Chapter 12

Recommended Soil Tests for Silicon

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Silicon (Si) is recognized as a quasi-essential plant nutrient. Although Si is the second most abundant element in mineral soils, supply of available Si to some crops may be limiting. In crop production the benefits from Si fertilization may include increased yield, disease and insect resistance, and tolerance to stresses such as cold, drought, and toxic metals. Wheat, rice, cucurbits, turfgrass, corn, and sugarcane are crops that have been shown to benefit from Si fertilization. In addition to crops, the value of silicon is gaining attention in animal nutrition where Si may play a role in the health of bone, joints, skin, hair, and connective tissues.

Monocot plant species generally take up more Si than dicots. Crops may be roughly classified as accumulators, intermediate, or non-accumulators with respect to their tendency to take up Si. Wheat, rice, and sugarcane are examples of Si accumulators: cucurbits are intermediate: tomato is a non-accumulator. In accumulators the amount of Si taken up is comparatively large and may exceed uptake of other major plant nutrients such as N, P, or K.

In soil, most of the Si is held in the crystalline structure of sand, silt and clay size particles. Plants take up Si from the soil solution as silicic acid (H_4SiO_4) as soil particles weather and release Si into the soil solution. While the total Si content of mineral soils can be very large, the amount of soluble Si available for crop uptake may be limited.

Soils vary substantially in ability to supply available Si for plant uptake. In general, less weathered, geologically younger mineral soils tend to supply more Si to plants than highly weathered or older soils. The soil orders, Ultisols and Spodosols common in the Eastern USA, tend to be extensively weathered and somewhat Si depleted. Oxisols that are common in the tropics are the most highly weathered soils and the most depleted in Si availability. In contrast, Mollisols common to the USA Great Plains, are less weathered, and contain more Si. Histosols, also know as peat or muck soils, contain little mineral material and are more likely to be deficient when planted to Si demanding crops.

Soil testing and plant tissue analysis can be performed to determine the Si status of soils and crops, but there is limited field calibration data available to support soil test interpretations and soil fertility recommendations. Most of the soil fertility research in relation to silicon has focused on soils and crops of tropical regions where large crop responses to Si fertilization are common in rice and sugarcane. In the Northeast USA, wheat, pumpkin, and Kentucky bluegrass are crops known to benefit from Si fertilization on some soils. In recent years there has been an increasing number of requests for Si soil testing among university scientists as well as professionals from the turfgrass industry. To serve this demand, some soil test laboratories in the Northeast began offering soil testing for Si using a modification (ICP in place of colorimetric Si determination) of the acetic acid test method that has been offered for many years through the University of Florida soils laboratory. Because glassware can leach Si into samples, plasticware must be used for Si analytical work in the laboratory.

0.5*M* Acetic Acid Extraction for Silicon

Equipment:

1. Soils scoop 10 cm^3 and leveling rod.
2. Oscillating shaker capable of 180 oscillations per minute (opm).
3. 75 mL wide-mouthed, plastic extraction bottles.
4. 50 mL plastic storage bottles
5. Plastic filter funnels.
6. Whatman No. 42, Whatman # 5 (or equivalent) filter paper
7. Pipette or automatic dispenser
8. Inductively Coupled Plasma Spectrometer (ICP)

Reagents:

1. **0.5*M* Acetic Acid (CH_3C00H):** In a 2 L plastic container, add 54 mL of concentrated acetic acid. Bring to volume with deionized water

2. **1,000 mg/L stock standard Si solution**

3. **Working ICP standards:**

   Standard 1: 0.0 mg/L Si: Use 0.5*M* Acetic Acid extractant

   Standard 2: 5.0 mg/L Si: Add 1 mL 1,000 mg/L standard Si solution to 200 mL volumetric. Dilute to volume with 0.5*M* acetic acid.

   Standard 3: 10.0 mg/L Si: Add 2 mL 1,000 mg/L standard Si solution to 200 mL volumetric. Dilute to volume with 0.5*M* acetic acid

   Standard 4: 20.0 mg/L Si: Add 4 mL 1,000 mg/ standard Si solution to 200 mL volumetric. Dilute to volume with 0.5*M* acetic acid.

Procedure

1. Scoop 10 cm^3 of air-dried sieved (< 2 mm) soil into a 75 mL plastic extraction bottle.
2. Add 25 mL of the 0.5 M acetic acid extracting solution to each bottle with automatic dispenser and cap. Let the mixture stand overnight (approximately 20 hours).
3. Shake on reciprocating shaker (120 OPM) for 50 minutes.
4. Filter and collect the extract into plastic containers.
5. Standardize the ICP and measure Si in the soil extracts.
6. Calculate Si in the soil as follows. ***Note that these results are on a soil volume basis.***

Si (mg/L) in soil = Si in soil extract (mg/L) * 2.5.

References

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