Silicon Symposium Press Release

Silicon Symposium at Tri Societies Conference Focuses on the Value of Silicon in Production Agriculture

Cincinnati, Ohio . . . . It has long been a topic of debate amongst experts, if the element silicon (Si), supplementally applied and made available to a host crop, results in tangible benefits in plant health and subsequent yield. Scientists from across the globe, who have researched and analyzed silicon, gathered recently at a special silicon symposium. They concluded that in many soils under a variety of situations, silicon does have a distinct value to both field and container crops.

Soil scientists and agronomists from the United States, Canada, China and Brazil took part in the symposium formally called ***Silicon Soil Fertility and Nutrient Management.*** It was held in late October in Cincinnati, Ohio at the Tri-Societies Conference conducted by the American Society of Agronomy (ASA), the Crop Science Society of America (CSSA) and the Soil Science Society of America (SSSA).

Participating scientists at the symposium noted that silicon has historically, not been given the same level of attention in soil fertility and crop production as other nutrients. This view, however, is changing as scientists and growers worldwide become more aware of the valuable function of silicon nutrition in crops and soils. Much of their research has indicated that supplying crops with plant available silicon can suppress disease, reduce insect damage, improve environmental stress tolerance and increase crop productivity. Silicon is now officially designated as a plant beneficial substance by the Association of American Plant Food Control Officials (AAPFCO). Plant available silicon will now be listed on fertilizer labels.

The Si symposium was chaired by Dr. Joseph Heckman, Ph.D. Heckman is Extension Specialist in Soil Fertility, the Department of Plant Biology and Pathology at Rutgers University. The first speaker was Dr. Emanuel Epstein, Ph.D., Professor Emeritus at the University of California, Davis. Epstein is a pioneer in the study of Si, and is noted as a global authority on the science of the element. His presentation, entitled Silicon: *A Plant Nutritional Enigma,* highlighted his position that Si has largely been ignored in studies of plant physiology and is not included among other commonly used nutrient solutions. This, despite the fact that all soil grown plants contain silicon in appreciable amounts. He noted that regardless of ideology, there is abundant evidence that Si can make the difference between healthy, productive plants, and their loss due to biotic or abiotic stress.

Studies on the development of a method for determining plant available Si in soils and fertilizers with data showing real world application in agriculture was co-authored by Dr. Gaspar Korndörfer, Ph.D., Dr. Hamilton Pereira, Ph.D. and Dr. Mary Provance-Bowley, Ph.D. Korndörfer, Ph.D. a professor at Universidade Federal de Uberlandia in

Brazil and Provance-Bowley, Global Technical Development Manager at Harsco Metals & Minerals in Sarver, Pennsylvania were the presenters. They discussed silicon's new designation as a plant beneficial substance as well as the approval process surrounding an analytical method specifically developed to quantify soluble (plant available) silicon from silicon-containing materials for use as fertilizers and soil amendments. They pointed out that there is now an analytical method that can be used to provide guidelines for quality control, production, and accurate labeling for the commercialization of Si fertilizers.

Dr. Lawrence Datnoff, PhD, is Department Head and Professor of Plant Pathology and Crop Physiology at Louisiana State University. He has studied Si and its effects on a wide range of agricultural crops both in Louisiana and Florida where he was formerly Professor of Plant Pathology at the University of Florida. His presentation focused on Si's ability to suppress foliar and root diseases in numerous crops. His research indicates that disease progress and severity is dramatically reduced by Si and, in fact, it may suppress plant disease as effectively as some fungicides. Also, as the Si concentration increases in plant tissue, plant disease suppression greatly improves. He suggested that there are two reasons that Si enhances plant resistance against pathogens. First, that Si, deposited in epidermal cells, forms a barrier that prevents penetration by the pathogens. Second, Si increases plant defense compounds and plant resistance proteins. He added that this quasi-essential element can play a major role in suppressing diseases of plants grown under greenhouse and field conditions, especially for soils or soilless mixes low in plant available Si.

Chinese scientist Professor and Dr. Yongchao Liang, Ph.D. discussed Si's value in improving the growth and development of plants, particularly in situations where plants are grown under stressful environmental conditions. Liang is a Professor at the Institute of Agricultural Resources and Regional Planning, Chinese Academy of Agricultural Sciences in Beijing. Liang pointed out that agricultural use of Si from slag sources is common practice in Southeast Asia, North and South America, Australia and Africa and significantly improves crop yields and quality. Liang said that many of the breakthroughs in Si research have been in characterizing Si uptake, transport and distribution in plants.

Liang said that Si is widely accepted as an element that can effectively mitigate various forms of abiotic stress such as salinity, drought, chilling, freezing, high temperatures and UV radiation. He added that Si can help plants withstand excess metal toxicities including aluminum, iron, manganese, cadmium, arsenic and zinc. And while the benefits of Si are evident to Liang and his colleagues, more research is needed to better understand the underlying mechanisms that are in play. Only then will Si's agronomic values be fully recognized.

Dr. Richard Bélanger, Ph.D., a Canada Research Chair in Phytoprotection from the Departement de phytologie-FSAA, University Laval, in Quebec, conducted research on Si and biotic (e.g. diseases and pests) stresses. Professor Bélanger was not able to attend the symposium but had had a colleague, Dr. François Belzile, Ph.D., a plant molecular geneticist and Professor at Université Laval and plant molecular geneticist

deliver the presentation in his stead. Belzile specifically addressed the uptake and accumulation of Si in various plants. He presented data on a method for determining, with precision, the potential of a plant to accumulate Si and therefore benefit from its assimilation. Their research identified a new family of Si transporters with unique properties. What's more, the discovery of these transporters provides a unique opportunity to understand the uptake of Si and possibly devise new strategies to control plant diseases.

Dr. Jonathan Frantz, Ph.D., is with the Greenhouse Production Group, USDA-ARS, in Toledo, Ohio. Frantz presented his work on the benefits of Si use in containerized crop production. Unlike field grown agronomic crops, studying Si on mainly single crop systems of monocots, Frantz and other scientists have evaluated silicon under greenhouse-grown ornamental cropping systems where multiple species of mainly dicot plants are grown at one time..

With Si, Frantz noted reductions in symptoms from the pathogens powdery mildew and Tobacco ringspot virus, decreased aphid population growth, reduced susceptibility to copper toxicity, improved salt tolerance during growth, and increased post-harvest longevity. He added however, that despite clear, beneficial responses to supplemental Si in containerized production, there is still a debate as to its value as a fertilizer product. He mentioned that more work is needed on cost-benefit analysis as well as refining methods of application. So while clear benefits can be derived from incorporating Si into fertility programs in ornamental crop production, significant hurdles remain.

Dr. Joseph Heckman, Ph.D., Rutgers University wrapped up the symposium by providing a synopsis of his research with Si. His presentation, Silicon Benefits to Crops and Soils in New Jersey, provided data from 12 years of research conducted at the New Jersey Agricultural Experiment Station on many different crops. His research indicated that calcium and magnesium silicate is both an effective liming material and Si fertilizer. Heckman noted that the calcium and magnesium silicate used in his research trials was AgrowSil®, commercially available from Harsco Metals & Minerals, Sarver, Pennsylvania. It is processed to remove metals, resulting in a Si based fertilizer product containing 30% Ca, 7% Mg, and 12% Si with a calcium carbonate equivalent (CCE) of 93%. To serve as a control in his trials, Heckman used an agricultural limestone containing 32% Ca and 2.4% Mg applied at the same CCE rate.

Heckman reported that crops grown on calcium and magnesium silicate amended soil exhibited increased Si uptake. Pumpkin fruit and wheat grain yield increases were associated with suppression of powdery mildew on Si amended soil. Corn response to residual calcium and magnesium silicate applications was exhibited as decreased injury to stem tissue by European corn borers. Forage yields were similarly improved by residual effects of liming low pH soil with either calcium carbonate or calcium and magnesium silicate. Cabbage yields were also improved by residual effects of liming low pH soil, with calcium and magnesium silicate increasing marketable head yields more

than calcium carbonate. The residual benefits of calcium and magnesium silicate applications were evident in crops produced 3 to 4 years after the last application.

In summary, Heckman noted that field trials using calcium and magnesium silicate show that enhancing plant Si uptake with soil Si amendments can impart crop production benefits beyond its service as a liming material and that enhanced Si soil fertility and nutrition may help in controlling powdery mildew disease on a wide variety of crops.