Executive summary on the claims related to MaxSil

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The main conclusions from this review are included below. Professor Rengel is Australia's preeminent scientist involved in the field of soil science and plant nutrition, and his background is shown at the rear of this document.

The analysis of plant-available Si (PAS) in MaxSil (determined by the 5-day method) was far superior to the PAS content in the other two diatomite-based materials. Hence, lower transportation costs and lower application rates and costs should be distinct advantages of MaxSil in comparison with the diatomite-based products.

A very high proportion of amorphous Si (98% based on X-ray diffraction analysis) in MaxSil contributes to its effectiveness as a Si fertiliser.

The sheer amount of experimental work done on MaxSil (applied to soil or foliarly) over more than a decade is impressive. A broad range of crops (wheat, barley, rice, sugar cane, tomato, capsicum, spinach, etc.) were tested in various edaphic and climatic conditions (mostly in Queensland and Tasmania, with some work done in NSW). Most field trials were set up and executed properly, with the majority including appropriate experimental designs and replications to allow statistical assessment. The assessment of quality as applicable to various crops was done as well.

In most trials, an appraisal of MaxSil safety was done, and the treated crops were found to be free of any visual symptoms of phytotoxicity or other damage, justifying the conclusion that MaxSil is safe.

Moreover, in all trials where the relevant assessments were made, the plants in the MaxSil treatment showed greater resistance to diseases and pests (e.g., a smaller percentage of insect-damaged zucchinis in the MaxSil treatment compared with the non-amended control in the trial in Gatton, QLD, in 2018; low insect pressure from aphids and potato moth in potato treated with MaxSil in Goulburn, NSW, in 2012, completely eliminating the need to apply insecticides). These results on MaxSil are in accordance with substantial scientific literature showing that additional supply of Si results in increased crop resistance to a range of biotic (pests and diseases) and abiotic stresses (e.g., salinity, frost, heat, drought, etc.).

The positive effects of MaxSil on crop growth were noted early in crop growth, such as increased vigour and leaf cover (e.g., in truss tomato as well as capsicum in the trials in Bundaberg in 2018). These effects would have not been related just to increased yield at the end of the season but would also have implications for weed control. Together with decreased insect pressures (as specified above) in various crops minimising or eliminating the need for insecticides, fertilising crops with MaxSil would enhance environmental sustainability of growing food.

In most trials there was a nominal increase in yield (and also marketable yield in case of vegetables) in the treatment with MaxSil fertilisation (+ grower standard practice, GSP) compared with the GSP fertilisation only. Hence, MaxSil fertilisation increased not just plant growth and yield, but also the quality of products, both of which determine the farmers' income. For example, the total truss tomato yield was increased by 17% and marketable yield by 10% in the MaxSil treatment compared to the no-MaxSil control (in Bundaberg in 2018). In some cases (e.g., potato in northern Tasmania in 2011, spinach in Tasmania in 2018), the yield increases in the MaxSil treatment were shown to be statistically significant, thus providing a scientifically acceptable proof of efficacy of MaxSil as the Si fertiliser.

The application of MaxSil frequently resulted in statistically significant increases in quality of agricultural products (e.g., decreased weight of undersized potato tubers in the MaxSil treatment in northern Tasmania, increased poppy capsule weight per hectare, increased yield of small-sized onion bulbs with excellent commercial value), which increased marketable yield and thus the farmers' income. The new statistical analyses [to identify and exclude extremely different values (outliers) to decrease variability] resulted in some additional differences in crop quality (better in the treatment with MaxSil than without) being declared significant (e.g. a smaller percentage of unmarketable red capsicums in the MaxSil treatment in Bundaberg in 2018), again providing scientifically acceptable evidence of the importance of applying MaxSil as the Si fertiliser to increase not just crop yield, but also the quality of the marketable products.

The MaxSil benefits recorded in the field (total yield and marketable yield and quality) extended also to the storage, with spinach leaves from the MaxSil treatment retaining freshness and greenness after a period of cold storage better that the leaves grown in the no-MaxSil control.

In the field trials where economic assessment was conducted, the application of MaxSil resulted in improved benefit: cost ratio, with higher economic returns (e.g., sweet corn trial in southern Queensland, in potatoes in Tasmania, in wheat and barley trials in northern NSW). The net financial benefit of using MaxSil was as high as $2000/ha of potatoes (which was statistically significantly higher than in the treatment without MaxSil).

The largest amount of field work with MaxSil was done on sugar cane at many Queensland locations and over many years. With a single exception, in all these trials there was an increase in sugar cane biomass (going as high as 24 t/ha, with an average of 8.3 t/ha increase), while maintaining commercial cane sugar (CCS) values (average of 14.18% in the MaxSil treatment and 14.12% in the control without MaxSil). In some trials, there was statistically significantly higher CCS (as well as biomass yield) in the MaxSil-treated sugar cane compared with the no-MaxSil control (e.g., Emdex 28A trial). Importantly, the incidence of orange rust (a devastating fungal disease in sugar cane) was reduced by 41-50% in the MaxSil-treated sugar cane compared with the non-treated control.

MaxSil was also trialled internationally (in West Bengal, India), with increases in rice yield ranging from 7.4% (with 74 kg MaxSil/ha) to 11.3% (with 124 kg MaxSil/ha). In rice in Australia (Mackay region), MaxSil application increased rice yield by 30% compared with the non-treated control.

In conclusion, a large body of pot and field trial work provides evidence of MaxSil being safe to crops as well as a proof of MaxSil application resulting in positive effects on growth, yield, and quality parameters of a range of crops grown in a variety of locations in Queensland, Tasmania and NSW. MaxSil application also increased crop resistance to pests and diseases, thus enhancing environmental sustainability of growing food. Importantly, the gross margin for crops grown with MaxSil was better than for those grown without.

Based on the very large difference in plant-available Si (as determined by the 5-day method), being 13- to 25-fold greater in MaxSil than the two diatomite-based Si products and the extensive field testing of MaxSil in a range of crops, it is clear MaxSil is an excellent source of plant-available Si, and its application is beneficial to crop growth, yield, and quality, resulting in increased gross margin per hectare.

Professor Zed Rengel
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Background - Professor Zed Rengel

Winthrop Professor Zed Rengel has been involved in research in plant sciences, including crop and pasture science, for 29 years. He has established extensive scientific networks in Australia and overseas and has been involved in many collaborative projects worldwide. Zed has extensive experience in reviewing papers, editing journals and books, and communicating orally and in the written form.

Zed is currently the Program Leader in Institute of Agriculture, University of Western Australia. He has been the recipient of 7 research prizes, 16 fellowships (e.g., Humboldt, OECD, Japanese STA, French Government), 4 Honorary Professorships (Nanjing Agricultural University, Zhejiang University, HuaZhong Agricultural University and Lanzhou University) and 6 Visiting Professorships (including Cornell-USA, Okayama-Japan, KVL-Denmark and Gissen-Germany). He was bestowed an Honorary Doctorate (Dr Honoris Causa) by the University of Zagreb and was elected Foreign Fellow of Croatian Academy of Sciences and Arts.

He was elected to some of the most important international discipline committees and councils [e.g., International Plant Nutrition Council, International Committee for Phosphorus Cycling in the Environment, International Committee on Phytoremediation & Ecosystem Health]. Zed gave 43 invited keynote addresses at international Conferences. He also gave 205 invited seminars at 51 Universities and Institutes in 23 countries.

Zed is the author/co-author of 310+ publications in peer-refereed international journals (including 2 invited Tansley reviews in New Phytologist*) and 39 invited book chapters. He has edited 6 books and 7 Journal Special Issues. Zed is currently serving as an editor for 2 journals (*J Plant Nutr-*USA,* J Bot-*India), associate editor for* Crop Sci-*USA and as a member of the Advisory Editorial Board of 8 journals (including* J Exp Bot-*UK,* Crop Research-*India,* J Soil Sci Plant Nutr-*Germany,* Tree Physiol-*Canada).*

Zed publishes in most of the highly ranked journals in plant sciences, analytical chemistry and agriculture and soil science. The papers have been cited more than 5000 times [excluding self-citations; his h-index is 41 (ISI, September 2013).