IDENTIFICATION OF NUTRITIONAL DISORDERS IN RICE

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Nutritional disorders can be defined as the abnormal pysiological conditions caused by deficiency or toxicity to an element or substance. These abnormal conditions are morphologically visible through significant changes in plant growth, development, leaf colour, etc.

In the field, deficiencies or toxicities to more than one element or substance may prevail at the same time. In addition, symptoms of certain diseases such as blast, brown spot, narrow brown spot, grassy stunt, virus diseases etc. produce brown spots on leaves that resemble nutritional disorder symptoms. For example, it is extremely difficult to differentiate between Zn deficiency and grassy stunt virus disease in the early stage of symptom development. For this reason, it is advisable to become familiar with above disease symptoms and nutritional deficiency symptoms encountered in the field.

A characteristic feature of disease symptoms caused by pathogenic organisms is that they spread from plant to plant while deficiency or toxicity symptoms do not. Deficiency or toxicity symptoms normally occur as patches rather than in individual plants. Furthermore, when observe fields for nutritional deficiency symptoms, it is advisable to compare the symptoms of affected plants with normal, healthy plants on whole plant basis. Normal plants could be found at field margins or in high fertile areas. Soil characteristics such as texture, salinity, drainage, etc. also should be taken into consideration in arriving at a final conclusion.

Intensity of nutritional disorder symptoms may also vary depending on varietal differences and other prevailing environmental conditions. Herbicide spray drift, excessive herbicide doses and residual effects of herbicides also could cause abnormal symptoms. Therefore, correct diagnosis of these disorders

in the field is very challenging and important for farmers to adopt correct remedial measures based on the identification of field problems. They have to apply appropriate amelioration methods to rectify the identified nutritional disorders for enhanced yields.

WHAT ARE THE PLANT NUTRIENTS INVOLVED?

Sixteen elements have been identified as essential for plant growth. Of these, N, P and K have been categorized as major nutrients and Ca, Mg and S are considered secondary nutrients. Zn, Fe, Mn, Cu, B, Cl and Mo are considered micronutrients. This classification however, is based on the relative amounts of these elements needed for plant growth and not on the degree of essentially. Each and every element is equally essential for normal plant growth and development.

DIAGNOSIS

Diagnosis of nutritional disorders can be based on the following criteria:

- Visual plant symptoms
- Plant tissue analysis
- Soil analysis

VISUAL PLANT SYMPTOMS

Deficiencies or toxicities of one or more elements cause impairment of general plant growth and result in externally visible specific characteristic symptoms in respect of each element or substance. A systematic observation of the major plant parts for tox city or deficiency symptoms is recommended as follows

Plant height: Stunting

Tillering: Number and size

Leaves: Chlorosis (Uniform or interveinal), Necrosis (brown spots) and orange discoloration

Roots: Discolouration (black)
Volume and length

Deficiency Symptoms

Nature of nutrient mobility within the plant and the position of leaf on which deficiency symptoms appear are interrelated. For an element with low mobility within the plant, deficiency symptoms normally appear in upper younger leaves, because the element fails to move from older leaves to upper younger leaves where it is needed for active growth. Iron, boron, and calcium are examples of low mobile nutrients. On the other hand, when a nutrient is mobile symptoms normally appear in lower leaves as the element is translocated from older leaves to younger active leaves. Nitrogen, phosphorus, potassium and sulphur are examples of mobile nutrients.

Toxicity Symptoms

Element toxicity symptoms normally appear in lower leaves, where the absorbed elements are accumulated. Iron, manganese, and boron toxicity symptoms appear first in the lower leaves.

In most cases, deficiency or toxicity symptoms appear when plants are in active growth stage of tillering when more nutrients are required. Early stages of symptom development are the best time for observing visible symptoms.

PLANT TISSUE ANALYSIS

When compared to plant tissue analysis data of healthy plants, the data of deficient plant could relatively give an indication of what elements may be deficient or excess. However, it is not possible to decide whether the deficiency is due to root diseases, which in turn affect nutrient absorption, non-availability or lack of nutrients in the soil. Samples for tissue analysis should be collected when the plants show symptoms of a disorder along with reference sample from adjacent healthy looking plants.

The Major nutrient deficiencies could be easily detected through tissue analysis than deficiencies of micronutrients in which the critical leval for deficiency or sufficiency is very small. Some tissue analyses reveal that despite the lower level of some elements even below the critical level, visual symptoms do not develop.

SOIL ANALYSIS

Methods have been developed to analyze available soil nutrients in low land rice soils. These levels should be compared with critical levcels of each nutrient in soil for normal plant growth. The measurement of soil pH is the simplest and most informative soil analysis in the diagnosis of nutrient deficiencies or toxicities. For example, the visible symptoms of Zn deficiency and Fe toxicity are very similar. However, measurement of pH of air dried soil sample, makes the diagnosis easier and more reliable because Zn deficiency is likely to occur on neutral to alkaline soils whereas Fe toxicity is more likely to occur in acidic soils.

Sometimes soil analyses indicate the presence of high level of certain elements. However deficiency symptoms are shown by the crop due to unavailability of the same elements for plant growth.

The characteristic symptoms of defiency or toxicity of essential plant nutrients in rice are described in the following table.

Characteristic symptoms of nutritional disorders caused by deficiency or toxicity of essential plant nutrients in rice

Element	Growth stage	Plant height	Tiller Number/Size	Leaf size/colour	Remarks
			Dificiency symptoms		
N	Vegetative 2 weeks onward up to flowering	Stunted slow growth	Number and size reduced	Narrow, short, erect uniform yellowing	Symptoms begins in lower leaves first and general yellowing if not rectified.
P	Vegetative 2-3 weeks after transplanting up to flowering	Stunted slow growth	Number and size reduced	Narrow, short, erect dirty green leaves. Reddish or purplish colour on leaves, if the variety has a tendency to produce anthocyanin pigments	Symptoms begin in lower leaves first and spread to other parts if not rectified. P availability is low in soils of pH<7. Most paddy soils in Sri Lanka are deficient in P.
K	Vegetative 2-4 weeks after transplanting	Stunted slow growth	Slightly reduced	Short droopy dark green leaves. Interveinal chlorosis starting from the leaf tip turn yellow and eventually dry to a light brown colour.	Symptoms begin with lower leaves. K availability is low in calcarious soil that have pH<7. K is deficient in coarse textured sandy soils.
S	Symptoms are very similar to and almost impossible to visually distinguish from those of Nitrogen deficiency. However, chlorosis by S deficiency appears first in young leaves and spread to lower leaves, whereas N deficiency chlorosis appear first on lower leaves and spread upward if not corrected.				

Element	Growth stage	Plant height	Tiller Number/Size	Leaf size/colour	Remarks
			Dificiency symptoms		
Ca	Vegetative	-	-	The growing tip of the upper leaves become white, rolled and curled. In extreme cases, plant is stunted and growing points die.	Symptoms appear first on upper leaves. Not common in Sri Lanka.
Mg	Vegetative	Little affected	Slightly reduced	Wavy and droopy leaves. Interveinal chlorosis of orangish-yellow colour	Symptoms are found in lower leaves. Mg absorption is reduced when Fe availability is high in aidic soil. Seen in wet zone.
Fe	Vegetative	Stunted	-	In upland entire leaves become chlorotic and then whitish: in severe cases newly emerging leaves become chlorotic. In low land entire leaves turn yellow	Symptoms first appear on upper leaves. More common in soils with pH<7.
Mn	Vegetative	Stunted	not affected	Newly emerging leaves become short and narrow. Interveinal chlorotic streaks spread down ward from tip to leaf base which, later become dark brown and necrotic.	Symptoms found on upper leaves. Appear in soils with pH<6.5.

Element	Growth stage	Plant height	Tiller Number/Size	Leaf size/colour	Remarks
				Dificiency symptoms	
Zn	Vegetative 2-4 weeks after transplanting	Stunted poor growth	-	Brown blotches and streaks appear on lower leaves. Midribs of younger leaves especially at the base become chlorotic dark brown and necrotic.	Symptoms appear on lower leaves first. High levels of N in soil aggravate Zn deficiency. More common in soils with pH<7.
B	Vegetative	Stunted	-	Tips of emerging leaves become white and rolled as in the case of Ca deficiency	Symptoms are found on upper leaves. Not common in Sri Lanka
Cu	Vegetative	-	-	Leaves appear bluish green and then become chlorotic near the tips. Chlorosis develops downward along both sides of midribs; it is followed by dark brown necrosis of the tip.	Not common in Sri Lanka

Element	Growth stage	Toxicity symptoms: Plant height	Tiller Number/Size	Leaf size/colour	Remarks
Fe	Vegetative beginning 2-3 weeks after transplanting and persist up to flowering	Poor growth	Tiller number reduced	Brown type: Tiny brown spots appear on the lower leaves, starting from the tips and spreadling towards the base. In severe cases the entire leaf looks purplish brown. Prominent in Sri Lanka. Yellow type; Newly energing leaves become yellow. More prominent in Bombuwela area.	Symptoms appear first on lower leaves. Low K content aggravates iron toxicity. Low pH and high organic matter induce iron toxicity.
Mn	Vegetative	Stunted	Tiller number reduced	Brown spots on veins of the leaf blade and leaf sheath specially on lower leaves. Chlorosis at the tip of older leaves especially along margins. Leaves ultimaely turn brown and dry up.	Lower leaves affected. Common in low country wet zone of Sri Lanka.
Salinity	Vegetative	Stunted	Tiller number reduced	Leaf tips become rolled and die-off. Some parts of the leaves become chlorotic.	Commonly seen in coastal areas of Hambantota and Ambalantota.