RICE PLANT MANAGEMENT

Paddy Fertilizing

AGENCY FOR AGRICULTURAL EXTENSION AND HUMAN RESOURCE DEVELOPMENT
MINISTRY OF AGRICULTURE

Objectives

After this session, participants were expected to :

- Understand how to maintain the soil fertility
- Do the fertilization in rice field

Does fertilizer play an important role in increasing rice production?

how do we give fertilizer to rice plants?

how to properly apply fertilizer to paddy rice plants?

How can the fertilizer that we provide can be used optimally?

Fertilizer and Fertilizing

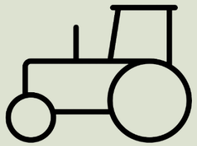
Crucial component in plant cultivation management

Fertilizer is a material that is added to planting media or plants to meet the nutrient needs needed by plants so that they can produce well

The addition of this fertilizer must be done because there is no balance in the amount of nutrients in the soil where the amount of nutrients will continue to decrease over time.

Fertilization should be seen as a function of providing nutrients or nutrients to plants.

The reduction in the amount of nutrients in the soil or growing media can occur due to several factors



Transported with the harvest

The plants nutrient absorption efficiency is quite low

Nutrient loss due to evaporation and nutrient leaching by irrigation

Adsorbed and bound (fixation) in soil particles

Plant Nutrients

Nutrients are substances that needed by animals or plants for tissue formation, growth, and other life activities. Nutrients can be organic (the result of weathering) living things and inorganic (derived from non-living things, elements from water, gases, acids and minerals).

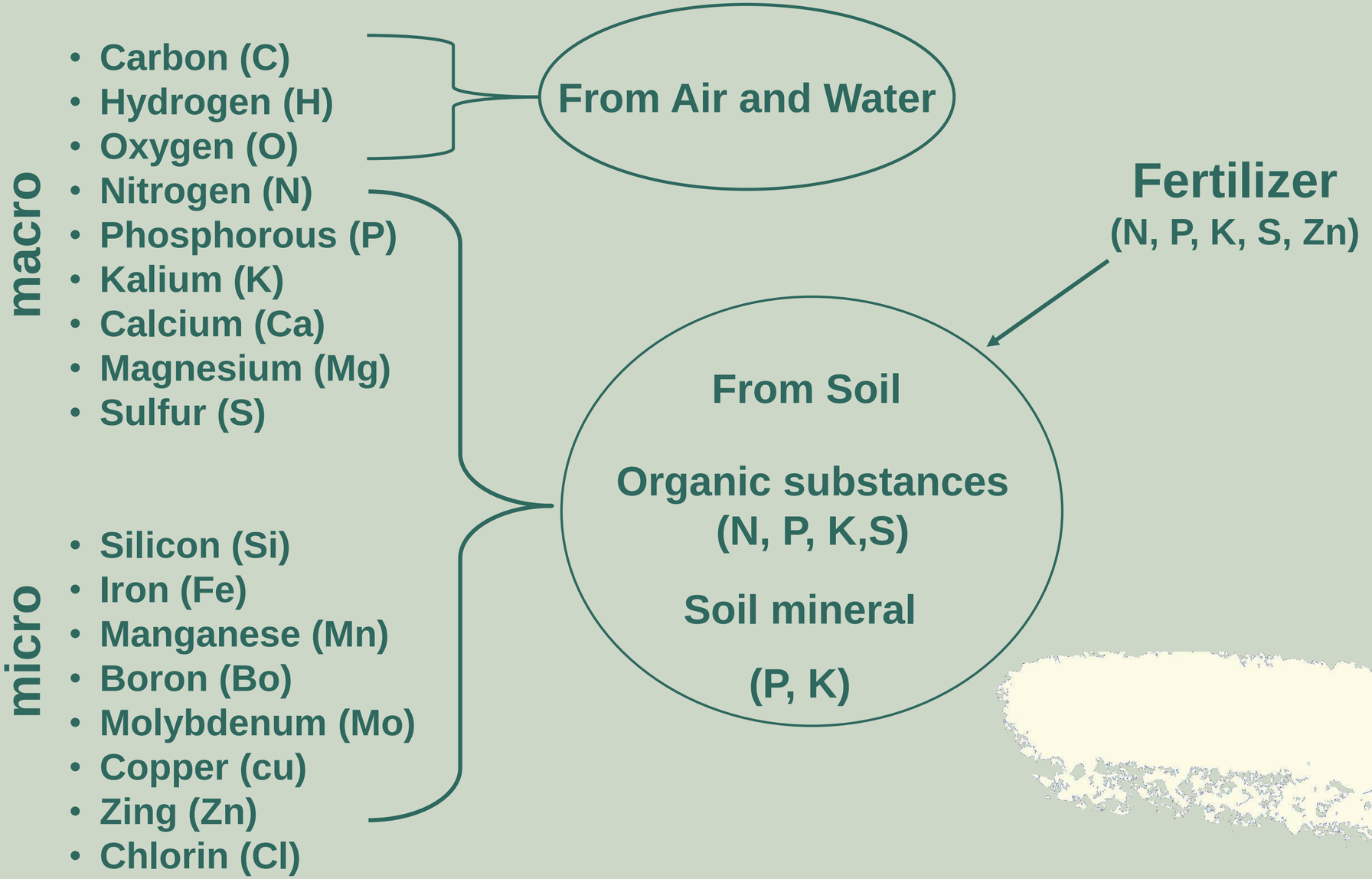
To be classified as “essential”, the element needs to meet the following criteria:

- The plant cannot complete its life cycle without it.
- The elements’ function cannot be replaced by another element
- The element is directly involved in the plant’s growth and reproduction.

MACRO ELEMENTS

MICRO ELEMENTS

Essential Nutrient elements (16)



Nitrogen

- ✓Role/function:
  - the most important constituent of amino acids, nucleic acids, and chlorophyll
  - accelerate vegetative growth (sapling formation, plant height, leaf width), panicle length, number of grain etc.
  - increase plant protein content
- ✓Nitrogen is taken up by plants from the soil solution in the form of NO_3^- or NH_4^+. Rice plants generally take N in the form of NH_4^+

- The highest N requirement during tiller formation to flower primordia
- Optimum N requirement: 14.7 kg N per ton of grain (40% is in straw)
- Symptoms of Nitrogen (N) deficiency:
  - ✓ Dwarf plants, yellowish leaves (chlorosis) especially old leaves
  - ✓ Little sapling/tillers with small leaves
  - ✓ Small amount of grain

Where does Nitrogen (N) deficiency occur?

- Soils with low organic matter content (<1% C), sandy soils
- Low P soils, continuously flooded soils
- Alkaline soil (pH > 7.0) with high Anhydrous ammonia (NH_3) volatilization potential

Symptoms of Nitrogen deficiency in paddy

Phosphorous (P)

- Role / function
  - the most important part of ATP (adenosine phosphate) chemical energy serves to store and transfer energy in all plant metabolic processes
  - main part of cell nucleus and nucleic acid
  - multiply tillers and root growth
  - accelerate flowering and ripening
- P is taken up by plants from the soil solution in the form of $H_2PO_4^-$, and HPO_4^{2-} ions,
- Optimum P requirement : 2.6 kg P per ton of grain (> 30% in straw)

Deficiency Symptoms of Phosphorous (P)

- Dwarf plant, dark green
- Small roots and tillers
- Small leaves, dark green, short
- The number of tillers, panicles and grain per panicle decreased
- Often a purplish color appears on the leaf midrib / stem
- Late ripening (especially with high N fertilization)
- High grain void
- Response to N fertilization, low

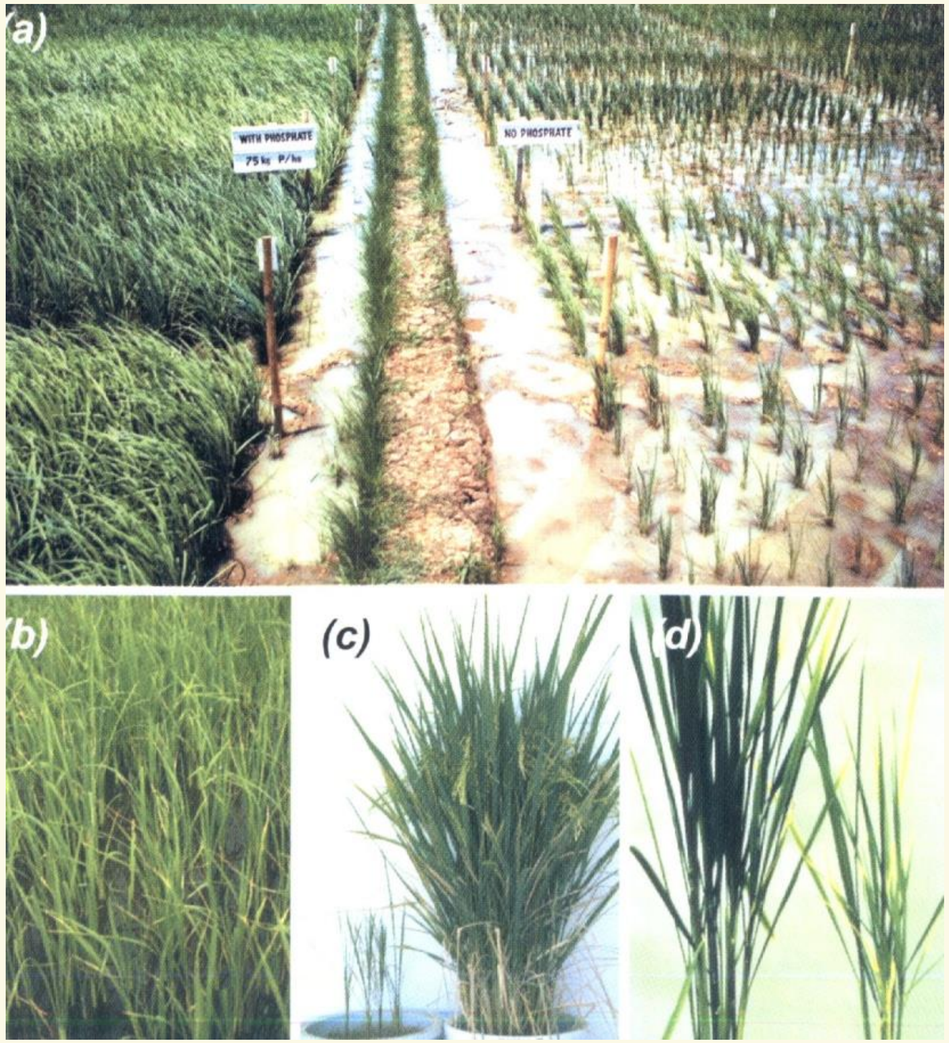
Causes of P . deficiency

- low soil P content
- low P fertilization
- low P fertilization efficiency (P fixation by Al and Fe on acid dry land, or P fixation by Ca in alkaline dry land) so that P is less available
- excessive liming on acid soil P fixation by Ca
- excessive N fertilization, while low P fertilization

Where there is a deficiency or deficiency of Phosphorus (P)?

- Sandy soil with low organic matter and P reserves
- Acid soils on dry land where P fixation is high such as Red Yellow Podsolic soils (Ultisols and Oxisols)
- Degraded paddy fields
- Peat soil, acid sulfate soil in tidal areas
- Alkaline soil, with pH > 7.5

Phosphorous deficiency symptom



Potassium (K)

- Role/function
  - transportation of assimilation/photosynthetic processes in leaves to other plant parts (roots, shoots/saplings, seeds/grain)
  - regulate osmotic pressure/turgor, strengthen cell walls
  - activator of enzymes in all plant metabolic processes
  - delay aging/sensence of leaves
  - increase the amount of pithy grain and reduce the void
- K is taken by plants from the soil solution in the form of K+
- Optimum K requirement : 14.5 kg K per ton of grain (> 80% is in straw)

Potassium (K) Deficiency symptoms

- The edges of the leaves are brownish yellow with orange spots, especially in old leaves, plants grow stunted and the leaves droop
- frequent collapse due to high N/K ratio
- faster leaf aging (leaf senescence)
- high grain void and incomplete grain filling (lots of green grains)
- unhealthy root growth (lots of rotten roots due to loss of oxidizing power, so nutrient uptake is disturbed)
- Plants are susceptible to diseases such as blast, sheath blight, leaf spot, especially when fertilized with excessive N

Causes of K deficiency

- Low soil K content
- less K fertilization
- every harvest, straw is transported out with the harvest
- K contribution from irrigation water is low
- low K fertilization efficiency due to K fixation by clay minerals or sandy soil so that K is washed off to the bottom layer because K can be mobile

The amount of fertilizer for paddy depends on:

- Nutrient status or nutrient supply of soil (environment).
- Plant needs for nutrients (varieties).

Optimum nutrient requirements and nutrient balance in rice and rice straw of high yield varieties

N	P	K	Zn	S	Mg	Ca	Fe
Nutrients in grain + straw (kg/ton)							
17,5	3,0	22,0	0,05	1,8	3,5	4,0	0,50
Nutrients in grain (kg/ton)							
10,5	2,0	7,5	0,02	1,0	1,5	0,5	0,20
Nutrients in Straw (kg/ton)							
7,0	1,0	14,5	0,03	0,8	2,0	3,5	0,30

NITROGEN fertilizing using Leaf Color Chart (LCC)

Transplanting | Active Tillering | Primordia | Panicles occurs | Harvest

1 st | 2 nd | 3 rd

-20 -10 0 10 20 30 40 50 60 70 80 90 100 DAT

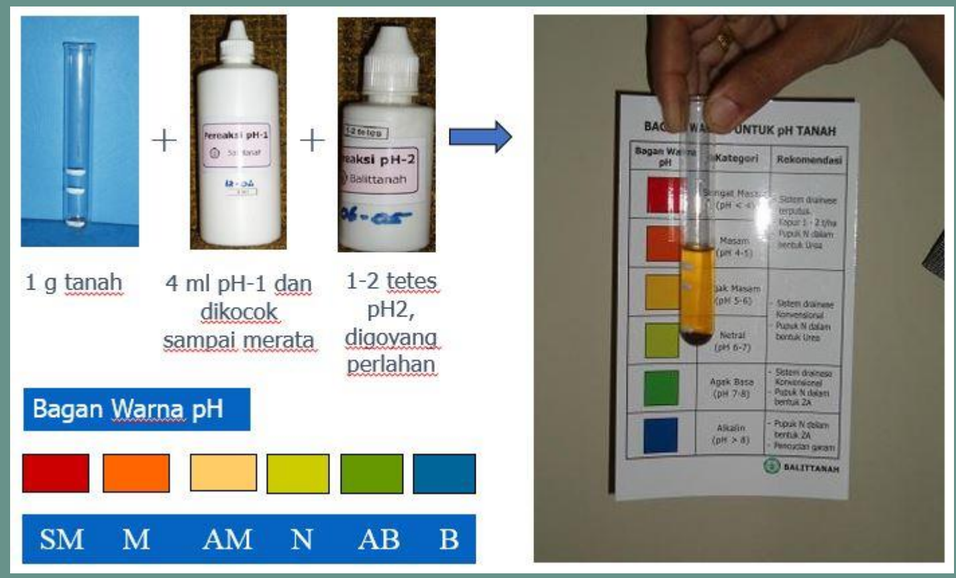
	1st/ basic Before 14 DAT	2 nd 23 – 28 DAT	3 rd 38 – 42 DAT	
	30 kg N/ha	Based on LCC Kg Urea/ha	Based on LCC Kg Urea/ha	High Yield season Target Yield : 7 t/ha
		LCC >4 — 75	LCC >4 — 125	
		LCC =4 — 100	LCC =4 — 125	
		LCC <4 — 125	LCC <4 — 175	
	0 - 20 kg N/ha *	Based on LCC Kg Urea/ha	Based on LCC Kg Urea/ha	Low Yield season Target Yield : 6 t/ha
		LCC >4 — 50	LCC >4 — 75	
		LCC =4 — 75	LCC =4 — 100	
		LCC <4 — 100	LCC <4 — 125	

Paddy soi test kit (PSTK)

- PUTS is a useful tool for determining levels of nitrogen, phosphorus and potassium in paddy soils.
- PUTS can be used for evaluating nutrient status quickly.
- The accuracy of PUTS depends on the quality of soil sampling and proper use of the kit.

Fertilizer recommendations should be based on soil nutrient status and crop requirements. Balanced fertilizer use provides only nutrients that are deficient in the soil. Excessive fertilizer use causes environmental pollution, especially in soils with high nutrient levels.

The Indonesian Soil Research Institute has developed a set of portable tools to determine nutrient status in paddy soils in the field and provide fertiliser recommendations. This tool is named PUTS (Perangkat Uji Tanah Sawah or Paddy Soil Test Kit).



Comparison of the use of PSTK and laboratory tests

Laboratory test	Paddy soil test kit / soil rapid test
• Longer procedure	• Quick procedures
• can extract various types of nutrients	• only extract available nutrients
• Various kinds of chemicals	• weak acid/base/salt chemicals
• measurement with a variety of laboratory equipment	• measurement by means of colorimetry or color change
• high accuracy quantitative numeric results (ppm)	• The results of qualitative numbers, lower accuracy (low, medium, high)

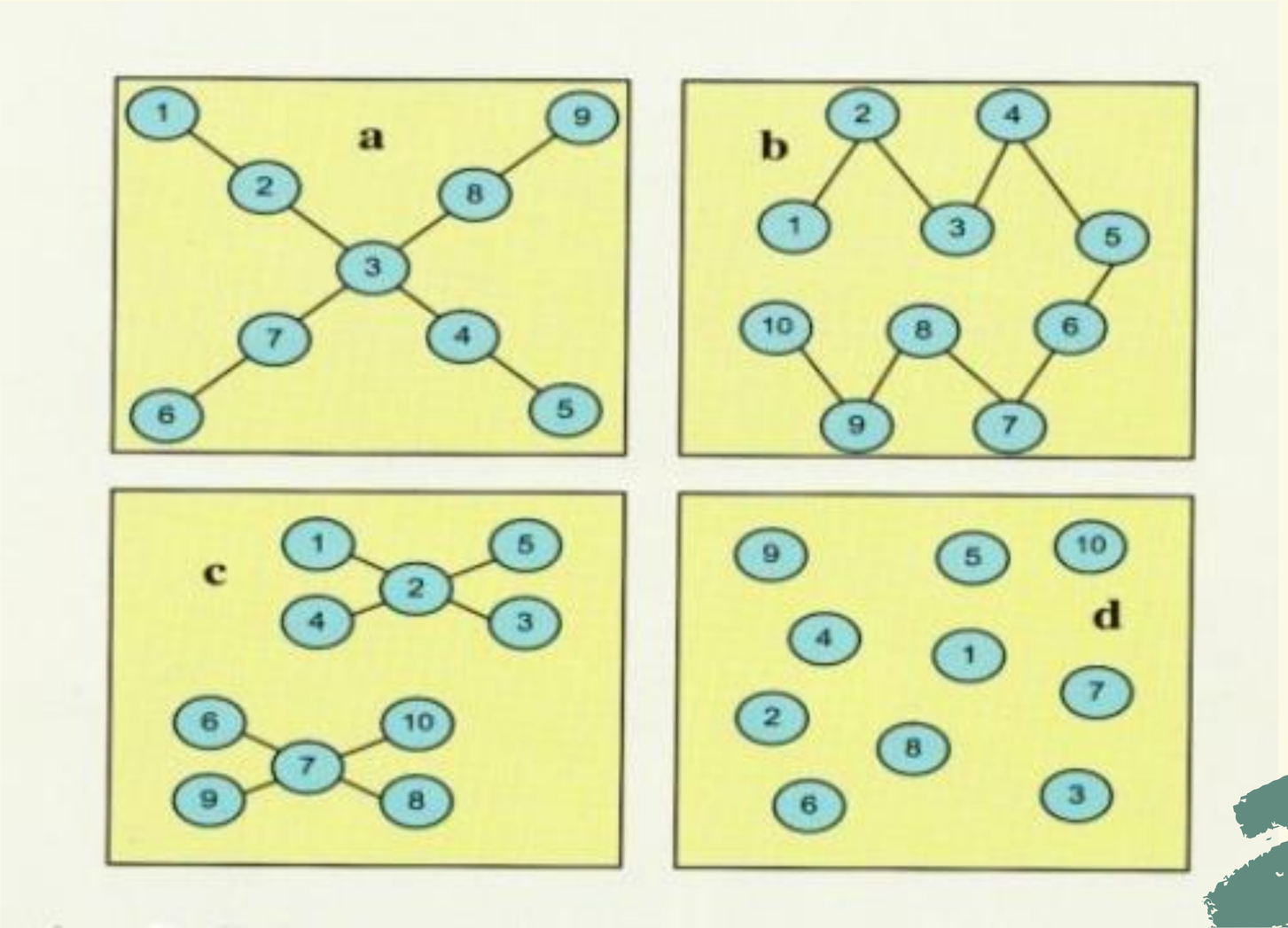
Stages of using PSTK

- Preparation of soil samples: method or method of taking soil samples
- Soil sample extraction process
- The process of measuring nutrient levels and their determination
- Establish fertilizer recommendations

Principles of soil sampling

- Representing the rice fields for which the recommendation is to be determined
- One example represents an area of uniform fertility
- Sample is taken in dominant condition
- Must be in the middle of the site
- Same volume and depth of soil
- Mixed evenly

Methods of taking composite soil samples: a) diagonal, b) zig zag, c) systematic, d) random

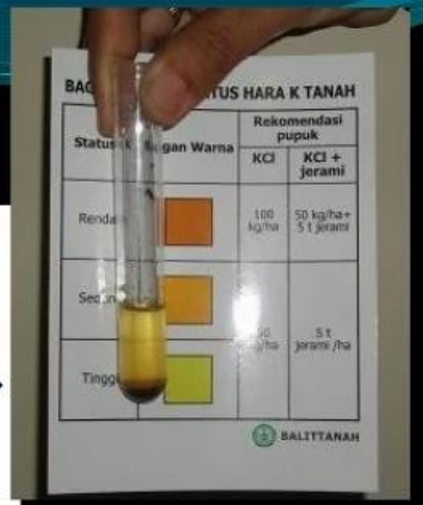


0,5 g tanah

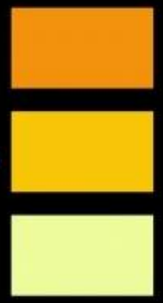
2 ml K1, dikocok merata

1 tetes K2, dan dikocok

1 tetes K3, dan dikocok



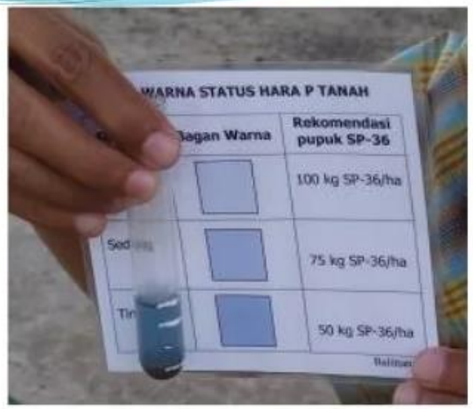
Bagan Warna K



Rendah

Sedang

Tinggi

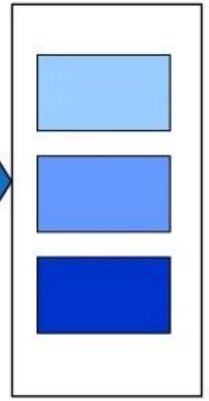


0.5 g tanah

3 ml P-1 dan dikocok

1 sendok kecil P2 dikocok merata

BAGAN WARNA



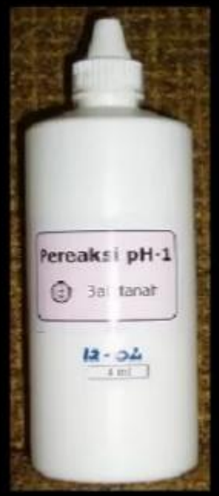
Rendah

Sedang

Tinggi

1 g tanah

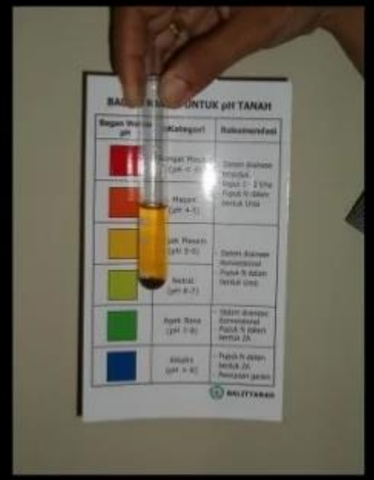
+



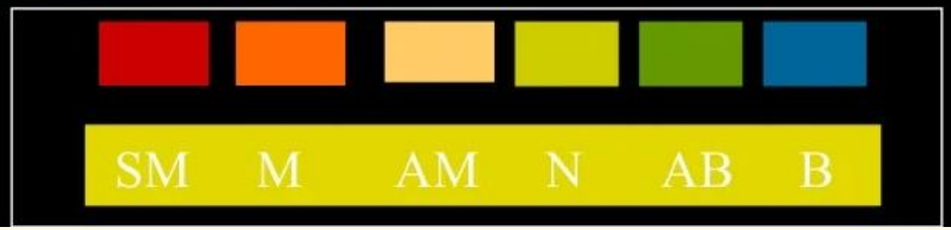
4 ml pH-1 dan dikocok sampai merata

+

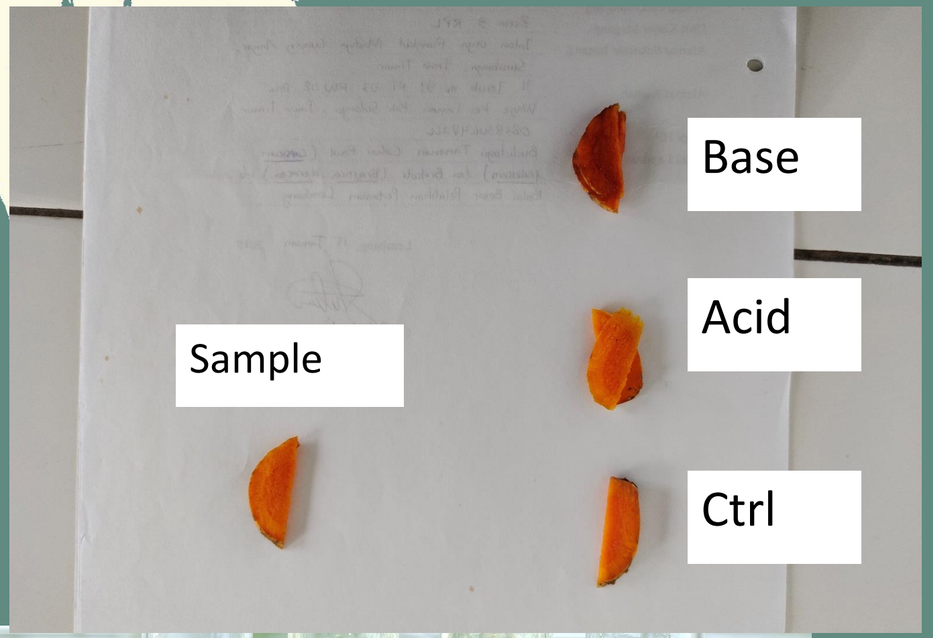
1-2 tetes pH2, digoyang perlahan

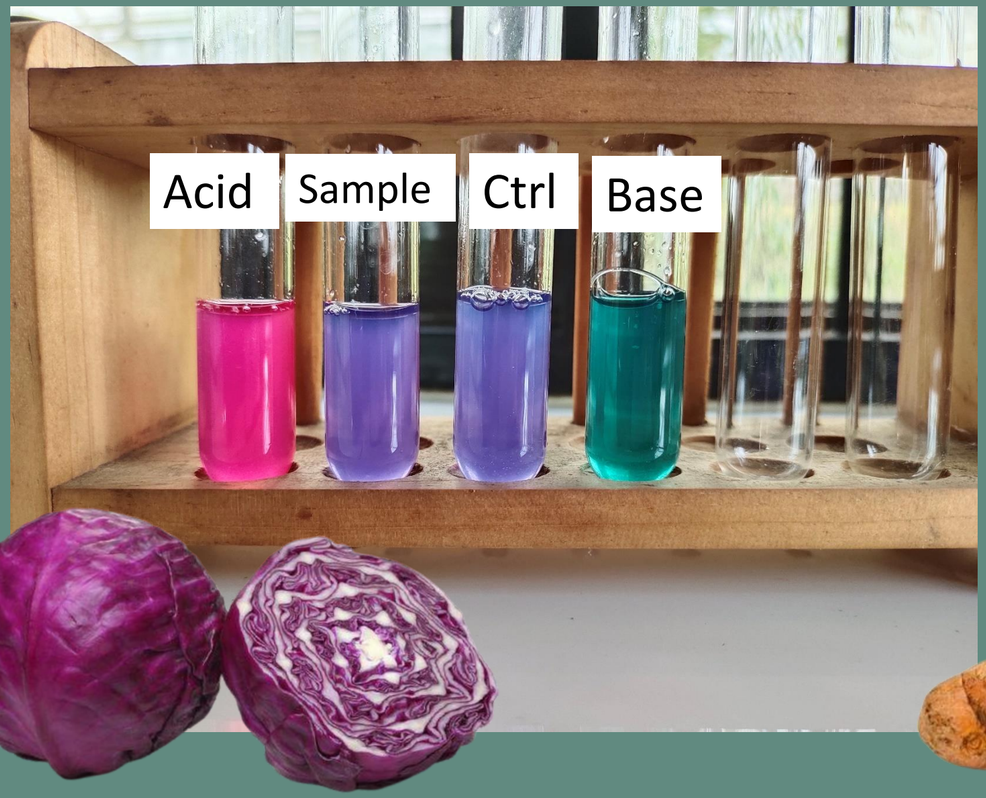


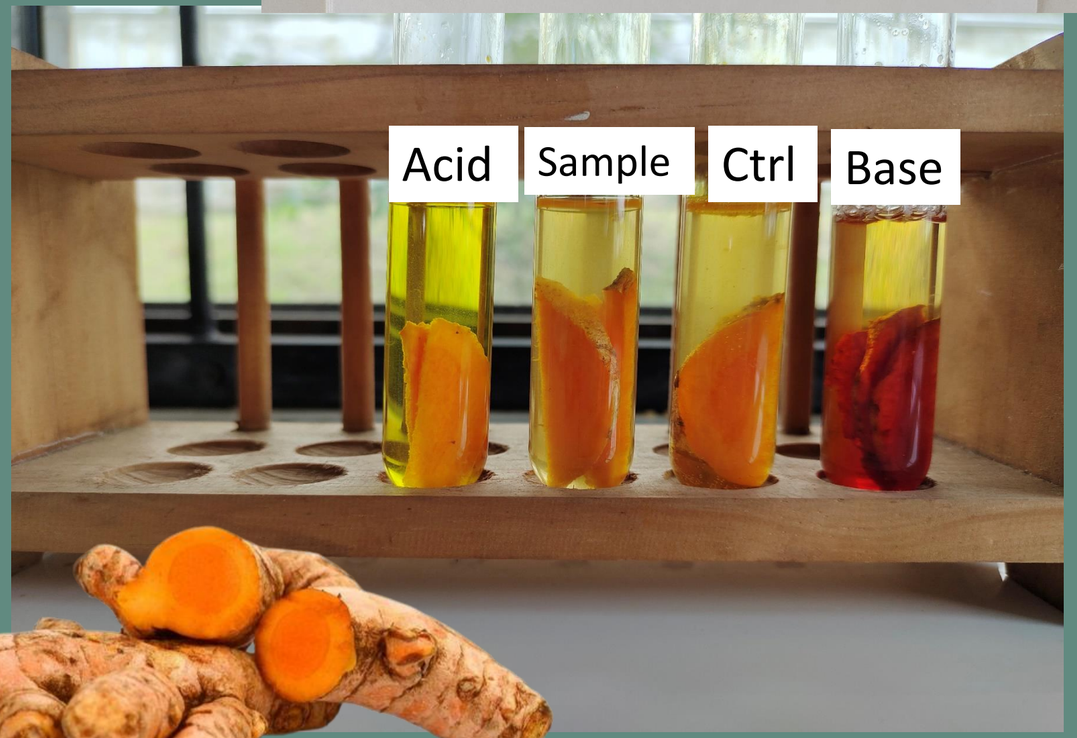
Bagan Warna pH



Another technique using natural indicator to check the soil pH







Maintaining the soil fertility

ORGANIC FERTILIZER

Organic fertilizers are defined as fertilizers partially or wholly derived from plants and or animals that have gone through a process, can be in solid or liquid form used to supply organic matter to improve soil physical, chemical and biological properties (Regulation of the Minister of Agriculture Number 2 of 2006) .

Reluctance to use organic fertilizers?

- The process is quite long
- High labor cost
- Expensive transportation
- Pest and Disease may still be carried away in Conventional Organic Fertilizer
- The volume of the material can be very large

Source of Organic Matter

Agriculture	Waste and Residue	Rice straw and husks, weeds, leaves, corn stalks and cobs, all vegetative parts of plants, banana stems, coconut husks
	Livestock Waste and Residue	Solid manure, liquid livestock waste, animal feed waste, bone meal, biogas process liquid
	Green Manure	Glirisidae, Mucuna bracteata, turi/ Sesbania grandiflora, lamtoro/ Leucaena leucocephala, centrosema, albisia
	Water plants	Azola, blue algae, seaweed, water hyacinth, other aquatic weeds
	Nitrogen fixer	Microorganisms, mycorrhizae, rhizobium

Industry	Solid waste	Wood sawdust, paper, bagasse, palm oil bunch, food canning waste, animal slaughter
	Liquid waste	Alcohol, paper processing waste, cooking spice factory waste (MSG), palm oil (POME/Palm Oil Mill Effluent), livestock liquid waste
Household waste	Garbage	Stool, pee, kitchen waste, municipal waste

The organic matter content in paddy fields is only 2% on average, whereas the ideal organic matter content is 5% as a result:

- Low soil microbes
- Decreased soil fertility
- The carrying capacity of the land is reduced

Land carrying capacity is the number of people who can be supported or supported by an area of land resources in a certain environment in a prosperous condition, in accordance with the technology and management of farming carried out by farmers.

Why Straw should be composted?

- Rice absorbs nutrients in the form of ions
- Straw is an organic macromolecule that cannot be directly absorbed by rice
- Rice straw can improve the physical properties of the soil or is referred to as a soil enhancer.

For every 1 ton of grain (GKG) from rice cultivation, 1.5 tons of straw is produced containing 9 kg N, 2 kg P, 25 kg K, 2 kg S, 70 kg Si, 6 kg Ca and 2 kg Mg.

Definition of Compost and Purpose

Compost is organic material that has undergone a weathering process due to interactions between microorganisms or decompose bacteria that work in the organic material.

- Stabilize organic materials comes from waste materials
- Reduce odor during storage
- Destroys pathogenic organisms and weed seeds
- The result is relatively dry, uniform, free from hazardous components and suitable for soil

Compost :

- Improve the structure of clay soil so that it becomes lighter,
- Increase the binding capacity of sandy soil so that the soil does not crumble,
- Increase the water holding capacity of the soil,
- Improve drainage and air conditioning in the soil,
- Enhances soil binding capacity to nutrients
- Contains complete nutrients, even in small amounts (the amount of these nutrients depends on the ingredients for making organic fertilizers),
- Helps the mineral materials weathering process o
- Provide food availability for microbes,
- Reducing the activity of harmful microorganisms

Benefits of compost:

- like a multivitamin for soil and plants
- Has a complete nutrient content
- Can reduce the need of chemical fertilizers
- Improve the physical properties/structure of the soil
- Improve soil chemical properties (increase cation exchange capacity / increase nutrient absorption efficiency
- Increase soil fertility
- Increases soil microbial activity

Making the straw compost (1)

Materials :

- Rice Straw
- Livestock manure (Cow, Chicken, or Lamb) as much as 10% of the weight of the straw
- 10% UREA solution
- Plastic cover

Procedures:

- Dried rice straw is dipped / sprinkled with 10% UREA solution.
- Wet straw is spread on the floor or rice field bunds with a length of ± 3 m, width ± 0.8, thickness ± 0.3 m.
- The top surface of a pile of wet straw is sprinkled with cattle dung.
- Steps 2 and 3 are repeated until a height of 1.80 m.
- Cover the top of the straw with a plastic cover or dry straw that serves to retain heat.
- After 2 weeks, the straw is turned over, then the haystack is closed again and it is estimated that 1 month after that the straw has become compost.

Making the straw compost (2)

Materials :

- Rice Straw
- Livestock manure (Cow, Chicken, or Lamb) as much as 10% of the weight of the straw
- 10% UREA solution
- EM4
- Molasses/sugar
- Plastic cover

Procedures:

- Make a 1x1 m pattern then add bamboo on all four sides
- Stack the hay and forage to a thickness of 20 cm then pile it with animal manure
- flush with decomposer solution
- make another layer using 20 cm straw, animal manure and moisten again with a decomposer solution
- humidity about 30-40%
- make layer up to a height of 1 -1.5 m
- then cover with tarpaulin
- after 3 days turned over to reduce heat and even out the compost.
- reversed every 3 days
- after 1 month the compost is ready to use


Thank
you