Beneficial nutrients news

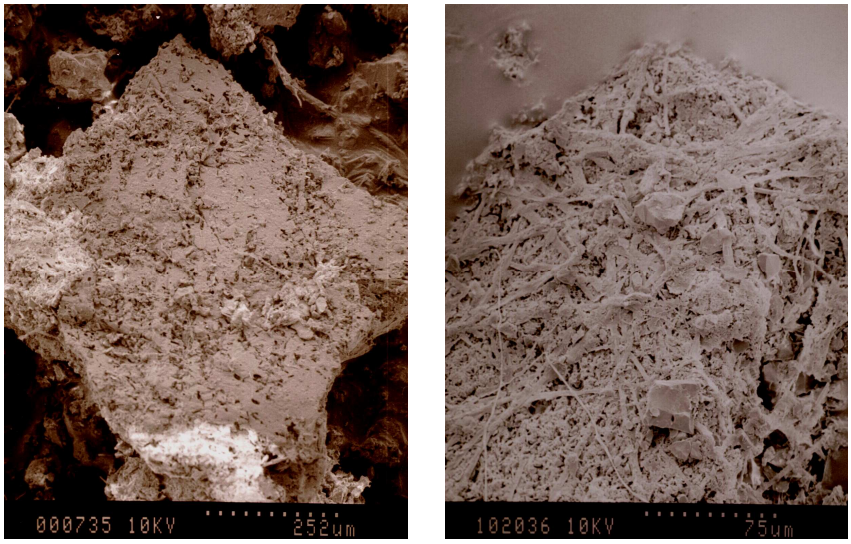
Volume 3 • Issue 6
December 2007

Digital newsletter about silicon and other beneficial elements

Mycorrhizae channel silicon to plants

Plants with mycorrhized roots often contain more silicon than non-mycorrhizal ones. Possible effects of the improved silicon status on crop health however are hardly ever investigated.

Soybean suffering from manganese toxicity profits from mycorrhizal infestation. The symbiotic root fungus makes the plants more tolerant, so it appears from experiments with soybean plants inoculated with the endomychorrizal species *Glomus etunicatum*. Marco Nogueira suspects that the improved tolerance may partly result from the doubled silicon. content in the roots. He conducted this thesis study at the Department of Soil Science of the Brazilian Escola Superior de Agricultura "Luiz de Queiroz". Information on effects of mycorrhizae on manganese tolerance however is scarce. The possible contribution of silicon to this phenomenon is even scarcer.



Mycorrhizal hyphae (*Paxillus involutus*) on a feldspar sand grain (left) and in 'soil' (right). *Patrick van Hees, Örebro University.*

Rock eating fungi

Patrick van Hees has no data on possible effects of silicon uptake by mycorrhizae. For several years he investigates the role of ectomycorrhizal weathering of soil minerals. Conifers like *Picea abies* and *Pinus sylvestris* take up more silicon from forest soil if seedlings are inoculated with these root-colonizing fungi. In his experiments at Örebro University he demonstrated a large variation in silicon mobilization by ectomycorrhizae species.
It is ten years now since Dutch and Swedish scientists published their finding of these so-called rock eating fungi. At the moment several American and European research groups study the mechanisms by which ectomycorrhizae can weather soil minerals and the possible role of the mined nutrients in forest nutrition and the alleviation of acidification effects. A possible contribution of mobilised silicon however has been overlooked up to know. Recently British scientists have shown that codeposition of silicon with aluminium results in amelioration of aluminium toxicity in conifers.

For literature on silicon and mycorrhizae: see page 2

Si improves potato yield and plant architecture

Application of calcium magnesium silicate increases potato tuber yield and average weight. Silicon nutrition also improves the plant's architecture. Plants are more erect and the plant height increases, Adriano Luíz Pulz concludes from greenhouse experiments with the cultivar Bintje. Furthermore silicon nutrition increases phosphorous uptake. Pulz conducted his experiments at the São Paulo State University (Brazil) within the framework of his Master's thesis.

SURfaPLUS records 2,500 patents in alert service

Recently the patent alert service from SURfaPLUS recorded the 2,500th patent publication that covers the formulation of agrochemicals. SURfaPLUS started this service in November 2005. A significant part of the recorded patent publications is related to fertiliser formulations and adjuvants for fertilisers. The Adjuvant Newsletter bases its quarterly summary of trends and developments on this service. The patent alert service is in its last free days.

China is a gold mine of applied silicon research

Unknown, unloved. Only few know the way to the Chinese mine of silicon information. In this way the yield of applied and basic research on silicon in arable and horticultural crops in China remains unnoticed.

What is the effect of silicon on the resistance of asparagus bean to the rust disease caused by the fungus *Uromyces vignae*? Chinese researchers know. They too know the physiological mechanism of this resistance. The results of their investigations however are only published in a Chinese-language university journal, the Journal of Zhejiang University (Agriculture & Life sciences). Who has no Chinese, has to rely on an abstract.
This asparagus bean story is not isolated. Many other Chinese researchers also publish their findings exclusive in Chinese-language journals. In this way the large yield of applied and basic research on silicon nutriation remains nearly unnoticed by interested parties outside China. A quick scan conducted by Beneficial nutrients news demonstrates the area of silicon research that has been published the last year in Chinese-language papers (see overview of recent Chinese-language silicon publications on page 3-4). Some papers deal with rice – in this respect a standard crop. The past year also papers about silicon nutrition in Chinese cabbage, cucumber, grasses, maize and waxy corn, asparagus bean and soybean, sugar cane, wheat and the spice crop ginger have been published.

Further reading about silicon and mycorrhizae

General
Silicon pools and fluxes in soils and landscapes - a review. Journal of plant nutrition and soil science 169(2006)3:310-329

Silicon uptake
Interactions among arbuscular mycorrhiza, rhizobacteria, phosphorus and silicon on manganese toxicity display in soybean. Thesis
Manganese toxicity and callose deposition in leaves are attenuated in mycorrhizal soybean. Plant and soil 246(2002)1:1-10
Influence of mycorrhizae on the mineral contents of cowpea and soybean grown in an oxisol. Agronomy journal 74 (1982)3:475-481

Mycorrhizal weathering
The biogeochemical impact of ectomycorrhizal conifers on major soil elements (Al, Fe, K and Si). Geoderma 136(2006)1-2:364-377
Mobilization of aluminium, iron and silicon by Picea abies and ectomycorrhizas in a forest soil. European journal of soil science 55(2004)1:101–112
Fungal degradation of calcium-, lead- and silicon-bearing minerals. Biometals 18(2005)3:269-281
Ectomycorrhizal weathering of the soil minerals muscovite and hornblende. New Phytologist 171(2006)4:805–814
Ectomycorrhizal fungi and Pinus sylvestris: aluminium toxicity, base cation deficiencies and exudation of organic anions. Thesis
Ectomycorrhizal fungi and biogeochemical cycles of boreal forests. Thesis
Responses of ectomycorrhizal fungi to mineral substrates. Thesis
Organic anion exudation by ectomycorrhizal fungi and Pinus sylvestris in response to nutrient deficiencies. New Phytologist 170(2006)1:153–163
Biological mobilization of potassium from clay minerals by ectomycorrhizal fungi and eucalypt seedling roots. Plant and soil 262(2004)1-2:351-361
The role of fungi in weathering. Frontiers in ecology and the environment 2(2004)5:258-264
An update on nutrient transport processes in ectomycorrhizas. Plant and soil 244(2002)1-2:165-175
Linking plants to rocks: ectomycorrhizal fungi mobilize nutrients from minerals. Trends in ecology & evolution 16(2001)5:248-254
Mycorrhizal weathering: A true case of mineral plant nutrition? Biogeochemistry 49(2000)1:53-67
Rock-eating fungi. Nature 389(1997):682-683

Bacterial weathering
Root-associated bacteria contribute to mineral weathering and to mineral nutrition in trees: a budgeting analysis. Applied and environmental microbiology 72(2006):1258–1266

Recent Chinese-language silicon publications

General
Mapping of QTLs for silicon contents in the stem and flag leaf recombinant inbred rice population. Scientia agricultura Sinica 40(2007):13-18
Optimization of fermentation of silicate bacterium. Acta agriculturae Jiangxi 19(2007)7:121-123,126

Crop protection
Research progress on inhibitory effects of silicon on cadmium absorption by plants. Chinese journal of ecology 26(2007)4:567-570 and Full text
Cadmium resistance improved by silicon and corresponding mechanisms in *Oryza sativas* l. seedlings. Journal of agro-environment science 26(2007)4:1307-1311
Effect of silicon on growth and anti-stress ability of Chinese cabbage (*Brassica pekinensis* Rupr.) in cadmium contaminated soil. Plant physiology communications 43(2007)3:479-482
Effect of spraying silicon in the seedling stage of ginger on membrane fluid peroxidation and leaf defense enzyme activity. Chinese journal of eco-agriculture 15(2007)3:58-60
Effects of silicon compounds on the resistance of *Cynodon dactylon* (L.) Pers. and seashore paspalum to *Curvularia lunata* (Wakker) Boed. Plant nutrition and fertilizer science 13(2007)2:351-354
Effects of silicon on plant growth, photosynthetic parameters and soluble sugar content in leaves of wheat under drought stress. Plant nutrition and fertilizer science 13(2007)3:471-478
Effects of silicon on photosynthesis and antioxidative enzymes of maize under drought stress. Chinese journal of applied ecology 18(2007)3:531-536 and Full text
Effects of salt stress on membrane lipid peroxidation and proline content in cucumber cultivars. China vegetables 27(2007)7:12-15
Effect of exogenous silicon on resistance of asparagus bean rust and its physiological mechanism. Journal of Zhejiang University (Agriculture & Life Science) 33(2007)3:302-310 and abstract
Study of resistance to stress of plant on silicon. Soils and fertilizer sciences in China (2007)3:10-14 and abstract
Regulative mechanism of silicon and calcium on the cadmium content of rice in the farmland polluted by acidic mine water. Journal of agro-environment science 26(2007)5:1854-1859
Effect of the steel residue silicon fertilizer in preventing disease and increasing production in *Zingiber officinale* Rosc. Journal of Changjiang vegetables (2007)7:55-56

Soil and fertilization
Silicon accumulation and distribution in rice as affected by nitrogen levels and genotype differences. Plant nutrition and fertilizer science 14(2008)2:213-220
Application of silicon fertilizer on paddy rice. Heilongjiang agricultural sciences (2007)4:41-43 and abstract
Study on the method and effects of rice available silicon application. Journal of Heilongjiang August First Land Reclamation University 19(2007)1:36-39 and abstract
Effect of silicon-calcium fertilizer on growing characters and yield of rice. Journal of Jilin Agricultural Sciences 32(2007)3:35-36,47
Research on the soil fertilizer effect of biological silicon fertilizer on albic rice soil. Journal of Heilongjiang August First Land Reclamation University 19(2007)1:36-39 and abstract
Relationship between output of rice and silion fertilizer level of soil in main rice production areas of Liaoning province. Journal of Anhui agricultural sciences 35(2007)16:4891-4892
Studies on effect of applying silicon fertilizer and suitable dosage in summer maize. Journal of Anhui agricultural sciences 35(2007)22:6869,6889 and abstract
The preliminary explore of silicon fertilizer application experiment on maize. Journal of Shandong Agricultural University (Natural science) 38(2007)2:216-218 and abstract
Effect of silicon fertilizer on yield, quality and lodging resistance of waxy corn. Journal of Shandong Agricultural University (Natural science) 38(2007)3:360-362 and abstract
Effects of silicon fertilizer on root system and yield and quality of waxy corn. Journal of Changjiang vegetables (2007)5:50-51 and abstract
Effects of silicon application on growth and transpiration rate of maize. Chinese journal of eco-agriculture 15(2007)3:55-57
Effect of silicon fertilizer on cucumber photosynthesis and yield in protected field. Journal of Changjiang vegetables (2007)2:43-45 and abstract
Efficiency test of silicon-calcium fertilizer on cucumber. Shandong agricultural sciences (2007)4:86-87
Effects of silicon, calcium, potassium fertilizers on production of sugar cane. Crops (2007)4:46-50
Roles of plants in biogeochemical cycling of silicon. Chinese journal of ecology 26(2007)4:595-600 and Full text

Study on the characteristics of phosphorus adsorption and desorption in slag containing silicon. Plant nutrition and fertilizer science 13(2007)3:504-511
Effect of mixing slag and fertilizer on silicon availability and phosphorus fixation rate. Plant nutrition and fertilizer science 13(2007)5:941-947
Quadratic polynomial regression analysis of silicon and calcium fertilizer, quicklime and sulfur powder on soybean yields. Soybean science 26(2007)3:351-354
Research on the silicon nutrition in soil and plant. Shandong agricultural sciences (2007)1:81-84
Effects of diatomite on phosphorus adsorption and desorption in ferrosols. Journal of soil and water conservation 21(2007)4:181-184,200
Influence of silicon on the adsorption characteristics of cadmium in soils. Ecology and environment 16(2007)2:446-448 and abstract

Calendar of events

2008

New Zealand Trace Elements Conference	13/02 - 15/02	Hamilton, NZ
3rd FMB America's Fertilizer Conference & Exhibition 2008	04/03 - 06/03	Miami, USA
IFA Technical Symposium	10/03 - 14/03	Sao Paulo, Brazil
Balanced fertilization for increasing and sustaining crop productivity	30/03 - 01/04	Dhaka, Bangladesh
The 6th New Ag International Conference & Exhibition	02/04 - 04/04	New Delhi, India
235th ACS National Meeting & Exposition	06/04 - 10/04	New Orleans, USA
5th FMB Asia Fertilizer Conference & Exhibition 2008	09/04 - 11/04	Beijing, China
7th International Workshop on Sulfur Metabolism in Plants	13/05 - 17/05	Warsaw, Poland
76th IFA Annual Conference	19/05 - 21/05	Vienna, Austria
VI International Symposium on Mineral Nutrition of Fruit Crops	19/05 - 23/05	Faro, Portugal
4th International Conference on Trace Element Speciation in Biomedical, Nutritional and Environmental Sciences	25/05 - 29/05	Munich-Neuherberg, DE
13th International Conference and exhibition on mechanization of field experiments	30/06 - 04/07	Århus, Denmark
2008 APS Centennial Meeting	26/07 - 30/07	Minneapolis, USA
236th ACS National Meeting & Exposition	17/08 - 21/08	Philadelphia, USA
International Symposium on Soilless Culture and Hydroponics	25/08 - 28/08	Lima, Peru
Eurosoil 2008	25/08 - 29/08	Vienna, Austria
2nd China Silicon Conference	19/09 - 21/09	Shenyang, China
IV International Symposium on Ecologically Sound Fertilization Strategies for Field Vegetable Production	22/09 - 25/09	Malmö, Sweden
2008 Joint Annual Meeting GSA-SSSA-ASA-CSSA-GCAGS-HGS	05/10 - 09/10	Houston, USA
4th International Conference on Silicon in Agriculture	26/10 - 31/10	Wild Coast Sun, ZA

Colophon

Editor	Gert van den Berg
Publisher	Landbouwkundige Uitgeverij G.C. van den Berg
Address	Van Maerlantstraat 5, 3906 EL Veenendaal, The Netherlands
Subscription	€ 85,00/year ex VAT
Single issues	€ 19,50/issue ex VAT
Website	www.silicon-nutrition.info

Beneficial nutrients news is a bimonthly digital newsletter on silicon and other beneficial elements in plant nutrition and crop protection. Authors and publisher declare the information in **Beneficial nutrients news** is provided to our best knowledge of the current situation, but they cannot accept responsibility for the validity or for the consequences of their use. Subscriptions will be extended, unless cancelled at least one month before the end of the yearly subscription.