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# VANSIL® Wollastonite

Natural Calcium Silicate

Wollastonite, a natural calcium silicate mineral, is unique among soil amendments as a source of silicon and carbon-neutral calcium. **VANSIL** wollastonite is sourced from a Vanderbilt Minerals deposit and processing facility in northern New York state. **VANSIL W-10**, **VANSIL W-20**, **VANSIL W-30**, **VANSIL W-40** and **VANSIL W-50** are OMRI Listed for use in organic crop production. These grades come from the only mine producing OMRI Listed wollastonite in the United States.

**VANSIL** products are made by crushing, drying and milling the wollastonite ore. The same ore is used for all grades, which differ only in particle size distribution. **VANSIL** wollastonite is not contacted by flotation chemicals or chemical treatments of any kind. Because it is milled natural ore, elemental analysis can show natural minor variations.

**Typical Chemical Analysis** (calculated as oxides):

| | |
|---|---|
| Calcium Oxide (CaO) | 44.1% |
| Silicon Dioxide ($SiO_2$) | 51.3% |
| Aluminum Oxide ($Al_2O_3$) | 1.1% |
| Magnesium Oxide (MgO) | 1.7% |
| Iron Oxide ($Fe_2O_3$) | 0.2% |
| Sodium Oxide ($Na_2O$) | < 0.1% |
| Manganese Oxide (MnO) | < 0.1% |
| Ignition Loss (1000°C) | 1.1% |

**Typical properties by grade:**

| | VANSIL | | | |
|---|---|---|---|---|
| | **W-20** | **W-30** | **W-40** | **W-50** |
| pH, 10 % slurry | 10- 11 | 10- 11 | 10- 11 | 10- 11 |
| +325 Mesh Residue | 2.5% | 0.03% | 0.03% | 0.02% |
| Median Size, µm*: | 16 | 9 | 7 | 5 |
| % >1 µm | 94 | 91 | 90 | 85 |
| % >10 µm | 65 | 45 | 37 | 24 |
| % >100 µm | 0 | 0 | 0 | 0 |

*Laser diffraction

Many studies have been undertaken to determine the beneficial effects of calcium silicates in agriculture. Following are abstracts describing examples of work that has included **VANSIL** wollastonite products.



05/25/23

**Silicon Soil Amendments for Suppressing Powdery Mildew on Pumpkin**

J. Lepolu Torlon, Joseph R. Heckman , James E. Simon and Christian A. Wyenandt
Sustainability 2016, 8, 293

A greenhouse experiment was conducted with Cucurbita pepo L. "Howden" pumpkin to compare the effectiveness of various soil amendments for providing Si nutrition, improving soil fertility, and suppressing powdery mildew (Podosphaera xanthii). A sandy loam soil with an initial soil pH of 4.5 was left unamended or amended with various liming materials or silicon sources. Calcite limestone, dolomite limestone, wollastonite, CaMg silicate slag, and wood ash were similarly effective liming materials for neutralizing soil acidity, but Montanagrow™ and glacial rock flour were not shown to be effective liming materials. Powdery mildew disease incidence and severity was visually scored on the foliage. Disease development was inversely related to Si concentration in vine tissue. Wollastonite was the most effective amendment at increasing Si uptake and for suppressing powdery mildew disease and glacial rock flour was not effective. [**VANSIL**]

**Silicon soil amendments for enhancing disease resistance while improving overall crop health for cucurbits in organic farming systems**

SARE 2010 Final Report, Project Number: LS06-187

The effect of amending soil with a high rate of Si (Vansil W-50, equivalent to 600 kg Si/ha) on anthracnose (Colletotrichum orbiculare) and Si uptake was also evaluated in multiple greenhouse experiments with 2-week-old 'Straight Eight' cucumber plants. Soil amendment with Si significantly reduced anthracnose severity in the leaves and increased Si uptake compared with the non-amended control. The results of this research indicate that Si may play a significant role in disease control of cucumber in a greenhouse setting where high pressure from multiple pathogens may be absent and arthropod pests and environmental factors can be better controlled. [**VANSIL**]

**Evaluation of Wollastonite As a Silicon Source for Production of Sunflower**

Jason S. Nelson, Kimberly A. Williams, Todd Cavins
American Society of Horticultural Science
The 2012 ASHS Annual Conference, August 1, 2012

Silicon-accumulating plant species may benefit from supplemental silicon application during production with stronger stems and disease resistance. A greenhouse experiment was conducted to compare two methods of silicon supplementation: a weekly drench with a solution of 20.8% $SiO_2$ from potassium silicate (AgSil 25™) and pre-plant incorporation of 50.1% $SiO_2$ from the dry powder wollastonite (Vansil W-10™) at both a low and high rate (1.5 and 3 g Vansil per liter of substrate) into a peat-based mix. A control with no Si was also included. Growth of *Helianthus annuus* 'Ring of Fire' plants was evaluated at mid- and end- crop. The weekly silicon drench resulted in the shortest plants. Compared to the untreated control, the wollastonite and AgSil treatments all resulted in increased silicon concentrations in the substrate and plant tissue. The silicon level in the substrate and resulting silicon tissue concentrations were comparable between the low rate of wollastonite and the weekly AgSil drench. The high rate of wollastonite provided the highest silicon level in the substrate when compared to any other treatment, and tissue Si was comparable to the AgSil drench. Both wollastonite rates resulted in a higher substrate pH than the untreated control or AgSil drench. Therefore, horticultural substrate manufacturers and crop producers may reduce the amount of lime when wollastonite is incorporated pre-plant into peat-based substrates. Pre-plant incorporation of wollastonite shows promise as a less labor-intensive means to provide silicon to crops that accumulate it during production. [**VANSIL**]

**Effect of root and foliar applications of silicon on brown spot development in rice**

D. C. Rezende, F. Á. Rodrigues, V. Carré-Missio, D. A. Schurt, I. K. Kawamura and G. H. Korndörfer
Australasian Plant Pathology, 2009, 38, 67–73

Silicon (Si) application is a strategy to manage rice brown spot, but no studies have been conducted on Si as a foliar spray for control of this disease. The purpose of this study was to compare root and foliar Si applications on rice brown spot development, and to determine if there is a biochemical defence response. Rice plants (cv. Metica-1) were grown in a Si-deficient soil that received the following treatments: root application of calcium silicate (CS) (1.25 g/kg of soil), foliar application of potassium silicate (PS) (40 g/L), and control (leaves sprayed with distilled water). Thirty-day-old plants were inoculated with a conidial suspension of *Bipolaris oryzae*. Si concentration in rice tissue was markedly higher for CS compared with the other treatments. The intensity of Si deposition, as determined by X-ray microanalysis, between the adaxial and abaxial leaf blades of rice plants in the control treatment was similar. Si deposition occurred in both the adaxial and abaxial leaf blades of rice plants that received CS while this Si deposition only occurred on the adaxial leaf blades of plants that received PS. The area under brown spot progress curve (AUBSPC) was not significantly different between the PS and control treatments, but was significantly lower in plants grown in soil amended with CS. The values for the AUBSPC and the number of lesions (NL) per cm2 of leaf area decreased by 37 and 47%, respectively, with CS compared with the control. Conidial germination was not inhibited by PS. The concentration of total soluble phenolics and lignin-thioglycolic acid derivatives was not linked with the reduction observed in the AUBSPC and the NL. Although the concentration of these two biochemical variables seemed to be slightly higher in plants from the control treatment, likely due to the greater disease severity and the NL, rice tissue was not efficiently protected against colonisation by *B. oryzae*. The results of this study suggest that foliar-applied Si can decrease the intensity of brown spot; however, the level of control achieved was not as great as that obtained when Si was supplied to the roots. [**VANSIL**]

**Silicon Sources for Rice Crop**

Hamilton Seron Pereira; Gaspar Henrique Korndörfer; Anelisa de Aquino Vidal; Mônica Sartori de Camargo
Sci. Agric. (Piracicaba, Braz.), v.61, n.5, p.522-528, Sept./Oct. 2004

Although silicon is not an essential nutrient, its application is beneficial for plant growth and development. To evaluate silicon sources in relation to agronomic efficiency and economic viability in rice crops (*Oryza sativa* L.), a greenhouse experiment was conducted, Quartzipsamment soil, in a completely randomized experimental design (n = 4). Treatments were 12 silicon sources and a control. Silicon was applied at the rate of 125 kg Si $ha^{-1}$. Data were compared to a standard response curve for Si using the standard source Wollastonite at rates of 0, 125, 250, 375, and 500 kg Si $ha^{-1}$. All treatments received $CaCO_3$ and $MgCO_3$ to balance pH, Ca and Mg. One hundred and fifty days after sowing, evaluations on dry matter yield in the above-ground part of plants, grain yield, and Si contents in the soil and plant tissues were performed. Wollastonite had linear response, increasing silicon in the soil and plants with increasing application rates. Differences between silicon sources in relation to Si uptake were observed. Phosphate slag provided the highest Si uptake, followed by Wollastonite and electric furnace silicates which however, did not show differed among themselves. The highest Si accumulation in grain was observed for stainless steel, which significantly differed from the control, silicate clay, Wollastonite, and AF2 (blast furnace of the company 2) slag. Silicate clay showed the lowest Si accumulation in grain and did not differ from the control, AF2 slag, AF1 slag, , and LD4 (furnace steel type LD of the company 4) slag. [**VANSIL**]

### Influence of Silicon on Grain Discoloration and Upland Rice Growth in Four Savanna Soils of Brazil

G.H. Korndörfer, L.E. Datnoff and G.F. Corrêa
Journal of Plant Nutrition Volume 22, Issue 1, 1999

In silicon deficient soils, calcium silicate fertilization can reduce rice diseases and increase rice yields. Experiments were conducted in the greenhouse to investigate effects of Si on rice yield and grain discoloration in four different savanna soils from Brazil: Typic Acrustox - isohyperthermic (LEa), Typic Acrustox - isohyperthermic (LVa), Rhodic Acrustox - isohyperthermic (LRd) and Ustoxic Quartzipsammentic - isohyperthermic (AQa). Five Si rates were applied to each soil (0, 120, 240, 480 and 960 kg $ha^{-1}$). Silicon applications increased total grain weights and dramatically reduced grain discoloration independent of the soil type. In addition, silicon concentration increased in the leaves. [**VANSIL**]

### Effects of silicon on the penetration and reproduction events of *Meloidogyne exigua* on coffee roots

Rodrigo Vieira Silva; Rosângela D'Arc de Lima Oliveira; Patrícia da Silva Ferreira; Douglas Barbosa Castro; Fabrício Ávila Rodrigues
Bragantia, Campinas, v. 74, n. 2, p.196-199, 2015

Considering that the root-knot nematode *Meloidogyne exigua* has caused great yield losses to coffee production in Brazil, this study aimed to determine whether the penetration and the reproduction events of this nematode on the roots of plants from two coffee cultivars with different levels of basal resistance to this nematode could be affected by silicon (Si). Coffee plants from the cultivars Catuaí and IAPAR 59, which are susceptible and resistant, respectively, to *M. exigua*, were grown in pots containing Si-deficient soil that was amended with either calcium silicate (+Si) or calcium carbonate (-Si). The Si concentration on the root tissue significantly increased by 159 and 97% for the +Si plants from the cultivars Catuaí and IAPAR 59, respectively, compared to the –Si plants of these cultivars. The population of *M. exigua*, the number of galls and the number of eggs were significantly reduced on the roots of the +Si plants of the cultivars Catuaí and IAPAR 59 compared to the -Si plants of these cultivars. It was concluded that the development and reproduction events of *M. exigua* were negatively impacted on the roots of coffee plants supplied with Si. [**VANSIL**]

### Biochemical responses of coffee resistance against *Meloidogyne exigua* mediated by silicon

R. V. Silva, R. D. L. Oliveira, K. J. T. Nascimento and F. A. Rodrigues
Plant Pathology (2010) *59*, 586–593

*Coffea arabica* cultivars Catuai´ 44 and IAPAR 59, susceptible and resistant, respectively, to the root knot nematode *Meloidogyne exigua*, were grown in pots containing Si-deficient soil amended with either calcium silicate (+Si) or calcium carbonate (-Si). There was an increase of 152 and 100%, respectively, in Si content of root tissue of cvs Catuaı´ 44 and IAPAR 59 in the +Si compared to the -Si treatment, but no significant difference between Si treatments for calcium content. Plants, assessed 150 days after inoculation (d.a.i.) showed that the number of galls (NG) and number of eggs (NE) significantly decreased by 16.8 and 28.1% respectively, for susceptible cv. Catuaı´ 44 in the presence of Si, whilst both NG and NE were significantly lower for cv. IAPAR 59 compared to the susceptible cultivar regardless of Si treatments. In a separate experiment, biochemical assays were carried out 5 and 10 d.a.i. There was no significant difference between Si treatments and cultivars for concentration of total soluble phenolics. The concentration of lignin-thioglycolic acid (LTGA) derivatives significantly increased by 11.5% in roots of nematode-inoculated plants of susceptible cv. Catuai´ supplied with Si. In roots of inoculated plants of resistant cv. IAPAR 59, the increase was 23 and 10%, respectively, for treatments with and without silicon. Peroxidase (POX), polyphenoloxidase (PPO) and phenylalanine ammonia lyase (PAL) activities significantly increased in roots of inoculated plants compared with roots of non-inoculated plants, regardless of cultivar or Si treatment. In +Si treatments at 10 d.a.i., POX activity in roots of nematode-inoculated plants of cvs Catuaı´ 44 and IAPAR 59 increased by 39.9 and 31.3%, respectively; PPO increased by 54.9 and 56.1%; and PAL activity was also higher at 26.6 and 62.9%. It was concluded that supplying Si to coffee plants increases root resistance against *M. exigua* by decreasing its reproductive capacity. [**VANSIL**]

### Changes in soil chemistry following a watershed-scale application of wollastonite ($CaSi0_3$) at Hubbard Brook, New Hampshire, USA

Chris E. Johnson, Charles T. Driscoll, and Youngil Cho
2010 19th World Congress of Soil Science, Soil Solutions for a Changing World
1-6 August 2010, Brisbane, Australia. Published on DVD.

Decades of acidic deposition in the northeastern United States is believed to have caused the loss of substantial amounts of calcium from forest soils. This process of 'calcium depletion' affected the chemistry of drainage waters in the region and may have impacted forest health. To study this phenomenon, we applied 45 Mg of wollastonite (1316 kg Ca $ha^{-1}$) to watershed 1 (W1) at the Hubbard Brook Experimental Forest, in New Hampshire, USA in October, 1999. Exchangeable Ca (1 M $NH_4Cl$) and soil pH increased significantly in the Oie and Oa horizons, and in the top 10 cm of the mineral soil, in samples collected 1, 3, and 7 years after treatment. Exchangeable acidity (1 M KCl) decreased significantly in the Oie and Oa horizons after treatment, but the effect in the upper mineral soil was not clear. Base saturation and effective cation exchange capacity ($CEC_e$) increased significantly after wollastonite application in all layers studied, primarily on the strength of the increased exchangeable Ca. We did not observe compensatory decreases in exchangeable Al, or other exchangeable cations, as initially hypothesized. Therefore, while wollastonite addition has improved the base status of W1 soils, it has not resulted in decreases in exchangeable Al. [**VANSIL**]

**Dissolution of wollastonite during the experimental manipulation of Hubbard Brook Watershed 1**

Stephen C. Peters, Joel D. Bum, Charles T. Driscoll and Gene E. Likens
Biogeochemistry 67**:** 309–329, 2004.

Powdered and pelletized wollastonite ($CaSiO_3$) was applied to an 11.8 ha forested watershed at the Hubbard Brook Experimental Forest (HBEF) in northern New Hampshire, U.S.A. during October of 1999. The dissolution of wollastonite was studied using watershed solute mass balances, and a $^{87}Sr/^{86}Sr$ isotopic tracer. The wollastonite ($^{87}Sr/^{86}Sr$ = 0.70554)

that was deposited directly into the stream channel began to dissolve immediately, resulting in marked increases in stream water Ca concentrations and decreases in the $^{87}Sr/^{86}Sr$ ratios from pre-application values of 0.872 mg/L and 0.72032 to values of ~ 2.6 mg/L and 0.71818 respectively. After one calendar year, 401 kg of the initial 631 kg of wollastonite applied to the stream channel was exported as stream dissolved load, and 230 kg remained within the stream channel as residual $CaSiO_3$ and/or adsorbed on streambed exchange sites. Using previously established values for streambed Ca exchange capacity at the HBEF, the dissolution rate for wollastonite was found to be consistent with dissolution rates measured in laboratory experiments. Initially, Ca was released from the mineral lattice faster than Si, resulting in the development of a Ca- depleted leached layer on mineral grains. The degree of preferential Ca release decreased with time and reached stoichiometric proportions after ~ 6 months. Using Sr as a proxy for Ca, the Ca from wollastonite dissolution can be accurately tracked as it is transported through the aquatic and terrestrial eco- systems of this watershed. [**VANSIL**]

**A 5-day method for determination of soluble silicon concentrations in nonliquid fertilizer materials using a sodium carbonate-ammonium nitrate extractant followed by visible spectroscopy with heteropoly blue analysis: single-laboratory validation.**

Sebastian D, Rodrigues H, Kinsey C, Korndörfer G, Pereira H, Buck G, Datnoff L, Miranda S, Provance-Bowley M.
J AOAC Int. 2013 Mar-Apr;96(2):251-9.

A 5-day method for determining the soluble silicon (Si) concentrations in nonliquid fertilizer products was developed using a sodium carbonate ($Na_2CO_3$)-ammonium nitrate ($NH_4NO_3$) extractant followed by visible spectroscopy with heteropoly blue analysis at 660 nm. The 5-Day $Na_2CO_3$-$NH_4NO_3$ Soluble Si Extraction Method can be applied to quantify the plant-available Si in solid fertilizer products at levels ranging from 0.2 to 8.4% Si with an LOD of 0.06%, and LOQ of 0.20%. This Si extraction method for fertilizers correlates well with plant uptake of Si (r2 = 0.96 for a range of solid fertilizers) and is applicable to solid Si fertilizer products including blended products and beneficial substances. Fertilizer materials can be processed as received using commercially available laboratory chemicals and materials at ambient laboratory temperatures. The single-laboratory validation of the 5-Day $Na_2CO_3$-$NH_4NO_3$ Soluble Si Extraction Method has been approved by The Association of American Plant Food Control Officials for testing nonliquid Si fertilizer products. [**VANSIL**]