

## Practical Guidelines in Predicting Fertility Status of Lowland Rice Soils



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# FOREWORD

Field technicians who do not have expertise in soil science often do not know how to advise farmers when they encounter problems in rice soils. They need to know some practical guidelines in predicting soil fertility status of rice soils even without the use of laboratory instruments, which may not always be available or appropriate.

There are field parameters including the condition of the standing crops adjacent to the rice field that can serve as indicators in predicting the fertility status of irrigated as well as rainfed lowland rice soils. These parameters are visually and qualitatively observed and are quantifiable if appropriate instruments are available. Thus, these could help them determine the soil fertility status of the area.

This practical guide should further assist field technicians develop their self confidence in diagnosing problems that the plant manifest. It should also provide them with a sound basis in giving recommendations to farmers.

  
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Executive Director

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## Site parameters to consider in predicting soil fertility status

### 1. Landscape

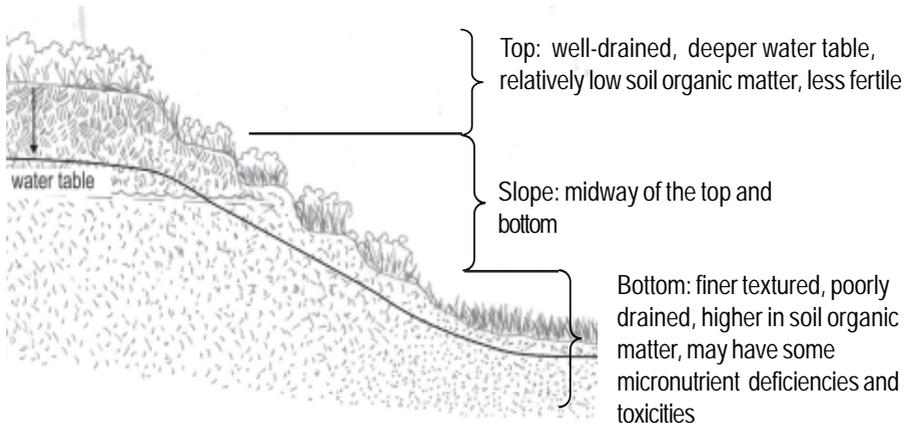
The general landscape of the area has a direct effect on the fertility status of the soil.

- **Flat plain areas:** There is less movement of soil materials from one field to another, therefore, it is likely that soil fertility is relatively uniform over the entire flat plain except in some low areas or depressions within the plain.



*Fig. 1 Flat plains*

- **Along rolling areas:** Generally have varying soil fertility than those in flat plains. Soils at the bottom of the landscape are more fertile owing to the accumulation of organic materials.



*Fig. 4 Fertility of a soil in the different positions in a sloping area*

**2. Depth of water table-** This influences the percolation rate or the rate of water to move downward, carrying soil nutrients away.

Shallow water table, which measures less than 25 cm from the surface, may indicate poor drainage condition or slow percolation, thus the soil is more fertile.

Deeper water table increases leaching rate or loss of nutrients. In rolling areas, soils at the top have deeper water table than those at the bottom. *(Please refer to Fig. 4)*

A "piezometer" tube can be used to measure the depth of water table.

When water table is deep, fertilizers should be applied in small amounts but more frequently.

If litmus paper is not available, use pH test in soil test kits following the prescribed procedures. Kits can be bought at the Bureau of Soils and Water Management (BSWM). Soils with neutral pH are fertile.

4. **Depth of mud-** The depth of mud represents the volume of soil that the roots of plants can explore for nutrients. Thus, soils with deeper mud (usually deeper than 25 cm) are more fertile than those with shallower ones.

The depth of mud can be measured by driving a measuring stick up to the dense, crust like layer called hard pan layer at several points in the field.

Rice is more prone to root lodging in deep mud soils especially if the field is not easily drained and during rainy season. In such case, plant non-lodging varieties.

5. **Drainage condition-** Poor drainage could enhance sulfur and zinc deficiencies. The soil losses oxygen if the field is continuously wet and not easily drained leading to iron toxicity especially in oxisols or ultisols (red soils). Potassium as well as sulfur deficiencies may also exist in red soils when soil is continuously flooded.

6. **Soil color**

- Dark brown and dark gray soil indicate relatively higher soil organic matter
- Light brown or yellowish red soils are less fertile
- Reddish soils contain more iron oxides, which can lead to iron toxicity when continuously submerged and deficiency in phosphorus and possibly sulfur. These elements could be fixed by iron under certain moisture conditions.

7. **Soil Texture-** This is the relative proportion of sand, silt, and clay particles in soils. The approximate soil texture can be determined by rubbing moist soil between your fingers or making a wire out of it.

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Indications for healthy rice plants:

- green color
- uniform stand
- no injuries or lesions in the leaves
- normal tillering (more than 20 tillers per hill at maximum tillering stage)
- spikelet number over 180 per panicle with reasonable percentage in productive tiller.

On the other hand, a crop is either suffering from insect pest, disease infestation, and nutrient deficiency when it has the following symptoms:

- yellow, pale green or blue green appearance
- low tillering
- stunted growth
- discoloration (physiological or nutritional disorder)
- leaf injuries or lesions (indicates disease)
- presence of insect pests (indicates insect infestation)

### Plants infected with pests and diseases

leaf discoloration



Rice plant infected with blight

leaf lesions



Grasshopper damage

presence of insect pests



Stem borer damage



Brown planthopper damage

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## Examples of diagnosis

### Case 1

#### Site Characteristics:

- relatively wide flat plain
- soil texture is loamy to clayey
- dark brown or grayish brown in color
- average depth of mud is 25 cm but there are certain paddies which has mud depth of almost 50 cm or deeper
- poorly drained (farmer claims the field does not dry up easily)
- irrigation water is alkaline based on litmus paper analysis
- water table is relatively shallow which is also supported by the farmer's claim that it is not drying up easily or the field remain saturated
- rice is grown in both seasons

**Diagnosis:** The area could be relatively fertile except in the paddies with a mud depth of almost 50 cm or deeper. It is poorly drained and thus, zinc and sulfur deficiencies may occur. It has fairly good amount of soil organic matter because of its dark brown color. The imbalance of positively charged ions such as calcium-magnesium induced K deficiency may occur owing to alkaline irrigation water.

### Case 2

#### Site Characteristics:

- gently rolling landscape
- specific farm is located on the top of the toposequence
- soil texture is about sandy loam
- relatively light brown in color
- average depth of mud is less than 25 cm
- relatively well drained
- deep water table
- rice is grown only during the wet season because it is a rainfed area.

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## Appendix 1

### **Nutrient deficiency symptoms in rice plants**

#### **Nitrogen deficiency**

- stunted
- limited tillers
- relatively uniform yellowing of leaves especially in older ones



Generally, most if not all lowland rice soils are deficient in nitrogen at varying degree.

#### **Phosphorus deficiency**

- stunted
- very dark green or bluish green, erect, short and narrow leaves
- reduced tillering



#### **Potassium deficiency**

- leaves have yellowish brown color at the margins or rusty brown spots appearing first on the tips of older leaves
- older leaves also droop and tillers spread out



Symptoms tend to appear during the later growth stages.

#### **Sulfur deficiency**

- young leaves are yellowish
- reduced tillering
- stunted growth



## **Nutrient toxicities symptoms of rice plants**

### **Iron toxicity**

- tiny brown spots on lower leaves starting from the tip or the whole of the leaves are orange-yellow to brown
- stunted plants
- greatly reduced tillering
- root surface are coated with dark brown to black and many are dead roots.

Symptoms initially appear 1-2 weeks (but sometimes after more than 2 months) after transplanting. Iron toxicity is usually encountered in poorly drained soils in inland valleys where there is an inflow from acid upland soils. This can also be found in kaolinitic soils with low cation exchange capacity (CEC) and small amounts of available P and K and in young acid sulfate soils.

### **Boron toxicity**

- first appears as chlorosis of the tips and margins of older leaves
- dark brown elliptical spots appear on these discolored areas, which then turn brown and dry up after two to four weeks
- necrotic spots are prominent at panicle initiation
- vegetative growth is not markedly reduced.

Boron toxicity is most common in arid and semiarid regions and soils irrigated from deep wells containing large B concentration and in some coastal saline soils.

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*Published 2005 by the Philippine Rice Research Institute.  
1st printing - 3,000 copies*

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