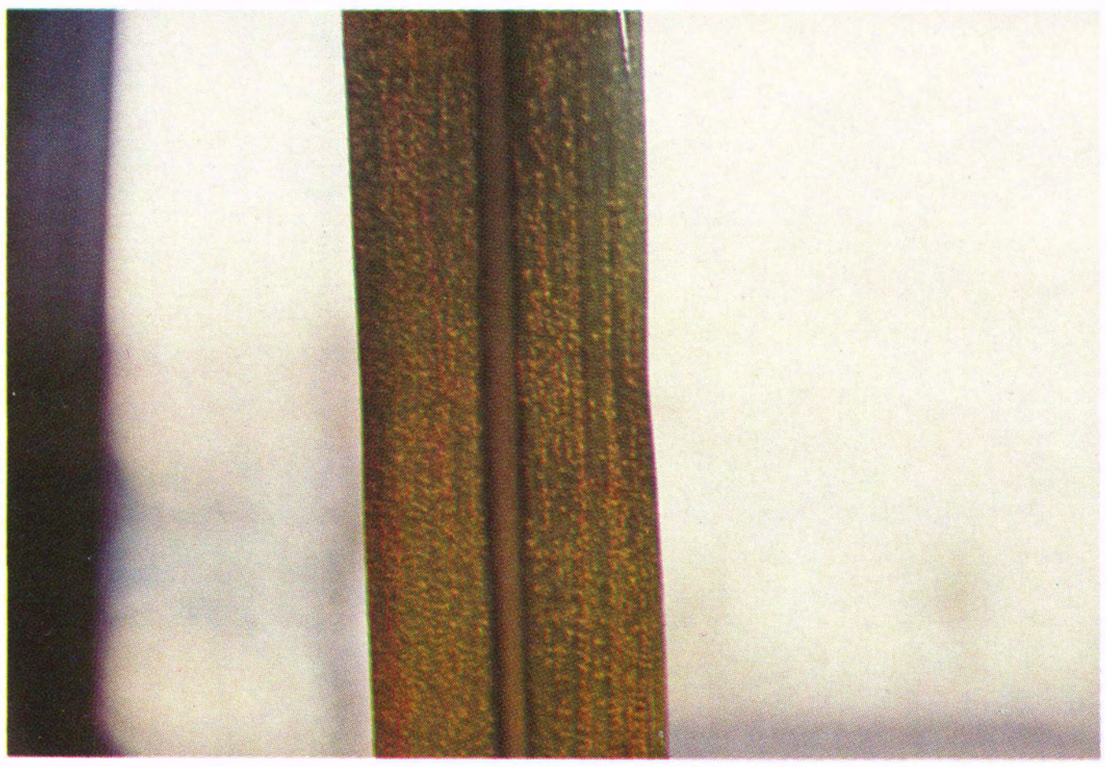
ILLUSTRATED CONCEPTS IN TROPICAL AGRICULTURE

A series prepared by the Department of Agronomy and Soil Science
College of Tropical Agriculture and Human Resources
University of Hawaii

SYMPTOMS OF PLANT MALNUTRITION: SILICON, AN AGRONOMICALLY ESSENTIAL NUTRIENT FOR SUGARCANE



The list of essential plant nutrients has grown over the years until, at the present time, 16 nutrients are generally recognized as meeting at least one of the criteria for essentiality. Briefly stated, these criteria are:

1. Plants will not complete their life cycle if the element is absent.
2. The element has a necessary biochemical or structural role.
3. No other element can substitute completely for the one in question.

Some elements are not essential by these strict standards, but under certain conditions they increase plant growth. These elements are said to be functional nutrients, and they may be so important for crop production that they are said to be agronomically essential. Such an element is silicon.

Some soils of the tropics are so highly weathered that the primary and secondary minerals containing Si have virtually disappeared from the soil. Saturation extracts of such soils may be 2 ppm or less Si. The Si content of sugarcane closely reflects the solubility of Si in the soil. Hawaii sugarcane containing less than 0.5% Si in leaf sheaths 3 through 6 is frequently afflicted with a disorder called "leaf freckle" disease. This disorder is not corrected—in fact, the disease may be made worse—by liming with calcium carbonate or by fertilizing with phosphate, but it is corrected by applying calcium silicate slags to the soil.

The photographs present the symptoms of leaf freckle disease and demonstrate how the symptoms disappeared when 6 tons/ha of slag were added to a soil (Gibbsihumox, Halii series) on the Island of Kauai.

Upper left: A representative leaf from a sugarcane plant growing in the no-silicate plot. Leaf freckle was most severe on old leaves. In severe cases such as this, plants had only 6 to 8 functional leaves. Severe leaf freckle decreases effective leaf surface for photosynthesis and decreases sugar production.

Upper right: Sugarcane in the no-silicate plot had an understory of weeds resulting from poor tillering of the cane and from senescence of older leaves, which permitted light to penetrate the canopy.

Lower left: Leaves from a plant in a plot that had been treated with 6 tons TVA (Tennessee Valley Authority) electric furnace slag per acre.

Lower right: A dense, weed-free canopy of sugarcane in a plot that had been treated with silicate slag.

Robert L. Fox and James A. Silva—No. 8, 1978