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ASAC 1101 : FUNDAMENTALS OF SOIL SCIENCE (2+1)

Level : B.Sc (Ag), I semester

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SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

**M.S.SWAMINATHAN SCHOOL OF AGRICULTURE,CUTM,
PARLAKHEMUNDI**

Topic

Soil physical properties

Soil texture

Soil texture: definition

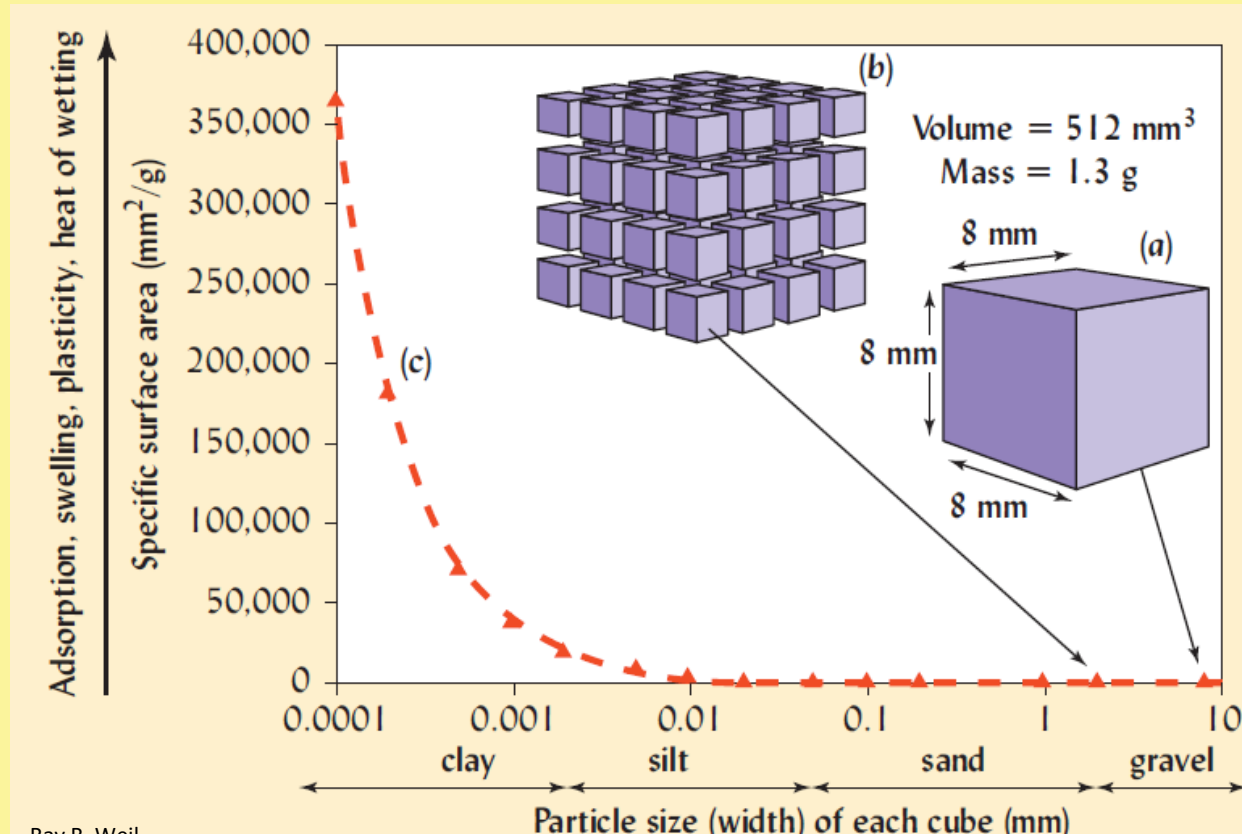
- ❑ Relative proportions of soil separates i.e. sand, silt and clay in the soil
- ❑ A basic, hard to alter property

Soil separate	USDA particle size range (mm)
Sand	0.05 - 2
Silt	0.002 – 0.05
Clay	< 0.002

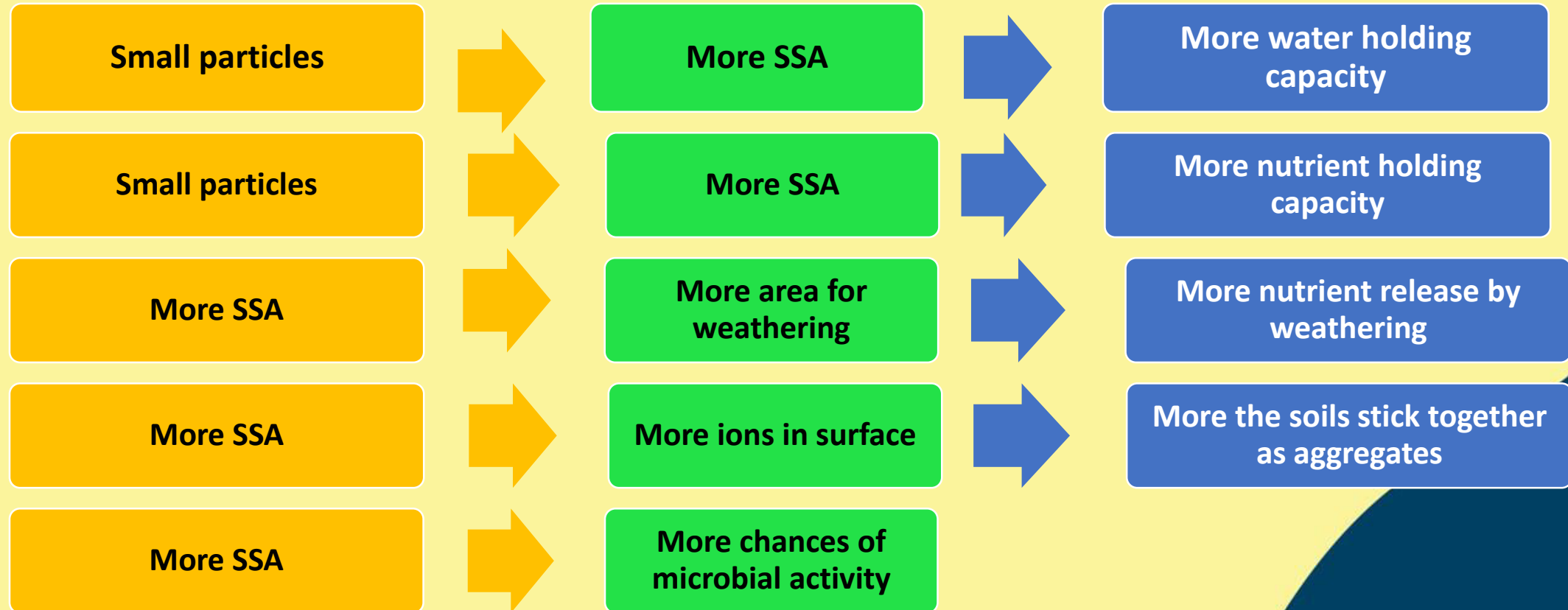
Soil separates

	Sand	Silt	Clay
Size	0.05 – 2 mm	0.002 – 0.05 mm	< 0.002 mm
Feel	gritty	smooth and silky	Feels sticky
Pore size	Large	Smaller than sand	Very small
Water and nutrient holding capacity	Less	More than sand	High but releasing capacity is less
Specific Surface Area	Low	Large	Tremendous

Specific Surface Area



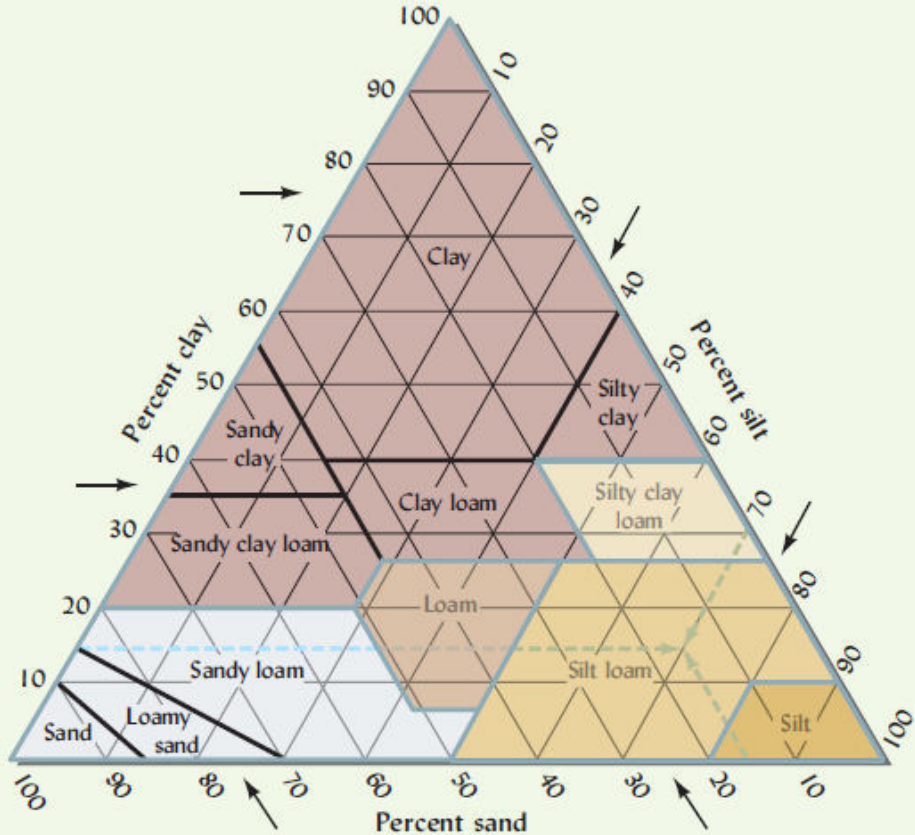
Importance of specific surface area(SSA)



Soil textural classes

- ❑ Soil textural classes convey an idea of size distribution of particles and the general nature of their physical properties.
- ❑ Depicted by using a **textural triangle**
- ❑ 12 textural classes

Textural triangle



GENERAL TERMS USED TO DESCRIBE SOIL TEXTURE IN RELATION TO THE BASIC SOIL TEXTURAL CLASS NAMES IN THE U.S. DEPARTMENT OF AGRICULTURE CLASSIFICATION SYSTEM

Basic soil textural class names

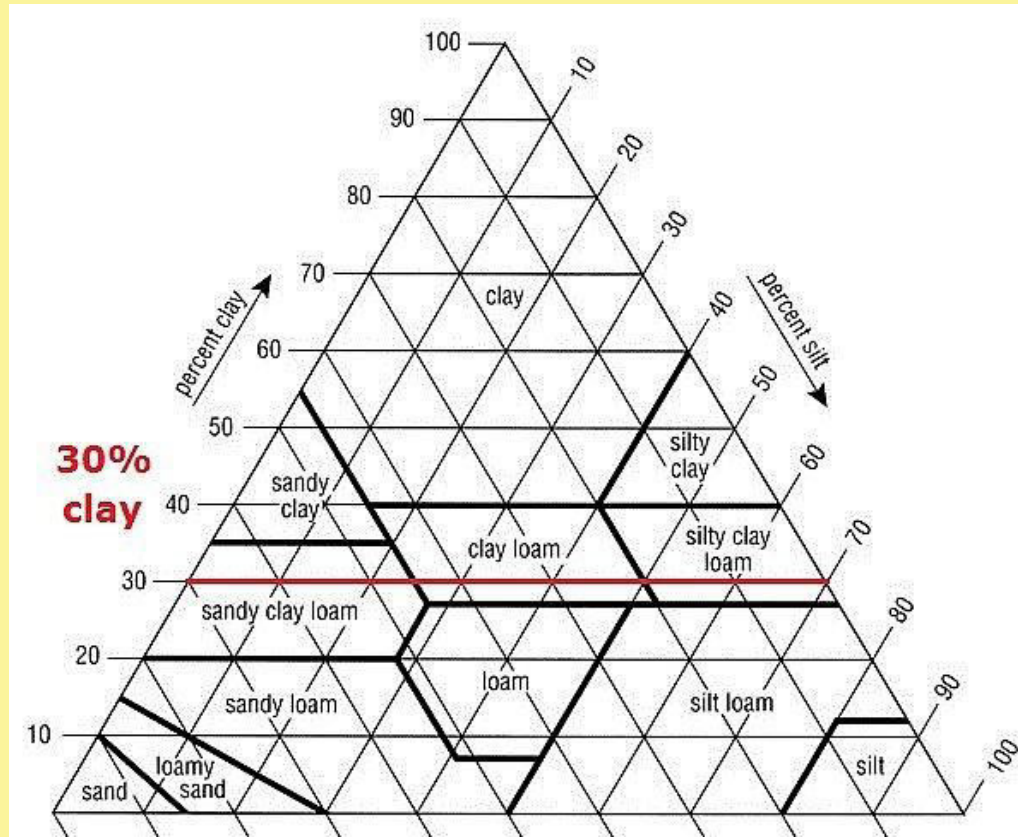
Loamy Sands	Sandy sands	Fine sandy loam	Very fine sandy loam ^a	Silt loam	Silt	Sandy clay loam	Silty clay loam	Clay loam	Sandy clay	Silty clay	Clay
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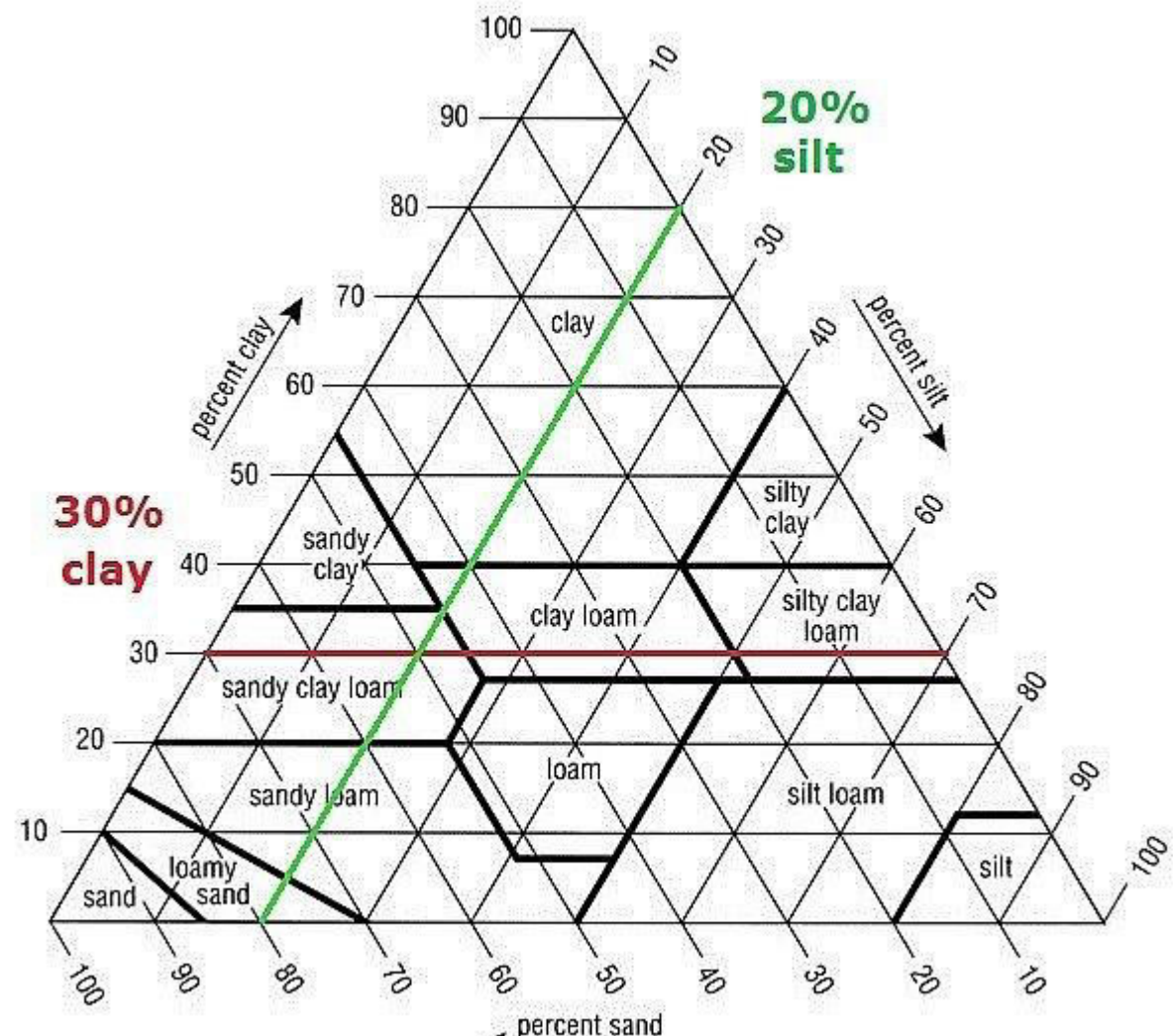
General texture terms

---- Coarse ----	-- Moderately -- coarse	----- Medium -----	--- Moderately fine ---	----- Fine -----
Sandy soils	----- Loamy soils -----		---- Clayey soils ----	

How to use soil texture triangle?

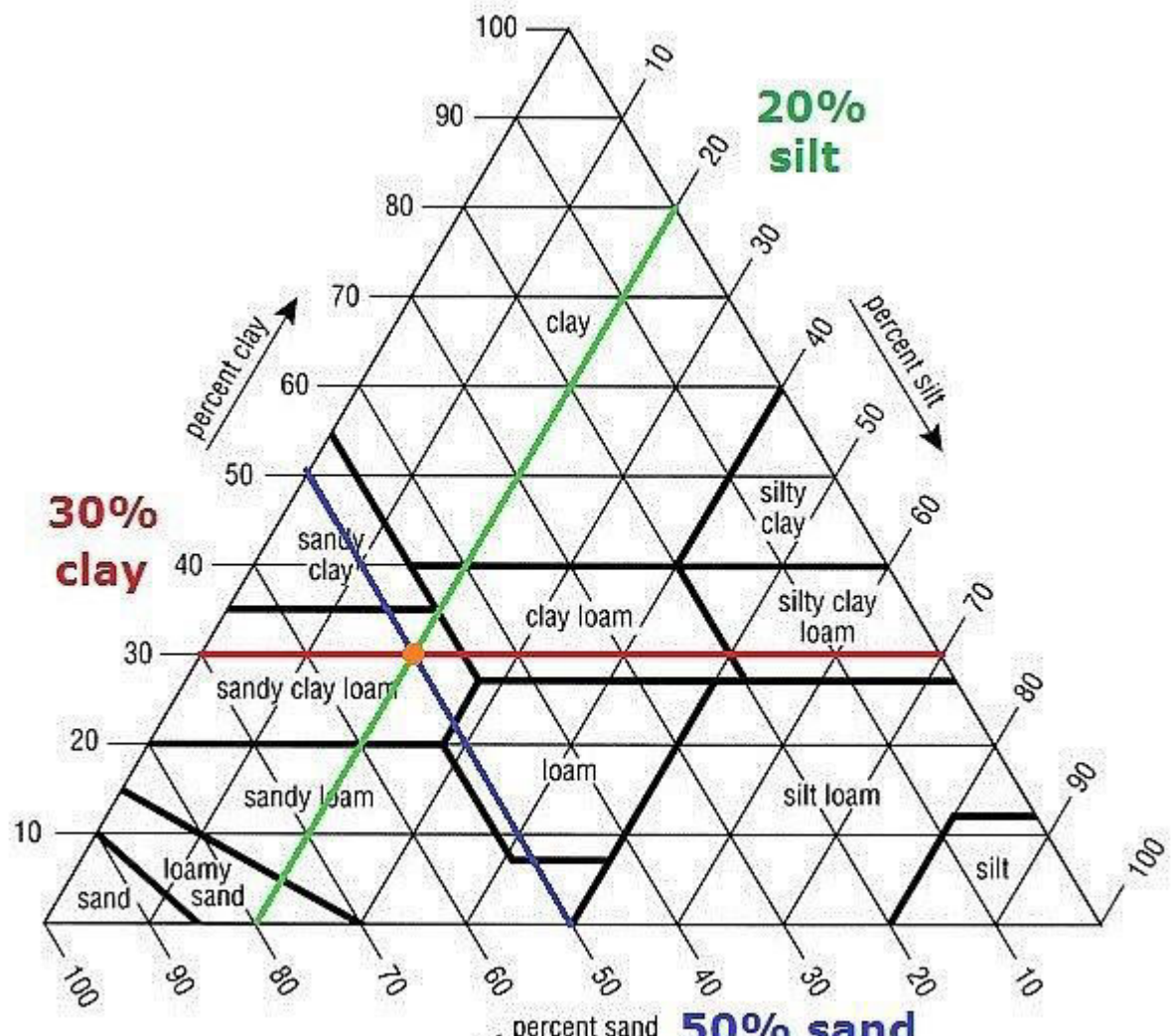
30% clay, 20% silt, and 50% sand





20%
silt

30%
clay

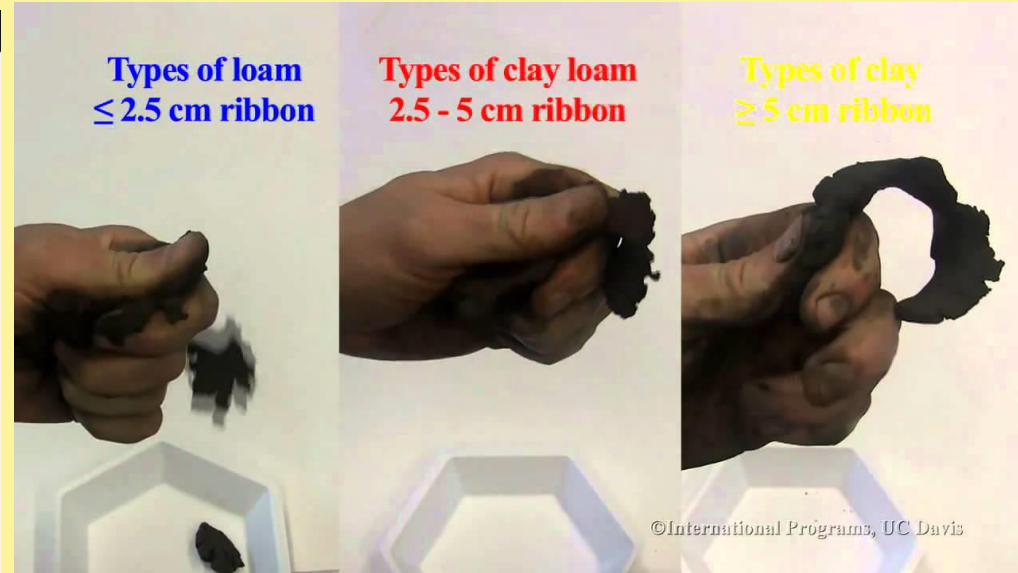
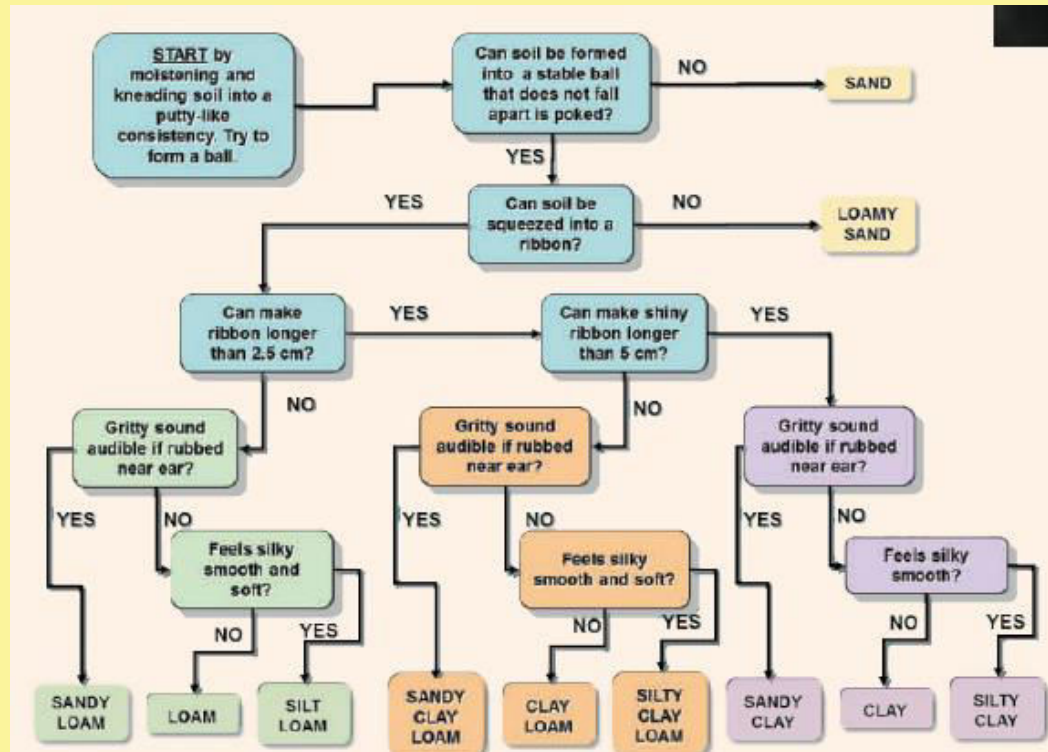


20%
silt

30%
clay

50% sand

Determination of soil texture – feel method



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Sand

- Feels gritty
- Considered non-cohesive – does not stick together in a mass unless it is very wet



Silt

- Does not feel gritty
- Floury feel –smooth like silly putty



Clay

- Wet clay is very sticky and is plastic or it can be molded readily into a shape or rod
- Easily formed into long ribbons



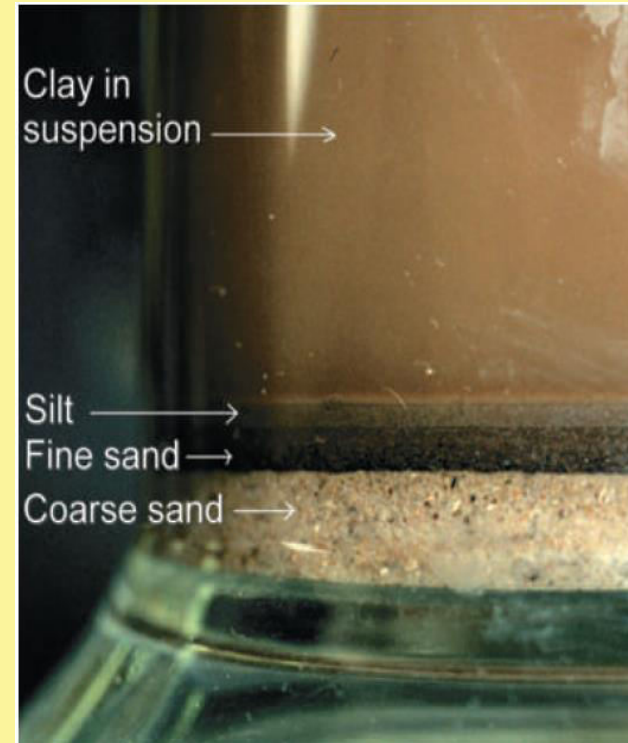
Determination of soil texture – laboratory analysis method

Classical sedimentation method

- soil dispersed using chemical agents and allowed to sediment
- “The bigger they are, the faster they fall”
- Pipette and Hydrometer methods
- Time consuming and inaccurate

Laser diffraction method

- Fast and precise
- However, greatly underestimates clay



LDPSA



Stokes' Law

$$V = \frac{h}{t} = \frac{d^2 g (D_s - D_f)}{18\eta}$$

Where:

g = gravitational force = 9.81 newtons per kilogram
(9.81 N/kg)

η = viscosity of water at 20°C = 1/1000 newton-seconds per m² (10⁻³ Ns/m²)

D_s = density of the solid particles, for most soils = 2.65 × 10³ kg/m³

D_f = density of the fluid (i.e., water) = 1.0 × 10³ kg/m³

Substituting these values into the equation, we can write:

$$\begin{aligned} V &= \frac{h}{t} \\ &= \frac{d^2 \times 9.81 \text{ N/kg} \times (2.65 \times 10^3 \text{ kg/m}^3 - 1.0 \times 10^3 \text{ kg/m}^3)}{18 \times 10^{-3} \text{ Ns/m}^2} \\ &= \frac{9.81 \text{ N/kg} \times 1.65 \times 10^3 \text{ kg/m}^3}{18 \times 10^{-3} \text{ Ns/m}^2} \times d^2 \\ &= \frac{16.19 \times 10^3 \text{ N/m}^3}{0.018 \text{ Ns/m}^2} \times d^2 \\ &= \frac{9 \times 10^5}{\text{sm}} \times d^2 = kd^2, \text{ where } \dots k = \frac{9 \times 10^5}{\text{sm}} \end{aligned}$$

Importance of soil texture

- Soil texture determines the water holding capacity of the soil
- Impacts the soil aeration-well drained soil allows good aeration
- Affects the degree to which the soil is susceptible to erosion
- Affects the organic matter levels of the soil