

Silicon for crop health

**Integrated
Crop Protection**
PROTECTING CROPS



Soil Wealth
NURTURING CROPS

Silicon is an available nutrient for all plants grown in soil, with its content in plant tissue ranging from 0.1%-10%. Although it is not currently classified as an essential nutrient for plant growth, recent research suggests that silicon may have a significant role to play in plant health.

In Australian soils, silicon deficiencies are common. This is due to the nutrient predominantly being 'locked up' by quartz and soil clays (e.g. kaolinite), that must undergo weathering over a number of years before the silicon is made available to the plant as mono-silicic acid. Once it is available, if the silicon is not taken up by the plant it may be bound to clay minerals or leached down the soil profile.

With nutrients regularly being removed through plant growth and crop harvest, and many common fertiliser inputs not replenishing this deficit, it is easy to see how silicon deficiencies readily occur.

Studies have suggested that amending these widespread deficiencies have a number of benefits for crop health and subsequent production.

Improved Nutrient Availability

Silicon interacts with plant nutrients such as nitrogen, phosphorus and potassium, influencing their uptake by the plant. Increased uptake occurs as a result of silicon's high Cation Exchange Capacity (CEC), adsorbing nutrients and making them more available to the plant.

It also plays a role in regulating excessive toxic elements such as aluminium, iron, zinc and manganese.

Research has further indicated that silicon can increase phosphorus availability indirectly by decreasing the availability of iron and manganese in the soil.

It may also regulate the uptake of phosphorus in deficient or excess situations. This is due to its disposition in root endodermal cells, acting as a physical barrier to decrease extreme P uptake by roots.

Resistance to Pest and Disease Pressure

Research has indicated that silicon increases resistance to pathogens such as fungi, bacteria and insects.

Silicon is prominent in cell walls as solid amorphous silica, this provides a barrier against pathogens such as fungi, serving as a direct fungicide, suppressing and preventing spore germination. It is not known, however, how long silicon residual activity on plants may last following an application. Therefore it is recommended that frequent applications may be necessary to maintain control.

Improved Resilience to Environmental Stress

Silicon has been shown to alleviate drought, salt stress and improve wind, rain and heat tolerance.

The presence of silicon aids crop plants by strengthening cell walls. This in turn slows transpiration, alleviating salt and water stress.

Further, this structural benefit is believed to play a role in relieving nitrogen stress through improved leaf structure and light interception.

Key messages

- The addition of silicon in horticultural production systems has been shown to be advantageous in regards to resisting environmental stresses
- This increase in nutrient regulation and alleviation of pathogens and environmental stress may lead to increases in yield and crop quality
- When choosing a silicon source, be sure to consider the solubility, nutrient profile cost and application method practicalities
- Check silicon sources for heavy metals

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Available Silicon

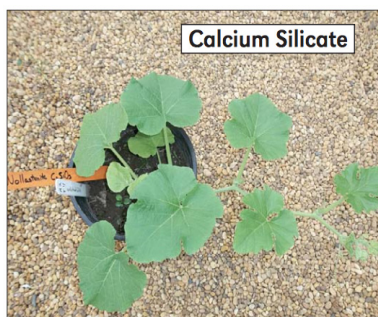
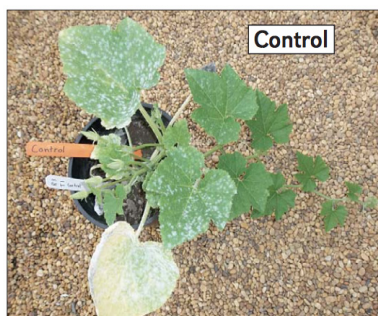
Currently, there is limited data available to indicate the parameters for silicon in plant tissue and soil testing practices. Silicon concentrations vary widely across conditions, species and soluble N concentration in the soil.

Although the industry is currently restricted in regards to these testing methods, there are soil types and conditions that may benefit from silicon applications. These include:

- Soils that are highly weathered and have been subject to leaching in a humid environment
- Sandy soils with good drainage prevent silicon accumulation. Although these sands have high concentrations of silicon dioxide, this provides almost no soluble or plant available silicon
- High organic matter soils. As silicon is a very small component of soil organic matter and in soils high in humus it may be deficient.

As with soils, the response of crops to silicon applications may vary. Research has shown that the following crops are most likely to show positive responses to silicon:

- | | |
|------------|------------|
| • Pumpkin | • Corn |
| • Cucumber | • Cabbage. |



*Powdery mildew disease suppression on pumpkin plants in response to adding calcium silicate to soil
(Source: Heckman 2013)*

Products available

When looking for a silicon source to apply to your crop, it is important to consider the amount of soluble silicon. Silicon sources include crop residues, manure and composts. Although sources such as wheat straw supply 0.15-1.2%, depending on the silicon profile of the soil it was grown on, it may take many years for this material to breakdown and make silicon readily available to the plant.

As with any other nutrient application, it is essential that the cost per kilogram of nutrient, other present nutrients, potential pH benefits, physical properties and ease of application are all weighed up. As a number of silicon sources are industrial byproducts, be sure to test for the presence of undesirable contaminants such as heavy metals.

Commercially available silicon can come in solid and liquid forms. When considering solid forms, the smaller the particle size, the more plant available silicon.

Sources include,

- Calcium silicate
- Magnesium silicate
- Potassium silicate
- Sodium silicate
- Silicon dioxide (Diatomaceous Earth).

Common sources of silicon for horticultural applications include potassium silicate, calcium silicate and sodium silicate. Application to the soil is recommended over foliar sprays if uptake is to be optimised.

High value crops may benefit from drip applications of soluble silicon such as sodium silicate and potassium silicate, or calcium silicate in soil-less mixtures.

It is suggested that the most practical approach for horticultural field crops is to add the silicon during the liming process by using calcium silicate.

In conclusion, there is an array of silicon sources available but it is important to consider your soil type, condition, crop type, cost, practicality of the application method and potential other benefits (soil amelioration through liming, other nutrients).

Further reading

Heckman J (2013) "Silicon: A Beneficial Substance", International Plant Nutrition Institute, Better Crops, vol 97, no. 4, pp. 14-16