

A highly economical 'refined not mined' alternative to entrenched agricultural products such as Gypsum with the added benefit of Silicon and other trace elements.

Silicon (Si)

Silicon may be one of Earths most prevalent macro nutrients, however its availability to plants is limited unless certain requirements are met. It must have a relatively high content of silicon and be able to provide sufficient water-soluble available silicon to meet the plants needs, be cost effective, have a physical nature that facilitates storage/application and not con- tain substances that will contaminate the soil.

Many potential sources meet the first requirement however very few meet them all.

Poor sources of Silicon

Inorganic materials such as quartz, clays, micas, and feldspars, although rich in Silicon, are poor silicon-fertiliser sources because of the low solubility of the element in this form.

Crop residues, especially of silicon accumulating plants such as rice, can be used as silicon sources. However, the crop demand for applications of Silicon fertilisers generally exceeds that which can be supplied from these crop residues.

Good sources of Silicon

Calcium silicate is one of the most widely used forms of silicon in fertiliser due to its high volume of water soluble available silicon . Mono-silicic acid (aka orthosilicic acid) is the only silicon form that is absorbed by the plant roots but it requires adequate Calcium to be present to move the silicon into the epidermal (outer) tissues and create a Si-cellulose membrane, this in turn makes Flinders Agriculture's Calcium Silicate with its provided 4 forms of highly available Calcium, Calcium Carbonate (Lime), Calcium Oxide Calcium Silicate and Calcium Sulphate (Gypsum) an ideal agricultural silicon and Calcium source.

Flinders Agriculture

Our Calcium Silicate is a unique product unlike any other fertiliser or soil amendments on the market. It contains both a high percentage of water-soluble silicon and available calcium (Ca) to allow plant uptake. The product has been manufactured with the end-user in mind being easy to store and apply, whist also being cost effective. Best of all it is sourced from 100% sustainable and recycled materials, containing no substances that will contaminate the soil.

'Silicon deficienies in the plant reduce the plants ability to resist disease and pest attack do to a loss of strength and cell structure'

Silica Deficiency

With nutrients regularly being removed through plant growth and crop harvest and many common fertiliser inputs not replenishing this deficit, nutrients predominantly are being 'locked up' by quartz and soil clays (e.g. kaolinite), that must undergo weathering over a number of years before the silicon is made available to the plant it is easy to see how silicon deficiencies are common and readily occur in Australian soils.

Silicon deficiency

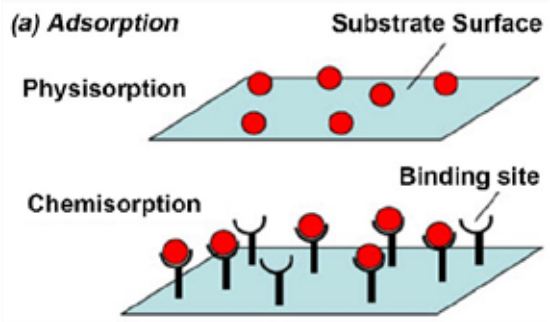
$2Al^{3+} + 2H_4SiO_4 + H2O = Al_2Si_2O_5(OH_4) + 6H^+$
Monosilicic acid (H_4SiO_4) reacting with Aluminium (Al)[17]

Forming Bonds

If the silicon is not taken up by the plant it will bind with other clays, minerals and elements through these new bonds. Silicon improves soil conditions that may contain toxic levels of heavy metals. This change also helps in the formation of new clay minerals such as Amorphous silicon, montmorillonite, and vermiculite. These new soils along with there altered physical and chemical properties tend to have larger surface areas and are able to adsorb more water, phosphates (P), potassium (K), nitrogen (N), plus heavy metals such as aluminum (Al).

Adsorption may occur as chemisorption's or physical sorption. Cations (Al, heavy metals) usually are chemosorbed on Silicon rich surface and lose their mobility. However Phosphates (P) Potassium (K) and Nitrogen (N) are weakly physically adsorbed and remain in the plant-available form. The amounts of amorphous silicon, monosilicic acids (aka orthosilicic acid is the only form that is absorbed by plant roots), and polysilicic acids in the soil are closely related to each other. Monosilicic acids regulate chemical properties of the soil solution. Polysilicic acids have an influence on the soils physical properties

Mono-silicic acid creates a Si-cellulose membrane which provides protection in performing an essential function in the healing of plants and increases resistance to environmental stresses such as drought, soil salinity, diseases, and pathogens resulting in improved plant health.



Calcium Silicate Benefits

- ✓ Increased Stress Relief, Drought, Frost, Heat and UV Resistance [1,8]
- ✓ Alleviation of salt stress [4,11]
- ✓ Stronger, more resilient plants through the hardening of the outer cell wall [12]
- ✓ Alleviates the toxicity of metal ions especially Fe, Al, Mn, Pb, Hg, Cd and Zn [2,3,5,6,7,14]
- ✓ Mitigates excessive Cu Stress[20]
- ✓ Improved Utilisation of Fertilisers , particularly nitrogen[13], phosphorus[2] and Potassium
- ✓ Effective in the control of Phytophthora[19]
- ✓ Increases the plant availability of P, whether deficient or excessive in soil.[2]
- ✓ Improves disease resistance, especially against blight and mildew.[9,10]
- ✓ Improves photosynthesis.[16]
- ✓ Reduced Lodging.[15]
- ✓ Denser root mass.[18]
- ✓ Adequate Calcium present to move into the epidermal (outer) tissues and create a Si-cellulose membrane which provides protection.
- ✓ Four forms of plant available Calcium, Calcium Carbonate (Lime), Calcium Oxide, Calcium Silicate and Calcium Sulphate (Gypsum).
- ✓ Sourced from 100% sustainable and recycled materials

References

1. HEATHER A. CURRIE and CAROLE C. PERRY* (Silica in Plants: Biological, Biochemical and Chemical Studies) Biomolecular and Materials Interface Research Group, School of Science and Technology, No□ngham Trent University, Clifton Lane, Notingham NG11 8NS, UK p 1384.
2. J. F. Ma, "Role of silicon in enhancing the resistance of plants to biotic and abiotic stresses," Soil Science and Plant Nutrition, vol. 50, no. 1, pp. 11–18, 2004.
3. Hodson MJ, Sangster AG. 1993. The interaction between silicon and aluminium in Sorghum bicolor (L.) Moench: growth analysis and X-ray microanalysis. Annals of Botany 72: 389–400
4. Matoh, T., Kairusmee, P., and Takahashi, E. (1986). Salt-induced damage to rice plants and alleviation effect of silicate. Soil Sci. Plant Nutr. 32, 295–304. doi: 10.1080/00380768.1986.10557506
5. Apoplastic Binding of Aluminum Is Involved in Silicon-Induced Amelioration of Aluminum Toxicity in Maize1 Yunxia Wang, Angelika Stass, and Walter J. Horst* Institute for Plant Nutrition, University of Hannover, D–30419 Hannover, Germany
6. A.M., D.; M.M., H.; N., S.; A.A., E.-A.; L., M. Effect of Silicon on the Tolerance of Wheat (Triticum aestivum L.) to Salt Stress at Different Growth Stages: Case Study for the Management of Irrigation Water. Plants 2018, 7, 29
7. Effect of Silicon Application on Cadmium Uptake and Distribution in Strawberry Plants Grown on Contaminated Soils Waldemar Treder &Grzegorz Cieslinski Pages 917-929 | Received 16 Apr 2003, Accepted 10 Aug 2004, Published online: 16 Aug 2006
8. J. F. Ma, "Role of silicon in enhancing the resistance of plants to biotic and abiotic stresses," Soil Science and Plant Nutrition, vol. 50, no. 1, pp. 11–18, 2004
9. A. Fawe, M. Abou-Zaid, J. G. Menzies, and R. R. Bélanger, "Silicon-mediated accumulation of flavonoid phytoalexins in cucumber," Phytopathology, vol. 88, no. 5, pp. 396–401, 1998
10. Y. Nakata, M. Ueno, J. Kihara, M. Ichii, S. Taketa, and S. Arase, "Rice blast disease and susceptibility to pests in a silicon uptake-deficient mutant lsi1 of rice," Crop Protection, vol. 27, no. 3–5, pp. 865–868, 2008
11. Z. Zhu, G. Wei, J. Li, Q. Qian, and J. Yu, "Silicon alleviates salt stress and increases antioxidant enzymes activity in leaves of salt-stressed cucumber (Cucumis sativus L.)," Plant Science, vol. 167, no. 3, pp. 527–533, 2004
12. E. Epstein, "The anomaly of silicon in plant biology," Proceedings of the National Academy of Sciences of the United States of America, vol. 91, no. 1, pp. 11–17, 1994
13. N. Ohyama, "Amelioration of cold weather damage of rice by silicate fertilizer application," Agriculture Horticulture, vol. 60, pp. 1385– 1389, 1985
14. Silicon alleviates the toxicity of cadmium and zink for maize (Zea mays L.) grown on a contaminated soil Karina Patrícia Vieira da Cunha1, Clístenes Williams Araújo do Nascimento1*, and Airon José da Silva1 1 Federal Rural University of Pernambuco, Department of Agronomy, Recife, PE, 52171900, Brazil
15. Importance of Silicon and Mechanisms of Biosilica Formation in Plants Biomed Research International Volume 2015 |Article ID 396010 | 16 pages | https://doi.org/10.1155/2015/396010
16. Deren, C.W. 1996. Photosynthesis, biomass partitioning, and nutrient concentration of silicon-fertilized rice, Agronomy abstracts 101Madison, WI: American Society of Agronomy.
17. D.G. LUMSDON, V.C. FARMER. (1995). Solubility characteristics of proto- imogolite sols: how silicic acid can de-toxify aluminium solutions. European Journal of Soil Science
18. J. Plant Nutr. Soil Sci. 2013, 176, Silicon uptake by wheat: Effects of Si pools and pH Martina Gocke1*, Wu Liang2, Michael Sommer3,4, and Yakov Kuzyakov5,6
19. EFFICACY OF WATER SOLUBLE SILICON FOR CONTROL OF PHYTOPHTHORA CINNAMOMI ROOT ROT OF AVOCADO Theo Frederik Bekker University of Pretoria
20. J. Environ. Monit., 2011,13,591 Effects of silicon on copper toxicity in Erica andevalensis Cabezudo and Rivera: a potential species to remediate contaminated soils

FLINDERS AGRICULTURE

ph: 1300 895 988
e: info@flindersagriculture.com