

3<sup>rd</sup> Meeting

# Physical Soil Properties

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Source: <http://blog.ub.ac.id/>

# SOIL MORPHOLOGY

defined as soil  
properties that can  
be observed and  
studied in the field.

# Physical Soil Properties

01

Soil Boundaries

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# SOIL BOUNDARIES

- A surface or transitional layer between two adjoining horizons or layers
- Most boundaries are zones of transition rather than sharp lines of division
- Soil Boundaries – Distinctness : Abrupt, Clear, Gradual, Diffuse
- Soil Boundaries – Topography : Smooth, Wavy, Irregular, Broken

# SOIL BOUNDARIES

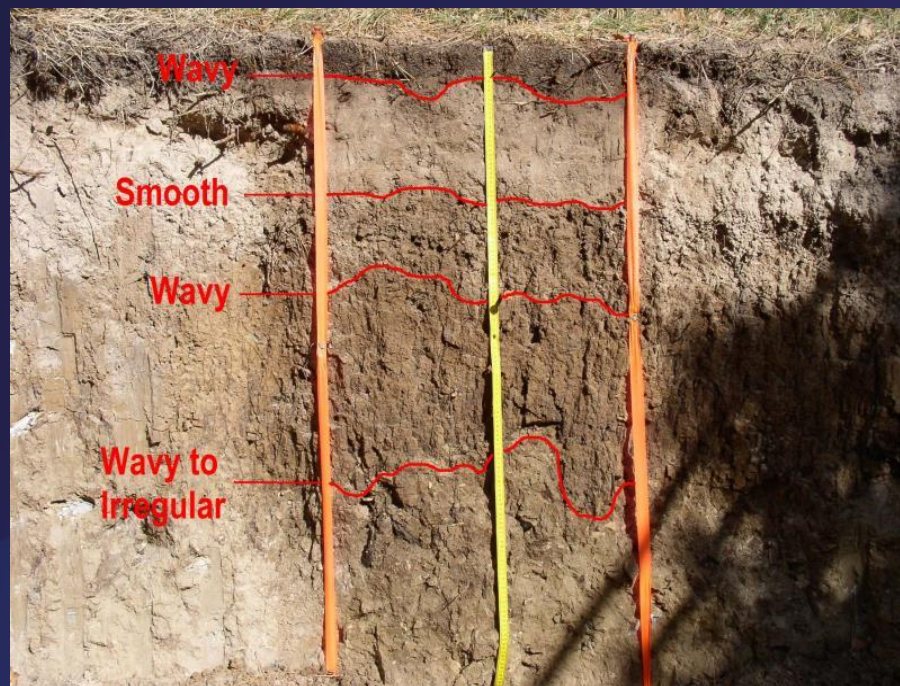
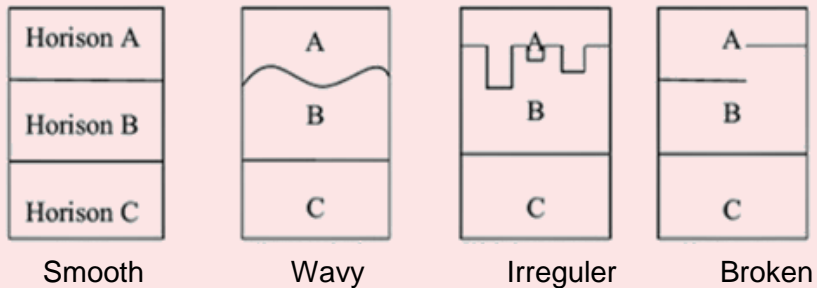
## Distinctness :

- Abrupt = less than 1 inch thick
- Clear = 1 to 2.5 inches thick
- Gradual = 2.5 to 5 inches thick
- Diffuse = greater than 5 inches thick

## Topography :

- Smooth = the boundary is a plane with few or no irregularities
- Wavy = there are undulations in which depressions are wider than they are deep
- Irregular = pockets that are deeper than they are wide
- Broken = One or both of the horizons separated by the boundary are discontinuous and the boundary is interrupted

# SOIL BOUNDARIES



# SOIL TEXTURE

- ❑ Soil texture refers to the relative proportion of particles
- ❑ It is the relative percentage by weight of three soil separates (sand, silt clay).
- ❑ Definition (USDA ) – The relative proportions of sand, silt, and clay
  - Sand = 2.0 to 0.05mm
  - Silt = 0.05 to 0.002mm
  - Clay = < 0.002mm
- ❑ Sand, silt, and clay in various proportions make up 12 textural classes

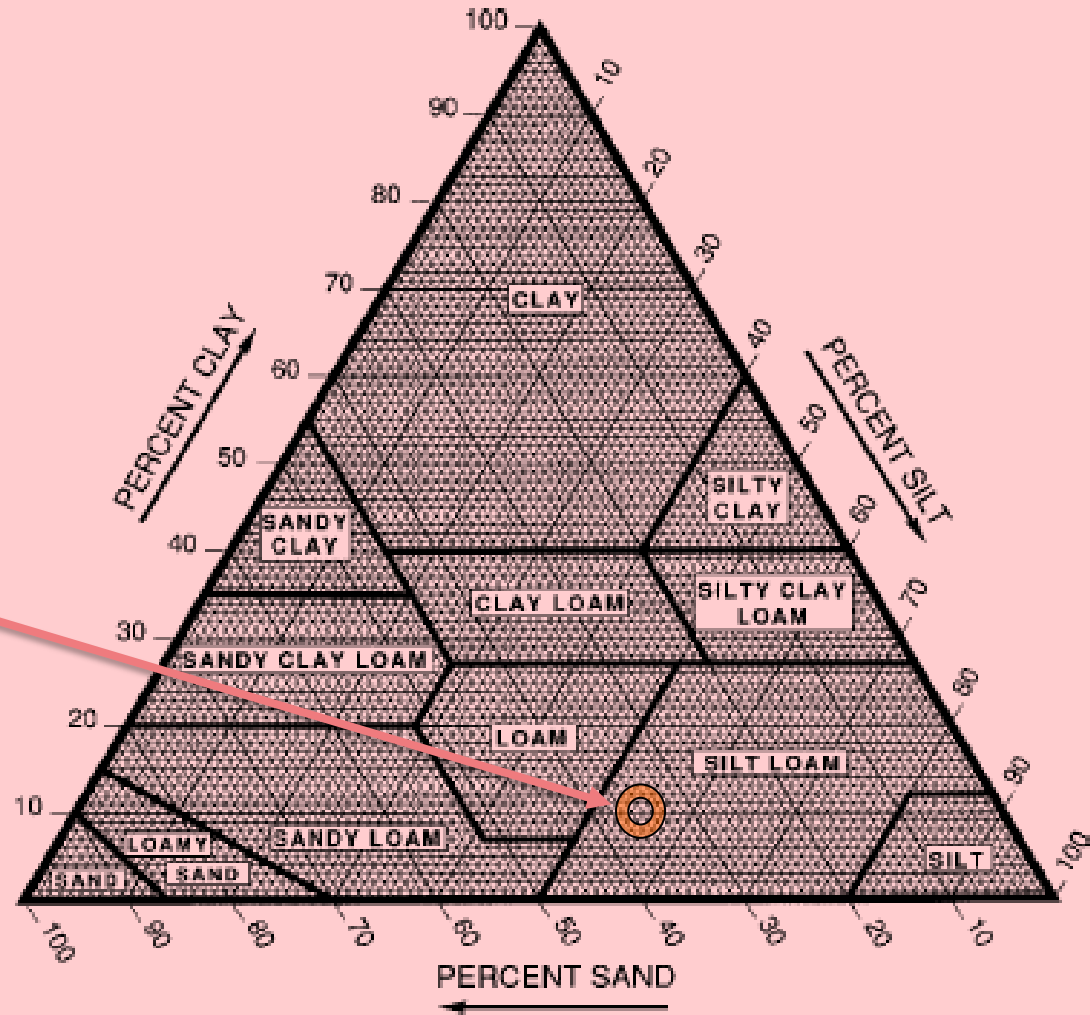
# SOIL TEXTURE

- ❑ Methods of Textural Determination :
  - Elutriation Method – Water and Air
  - Test Tube Shaking Method
  - Pipette Method
  - Feel Method – Feel by fingers
- ❑ Importance of soil texture :
  - Texture has good effect on management and productivity of soil
  - Texture can affect : CEC, Water content, Drainage, Erosion, etc



# USDA TEXTURAL TRIANGLE

Example:  
35 % sand  
55 % silt  
10 % clay



# SOIL STRUCTURE

- ❑ Definition : the arrangement and organization of primary and secondary particles in the soil
- ❑ Structure is describes under three categories :
  - Type – Shape or form and arrangement pattern of peds
  - Class – Size of peds
  - Grade – Degree of distinctness of peds

# SOIL STRUCTURE-TYPE

- **Platy** - the peds are flat and “platelike”; they are usually oriented horizontally (E horizons)
- **Prismatic** - peds are longer than they are wide (Lower B horizons)
- **Blocky** - somewhat “blocklike”; bounded by flat or slightly rounded surfaces; nearly equidimensional (Upper B horizons)
- **Columnar** - Similar to prismatic; vertically elongated units with rounded tops; found in natric horizons
- **Granular** - peds are approximately spherical or polyhedral and are bounded by curved or irregular faces (A horizons)
- **Crumb** - very porous (A horizons)



# Soil Structure

# SOIL STRUCTURE-CLASS

- Depending upon the size of the individual peds :
  - Very fine / Very thin
  - Fine/ Thin
  - Medium
  - Coarse / Thick
  - Very Coarse / Very thick

# SOIL STRUCTURE-CLASS

Size	Platy	Prisma/Columnar	Blocky	Granular	Crumb
	-----mm-----				
Very Fine	< 1	< 10	< 5	< 1	< 1
Fine	1 – 2	10 – 20	5 – 10	1 – 2	1 - 2
Medium	2 – 5	20 – 50	10 – 20	2 – 5	2 - 5
Coarse	5 – 10	50 – 100	20 – 50	5 – 10	-
Very Coarse	> 10	> 100	> 50	> 10	-

# SOIL STRUCTURE-GRADES

- Grades indicated the degree of the distinctness of the individual peds :
  - 0 : Structure less → there is no noticeable aggregation
  - 1 : Weak structure → Poorly developed which are not durable
  - 2 : Moderate structure → Moderately well developed peds which are fairly durable and distinct
  - 3 : Strong structure → Very well formed peds which are quite durable and distinct

# FACTOR AFFECTING SOIL STRUCTURE

- Climate
- Soil Organic Matter
- Soil Organism (Include Plant)
- Tillage
- Time



# SOIL DENSITY

- ❑ Density of a soil is expressed as weight (mass) per unit volume
- ❑ Soil density expressed in two concepts :
  - Particle Density : Absolute specific gravity
  - Bulk Density : Apparent specific gravity
- ❑ The particle density of normal soils are **2.65 g/cc**
- ❑ The bulk density of normal soils ranges b/w **1.00 – 1.6 g/cc**

# SOIL DENSITY

$$\square \text{ Bulk density} = \frac{\text{soil dry weight (g)}}{\text{soil volume (cc)}}$$

$$\square \text{ Percentage of solids} = \frac{\text{bulk density}}{\text{particle density}} \times 100$$

This percentage of solids subtracted from total volume (100%) will give the percentage of pore space. Hence, the formula :

$$\square \text{ Percentage of pore space} = 1 - \left[ \frac{\text{bulk density}}{\text{particle density}} \times 100 \right]$$

# SOIL POROSITY

- ❑ The spaces occupied by air and water between particles in a given volume of soil are called pore spaces
- ❑ The percentage of soil volume occupied by pore space or by the interstitial spaces is called porosity of the soil
- ❑ It depends upon the texture, structure, compactness and organic content of the soil

# SOIL CONSISTANCE

- ❑ Soil consistence is the resistance of a soil to deformation or rupture and is determined by the cohesive and adhesive properties of the soil mass
- ❑ A knowledge of the consistence of the soil is important in tillage operations, traffic, etc
- ❑ Consistence is described for three moisture levels :
  - **Wet Soil** → Non sticky, slightly sticky, sticky, very sticky,  
→ Non plastic, slightly plastic, plastic and very plastic
  - **Moist Soil** → Loose, very friable, friable,  
→ Firm, very firm, extremely firm
  - **Dry Soil** → Loose, soft,  
→ slightly hard, hard, very hard, extremely hard

# SOIL COLOUR

- ❑ Soil colour gives an indication of the various processes going-on in the soil as well as the type of minerals in the soil
- ❑ For example :
  - Dark colour is generally due to the accumulation of highly decayed organic matter
  - Red colour in the soil is due to the abundance of iron oxide under oxidised conditions in the soil
  - The colour of the soil in terms of the above parameters could be quickly determined by comparison of the sample with a standard set of colour chips mounted in note-book called **Munsell Soil Colour Charts (1973).**

# SOIL COLOUR

- ❑ Soil colour is described by the parameters called hue, value, and chroma
  - Hue represents the dominant **wave length** or colour of the light
  - Value refers to the **lightness** of the colour
  - Chroma, relative **purity** or strength of the colour
- ❑ In these charts, the right hand top corner represents the hue; the vertical axis, the value; and the horizontal axis, the chroma.





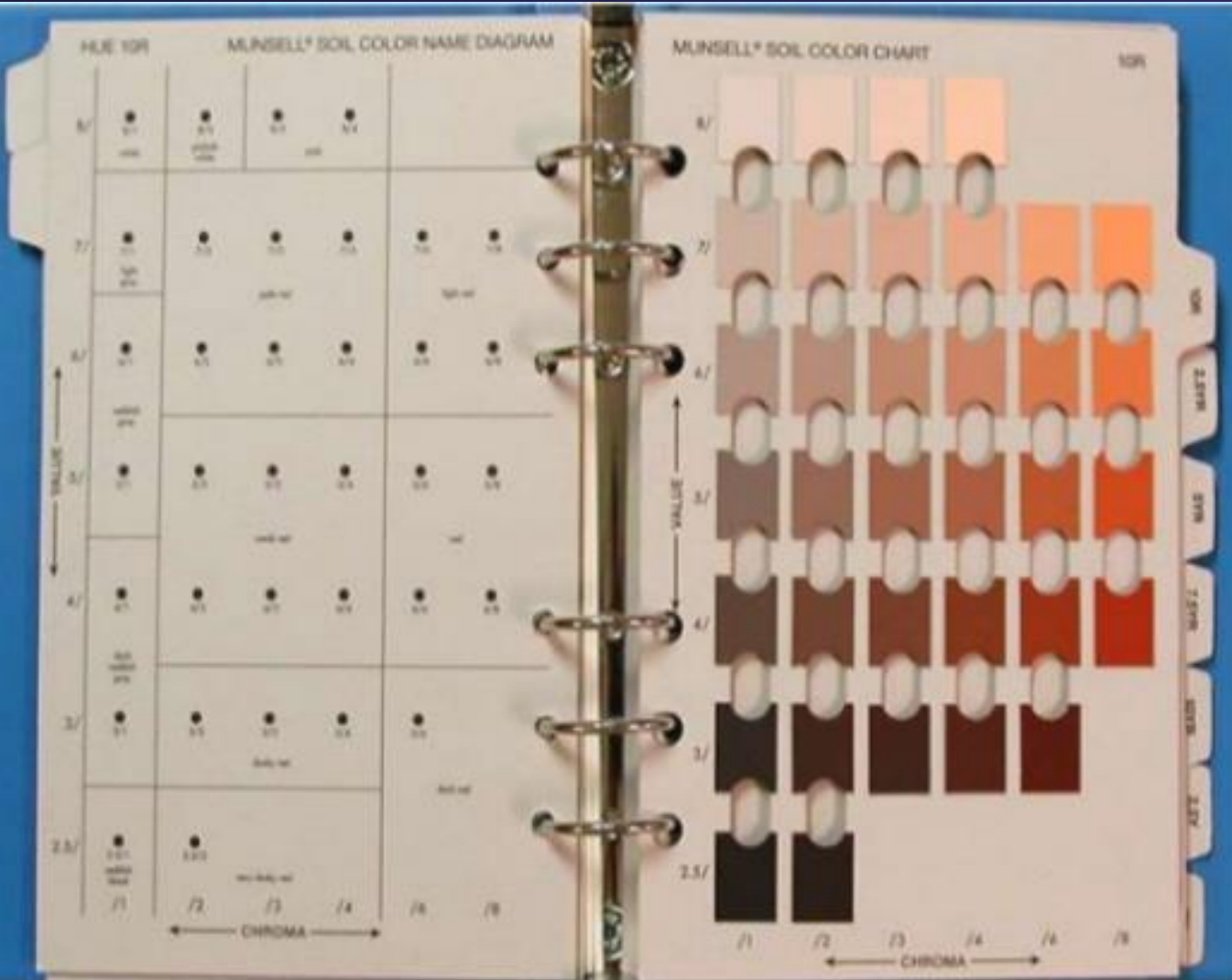
# Soil Colour

Hue

10YR 5/3

Value

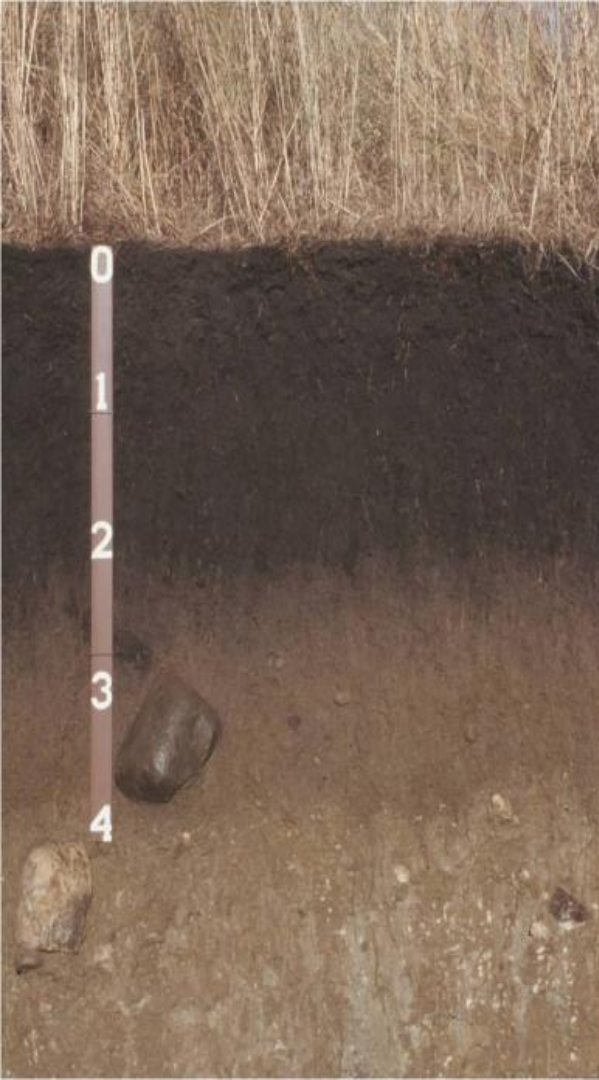
Chroma



10R 4/6

“Red”





<u>Simbol Horison</u>												
<u>Nomor Lapisan</u>												
<u>Dalam Lapisan</u>												
<u>Batas Lapisan (batas topografi)</u>	a	c	g	d	a	c	g	d	a	c	g	d
	s	w	i	b	s	w	i	b	s	w	i	b
<u>Warna</u>												
<u>Tekstur</u>		gr				gr				gr		
	s	c	l		s	c	l		s	c	l	
		si				si				si		
<u>Bahan Kasar</u>	Fe	Ca			Fe	Ca			Fe	Ca		
	Mn	B			Mn	B			Mn	B		
<u>Struktur</u>	0	VF	pl		0	VF	pl		0	VF	pl	
	1	F	p		1	F	p		1	F	p	
	2	M	cp		2	M	cp		2	M	cp	
	3	C	b		3	C	b		3	C	b	
		VC	sb			VC	sb			VC	sb	
			ab				ab				ab	
			g				g				g	
			l				l				l	
			m				m				m	

<u>Konsistensi</u>		B	L	K	B	L	K	B	L	K
		so	l	k	so	l	k	so	l	k
		ss	vf	s	ss	vf	s	ss	vf	s
		s	f	sh	s	f	sh	s	f	sh
		sv	t	h	sv	t	h	sv	t	h
		pp	vt	vh	pp	vt	vh	pp	vt	vh
		ps	et	eh	ps	et	eh	ps	et	eh
		p			p			p		
		Vp			Vp			Vp		
<u>Karat</u>	<u>Jumlah</u>	sd	bi	ba	sd	bi	ba	sd	bi	ba
	<u>Ukuran</u>	k	s	b	k	s	b	k	s	b
	<u>Bentuk</u>	bi	bs	li	bi	bs	li	bi	bs	li
		Ap	pi		ap	pi		ap	pi	
	<u>Batas</u>	j	s	k	j	s	k	j	s	k
	<u>Bandingan</u>	b	j	n	b	j	n	b	j	n
<u>pH Lapisan dan reaksi terhadap HCl</u>										
<u>Perakaran</u>										
<u>Epipedon</u>		Mollic / umbric / anthropic / plaggen / histic / ochric								
<u>Horison Penciri</u>		Tanpa / argilic / natric / agric / spodic / cambic / oxic								
<u>Horison Tambahan</u>		Petro ferric / petro plintic / calcic / gypsic / albic / salic / sulfidic / sulfuric								
<u>Bahan organik</u>		Fibric / hemic / sapric								

# REFERENCES

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2. Hardjowigeno, S. 2003. *Ilmu Tanah*. Akademika Pressindo. Jakarta
3. Soepardi, G. 1983. *Sifat dan Ciri Tanah*. IPB Bogor.



THANK YOU

*Stay Safe and Healthy everyone..!!*