarse textured (low CEC) acid soil for bringing about the same change in pH.

Apparatus and Materials

1. Beaker- 50 ml - 2 in number,
2. Beaker -250 ml - 2 in number,
3. Funnel top test tube - 2 in number,
4. Filter paper Whatman No. 2 in number,
5. Pipette – 20 ml or graduated cylinder -1 in number,
6. pH meter.
7. Stirring rods -2 in number,
8. Burette -100 ml
9. NaOH–dissolved 4.0 g NaOH per litre. Dilute this ten times and standardize against acid.

Procedure

1. Weigh out 10 g of soil I (Coarse-textured) in a 250 ml beaker. Similarly weigh 10 g of soil II (Fine-textured) in a 250 ml beaker.
2. Add 20 ml water, stir intermittently for half an hour. Read the pH.
3. Also take 20 ml water in 250 ml beaker and record the pH.
4. From a burette add 25 ml increments of 0.01 N NaOH and record the pH of soils, I, II and water at every 25 ml increment.

STUDY OF SOIL MAPS

Apparatus and Materials

1. Different maps
2. Scale and pencil

Procedure

A. Cadastral maps and top sheets

1. Carefully see the given maps and write the scale of each map.
2. Identity different objects and features indicated on the maps as per the legends given

B. Aerial photographs

1. Calculate the representative factor (RF) of the aerial photograph by following formula:

$$RF = \frac{\text{Distance between two points on aerial photographs (cm)}}{\text{Actual distance between same points on land (m)}}$$

2. To calculate RF: Select two points like railway Station, Bus stand, Building, Aerodrome, Road crossing etc. in the aerial photograph whose land distance you know very well.
3. Now find out distance between these two points on the photograph with the help of scale.
4. Find out the R.F.
5. Note down the features and objects indicated on the photograph according to legend.
6. Representative factor of photograph can also be calculated with the help of scale of other map, if the distance between two points in land is unknown. At this condition the RF will be

$$RF = \frac{\text{Distance between two points on aerial photographs (cm)}}{\text{Actual distance between same points on land (m)}}$$

C. Estimation of Slope

Height of any point from mean sea level (MSL) can be known with the help of contour lines shown on toposheets. If contour lines are not shown height of nearby triangulation point can be considered for the equally high points.

1. To find out slope between two points, first find out difference between their heights with the help of contour lines or triangular points.

2. Find out distance between these two points on land with the help of the map.
   Distance on land = Distance on map (cm)/R.F. of map
3. Find out percent slope with following equation.
   Slope (%) = Difference in height (cm)/ Distance on land

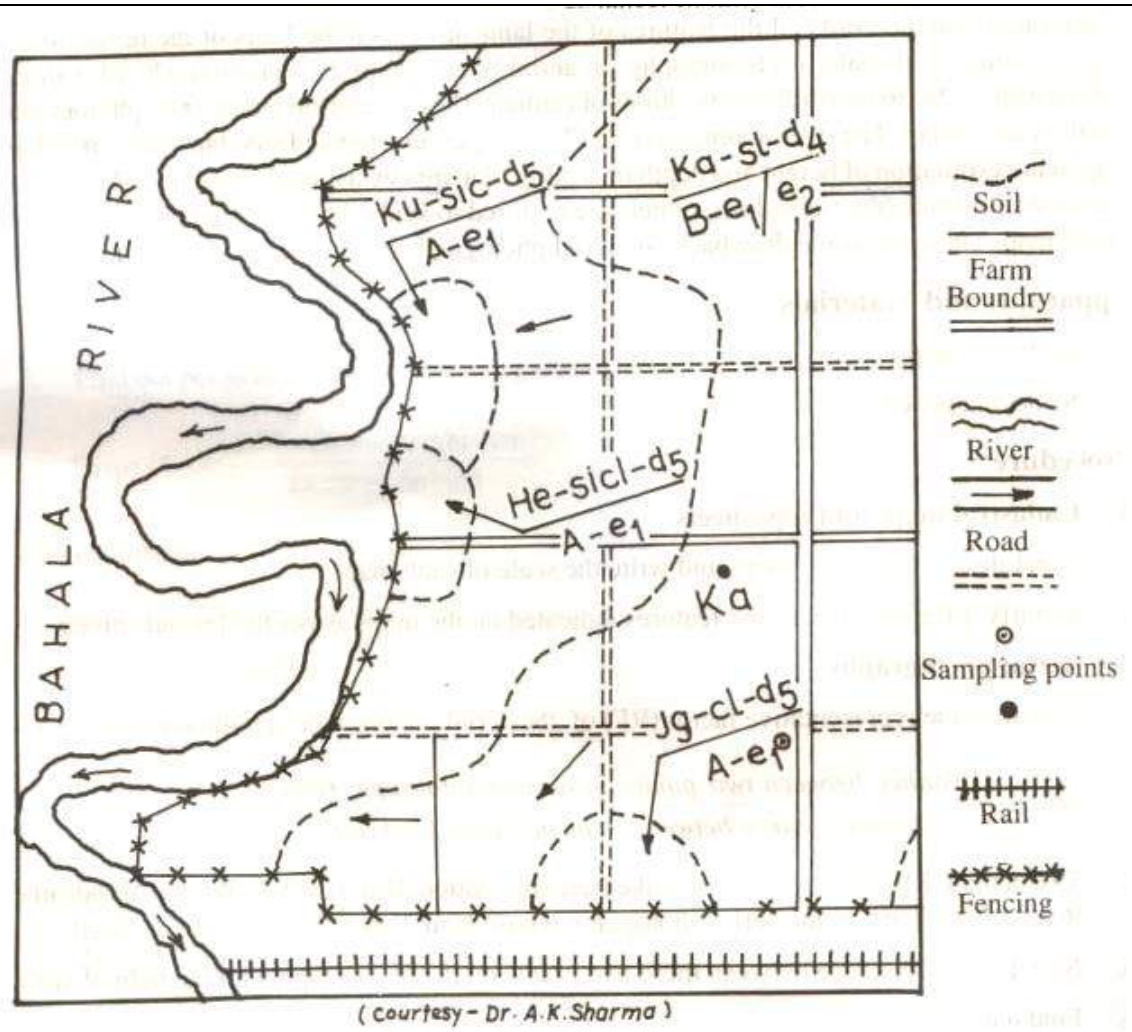
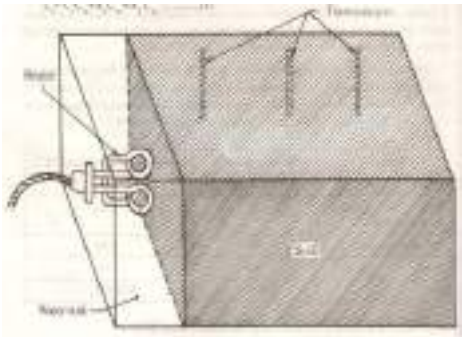


Fig: Soil map

DEMONSTRATION OF HEAT TRANSFER IN SOILS

Soil temperature is a very important property of soil since it affects several processes. Some of the processes affected a microbial activity, seed germination, water uptake, nutrient availability, plant growth and rate of chemical and physical processes.



Heat conductivity apparatus

ESTIMATION OF ORGANIC MATTER CONTENT OF SOIL

The organic matter content of soil varies from less than 0.5% in very sandy arid soils to more than 86% in peat and mucks. The Tarai soils are rich in organic matter content (2-3% on an average) as compared to soil in other parts of India. Organic matter plays very important role in supplying nutrient and water to the plants besides providing good physical condition to the soil. A major portion of nitrogen (95-99% of the total), phosphorus (33-67% of the total) and sulphur (about 75 % of the total) in the soil occurs in organic combinations which mineralize to release the nutrients in plant available form.

Accurate determination of soil organic matter is difficult and requires complex apparatus. A simple and commonly used method called Walkley and Black (1934) is followed in this exercise.

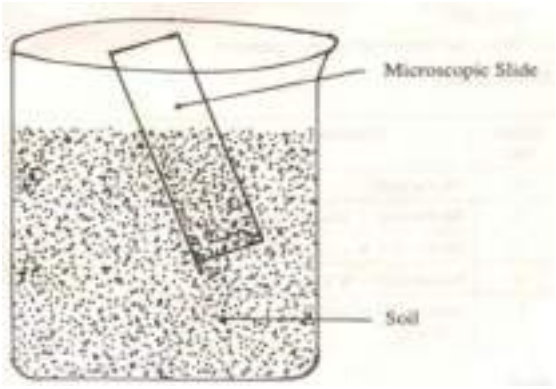
Soil organic matter is the seat of nitrogen in soil and its determination is often carried out as an index of nitrogen availability. Approximate organic matter can be estimated by visual inspection or by multiplying the % total N by 20.

MICROSCOPIC EXAMINATION OF SOIL MICROBES

A vast number of organisms live in the soil. Most of the soil organisms are so small that the aid of microscope is indispensible for their study. Organisms of plant nature are more numerous and are more important for the point of view of soil processes like organic matter decomposition. 'N' fixation, Nitrification, 'S' oxidation etc. In this exercise, we will study only selected and most important groups of organisms.

Apparatus and Materials

1. Beaker-250 ml – five
2. Microscopic slide
3. Water bath
4. Staining rack
5. Spatula
6. Soil samples
7. Wheat straw
8. Soybean straw
9. Incubator
10. Potassium nitrate
11. Phenolic rose Bengal
12. Watch glass



Study of soil microbes