MaxSil Pty Ltd

MaxSil™

The measure of efficiency of any silicon based material designed for use as a plant nutrient is the level of "plant available" or "soluble" silicon in the form of *silicic acid* that the product delivers. Silicic Acid is the critical element that promotes a number of beneficial responses for plant life.

This document shows results from trials and analyses for MaxSil™, a patented high efficiency granule designed to deliver maximum levels of plant available silicon.

Competitor Product

Many products marketed in Australia and overseas claim extremely high overall levels of silicon but unfortunately provide very little soluble silicon.

Some product such as diatomite for instance may have silicon levels of up to 800,000 to 900,000 parts per million, but provide only 1,200 parts per million of plant soluble silicon. These types of claims tend to confuse rather than educate, and the situation is further complicated by the fact that there have been a number of different methods developed to analyse for soluble silicon.

Testing

In recent years, plant soluble silicon has been classified as a "*Plant Beneficial Substance*" by the peak body in the USA responsible for all fertiliser labelling. The problem they then faced was having insisted that all silicon plant nutrient materials have a certified value on the packaging showing the analysis of plant soluble silicon, there was no standard test. The problem was solved by developing a standard extraction method known as the "5 day test" which is now applied to all silicon material marketed in the USA. MaxSil Pty Ltd has adopted this test for our MaxSil™ products so as to establish a level playing field.

Analyses

We recently had our product and competitor product analysed by a specialist laboratory in the USA using the "5 day test" and the results are shown below. Minor products such as basalt rock dust, guano and recycled plaster board have negligible levels of soluble silicon and were not considered.

Supplier	Sample	Soluble Silicon %	Soluble Silicon in parts per million
Agripower Pty Ltd	AgriSilica Diatomite	0.12%	1,200 ppm
Nutrifert Australia	Amorsil Diatomite	0.06%	600 ppm
MaxSil Pty Ltd	MaxSil™	1.52%	15,200 ppm

The results clearly show that MaxSil™ provides much higher levels of soluble silicon than competitive products. This translates to lower dose rates, lower application costs and increased efficiency

August 2021

Sustainability, Yield and Environmental results - MaxSil™

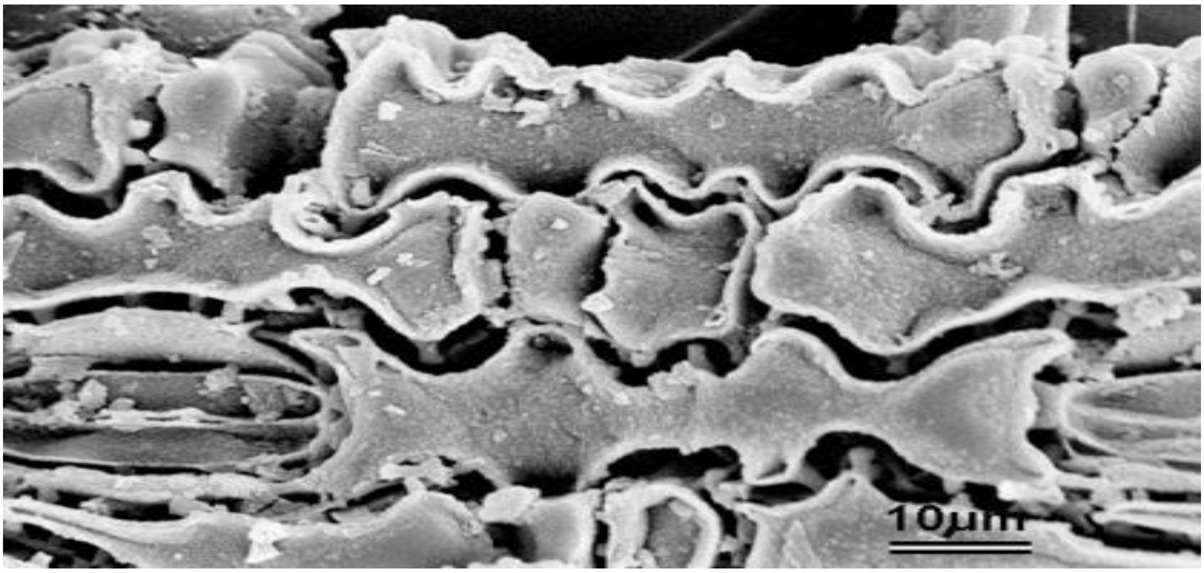
The Carbon Story

Fertiliser production has a high carbon footprint
Production of NPK fertilisers generates in excess of one tonne of CO_2-e per tonne of fertiliser produced
(Fertilizer Industry Environment Report 2011)

MaxSil™ has a low carbon footprint
Production of MaxSil™ is calculated at 268 kg CO_2-e per tonne. If up to 20,000 tonnes of MaxSil™ is used to displace an equivalent amount of fertiliser there is a net reduction of greenhouse emissions of 14,640 tonnes of CO_2-e per year.

MaxSil™ can facilitate Carbon Sequestration
Researchers from around the world and also the Southern Cross University (Australia) have discovered that a process that occurs naturally in plants (especially grasses such as sugarcane) plays an important role in countering CO_2 emissions and global warming. This process revolves around phytoliths, silicified plant cell structures created by uptake of silicon from soils. The uptake of silicon into the plant results in carbon being locked into a "silicon vault" – silicon saturates the phytoliths cell wall forming a glass-like coating of opalised silica which encases carbon. Phytoliths are very stable and highly resistant to degradation with a life cycle of over 35,000 years. Sugar cane is grown on over 20 million hectares worldwide and growing high phytoliths carbon varieties could result in the secure soil carbon sequestration of an additional 5 million tonnes of CO_2 each year. Obviously, in order for a plant to utilise soluble silicon in this manner there must be adequate levels of silicon available in the soil matrix and this is what MaxSil™ provides.

A high magnification photograph shows silicified cell walls encasing plant (carbon) material.



MaxSil™ can reduce dependence on NPK fertilisers

Application of silicon improves the uptake of standard fertilizers, particularly phosphorous. This can improve yields, but more importantly, reduces the requirement for standard Nitrogen, Phosphorous and Potassium (NPK) fertilisers which can significantly reduce farm costs, reduce the amount of fertiliser being applied to farmland (thus mitigating environmental issues such as phosphate run off).

A high percentage of phosphate applied to the soil is not available to the plant because it is not in a form that the plant can take up. Increasing soluble silicon concentrations in the soil causes transformation of plant-unavailable phosphates into plant available phosphates. This is commonly referred to as "mining the phosphate bank" in the soil and provides a major environmental benefit as well as increasing the sustainability of soil systems.

Trial work is detailed below:

Cotton field trial, Wee Waa, New South Wales, May 2012
MaxSil™ was used in comparison trials (at 50kg ha) on cotton at Wee Waa. In addition to the controls, a liquid biological product ("Great Land Bio") was trialled at the same site. Both the plot treated with the "Great Land" product and MaxSil had the NPK inputs halved. The control had full (100%) NPK input.

The crop was lost before harvest due to extensive flooding in the region but a physical count prior to this showed the MaxSil™ yield was 12% above the control and 36% above the "Great Land" biological treatment. In this instance the use of MaxSil™ allowed a 50% reduction in the normal NPK inputs and yet demonstrated higher yields.
(Trial conducted by Baird and Associates, Agronomists, Wee Waa, New South Wales 2011-2012)

Wheat field trial at Tulloona, New South Wales 2010
MaxSil™ was trialled (at 20kg ha) in a wheat crop established by Landmark in New South Wales during 2010. Of the replicates with MaxSil™ where the NP inputs were the same as the rest of the trial crop, the highest test weights were recorded. In the replicate where the NP was reduced by 50%, MaxSil™ demonstrated an additional net benefit of $3.05 per hectare.

The Landmark trial report by the Senior Development Agronomist stated **"The results for treatments 3 and 4 (MaxSil™ treatments) support the manufacturers claim that MaxSil™, a calcium silicate product, assists the plant to more efficiently utilise Nitrogen, Phosphorus and Potassium which improves quality characteristics of the end product, which in this case was the grain"**
(Landmark report NE10-07 "Cereal nutrition trial in wheat, Tulloona, NSW" 2011)

Wheat field trial Western Australia 2016
MaxSil™ granular product was slurried and diluted with water. The product was applied at an equivalent 5 kg ha over a trial block of 10 ha. The crop was damaged by frost which did not affect the area treated with MaxSil™. The treated area cropped some 500-600 kg ha over the control, a 30% increase. Further trial work will be undertaken in 2017 with well documented trial layouts and replicates. The trials will include using MaxSil™ as a foliar and granular (soil applied) application as well as trialling it as a coat for starter fertiliser granules.

MaxSil™ enhances Nutrient Uptake Efficiency (NUE) and provides resistance to Chemical and Physical ("Abiotic") Stress

Silicon has been demonstrated to protect plants from various Abiotic stresses including:

- **Metal toxicity** - by preventing the uptake of heavy metals such as manganese;
- **Salinity** – silicon increases tolerance to salt by inhibiting uptake by roots and accumulation within plant tissue;
- **Temperature variation** - increased tolerance of both low and high temperatures;
- **Frost** – increased resistance, due to strengthening of the plants structure;
- **Lodging (falling over)** – there is reduced incidence which is also due to improved structural strength.

Trial work is detailed below

Barley (pot) trial, October 2007

Barley seed was planted in pot trials into typical red soil from the Riverina region of New South Wales. Leaf tissue was analysed after harvesting at 15 days. The results showed that the sodium uptake into leaf tissue of the MaxSil™ treated plants was 60% lower than the untreated control. Enabling plants to cope with saline conditions is a known benefit of silicon and is reported in literature.

(Analytical results from NATA laboratory, SGS Agritech, Test Certificate CTW 2706304 dated 16 Nov 2007)

Corn (pot) trial November 2007

Corn seed was planted in pot trials into seed raising mix. All samples were treated with a nitrogen fertiliser at 10ml/litre and harvested on 1st December 2007. Leaf tissue analysis showed a major difference in Zinc uptake between the control and MaxSil™ treated samples. This is significant as corn is a known accumulator of this element and has further ramifications for corn production in the Third World where dietary zinc deficiency is a known problem.

(Analytical results from NATA laboratory, SGS Agritech Test Certificate CTW 2706715 dated 12 December 2007)

Barley (pot) trial January 2008

Barley seed was planted in pot trials into commercial seed raising mix. After harvesting the plants leaf tissue analysis showed a 8% increase in NPK uptake where MaxSil was included at 10 grams per pot and a liquid NPK fertiliser applied once only to all pots at 10g/litre.

(Analytical results from NATA laboratory, SGS Agritech, Test Certificate CTW2800499 dated 6 February 2008)

Peanut Field Trial April 2009 – Department of Primary Industries Research Station, Kingaroy, Queensland

An ad-hoc field trial was commenced in January 2009 at the DPI Research Station. MaxSil™ was applied as a foliar and soil application at 10kg per hectare on peanuts. The plants were hand harvested in April and the whole plants sent for tissue analysis. The results showed a large (15-17ppm as opposed to 350ppm) reduction in Zinc levels in the treated plants. The result is significant as Zinc at the levels seen in the controls can be toxic to peanut and in this instance; good levels of soluble silicon available to the plant have allowed it to selectively avoid unwanted elements in the form of excess zinc.

(Analytical results from NATA laboratory, SGS Agritech test certificate TW 09-02739 dated 3 April 2009.)

MaxSil™ increases yield

Trial work is detailed below

Sweet Corn Trial (Ausmin Pty Ltd) 2009

A field trial was established under the guidance of Ausmin Pty Ltd. The objective was to test the efficacy of MaxSil™ in conjunction with a biological treatment and in isolation against controls with a replicate test regime. The trial showed the MaxSil™ increased the nutrient uptake efficiency of the treated crop and also facilitated a 13% increase in yield.

Potato replicated field trial 2010

A field trial was established with the same MaxSil™ variant used in the onion trials detailed above. Product was applied at 100 kg ha. As with the onion trial there was a marked (10.25%) increase in marketable yield when the crop was harvested in April 2010. The net benefit to the grower was in excess of $2,000 per hectare.

(Serve Ag Pty Ltd report, "HumaSil™ in processing potatoes 09/10")

Wheat and Barley Trials, Northern NSW 2014 and 2015

Field trials were established by a leading agronomy services and agri product provider based in NSW. The trials were conducted over a period of two seasons and a number of products were compared on a head to head basis. MaxSil™ was applied at a rate of 25kg ha and the results clearly show that it facilitated a significant increase in yield and profitability. The results are particularly significant in that the viability of wheat and barley are extremely sensitive to the cost of inputs. The full trial results are separate to this document.

Potato field trial at Hinemoa in New Zealand 2014

A field trial was established with a commercial potato grower in New Zealand via our local licensee. Early sampling showed a large increase in marketable yield as demonstrated in the photographs below. This result is consistent with other trial with potato elsewhere in Australia and shows the potential for yield increase in this staple food.

Poppy field trial 2011

MaxSil™ was trialled by a large agronomy services provider, Serve Ag Pty Ltd (Tasmania) on a poppy crop during 2010-2011. Trial size was a 5 ha (control) and 3 ha (MaxSil™) treatment. MaxSil™ was applied at 100 kg ha. Yield was assessed on 15th February 2011 and showed a 23% increase in capsule yield in the treated area. The net benefit (after allowing the cost of the inputs) was approximately $1,000 per hectare

(Serve-Ag Pty Ltd report, "Silicon Fertiliser in Poppies Demonstration 2011)

Onion field trial 2011

A trial was established in late 2010 by Serve-Ag Pty Ltd with "cream gold" onion varieties. The product used was a MaxSil™ variant ("HumaSil™") applied at 100 kg ha. The crop was harvested in February 2011 and showed a 13% increase in the treated areas. This increase was largely attributable to a greater weight in the small onion grades which attract a premium price. The net benefit (after allowing the cost of the inputs) was over $1,000 per hectare.

(Serve-Ag Pty Ltd report, "Silicon Fertiliser in Onions Demonstration, 2011)

MaxSil™ in seed potato production 2010/2011/2012

A commercial seed potato grower at Crookwell (NSW) started using MaxSil™ at 50kg ha for his crop in 2010 and has been incorporating the product into his crop cycle since. The initial and now subsequent crops continue to show a 20% increase in the "pack out" (optimum yield size) rate which greatly improves the dollar return.

(Email communication Julian Minehan, Landmark agronomist at Goulburn NSW to Paul Lomax, National Fertiliser Manager, Landmark Australia)

MaxSil™ in sugar cane 2012-2018

Two farm trials were established with sugar growers in the Tully region during 2012. Both growers purchased the product so the trial was reliant on their observations. These crops were harvested during October 2013. Both growers reported an observed increase in yield and sugar content. Both growers have since repurchased MaxSil™ product for plant and ratoon cane for the 2013 season.
(Personal communication with Mr Greg Shannon, Tully Sugar Productivity Board agronomist and Mr Rod Trost, Landmark Tully)

Sugar cane trials were established with Maryborough Sugar via a distributor who used a rebranded MaxSil™ product. Quadrant sampling prior to harvest showed a significant increase in biomass. Tabulated results are show below.

MAXSIL™ AND HUMIC SG - 2013 SUGARCANE TRIAL - MARYBOROUGH QLD

Site: TINANA CREEK		**Variety: 232**			**Date: 26/03/13**							
Sample No.	Treatment	Tiller No.		Nodal Length					Stalk Diameter			
1	C	15		148	130	143	150		27.5	26	31	26.5
2	C	18		135	150	100	175		28.5	27	22	29
3	C	20		140	130	135	180		26	31	26	24
4	C	19		110	138	167	150		28	26.5	24.5	28
5	C	17		158	130	152	155		30.5	24	26 ..	24.5
6	C	11		145	160	170	162		27.5	26	24.5	25
7	C	14		144	172	150	168		28	27.5	30	30
8	C	10		115	170	140	132		25	27	24	26
9	C	15		100	125	165	115		24	28	27	25
10	C	11		145	165	175	120		26	25	24.5	28.5'
CONTROL	AVE:	15			C	AVE:	145.35			C	AVE:	25.975
11	T	12		145	152	150	162		30	26	28	27
12	T	22		180	140	100	140		24	27	29.5	28.5
13	T	13		155	165	145	142		30	27	30	25
14	T	22		150	192	168	170		26	27	29	27
15	T	19		152	145	154	140		27	27.5	27	28
16	T	22		154	152	137	168		27	27	29	27
17	T	24		148	150	160	152		27.5	27	25	27.5
18	T	24		150	145	143	152		30	22	25	23
19	T	21		145	165	180	163		28	30	25	26
20	T	22		157	162	160	165		27	28	28	23
TREATED	AVE:	20.1			T	AVE:	153.875			T	AVE:	27.0625
T-C		5.1					8.525					1.0875
CHANGE		**34**					6					**4**

C = CONTROL; T = TREATED
THE TREATED BLOCK HAD 150 KG/HA MAXSIL AND 20 KG/HA HUMIC SG APPLIED WITH THE BASE NPK GRANULE
THE BASE FERTILISER USED ON BOTH TREATED AND CONTROL WAS CK 150S (N:24.4 P:3.0 K:15.5 S:3.1)

Further sugar cane trials were established in late 2013 and 2014 with ISIS, Maryborough, Bundaberg and Tully Sugar and with Sugar Productivity agronomists at Proserpine and Ingham. These trials were in the form of comparative “strip” trials that allowed for controlled monitoring of the crop through to harvest as well as harvest yield and sugar (ccs) content. The trials were significant as they encompassed some 300 hectares of sugar cane in both new “plant” cane and ratoon (regrowth) crops monitored by the agronomists and farm managers responsible for farm assets owned and operated by the sugar mills themselves.

Sugar Cane Results 2013 - 2018 in the Childers, Bundaberg, Ingham and Tully areas

The average yield increase was in the order of 8.3 tonnes per hectare.

Company	*Farm or Block*	*Area (ha)*	*Variety*	*Crop Class*	*MaxSil™ Increase per ha (tonnes)*	*ccs MaxSil™*	*ccs Control*	*Crop age*
ISIS								
Tobins	*Wallaville*	*9ha*	*KQ228*	*1R, Plant*	*4.953*	*10.561*	*10.95*	*8*
Tobins	*Wallaville*	*9ha*	*Q232*	*1R, Plant*	*4.953*	*10.561*	*10.95*	*8*
Emdex	*8A*	*26.4ha*	*KQ228*	*1R*	*3.016*	*13.679*	*13.89*	*8*
Emdex	*29A*	*41ha*	*KQ228*	*1R*	*5.735*	*14.032*	*14.05*	*9*
Emdex	*28A*	*40ha*	*KQ228*	*2R*	*5.778*	*13.941*	*13.68*	*9*
Emdex	*20A*	*26ha*	*Q2332*	*1R*	*8.38*	*14.445*	*14.20*	*10*
Takalvan	*8523*	*13ha*	*Q240*	*1R*	*-3.14*	*13.82*	*14.03*	*12*
Takalvan	*8524*	*50ha*	*Q240*	*Plant*	*6.34*	*15.04*	*14.87*	*12*
Tully Sugar								
TSL	*Block 11B*	*4.34ha*	*Q200*	*7R*	*8*	*14.4*	*14.12*	*10*
TSL	*Block 11C*	*6.36ha*	*Q200*	*3R*	*4.5*	*14.5*	*14.8*	*10*
Camilleri	*Block 4A*	*4.49ha*	*Q200*	*5R*	*9.5*	*17.52*	*17.51*	*11*
Henry	*Block 05A*	*14ha*	*Q200*	*5R & 4R*	*8.5*	*13.50*	*13.70*	*11*
*Henry ** 2015*	*Block 05A*	*14ha*	*Q200*	*6R & 5R*	*7*	*14.93*	*14.96*	*11*
Musumeci	*Block 3G*	*5.3*	*Q200*	*7R*	*10.5*	*16.84*	*16.65*	*11*
Bundaberg	*10A*	*20.8*	*KQ228*	*2R*	*9.47*	*13.73*	*14.11*	*10*
Sugar	*11A*	*27.96*	*KQ228*	*2R*	*0.77*	*14.06*	*14.06*	*10*
CRT Ingham								
Farm 1		*1ha*	*Q232*	*Plant*	*24.21*	*13.6*	*12.9*	*10*
Farm 2		*1ha*	*Q208*	*Plant*	*22.54*	*15.3*	*14.5*	*11*
Abbington Qld		*1 ha*	*Q208*	*4R*	*16.9*	*14.9*	*14.33*	*11*
(Bundaberg)								

(Yield reports received from ISIS Sugar Ltd and Bundaberg Sugar Ltd, August 2014, Tully Sugar late 2015 and mid 2016, CRT Ingham in early 2016)

***** The results from Henry 2015 harvest are significant in that no MaxSil™ was applied to the crop in that year. The yield increase was facilitated by a carryover effect of the product applied the previous year. Also significant is that the soils were tested and were not silicon deficient.***

MaxSil™ in rice 2016 – Australia and India

Product was supplied to a large India agribusiness who trialled MaxSil™ on rice at East Midinapur in West Bengal. Yield increases ranged from 7.35% at a dose rate of 30kg per acre up to 11.27% when MaxSil™ was applied at 50kg per acre.

The trial data is as follows:

Crop: Paddy Boro **Location: East Midinapur, West Bengal**
Date of transplanting **2.02.2016**
Date of Application **16.02.2016**
Date of harvesting **28.04.2016**

Treatment	**Plot size**	**Dose per acre**	**Control Yield acre**	**Treated Yield acre**	**Yield growth**
P1T1	11,500 sq ft	30 kg	2,040 kg	2,190 kg	7.35%
P1T2	11,500 sq ft	40 kg	2,040 kg	2,265 kg	11.03%
P1T3	11,500 sq ft	50 kg	2,040 kg	2,270 kg	11.27%
P1T4	11,500 sq ft	0	2,040 kg	2,040	0.00

Rice in the Mackay area – 2016 harvest
MaxSil™ was applied at 120 kg ha to a 40 ha upland rice crop (irrigated) in the Mackay area during 2015. The grower applied product across the entire crop which was not an ideal trial situation. He did comment however that his crop was the stand out in the district despite some losses at harvest.

Rice in the Mackay area – 2017 harvest
The same grower identified in the 2016 harvest replanted for the 2016 season. He had applied MaxSil early in 2016 but did not sow a crop at that time. He eventually planted rice in late 2016. The crop was harvested in January 2017 and the untreated areas yielded 5.8 t ha with the MaxSil treatment showing 7.6 t ha. This was a 30% yield increase

Sugar Cane (Ratoon) in the Bundaberg area 2018 harvest
A trial on ratoon cane was established in late 2017 and harvested during mid-2018. The MaxSil treatment conferred a 19.7% (16 tonne) increase with a 4% (.57) increase in ccs.

Sugar Cane (Plant cane) in the Bundaberg area (planted April 2018)

At 188 DAP the treated areas showed a significant (46%) increase in Top Visible Dewlap over the control

As of July 2019, this crop is yet to be harvested. The TVD assessment is summarised in the table below

Table 3. TVD assessment

No.	Treatment	Rate (kg/ha)	TVD (cm)
			188DAP
1	GSP	Nil	19.75 a
2	GSP + MaxSil	105	28.94 b
		t Stat	-5.43813
		P(T<=t) two-tail	0.000286

DAA = Days after application

Control, no additions at 188 DAP

GSP + MaxSil @ 105 kg/ha at 188 DAP

Spinach Tasmania 2018
This crop was harvested in August 2018. The result was an increase in the MaxSil treated area of 160 kg per ha which is a significant increase in yield. The grower estimated the value of the increase in the order of $8,000 per ha.

Truss Tomato Bundaberg 2018
This crop was harvested in September 2018 and showed a number of positives, namely a 16.6% increase in total yield and a 10% increase in marketable yield. This increase equates to a dollar value of approximately $4,000 per hectare

Capsicum Bundaberg 2018
This crop was harvested in September 2018 and showed the MaxSil treatment conferred a numerical increase in vigour, red capsicum product and a 23% increase in yield of red capsicum. There was also a 81.5% decrease in unmarketable red fruit from the MaxSil treated plots. The result equates to an increase of approximately $6,000 per hectare.

Zucchini, Gatton Queensland May 2018
The zucchini trial showed and increase of 1.8 good fruit per ten plants with the MaxSil treatment. This equates to an additional 2,250 plants per ha with an average weight of 220 grams each or 495 kg per hectare. This equates to approximately $643 per ha in dollar terms.

The MaxSil treatment also reduced the number of distorted and insect damaged plants

MaxSil™ increases resistance to Pests and Disease ("Biotic Stress")

Silicon increases the ability of plants to resist many types of pests and diseases which not only indirectly improves yield, but can also reduce the need for the application of pesticides. The yield improvement increases revenue, the pesticide reduction reduces costs. The increased resistance to pests and disease is due to an accumulation of silicon in the plant walls which creates a barrier to chewing insects, the development of a physical barrier to infection by bacteria and fungi and the biochemical stimulation of host defence responses.

Silicon therefore provides major environmental and sustainability benefits by reducing the need for chemical fertilisers

Trial work is detailed below

MaxSil™ in seed potato production 2010-2012
The most recent crop grown by the seed potato grower mentioned above was inspected in July 2012 by the local Landmark Agronomist who commented that in addition to the substantial yield increases noted above **"the grower has had low insect pressure from green peach aphids, aphids and potato moth and no insecticides have been applied last year and this season so far. The MaxSil™ appears to improve the plant health and improves the flow of nutrients throughout the plant (efficiency of the nutrient metabolism) – although only an observation"**
(Email communication Julian Minehan, Landmark agronomist at Goulburn NSW to Paul Lomax, National Fertiliser Manager, Landmark Australia)

MaxSil™ in sugar cane 2013
One of the largest sugar producers in Australia is Maryborough Sugar Limited. They conducted a replicated trial which commenced in mid 2012. The crop was harvested in August 2013 and showed no statistical difference in yield between the treated and untreated crop. What it did demonstrate however was a statistically significant

(40%) reduction in the incidence of the cane disease known as “orange rust”. This disease has the potential to reduce crop yields by over 40% so the results are significant and coincide with the published literature on efficacy of silicon to control pests and disease in sugar cane.
(Report on “Mean USDA Rust Rating” by the Senior Extension Officer, Maryborough Cane Productivity Services, February 2013)

USDA rust ratings MaxSil™ strip vs untreated

	19th February 2013		**14th March 2013**	
	Treated	Un-treated	Treated	Un-treated
Mean	8.70	14.86	1.11	2.20
Standard Deviation	11.11	11.25	0.76	1.26

Executive summary on the claims related to MaxSil

by Zed Rengel, Professor of Soil Science and Plant Nutrition, University of Western Australia

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 extensive 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.

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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
4th June 2021

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).

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