Silicon for strawberries

A summary of research findings

STRAWBERRY INNOVATION

Silicon is an available nutrient for all plants grown in soil, with its content in plant tissue ranging from 0.1% - 10%. Silicon is a major inorganic constituent in plants, and a significant amount of evidence has been published showing the value of silicon in crop productivity.

In Australian soils, silicon deficiencies are common. This is due to the nutrient being 'locked up' by quartz and soil clays (e.g. kaolinite), that must weather over a number of years before the silicon is 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 may occur.

Studies have suggested that reducing deficiencies has a number of benefits for crop health and subsequent production. These include:

- Improved nutrient availability
- Management of powdery mildew
- Improved tolerance to environmental stress

The addition of silicon can improve nutirent regulation and aid in powdery mildew management in strawberry crops, leading to potential increases in yield and crop quality

KEY POINTS

- **The addition of silicon to crops has been shown to help plants resist environmental stresses.**
- **Silicon can also improve nutrient regulation and aid in powdery mildew management, leading to potential increases in yield and crop quality.**
- **Soil testing is the best way to measure the amount of plant available silicon in the soil.**
- **When choosing a silicon source, be sure to consider the solubility, nutrient profile cost and application method practicalities.**
- **Check silicon sources for heavy metals**

IMPROVED NUTRIENT AVAILABILITY

Silicon interacts with plant nutrients such as phosphorus and potassium, influencing their availability to the plant. Increased availability of cations such as potassium, magnesium and calcium would be a result of silicon's high Cation Exchange Capacity (CEC). Research has shown that silicon:

- Plays a role in regulating excessive toxic elements such as aluminium, iron, zinc and manganese
- Can increase phosphorus availability indirectly by decreasing the availability of iron and aluminium in the soil
- 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.

MANAGEMENT OF POWDERY MILDEW

Powdery mildew can reduce strawberry yields by up to 30%. Protected cropping systems (e.g. tunnels) also favours the disease. Producers are finding it increasingly difficult to control the fungal disease with longer production periods and the limited fungicides available.

This project has been funded by Hort Innovation, using the strawberry research and development levy and contributions from the Australian Government. Hort Innovation is the grower owned, not-for-profit research and development corporation for Australian horticulture.

Hort Innovation Strategic levy investment | STRAWBERRY FUND | RMCG

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Silicon fertiliser can provide a management option.

Silicon is prominent in cell walls as solid amorphous silica, providing a barrier against pathogens such as fungal diseases. Silicon can delay and reduce the incidence of powdery mildew in strawberry plants. A recent study conducted in substrate/tunnel production showed silicon significantly reduced powdery mildew severity and led to a noteable increase in yield (Ouellette et al., 2017)

The use of silicon in an integrated disease management program for strawberry crops may decrease reliance on fungicides and slow down the build-up of fungicide resistance. Silicon fertilisers generally do not have a harvest withholding period, so producers can manage powdery mildew throughout harvest. It is important to note that silicon fertiliser is a preventative tool not a cure for powdery mildew and frequent applications may be necessary to maintain control.

IMPROVED TOLERANCE TO ENVIRONMENTAL STRESS

The presence of silicon aids plants by strengthening cell walls. This in turn can slow transpiration, alleviating drought and salt stress and improve wind, rain and heat tolerance. Further, this structural benefit is believed to play a role in relieving nitrogen stress through improved leaf structure and light interception.

Recent research has also suggested that weekly foliar or sub-irrigation application of silicon alleviates heat stress in strawberries. Heat stress can be particularly challenging as it restricts leaf development, flower development and photosynthesis in strawberry plants, with temperatures above 30°C reducing fruit size and weight.

AVAILABLE SILICON

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

Despite the limitations in available testing, there are soil types and conditions that may benefit from silicon application, including:

- Soils that are highly weathered and have been subject to leaching in a humid environment
- Sandy soils with good drainage preventing 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, it may be deficient in soils high in organic matter.

APPLICATION METHODS

Silicon can be applied to the soil at pre-planting or directly to the plant through foliar or sub-irrigation application. The following tips are recommended:

- Frequent applications by root uptake (e.g. weekly) of silicon give best results against powdery mildew.
- Smothering leaves in silicon may reduce yields. Excess silicon is not harmful to the plant but it can block sunlight in extreme concentrations. White leaves are a good indicator of excess foliar application.
- The most practical approach for application is to add silicon during the liming process by using calcium silicate.
- The impact of silicon fertiliser will depend on soil type, pH, soil texture, electrical conductivity, silica content and nutrient availability. Strawberries in sandy soils and highly acidic soils tend to respond best to silicon fertiliser.

Powdery mildew can reduce strawberry yields by up to 30%, silicon fertiliser can be considered an alternative to a fungicide management strategy.

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- Some silicon fertilisers (e.g. K_2SiO_3) can block irrigation pipes.
- Some wetting agents already contain silicon. These will not block irrigation pipes and can be used as substitutes for silicon fertiliser if applied in high doses.
- Some studies have found potassium silicate (K_2SiO_3) to be more effective than sodium silicate (Na_2SiO_3) and calcium silicate ($CaSiO_3$) for reducing powdery mildew and tolerating heat stress.

PRODUCTS AVAILABLE

When looking for a silicon source to apply to your crop, it is important to consider the amount of soluble silicon.

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

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

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

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