Biostimulants:

More than 10 new products and technologies announced in New Delhi!

IRON PYRITE AS SEED TREATMENT BIOSTIMULANT: THE NEW REVOLUTION?

Iron pyrite (FeS_2), commonly known as 'Fool's Gold' is ubiquitous in nature. It frequently occurs in underclays of coal seams, shales, sedimentary rocks including some limestones. As an accessory mineral it is associated with igneous and metamorphic rocks. Nanostructures of iron pyrite are continuously synthesized in the quartz veins and hydrothermal vents. It is either mined or comes out as waste products from the coal mining operations. It exists in several forms depending on its origin and crystallinity. Most of the naturally occurring pyrite has several impurities including arsenic, antimony, copper, lead, zinc, calcium, aluminum, bismuth, cobalt and phosphorous. Till date, in agriculture industry, naturally occurring pyrite is partially purified, and used as a fertilizer to supply iron (Fe) and sulfur (S) to the crops, and as an ameliorating agent to reclaim alkaline soil.

In his outstanding keynote lecture that opened the biostimulants session in New Delhi, Prof Mainak Das described a new role of pure iron pyrite, which is readily synthesized in the laboratory using an energy efficient chemical route. Das and his Team (see separate box) found that pure FeS2 is a potent 'seed biostimulant'. Initially, in a seven day laboratory trial, they observed significant increase in biomass of chick-pea plants, which prompted them to assess the feasibility of translating the laboratory observations using appropriate field trials. When the seeds were pre-treated for 12-14 hour in an aqueous suspension of FeS_2 (100µg/ml), it increased the productivity in spinach, sesame and fenugreek.

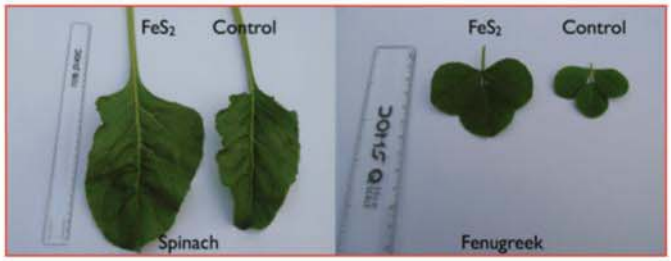
Field trials with Spinach seeds treated with `FeS_2 decoction' resulted in ~46% increase in leaf numbers per plant, ~62% increase in leaf area index, and ~98% increase in the plant biomass; after the full life cycle of 60 days (see Picture 1). Though Das did not see major change in iron content of the spinach, significant increases were observed in the case of manganese, zinc and calcium.

Similar `FeS_2 biostimulant' treatment was given to sesame seeds and field trials were conducted. The research team observed that number of seed pods per plant increased by ~250% with respect to control population, and seed yield per plant (in grams) increased by ~77%; after completing the full life cycle of 110 days.

Fenugreek seeds were treated with FeS_2 nano-particles like others and field trials were conducted against non-treated plants. It was found that the number of leaves per plant increased by 79% after 50 days of growth and the size of the leaves are also larger in plants grown from FeS_2 pretreated seeds (Figure 1).

Hence the question: How FeS_2 acts on seeds? Das and his team propose that this effect is partly due to pyrite induced peroxide formation and the later playing an imperative role as a 'master hormone' in early plant life.

"Here simply by using FeS_2 and water in a controlled manner, we are possibly controlling the peroxide activity, thus increasing the productivity of the crop. Based on the results, we believe that pre-treatment of seeds may be the way to future for enhancing the yield of other commercial crops in a sustainable manner", concluded Mainak Das.



Picture 1: The spinach and fenugreek leaves. The FeS2 seed pretreatment resulted in plants with significantly larger leaves.

"We have found a new, maybe revolutionary use for pure iron pyrite, as a seed treatment"

PROF MAINAK DAS

SEAWEED EXTRACTS: ALWAYS AT THE FOREFRONT OF BIOSTIMULANTS TECHNOLOGY

Leili Marine Bioindustry Inc from China introduced Alga600, a fresh seaweed extract, from brown seaweeds such as Sargassum, Ascophyllum nodosum, and Laminaria. It comes as a fully water-soluble dark brown powder,

with a specific gravity of 0.50 g/ml and pH of 9-11. It is suitable for most application methods, such as foliar spray, macro-, and micro- irrigation application, soil application, seed treatment and mixture with bulk fertilizers. It is certified as "Organic product" by India's Institute of Marketecology (IMO).

Chinese Leili Marine Bioindustry Inc.'s Zhifeng Huang, has presented an array of positive results, obtained by using Alga600 on two important Indian crops, i.e. sugarcane (5.06 million ha) and paddy rice (42.4 million ha). These were actually two sets of experiments intended to optimize the application method and rate for each one of these crops under Indian conditions. The experiment with the sugarcane took place in Vasantdada Sugar Institute, R&D farm, in the Pune area. Alga600 has been applied to the soil at 500, 1,000 or 1,500 g/ha, at planting, and 45 and 120 days after planting (DAP), along with the normal application of urea. A control treatment without Alga600 was run in parallel. Same application rates and timings were used also for foliar sprays. It has been found that highest cane-, and sugar- yields were obtained by the highest soil application rate. Also the foliar spray results indicated that the higher the application rate, the higher the yield. Let us suggest to Leili to repeat this experiment with higher rates until

"Alga600 shows excellent results on two important Indian crops, sugarcane and rice"

ZHIFENG HUANG

an absolute optimum is being found. The effect of soil-applied 1,235 g/ha of Alga600 on the growth of paddy rice, was checked in the state of Madhya Pradesh. The product was evenly distributed between the applications at 25 DAT and at 35 DAT. The results showed 30% higher grain yield, in the Alga600 treatment, 125% higher root number and 150% higher root length.

Valagro's presentation on seaweed extracts in the 13th NewAg meeting showed the trend increasingly featured by other seaweed and biostimulants companies, which produce high level studies of applied science, by cooperating with university researchers. This cooperation lays the foundations for deeper understanding of the metabolic mode of action of their products. In the current case, Italian Valagro exposed a serious effort to fully understand the mechanisms that drive the biostimulative activity of its Mc line product series. Mc line products are based on active phyto-ingredients derived from the algae Ascophyllum nodosum, obtained through specific extraction processes, and developed with exclusive technology. The outcome of this effort is comprehensive knowledge of the ingredients of the said algae, and their mode of action. This knowledge has been applied by producing three specific products belonging to the MC Line, i.e. MC Cream, MC Set and MC Extra. Some of the findings were obtained by applying these products on the universal model plant Arabidopsis thaliana, and other- on the highly-important commercial crop- soybean. Alfredo Sgrignuoli, Valagro's Product Manager, highlighted the fact that after isolating around 1,000 recurring biological compounds from treated Arabidopsis and soybean plants, the following results became obvious. MC line products showed a 7-20–fold increased activity of A. Thaliana's genes responsible for response to light intensity, cell expansion, cell proliferation, response to auxin stimulus, solute transport, pollen development, and pollen tube growth. The application of MC Cream increased the occurrence of plant-compounds with porphyrine ring, which indicates increased photosynthetic capacity, it also increased the levels of membrane lipids, and phosphatidylcholine, which indicate high plant performances; accompanied by remarkable decrease in stress-related compounds such as: terpenes, terpenoid alkaloids, inulin, flavonoids, glucosinolates, phytoalexins, and homocysteine. These findings indicate high state of plant health. Increased methyonine biosynthetic intermediates points to improved nutrients assimilation. The applica-

"MC line products showed a 7-20-fold increased activity of A. Thaliana's genes, responsible for response to light intensity, cell expansion, cell proliferation, response to auxin stimulus, solute transport, pollen development, and pollen tube growth"

VALAGRO'S MR. A. SGRIGNUOLI

tion of MC Extra increased the amounts of auxin degradates, and dihydrozeatin, which illuminates the role of this product in better regulation of the plant growth substances. It also decreased levels of homocysteine, homoserine, terpens and flavonoids, which interprets MC Extra's effect as a stress reducing agent. Unfortunately, no details were presented, showing actual increase in plants' product quantity or quality.

Bioatlantis Ltd is a now well known Irish company that focuses

Rio Tinto, hydrothermal vents to 'seed biostimulant': Journey of Fool's Gold

The revolutionary work presented on Iron Pyrite by Mainak Das in Delhi has been conducted by an outstanding Team of Indian Researchers:

Gaurav Srivastava (1), Chinmaya Das (2), Amarish Dubey (1), Niroj K Sethy (3), Kalpana Bhargava (3), Sushil Singh (4), Deepu Phillip (5,6), Mainak Das (1,6).

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on the production of advanced biostimulatory products from the brown seaweed Ascophyllum nodosum. It specializes in producing agricultural plant strengtheners that can act at the different phenological stages of plant growth, to enhance crop vigor, yields & quality. Furthermore, it provides sustainable solutions to biotic and abiotic stresses that reduce crops' performances. Bioatlantis is aware of the current trends in the developed countries, mainly USA and the European Union, that are intended to ban unsustainable fungicides, pesticides & nematicides, and to base the plant protection and plant biostimulation on compounds that do not leave any residues, and thus, prevent their accumulation in our planet. The product presented by Bioatlantis in this context is branded Super Fifty®. It is highly concentrated and contains 500 g/L of the seaweed extract. It is formulated as a black liquid with an over 99.5 % solubility, and basic pH of 8.5-10.5. Super Fifty® contains a range of naturally derived bioactive molecules with well characterized functions in plants. These include: A) Polyphenols, which function as antioxidants, for reduction of reactive oxygen species (ROS). B) Fucoidan, which apart from ROS reduction, it maintains microbial ecosystem in the soil. C) Laminarin, which serves as a precursor and component in elicitation of plant defense, and maintenance of the microbial ecosystem in soil. D) Mannitol, active in osmo-protection, and abiotic stress reduction. E) Alginate, component for Water retention and acts as a soil conditioner.

While describing the bio-stimulation features of this product, JT O'Sullivan, Bioatlantis' CEO, elaborated on its special virtues for table-grapes and walnuts.

He stressed that when Super Fifty® was applied by a single application foliar spray, at 1 L/ha, diluted in 1,500 liters/ha, on cv. Crimson seedless table grapes, higher proportion of grape bunches could be harvested at the 1st and 2nd picks, which are much more profitable, and less at the 3rd pick, without any total yield loss. These results were more or less similar, regardless of the timing of the sprays that were: when the vegetative sprouts were 150-200 mm long; or at pre-flowering stage, or at post-flowering, or at bunch closure, or at veraison. Similar results were obtained when the grapes cultivar has been Thompson seedless, and there, total harvest was significantly improved by 6% compared to untreated. However, again in Crimson seedless table grapes: 1) Post-flowering application increases bunch weight (11%), rachis weight (49%) & berry weight (10.6%). 2) Application before bunch closure increases berry size. 3) Shattering, splitting & fine cracks in berries were significantly reduced by >85%.

"Super Fifty® enhances ripeness precocity of table-grapes and walnuts"

J.T O'SULLIVAN, BIOATLANTIS' CEO

When Super Fifty® was applied by a triple application foliar spray, at 1 L/ha, diluted in 2,000 liters/ha, on walnut trees cv. Chandler, a high proportion of the kernels (nut 'meat') was light colored, which is considered as grade 1 that achieves better market price. Additionally, 41% more fruits could be harvested at 1st pick,

compared to untreated & 17% more, compared to a commercial control. Also, total yield was improved by 4%.

Oilean Glas Teoranta (OGT) is an Irish company that has started up its R&D activity in the early 2000s, focusing on improving the extraction processes of the brown seaweed Ascophyllum nodosum. The innovation introduced by this company has been to do all extraction procedures by applying mild and gentle means, at cold temperatures, in order to maintain all the seaweed 's active ingredients. OGT was acquired in 2014, by the

"The English marketplace for premium health products has developed an impressive demand for vegetables treated with Ascophyllum extracts"

TRADECORP'S MR. FRANK HENNEQUART

Spanish Tradecorp – Sapec Group. The resulting products are now branded algaegreen and phylgreen. The production procedure consists of the following stages: harvesting, fresh-water washing, hand sorting, micronization, high-pressure cell rupture, and filtration. All these procedures are carried out under mild conditions, as compared to temperatures above 1200C, commonly practiced during the rough commercial drying procedures. No wander, therefore, that while the most commonly found Ascophyllum extract is a black powder, algaegreen and phylgreen are green products formulated as liquids. Phylgreen helps crops express their best performances under stressful conditions due to the multitude of their natural ingredients, This potential activity is not expressed until the treated crop encounters these challenging conditions.

Interestingly, Frank Hennequart, Tradecorp's Global Seaweed Product Manager, says that the English marketplace for premium health products has developed since the last 6 years an astounding demand for vegetables that have been treated with Ascophyllum extracts. This special demand is concentrated mainly around green broccoli, various cole vegetables, onions, and potatoes. Moreover, this health trend is strongly supported by human physiologists and medical doctors who discovered the clear health advantages that this seaweed extract indirectly elicit on humans consuming the treated vegetables. A variety of their scientific papers has been presented by Hennequart in New Delhi.

MICROBIALS : A GROWING INTEREST FOR REVOLUTIONARY SCREENING METHODS

The current requirement to effectively and efficiently improve plants performances at short timeframes has produced various advanced treatment methods. Some of these techniques are A) genetic modification, which normally takes some 12-13 years, and an expenditure of some Million US$130; B) development of a new synthetic pesticide (8-10 years & Million US$250; C) development of a new bio-pesticide (5-7 years & Million US$ 15-25). The presentation delivered by BioConsortia, Inc.'s CEO, Dr. Marcus Meadows-Smith, has exposed a brand new method, recently developed, that features a development time-span of only 3-5 years, and an expenditure reduced to 5-15 Million US$ 15-25. The method is based on an important component of the crop complex that has a crucial impact on its performance, but has been underestimated so far, i.e. the microbial population, found within the plant

"Our advanced microbial selection protocol is based on exposing the crop plants to many different soils and soil-microbes populations "

BIOCONSORTIA'S DR. MARCUS MEADOWS-SMITH

continuum, and in its intimate vicinity, e.g. on its root-system surface. It has been established that some types of microbial populations may provoke plant diseases, others may leave the plant at normal functioning level, and yet, other, may markedly improve the plant's performance, way superior to the normally found level. The advanced microbial selection process performed by BioConsortia protocol is based on exposing the crop plants to many different soils and soil-microbes populations, and identify the positively outstanding ones that perform best under challenging conditions, predetermined as the breeding target. These challenging targets are, e.g. increased leaf-, or fruit- biomass, a specific fruit ingredient, resistance to chill, heat, drought, or to salinity, etc. The microbial population of the individual plants expressing the required trait, is then extracted and genetically identified, including the partial occurrence of each microbial-species. More about the approach can be read in the plant protection section of this issue of the magazine. BioConsortia has proved that application of this selection system could be beneficial for improving the "design" of new generation biostimulants based on microbials.

CONSOLIDATED INTEREST FOR OTHER TECHNOLOGIES: AMINOACIDS, HUMICS AND MUCH MORE

The problem of insufficient natural dormancy-breaking in deciduous fruit-trees was aggravated in recent years, due to the global-warming phenomenon. Natural bud-break in these crops takes place only after the plants have satisfied their "chilling requirement", following a large enough number of hours, in which they have been exposed to temperatures, below a cultivar-specific threshold. But if this number has not been attained, the dormancy is prolonged to the spring, with a late and non-uniform bud-break, which negatively affects the yield mass and fruit quality.

Valagro decided to lift this glove, and to use it as an opportunity to produce a new type of biostimulants, capable to deal with this problem, by applying advanced research methods based on molecular biology. For this task, Valagro started a collaboration with Nsure research institutes of Wageningen University. Nsure has been selected for this project thanks to its proven contributions as a leader in advanced technologies for the detection of gene-sequence and expression in plants. A basic study was launched in order to discover the specific genes involved in bud break, their role in the different dormancy-breaking stages, and how their activity can be modulated by exogenous compounds. The study has revealed that most important genes involved in bud-breaking exert their main effect in pectin catabolic process, cell wall changes, and trans-membrane transport. The changes in their activity took place mainly between weeks 33 and 35. This cooperation yielded an innovative approach

that culminated with the creation of Erger®, a biostimulant, containing selected diterpenes, polysaccharides, calcium and nitrogen. Erger modulates mainly cell wall modifications and catabolic process genes, but also, amino acid metabolism, sugar transport, secondary metabolism, chitin metabolism, nitrate assimilation, gibberellin-related sequences and more. Erger®, was recently experimented on kiwifruit in New Zealand, by application at 3 different stages, defined by Richardson Chill Units Model, at 60-63, 46-49, and 34-39 days before natural bud break, (too early, optimal and too late, respectively). It has been found with statistical significance that best results were obtained by spraying Erger® at 35 days before expected bud-break that has been previously considered a too-late timing. Happily, there has been found a considerable overlapping between genes aroused by natural dormancy-breaking and those aroused by spraying Erger, which indicates the validity and importance of this applied research. The

"Erger® is an innovative and advanced biostimulant, enhancing bud-break under insufficient chilling conditions"
VALAGRO'S MR. GIOVANNI MARROLLO

take-home message stated by Valagro's Product Manager, Mr. Giovanni Marrollo, is therefore that correct dosage and timing of application are crucial for obtaining optimal results. Correct timing is determined by the actual climatic conditions, and it varies by year and depends on the certain crop and cultivar.

"Application of Activ CAL by foliar spray increased total tomato yield by 28.8%, and the leaves' calcium contents- by 11.4%"
T. STANES' DR. K. LATHA

Calcium is a secondary nutrient with a variety of important roles for regular functionality of plants. In its soluble form it enhances ureic-nitrogen use-efficiency by reducing ammonia volatilization. Calcium counteracts the activity of polygalacturonase and pectate-transeliminase of pathogenic bacteria and fungi. Calcium cations are probably the most widely found intracellular messengers, relaying signals received at receptors on the cell surface.

Dr. K. Latha, of the R&D Centre of the Indian company T. Stanes & Co., Ltd., undertook a project to produce a "green" reliable solution to calcium-deficient soils that can be applied efficiently by foliar spray. This application method has a great potential, mainly because it is generally believed that calcium cannot be redistributed within the plant by the phloem system, because it only moves in the plant over the transpiration stream, from the root-system directly to the most actively transpiring plant organs, i.e. its young foliage. The R&D group could create an organic calcium product, brand-

ed Activ-CAL that exhibits the required performance. It comes as a fully-soluble white powder, containing 25–30% Calcium (similar to 26.5% CaO, found in calcium nitrate) with pH=5–6 (1% Soln.). This product is the outcome of processing common mineral calcium sources, e.g. lime, dolomite and gypsum with carbohydrates, water and natural calcium-rich substances (bone-meal?), mainly by fermentation of these ingredients. Application of Activ CAL by foliar spray, and by fertigation showed enhanced uptake of Ca in root tips, and shoot apices of rapidly growing plants. Application of Activ CAL by foliar spray at 5 g/L to tomato plantlets, at a variety of application rates showed that the preferred application rate has been 0.5%, under the specific experiment condition. This treatment increased the plant's number of branches by 24.6%, the total yield- by 28.8%, fruit firmness- by 14.8%, and leaves' calcium contents- by 11.4%, as compared to the unsprayed control.

Amino-acids based biostimulants are generally made up of a mixture of amino acids and peptides. In many cases this mixture is a by-product of leather-, fish-, and meat-industries, whereby inferior tissues and organs are processed by chemical or enzymatic hydrolyzation, to produce the said mixture that is definitely valuable for the crops. In many cases the biostimulants industry is also taking advantage of unusable crop residues like stems, peels, roots, grains, etc. for the same purpose. However, Italian company Italpollina, in the cooperation with the University of Tuscia, developed an advanced enzymatic digestion system, which produces a genetically-modified-free protein hydrolysate, from leguminous seeds. The product, branded Trainer, has a high concentration of 35.5% of organic matter, the lion's share (31%) of which consists of soluble peptides and amino acids, with 5% organic nitrogen. Amino-acids with highest proportions are Glutamic acid (18.5%), Aspartic acid (11.3%), Leucine (8.1%), Lysine, Arginine and Serine and 6.7%, 6.5% and 6.0%, respectively. Phenylalanine and Proline are present at 5.6% and 5.3%, respectively, but Hydroxyproline and Hydroxylysine are not existent. It has a pH of 4.5. Trainer has already been approved as an organic product by OMRI (Organic Materials Review Institute) and certified for use in organic farming in Europe, USA, and many other countries. As such, it got the approval to be applied to edible parts of the crops, while such usage is not approved by the new organic farming regulations for animal-based protein-hydrolysates. Thanks to its strict plant origin, Trainer can be applied on crops intended for consumption by vegetarians, and/or by people with religious dietary restrictions (Kosher / Halal).

According to Giuseppe Colla who delivered this presentation on behalf of the Italian company Italpollina, the main virtues of the amino acids and peptides, found in Trainer, are that they serve as

"Protein hydrolysate bio-stimulants, made from leguminous seeds carry advantages in many respects compared to those produced from animal wastes"

GIUSEPPE COLLA, ITALPOLLINA

"The innovative biostimulant product Ecohume®, has a multitude of horticultural advantages"

DR. DEVENDRA KUMAR, PJ MARGO

sources of nitrogen for plant metabolism, they act as complexing agents for inorganic nutrients, enhancing their availability to the plants, and they promote nutrient uptake and assimilation, through stimulation of specific enzymes and of the total plant metabolism. For example, soil application of 0.25%Trainer on maize seeding, increased the shoot dry matter contents by 6.8%, SPAD value by 27% and leaf nitrogen content- by 24%. Additionally, the Tryptophan contained is progressively turned into the auxin IAA, which promotes the axillary development of the treated plants. Furthermore, an auxin-like activity has been recently identified also in another component of the Trainer. This is a short peptide called Root Hair Promoting Peptide (RHPP). Other advantageous effects brought about by this product are: enhanced stress tolerance against high temperatures, drought, salinity and sub-optimal light intensity. It also promotes the accumulation of sugar and antioxidants (carotenoids, polyphenols, and flavonoids) mainly by activation of secondary metabolism.

The biostimulant product Ecohume®, containing humic substances, presented by Dr. Devendra Kumar, Margo Biocontrols Pvt Ltd (India), claims the following advantages: 1) it is produced from freshly processed renewable agri biomass; 2) The process of converting the raw materials into the finished product takes 6-8 months, however no further details were given during the presentation about the nature of this process, nor about the specific raw materials used; 3) The humic substances derived from the said raw materials show higher bioactivity than humic acid derived from the conventional raw-material-leonardite.

The product is manufactured in two formulations: A) liquid solution of 6% humic substances for application by foliar spray (recommended rate 750-1,500 ml/ha) or by fertigation; B) Granules of 1.5% humic substances for soil application (recommended rate 12.5-25 kg/ha). Both are certified as "Organic product" by India's Institute of Marketecology (IMO).

According to Dr. Devendra Kumar, both formulations have the following horticultural effects: 1) Improved soil porosity, soil aeration and enhanced soil's water-holding capacity; 2) Increased cation exchange capacity of soil, which helps enhance soil's ability to store more nutrients and make them available to the plant; 3) Chelating micronutrients and increasing their uptake by roots; 4) Exhibiting activity similar to phytohormones like betaines, and cytokinins; 5) Stimulated plant growth by accelerating cell division and root-shoot growth rate; 6) Enhanced resistance to abiotic stresses; 7) Effective on vegetables, fruits, paddy, sugarcane, wheat, barley, floriculture , horticulture and plantation crops like tea, coffee etc. A controlled field-experiment in potatoes, held in Gubbi, Karnataka in 2014, has indicated the following virtues of Ecohume granules applied at 12.5 kg/ha: it increased by 27% the number of plant branches, by 15% the number of tubers, by 10.7% the

total tuber yield, and the additional resulting grower's income came up to 66,246 RS/ha (1,050 $US/ha), as compared to the standard grower's practice.

SILICON: A MIRACLE ELEMENT STILL FAR TOO MUCH IGNORED?

It has been argued since long time ago that plants require the element silicon (Si) for their normal development, and that it is one of the standard trace elements. However, it looks that the practice of adding this element to crops' fertilizers regime has not gained much success. Probably because most people know that silicon makes up over 28% of the crust of our planet, and that 'average' soil contains 30% silicon. Furthermore, most monocot plants (e.g. grasses, cereals, maize and sugarcane) accumulate Si in a passive way, with the absorbed water, to a level of 1- >10% of their dry matter, while dicots contain it at much lower rates of <0.1-1%, and sometimes they Si exclude it. So, if there is "enough silicon", there is no need for Si-fertilizers. But, according to Dr. Henk- Maarten Laane, of ReXil Agro BV, (Netherlands), the picture is rather different, and silicates that are Si-salts are distinct from silicic acid, mainly in terms of plant availability. Actually, only mono-silicic acid (mSA) is the key Si-nutrient, absorbable by plants' roots, and its concentration in the soil is very low, down to practical deficiency. mSA is very unstable due to its tendency to polymerize into poly-silicic acid. Silicic acid deficiency results in plant's stunted growth, reduced uptake of soil nutrients and increased sensitivity to diseases, pests and to abiotic stresses. In order to avoid these adverse effects the Silicic Acid Technology has been developed, based on the application of stabilized silicic acid (sSA), which is absorbable by plants when applied by soaking the seeds before sowing them, as foliar spray, by hydroponics or,- directly to the soil. The outcome of these treatments is higher uptake of most nutrients, higher resistance to abiotic- (heat, drought), and biotic- stresses (infections, pests, rodents). These are manifested in terms of more root-, and shoot- biomass, larger leaves with higher chlorophyll content, yield increase, better produce quality (brix, longer shelf life, etc.) and shorter crop cycle. For example, a controlled experiment of foliar spraying of sSA on wetland rice in India, during Kharif 2007 has produced very good results: The results indicate that spraying sSA could even partially replace the standard pesticides application, with a big yield advantage, and that yield was further increased when pesticides were applied at a 50% reduced rate (!) Similar results were obtained by treating tomatoes, cucumbers, watermelon, okra, chilly-pepper, aubergine, grapes, bananas, wheat, soybeans, sugarcane, sweet corn, sunflower, and more, in many countries. In order to comply with EC regulations ReXil Agro BV markets sSA combined with boron, molybdenum and zinc, branded as 'AB Green'. Silicic acid is considered to act as a nutrient and as a biostimulant. And the fact is that there is no lack of scientific evidence that it works! ■

"Application of stabilized silicic acid acting as a fertilizer and as a biostimulant markedly enhances the performance of many crops "

REXIL AGRO'S
DR. HENK- MAARTEN LAANE