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The Biopesticide Company

AgSil®

BIONUTRIENT

Benefits of Silicon

Silicon is the second most abundant element in the Earth's crust and is present in rocks and clay. This element combines with oxygen and can interact with other metals, such as aluminum, calcium and iron. Silicon is used in various every-day products, such as electronics, cosmetics, industrial lubricants and food additives.

Silicon is an essential nutritional element for living things. In humans it is involved in bone and heart health. In plants it is important for stress responses.

Source:
Wendy Zellner, Ph.D., USDA

Increased Shelf-life

Poinsettia, Mini Rose, Gerbera Daisy

Reduced Biotic Stress

Fungal

Anthracnose
Morning Glory, Paper Daisy

Black Spot
Rose

Powdery Mildew
Rose, Tomato, Zinnia

Fusarium wilt
Tomato

Fusarium crown and root rot
Tomato

Bacterial

Bacterial Spotted Wilt
Tomato

Viral

Tobacco Ringspot Virus
Tobacco

Reduced Abiotic Stress

Temperature

Cold
Cucumber, Wheat

Heat
Creeping Bentgrass

Heavy Metal Toxicity

Copper
Snapdragon, Arabidopsis

Manganese
Cucumber, Rice

Aluminum
Corn, Soybean

Cadmium
Peanut, Corn, Chinese Cabbage

Salt Stress

Enhanced tolerance
Corn, *Medicago*, Soybean, Rice, Wheat

Silicon as a Plant Nutrient

Forms of Silicon:

When elemental silicon is bound to oxygen, it is referred to as silica. Quartz is a form of silica that has a strong, crystalline structure, making it difficult to weather or break down into a form that plants can use. Sand is a good example of quartz, and its structure makes the silicon present in the granules unavailable for plant uptake.

Amorphous silica (also referred to as a phytolith) has a more loosely organized crystalline structure of silicon and oxygen then that of quartz. This makes it easier for phytoliths to break down into plant-available forms. The plant-available form of silicon is silicic acid, represented as either H_4Si0_4 or $Si(OH)_4$. This small molecule is uncharged at neutral pH.

Distribution of Silicon in Plants:

Plants were originally classified as high, intermediate or low silicon accumulators based on the concentration of silicon in the leaves of plants. While high accumulators, such as grasses, grains and some dicot species, like zinnia, have higher silicon (dry weight basis), most dicots fall into the intermediate to low range. While foliar tissue is easy to collect and test, these values can be misinterpreted. In all plants, silicic acid is absorbed from the growing media by the roots and transported throughout the plant via the xylem. While the movement of silicon can follow the transpiration stream, it is also preferentially transported to specific tissues, depending on the developmental stage and needs of the plant. In higher accumulators, the foliar tissue contains

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	Silicon (ppm)
Zinnia	12,682
Garden Mum	10,430
Cucumber	10,164
Lantana	8,780
Verbena	8,417
Watermelon	6,340
Sunflower	5,180
Pumpkin	4,591
Torenia	4,331
Dahlia	3,714
Streptocarpella	3,704
Purple Coneflower	3,589
Summer Squash	3,497
Rudbeckia	3,469
Phlox	3,249
Florist Mum	2,641
New Guinea Impatiens	2,314
Okra	2,130
African Violet	2,041
Winter Squash	2,031
Impatiens	2,008
Arabidopsis	2,000
Calibrachoa	1,536
Tomato	747
Vinca and Periwinkle	330
Tobacco (traditional)	290
Gerbera Daisy	266
Petunia	197
Primula	182
Spinach	152
Swiss Chard	152
Pansy	126
Onion	121
Tobacco (ornamental)	102

the highest concentration of silicon and other tissue, such as the roots, stems and petioles, also contain good amounts of the nutrient. In intermediate and low accumulators, the roots tend to have a higher concentration of silicon compared to the leaves. These plants also have detectable amounts of silicon in other tissue, including stems, petioles and inflorescence. It is important to understand the silicon tissue distribution in order to conclude whether or not plants are silicon deficient.

When Do Plants Need Silicon?

The need for silicon in plants is dependent not only on the species, but also the environmental conditions in which the plant is growing. We are learning that silicon is needed at certain stages of plant growth, including biosilicification of grass leaves and during grain development in rice. The plants use silicon to enhance their physical strength. However, silicon is also required for other physiological processes, as well. Silicon helps plants deal with stress and is needed prior to or at the time of a stress event to impart its beneficial effects. We are still learning how silicon is used by plants to defend against drought, temperature changes, metal toxicity, salinity, herbivore feeding and infection by plant pathogens. It is important to note that these physiological responses have been well documented in high, intermediate and low silicon accumulators showing that most plants benefit from silicon.

How to Test for Silicon:

Testing for silicon and determining silicon deficiency are not easy tasks. The available test methods for determining soluble silicon in media are highly dependent on the type of media being tested and can be hard to interpret. Testing of plant tissue is a better indication of the amount of available silicon in your current cropping system. It is best if this test uses either an HF or KOH digestion to solubilize as much of the silicon within the plant material as possible. Test methods using acetic acid or nitric acid do not give accurate measurements regarding the total amount of silicon in the tissue. Check with your preferred lab to see if these methods are available. As of yet, there are no optimal ranges for silicon in plant tissue, and these values will vary greatly depending on the plant type and variety.

Silicon Products/Labeling/Sale:

Many silicon products are available for various needs. These include both liquid and solid amendments that provide both quick- and slow-release amounts of available silicon.

Currently, the products are labeled with total percent silicon. Unfortunately, this value cannot be used to adjust application rates accurately, as there is a poor correlation between total and available silicon for many of the products. One should consult with the company and sales representatives to determine what the best timing and application rate is for their specific needs.

The Need for Further Silicon Research:

Even though we know silicon is a plant nutrient and is used by plants for both physical and defense responses, we do not understand the underlying mechanisms that make this happen. Silicon is not a super nutrient that when added to your fertilizer plan will fix all the growth problems, but it is an important component in the nutritional status of plants. In order to optimize plant health, we need to further understand how silicon fits into the nutrient regime of various plants and how this in turn can improve the quality of those crops.

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AgSil potassium silicate helps plants to resist toxicity from phosphorous, manganese, aluminum and iron and increases tolerance to salt[1]. AgSil potassium silicate also aids in resistance to drought by reducing water loss, and in some cases it may increase growth and yield[1-5].

AgSil® Potassium Silicate: Soluble Silicate for Agriculture

AgSil® potassium silicate offers growers these performance benefits in many agricultural applications:

- Provides resistance to mineral stress
- Decreases climate stress
- Improves strength
- Increases growth and yield

Application of AgSil potassium silicate improves leaf erectness, reduces susceptibility to lodging in grasses and improves photosynthesis efficiency[1]. For turf this can result in faster, healthier greens and athletic fields. Row crops, vine crops, ornamentals and hydroponically grown plants can all benefit from potassium silicate supplementation.

AgSil potassium silicate provides a soluble source of silicates and supplementary potassium for plants.

Product	% K_2O	% SiO_2	% H_2O	Description
AgSil 21	12.7	26.5	60.9	liquid pH 11.7
AgSil 25	8.3	20.8	70.9	liquid pH 11.3
AgSil 16H	32.4	52.8	14.8	hydrous powder

Hydrous AgSil potassium silicate powders can be used in dry mix applications for land spreading. They may also be dissolved in other formulations (subject to compatibility) where additional water is not desired.

Approximate AgSil Potassium Silicate Application Rates

Nutrient Solution – 100 ppm SiO_2 (w/w)		
	AgSil 21	**AgSil 25**
Lb. (fl.oz) in 100 gal. H_2O	0.32 lb. (3.5 oz.)	0.40 lb. (4.9 oz.)
ppm K_2O	48	40
Foliar Spray – 1,000 ppm SiO_2 (w/w)		
	AgSil 21	**AgSil 25**
Lb. (fl. oz.) in 100 gal. H_2O	3.2 lbs. (35 oz.)	4.0 lbs. (49 oz.)
ppm K_2O	485	400

Warning: Call for information on tank-mixing compatibility.

References

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2.Datnoff, L.E., et al., "Influence of Silicon Fertilizer Grades on Blast and Brown Spot Development and on Rice Yields," Plant Disease, October 1992, pp. 1011-1013.

3. Miyake, Y. and E. Takahashi, "Effect of Silicon on the Growth of Cucumber Plant in Soil Culture," Soil Sci. Plant Nutr., 29(4), 1983, pp. 463-471.

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5. Miyake, Y. and E. Takahashi, "Silicone Deficiency of Tomato Plant," Soil Sci. Plant Nutr., 24, 1978, pp. 175-189.

6. Schmidt, R.E., et. al., "Response of Photosynthesis and Superoxide Dismutase to Silica Applied to Creeping Bentgrass Grown Under Two Fertility Levels," J. Plant Nutrition, 22 (11), 1999, pp. 1763-1773.

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8. Chen, J., et al., "Let's Put the Si Back into Soil," University of Florida, Mid-Florida Research and Education Center, Apopka, FL.

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Always read and carefully follow label directions.