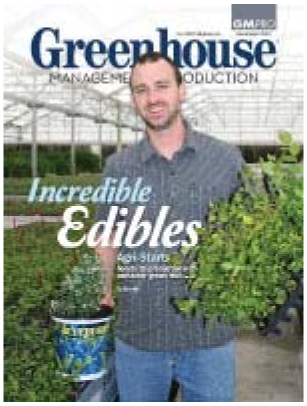

Features - Disease Control

Silicon enhances disease suppression

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Silicon stimulates photosynthesis, reduces transpiration rates and enhances plants' resistance to stresses.

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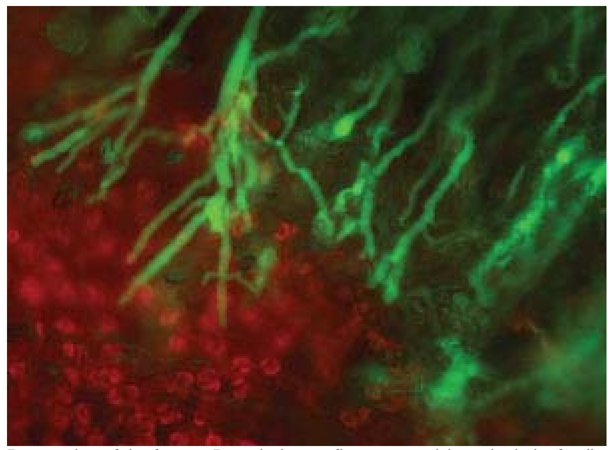
Silicon is the second most abundant elemental nutrient in field soils. Its concentration in plants is comparable to nitrogen and phosphorous levels. However, silicon hasn't been studied as much as other plant nutrients since its abundance in field soils has undervalued its role.



Penetration of the fungus Botrytis (green fluorescence) into zinnia leaf cells (red fluorescence) was delayed when plants were provided silicon.

Silicon is not considered an "essential" nutrient for most plants. The exception is members of the horsetail family (Equisetum). Therefore, it is not generally incorporated in commercial fertilizers. Additionally, peat moss and pine bark potting mixes have very small amounts of silicon so it's unlikely that most floral crops are ever provided significant silicon quantities.

Effects of silicon

The results of several experiments indicate that silicon affects plant growth and crop quality, stimulates photosynthesis, reduces transpiration rate and enhances plant resistance to stresses, such as water, chemical, nutrient imbalances, metal toxicities, diseases and pests. Our goal during the past five years was to determine if silicon might provide benefits to greenhouse-grown floral crops.

The best methods of silicon applications have not been determined. It is believed that most floral crops don't readily take up silicon from growing media. This may mean that some crops react favorably and show growth enhancement and disease resistance, while others show no differences when provided with silicon compared to traditional fertilizer applications.

Our goal was to examine several methods of applying silicon to floral crops to determine if there was a benefit to include silicon fertilizer and suppress or prevent diseases. These are preliminary findings and we continue to search for optimum application methods and rates.

We hope to eventually make definitive recommendations using commercially available silicon products.

Powdery mildew

One of the most prevalent and important floral crop diseases is powdery mildew, caused by the fungus Golovinomyces cichoracearum. Powdery mildew susceptible cultivars of zinnia and helianthus (sunflower) were produced in a peat-based potting mix supplemented with various forms of soluble silicon and treated with half- or full-rate applications of the fungicide myclobutanil.

Silicon was incorporated into peat substrates from various sources and rates: a potassium silicate powder at 0.96 pounds per cubic yard; calcium silicate at 1.3 pounds per cubic yard; five weekly substrate drenches of soluble potassium silicate at 50 parts per million silicon and five weekly foliar applications of sodium silicate at 50 ppm silicon, applied until runoff. These sources and rates were based on several years of previous research on a variety of floral crops. The presence of powdery mildew and its severity were recorded one, two and three weeks after the pathogen was introduced onto the lower and upper leaves of the plants.

Zinnias that received supplemental silicon were more resistant to powdery mildew compared to silicon supplemented helianthus. The greater resistance in zinnias likely occurred because they accumulate higher concentrations of silicon in their leaves compared to helianthus. Even when plants were not treated with mycobutanil, several silicon supplements delayed disease development compared to non-supplemented plants. After three weeks, even though the disease was present on all plants, it was less severe on most of the silicon supplemented plants. This indicates that silicon generally delayed powdery mildew development.

Mycobutanil treatments suppressed powdery mildew in both zinnia and helianthus. We found that silicon supplementation may synergistically prolong myclobutanil's efficacy against powdery mildew in zinnia. In helianthus, myclobutanil suppressed powdery mildew almost completely throughout the three weeks of the study. Thus, we were unable to observe if there was a synergy effect in sunflower.

Among the silicon supplements trialed, only foliar sprays of sodium silicate failed to suppress powdery mildew in helianthus, though it successfully reduced powdery mildew in zinnia. Overall, application of silicon supplements delayed powdery mildew development in greenhouse-produced zinnia and sunflower.

Phytophthora root rot

Phytophthora sp. are fungus-like pathogens also known as water molds that can cause foliar blights and crown and root rots in a wide range of plants. Humid, warm greenhouses and poor irrigation practices encourage Phytophthora-caused diseases.

Since water molds behave differently than foliar diseases like powdery mildew, we were interested in determining the efficacy of silicon against this type of disease. We assessed various forms of silicon (except the foliar sodium silicate spray), in combination with half- or full-rate drenches of mefenoxam, against root rot caused by Phytophthora drechsleri over 14 days.

On gerbera plants not treated with mefenoxam and supplemented with weekly potassium silicate drenches, root rot was reduced for up to 10 days. However, after 14 days, all plants were equally diseased. It is unknown whether plants accumulate silicon in their roots, where Phytophthora attacks.

We previously found that silicon supplemented gerbera plants accumulate less silicon than zinnia and helianthus. Also, high rates of silicon supplements have resulted in deformed gerbera flowers. It appears that silicon may not be a good option against root rot in gerbera, as it only delayed the disease in our studies. However, the fact that the disease was delayed in a plant that doesn't readily accumulate silicon provides some hope for better efficacy in other crops.

Botrytis gray mold

Botrytis blight, more commonly known as gray mold, is caused by the fungus Botrytis cinerea. Botrytis causes necrotic lesions on aerial plant parts, including stems, leaves and flowers, and produces numerous spores (gray mold) on senescent tissue.

To determine if silicon might help combat this disease, the same silicon treatments that were used for powdery mildew were applied to helianthus plants. An additional treatment of five weekly foliar sprays of potassium silicate was also evaluated. These silicon treatments were assessed in combination with half- and full-rates of the fungicide chlorothalonil.

One week after exposing plants to Botrytis, disease symptoms became obvious. Flower petals were the most susceptible plant part and neither the silicon treatments nor chlorothalonil protected the flowers. However, silicon decreased the disease on the stem and leaves.

Foliar sprays of sodium silicate or potassium silicate, potassium silicate drenches, or calcium silicate incorporated into the growing medium alone or in combination with the fungicide most effectively delayed disease infection of the stems and leaves.

To better understand how silicon worked, we genetically modified Botrytis to glow (fluoresce) under ultraviolet light, repeated the experiments and found similar results. However, using a special microscope we were able to observe the fluorescent fungus and found that fungal penetration was delayed when plants were provided silicon.

Supplemental silicon can provide additional disease control for some greenhouse floral crops. Although the supplemental silicon used in our studies was not detrimental to plant health, further research is needed to fine tune the optimal rates and sources. With the increasing interest in sustainable crop production and reduced pesticide use, silicon could become a major component of greenhouse production programs.

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