HOW 'PURE' IS OUR SCIENCE?

Few products like silicon-based amendments solicit such contrasting attitudes in the application of these products in agriculture and horticulture, from the scientific community, agricultural authorities that regulate the use of such substances and the agrochemical industry at large.

An important problem with Silicon (and biostimulants in general) is that research to evaluate their effectiveness tends to demostrate only small to medium-scale effects on plant growth and development and rarely is there a clean kill of whatever pest or disease is under examination. Secondly, silicon (and some other biostimulants) affect so many growth parameters, that credit can easily be given to the effect of *other* nutrients rather than to the secondary effects (in this case) of *silicon* in checking nutrient imbalances, all this starting in the soil. Thirdly, silicon sits uncomfortably in the category 'biostimulant' (the accepted definition of biostimulants by EBIC) since Si has well documented effects against *biotic* stress as well as abiotic stress, not by killing pests and diseases but by rendering plants more resistant to attack through the deterrent effects of enhanced immunity response and silificated leaf surfaces. Finally, there are a great many commercially available products in which silicon is combined with other mineral elements and other substances; what is doing what and where?

Results from commercial trials with silicon-based products, often create distrust if not disbelief from the scientific community and an independent rebellious attitude from growers who obtain positive results from the Si products supplied, in the absence of approval by agricultural authorities and contrasting opinions from the agrochemical industry. It has been said that 90% of experiments supported and financed by commercial interests will prove positive to the products under trial. There is an obvious grain of truth, especially when today, publicly funded experimental stations, independent of commercial interests are a very rare commodity indeed. In fact, divulgation of information on many agricultural products is increasingly placed in the hands of consultant agronomists working for agrochemical companies or other commercial interests and cannot be said to be impartial. However, these companies have to support the high costs of research and development, marketing, promotion and sales of new products and make adequate profits.

Commercial interests do not have the luxury of saying to themselves '*scientific evidence looks favourable but what is causing the effect is not clear and needs further study'*. They must pronounce in the media that their brilliant new product DOES work, they must inform and motivate their consultant agronomists who in turn - with the maximum of conviction - tell their grower clients to buy it and to use it.
Not all agronomists however! One interesting quip heard recently at the Fieragricola di Verona, Italy, explains the difference between a physicist, engineer and agronomist when asked the time. The first looks at his watch and say "13.30", the engineer instead says "between 13.00 and 14.00", while the agronomist will say "IT DEPENDS!". On what, one might ask? On the huge number of variables growers have to face in terms of the soil-water ecosystem and the climate. There are no sealed compartments in the ecosystem!

Quite naturally, to the scientific community many reported trial results are dubious, tainted by commercial prerogatives. The scientific community is bound by different rules. Scientists need to have their scientific papers published (*publish or perish*) they need peer reviews and face strong competition for research funding. Scientists also tend to further their knowledge and careers *from within* the international scientific community and scientific conferences. They are less involved, sometimes indifferent, to thinking about how growers might use new discoveries or products or how agronomists and growers are informed about them and how they should be applied. To create agricultural innovation. In this respect there is a need for experienced scientific writers and journalists to distill pure science, to bridge the gap between laboratory and grower, to contrast the weaving together of factual data and promotional hype. To this end, legislation that restricts internet access to recognized scientific institutions could prove an obstacle to this objective rather than a guarantee.

The application of silicon in agriculture is also complicated by the fact that its effects on plant growth and development are ubiquitous, presenting to plant scientists a great many diverse facets to explore, from signalling and response mechanisms to structural reinforcement, metabolic processes and the orchestration of mineral uptake, not to mention responses to Si that tend to be plant-specific. Judging by silicon science (and scientific papers) over the last decade, silicon provides great freedom for the 'duplication' or 'adaptation' of experiments, especially with crops such as rice and sugarcane where results are certain to be positive in very similar ways. Legitimately, growers are interested to learn about the effects of silicon on a broader range of agricultural, horticultural and floricultural crops. Fortunately, pure science is also breaking new ground in unravelling the effects of silicon in terms of molecular

transport, signalling and response mechanisms whereby for instance, foliar-applied silicon stimulates root growth.

Lastly, because of the huge number of variables involved in growing crops, scientific experiments are often conducted on a small scale in artificial laboratory environments that are divorced from the environmental and commercial influences that growers have to face in field (or protected cropping). Scientists might insist that commercial field trials are repeated over several production cycles or seasons in order to prove claims being made. But how can such trials be repeated the following year in order to obtain statistically relevant analysis?! Field trials often require multiple sites and/or multiple of years – where practically anything can happen from damage created for example, by animal feeding, hail, flooding, drought and wind. Growers (and agronomists) can be expected to say that results from each production cycle and season will depend on the variability of environmental stresses experienced by the crops under trial. Or their interest to repeat a commercial trial might wain due to sudden changes in market prices and consumer interest! If a new product WORKS for a grower (who also has to pay for it), he can legitimately ask the scientific community in what way it works. It also might provide gains post-harvest.

The scientific community should look more closely at what the growers are doing and what works for them in order to create new research projects. The scientific community, agro-companies and other commercial interests, should meet together more regularly in order to better understand the different needs and approaches in order to create new synergy and reduce the costs of duplication in both pure and applied science in agriculture.
A news release by Youris states that for innovation managers and start-up advisors, scientists and researchers are not business people and that pure scientists are not adequately able to proceed in this environment. *Policy brief n.3 by the European Forum on Forward Looking Activities of the European Commission has criticised the bioeconomy research plans of the HORIZON 2020 program for being too focused on research-driven innovation instead of market-driven innovation. http://commnet.eu/05_News/Bioeconomy-Innovations-Tough-Starting-up.kl*

It is also increasingly necessary for end-users (and the industry itself wherever possible) to oppose misleading marketing and promotional claims for products such as: "*20% increase*" (over what and what base-line), even more brazen and useless *"5 times more!"* (than what?).

Thanks to a contribution made by Dr. Mary Provance-Bowley. The most important meeting point for this argument is the ISSAG (International Society for Silicon in Agriculture and Related Disciplines: www.issag.org See Blog: www.hortcom.wordpress.com (theme: bioactive silicon)

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