IDENTIFYING CRITICAL STAGES OF MACRO AND MICRONUTRIENT DEFICIENCY DISORDERS IN OKRA & EGGPLANT

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INTRODUCTION

Visual diagnosis of nutrient disorders is a powerful tool for rapid identification of plant health linked to fertility, nutrient availability, uptake and verification of soil or foliar test results. Careful observations of the growth of plants can furnish direct evidence of their nutritional conditions. Metabolic disruptions resulting from nutrient deficiencies provide links between the function of an element and the appearance of a specific visible abnormality. Symptoms of disorders could provide a guide to identify nutritional disorders in plants. Deficiency symptoms are only one of several diagnostic criteria that can be used to assess the nutritional status of plants. Plant analysis, biological tests, soil analysis, and application of fertilizers containing the nutrient in question are additional tools used in diagnosis of the status of plant nutrition. Careful experimental work and observations are needed to characterize symptoms. For example, nitrogen is needed for protein and chlorophyll synthesis, and symptoms appear because of the disruption of these processes. Symptoms of nitrogen deficiency appear as uniform pale-green or yellow leaves starting from the bottom (starts with on older leaves and extending upward or sometimes covering the entire plant (Pitchay et al., 2007). Iron deficiency also affects protein synthesis and chlorophyll synthesis, but the symptoms first develop on young leaves as interveinal chlorosis progress downward to maturing and matured leaves. Symptoms of deficiency can be quite specific according to nutrient, especially if the diagnosis is made early in the development of the symptoms. Symptoms may become similar among deficiencies as the intensities of the symptoms progress. Deficiency symptoms can occur at any stage of plant growth and development. Early diagnosis of deficiencies may also allow time for remedial action to take place. Experiments were conducted to achieve the following objectives:

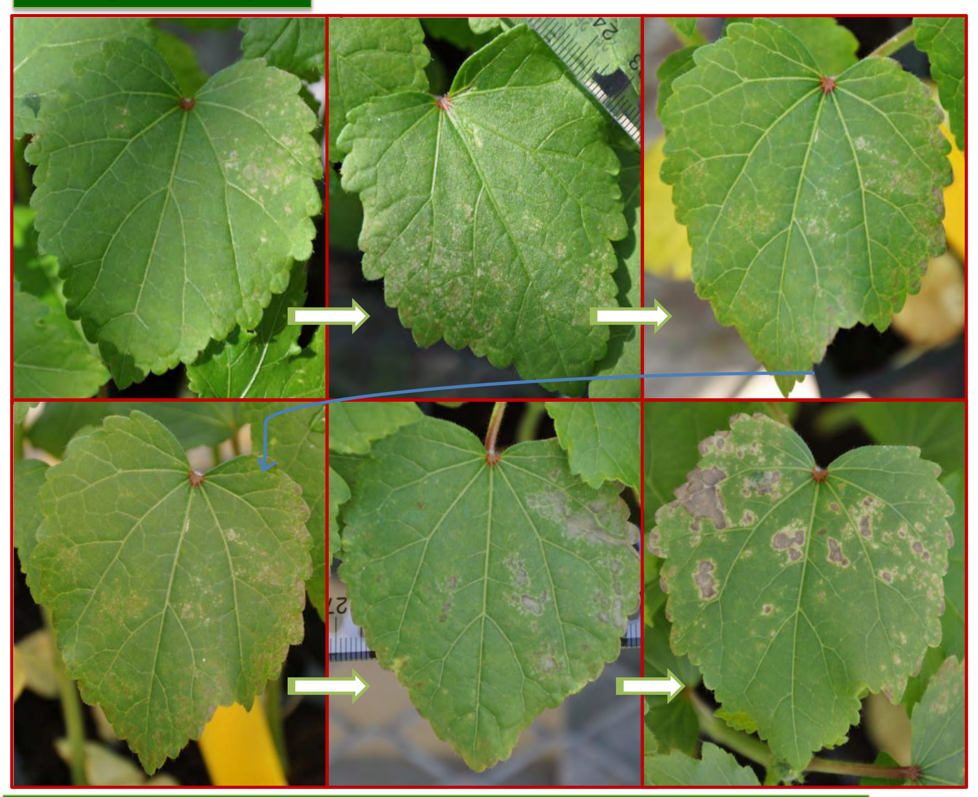
1. Generate visual symptoms of nutrient deficiencies in sequential order in which they appear at various stages in okra and eggplant.
2. To measure and document the rate of growth of macro and micronutrient deprived plants.

MATERIALS & METHODS

The plants were grown hydroponically in a glass greenhouse at the Tennessee State University, USA. The treatment consisted of a complete modified Hoagland's millimolar concentrations of macronutrients (15 NO3-N, 1.0 PO4-P, 6.0 K, 5.0 Ca, 2.0 Mg, and 2.0 SO4-S) and micromolar concentrations of micronutrients (72 Fe, 9.0 Mn, 1.5 Cu, 1.5 Zn, 45.0 B, and 0.1 Mo) and eight additional solutions each devoid of one essential nutrient (N, P, K, Ca, Mg, S, Fe, or B). The plants' growth response (height, rate of growth, spad values, etc.) was measured for each treatment. The images of sequential development of visual nutrient deficiency symptoms were photographed. The atlas of macro and micronutrient deficiency symptoms are presented.

RESULTS

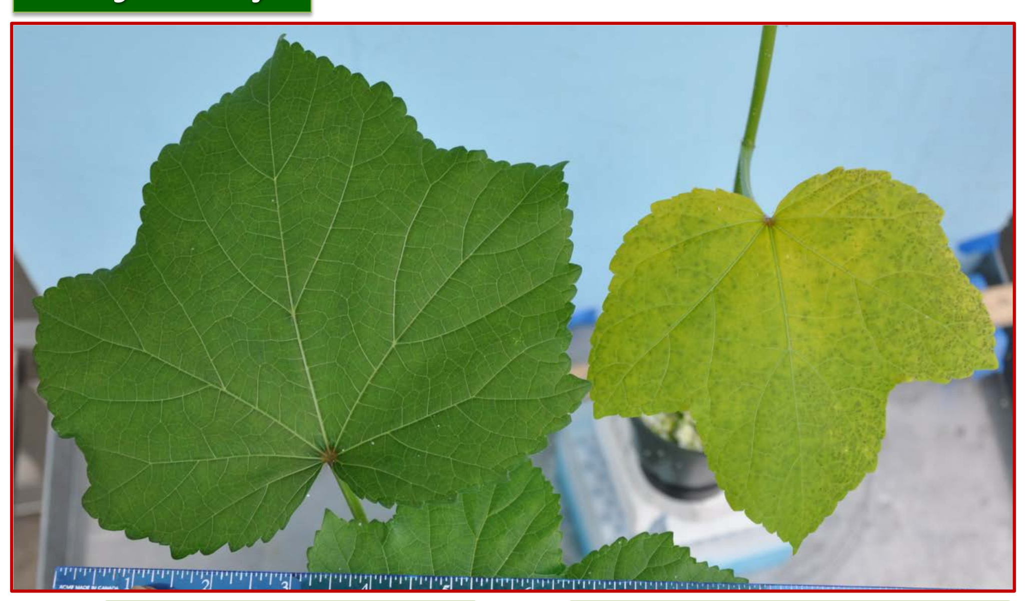
K deficiency



Rapid progression of K deficiency symptoms

Initially, K deficient leaves appeared darker green with a slight reduction in growth, followed by a sudden development of light grayish discoloration along/adjacent to the margins of matured leaves. Within days it spread across the entire lamina. These symptoms progressed rapidly to severe necrosis within two days, more so on a hot sunny day. There was no symptoms of chlorosis prior to necrosis.

N deficiency



Normal - older leaf | N deficient - older leaf

Older leaves developed uniform chlorosis (yellowish green to greenish yellow). These symptoms gradually progressed upwards to matured and maturing leaves. Overall, N deficient plants appeared lighter green, and significantly smaller compared to normal. Leaf size reduced by 55% to that of normal leaf.

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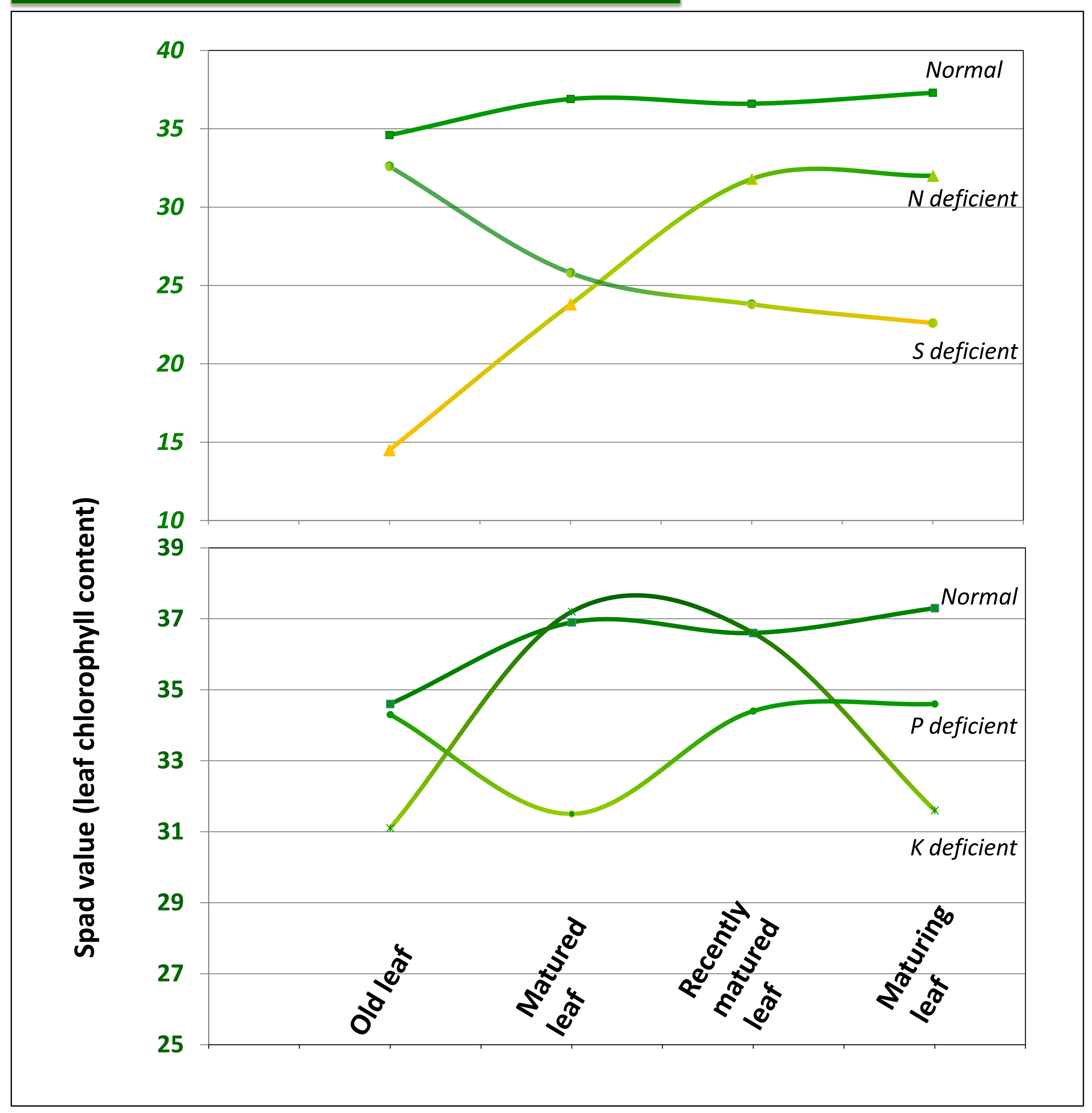
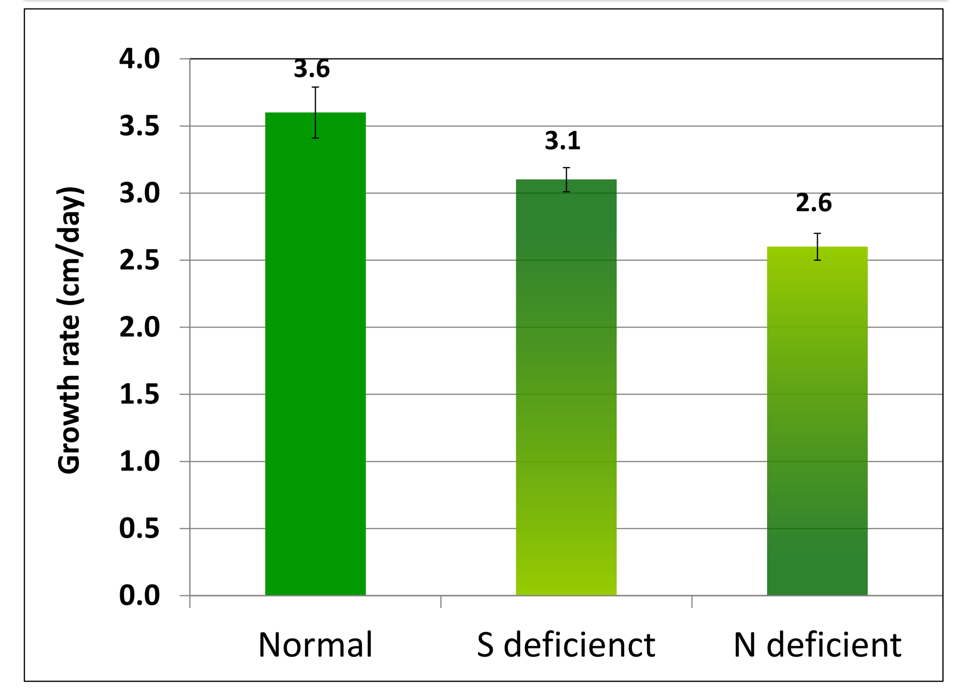
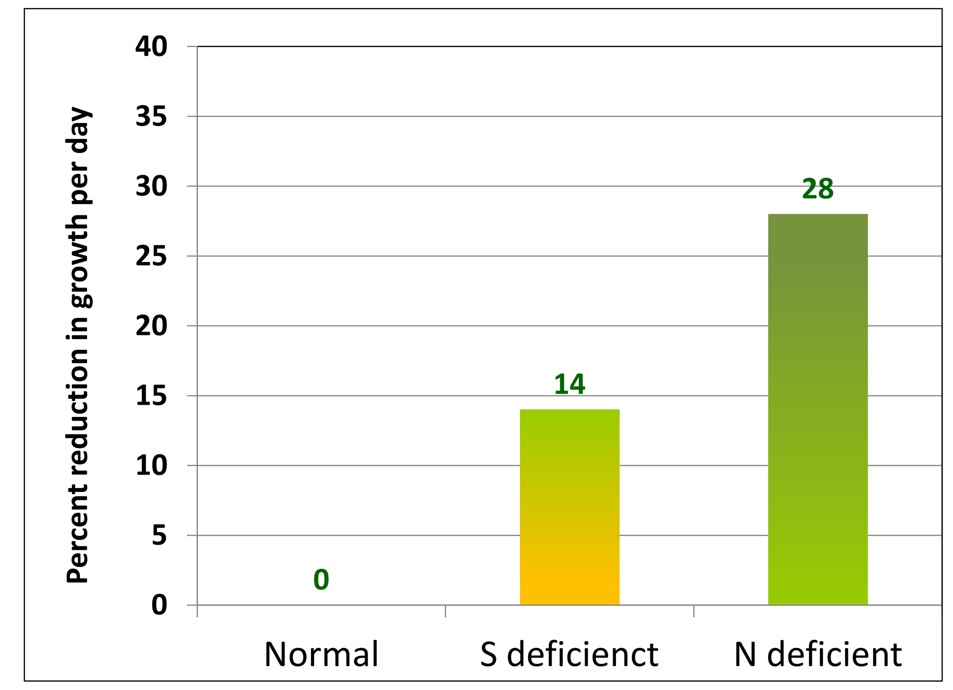
Spad values of nutrient deficient leaves



Spad value measurement of N, P, K, and S deficient plant leaves at different stages of development and physiological age corresponds significantly with the visual nutrient symptoms as compared to normal. The spad value of N deficient leaves declined with the physiological age. Whereas, the spad value of S deficient plant leaves increased with physiological age. Higher spad values of K deficient matured leaves may give a false indication of normal plants. This fits well with the sudden development of necrosis without any warning signs of chlorosis.

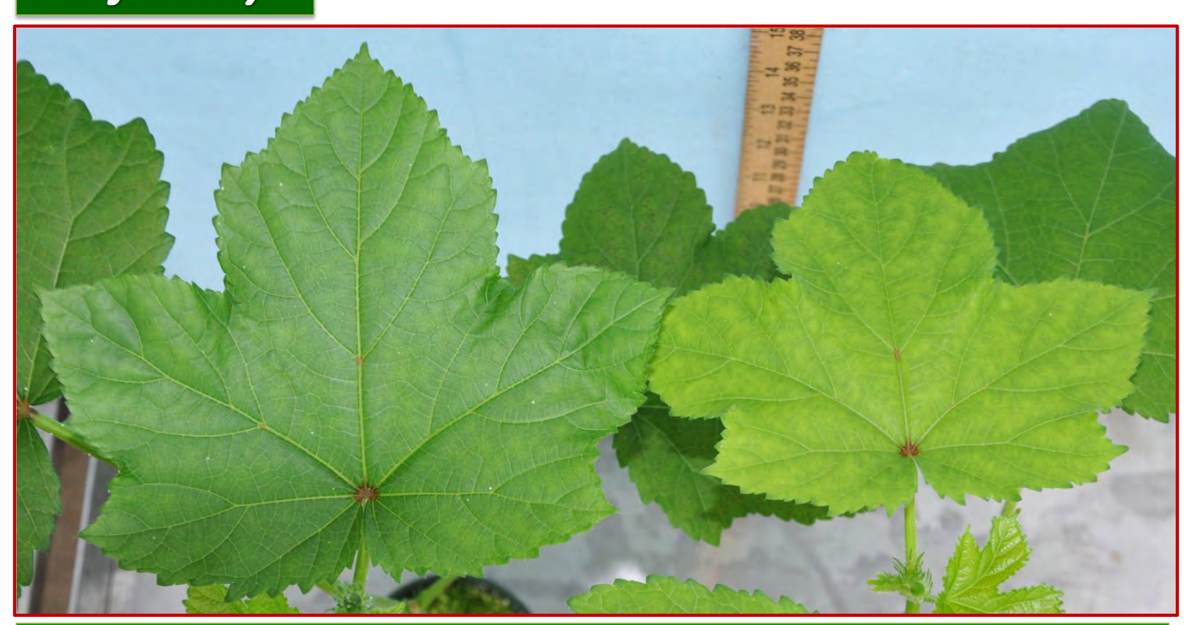
Impact of nutrient on plant growth rate





Significant reduction in growth rate was noted when plants were deprived of essential nutrient elements. A significant reduction in the rate of growth was noted in N and S deficient plants. The growth of N and S deficient plants declined by 27% and 14%, respectively, on daily basis, compared to normal.

S deficiency



Normal - maturing leaf | S deficient – maturing leaf

Initially, uniform chlorosis developed on maturing leaves of S deficient plants. The symptoms gradually progressed downwards to matured leaves. Older leaves remained green. Compared to normal, S deficient plants had reduced leaf size and number by 56% and 25%, respectively.

Fe deficiency

First, light chlorosis developed on young leaves, followed by distinct interveinal chlorosis, which gave way to uniform chlorosis of the entire leaf blades except the primary and secondary veins. Eventually, the entire lamina turned bleached white.