Floriculture Research Alliance

Ready Research Results:
Silicon In Floriculture **Fertility Programs**

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by **JONATHAN M. FRANTZ** and **JAMES C. LOCKE**

SILICON (Si) is not considered an essential plant nutrient because most plant species can complete their lifecycle without it. Still, some plant species can benefit from supplemental silicon in a variety of ways.

Reports on dozens of ornamental species, including gerberas, roses, asters, New Guinea impatiens, zinnias, sunflowers, poinsettias and orchids, have begun to illustrate wider potential use for this poorly understood element. Beneficial effects reported include improved salt and drought tolerance during production and post-harvest environments; stronger, thicker stems in some cut flowers; and larger orchid liners.

In this report, we highlight some positive responses we have observed with supplemental silicon in several species.

Powdery Mildew in Zinnia, Phlox, Cucumber & Sunflower

Powdery mildew species have a wide range of hosts, including many economically important to the greenhouse industry (e.g. gerbera, chrysanthemum, rose, verbena). Zinnia, phlox, cucumber and sunflower were supplied with 30 to 60 ppm Si (in the form of potassium silicate) as a supplement to complete fertilizer mixes and compared with plants not receiving supplemental silicon (background levels in peat-based mixes can be as high as 5 ppm Si).

After plant establishment for two weeks, leaves of all plants were inoculated with powdery mildew utilizing previously infected plants. Mildew development and disease progress were monitored periodically for up to eight weeks. In all cases, mildew colony formation was delayed and progress slowed by between one and two weeks relative to the control plants (Figure 1). Other research has indicated that silicon activates plant defense pathways inherent in these species to suppress this pathogen rather than there being some physical barrier that silicon forms or stimulates.

Alleviating Copper Toxicity

Copper (Cu) is widely used in agriculture as the active ingredient in some pesticides and sanitizers, and it is used in some water treatments as an algicide. So the potential to overapply could result in copper toxicity. Symptoms of copper toxicity initially manifest as iron deficiency, so it is likely that misdiagnosis has underestimated the scope of copper toxicity.

We supplied zinnia, snapdragons and a model laboratory plant, arabidopsis, with control and toxic levels of copper, as well as with low (1 ppm) and supplemental (50 ppm) silicon. In all cases, supplemental silicon delayed the onset of copper toxicity symptoms and, in the case of zinnia, eliminated long-term detrimental effects of copper toxicity at those treatment levels.

The mechanism appears to be a combination of silicon restricting copper uptake and preventing it from reaching the shoot, but instead accumulating in the root tissue. Previous studies from other labs have demonstrated similar toxicity ameliorating effects with iron and manganese, which is significant for the floriculture industry because pH shifts can lead to these micronutrients reaching toxic levels – even in appropriately fertilized plants.

Delivery Of Silicon

Silicon can be applied in a variety of methods. For the greatest control, a potassium silicate solution can be applied as a drench up to 60 ppm with each irrigation or fertigation. Tank mixing with fertilizers is possible, but pH should be closely monitored and not allowed to rise above 7.0 during the mixing to prevent precipitation of silicon with other essential elements. Some substrate amendments like rice hulls contain high levels of silicon and can supply sufficient silicon to result in beneficial ef-

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Figure 1. Powdery mildew disease progression on zinnia plants with and without supplemental silicon. Disease was still present on plants fed with supplemental silicon, but progression was slowed by one to two weeks. The photograph shows example leaves from each treatment showing the disease presence at the end of the evaluation period.

fects. A rate between 10 and 20 percent rice hulls by volume appears to be ideal for the beneficial effects reported in this article.

Finally, the industrial co-product slag resulting from steel manufacturing can also supply silicon as a "slow-release" silicon source. However, due to some slag types' potential to shift pH and act as a liming agent, the correct choice of slag is important before incorporating within your growth substrate.

Notes Of Caution

Interestingly, silicon supplementation does not always provide a benefit to plants. Other researchers have observed sunflower head deformation when silicon was supplied in 100 to 200 ppm drenches. Solutions containing silicon can have elevated pH if not adjusted after mixing, so container pH can rise with supplemental silicon additions.

Not all stresses are influenced by silicon fertilization: Researchers at the University of Illinois saw no effect of supplemental silicon fertilization of a woody ornamental ficus on citrus mealybug (*Planococcus citri*). We have observed slight suppression of aphid population growth on zinnia fed with supplemental silicon, but probably not sufficiently suppressed to be commercially practical as a control method. Because of these issues, and the seeming plant-to-plant stress specificity of observed benefits, growers should proceed with caution and only attempt silicon amendments on a small scale to determine its practical use before widespread implementation. **GG**

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