Trial Report

HumaSil™
In Processing Potatoes

September 2009 – April 2010

SERVE-AG

Contents

Trial Objective

This trial was commissioned by Advanced Plant Nutrition Pty Ltd to investigate the role of the silicon-based fertiliser product HumaSil™ on productivity of a processing potato crop in northern Tasmania.

The key goal of the trial was to determine if application of HumaSil™ improved crop productivity and led to an increased financial return to the grower.

The trial comprised replicated plots of treated and untreated (control) potatoes and assessment components included crop yield; soil nutrient testing; and plant sap testing. Pest and disease incidence was also observed throughout the trial.

The trial began October 2009 and concluded at crop harvest in April 2010.

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Location and Grower

The trial was carried out on the property of 'Addison Farm Produce' (D & R Addison), 340 Oppenheims Rd, Moriarty, Tasmania 7310.

The site was the 'Long Gum' paddock, southwest of the main house and machinery sheds. The paddock covered approximately 11.5 hectares and was a well-drained ferrosol. It faced north, and whilst it had several undulations, it generally sloped from the southeast corner down to the north and west boundaries.

Image courtesy of Google Earth.

Specific details of the site are presented in the table below.

Table 1. Site details

Grid reference	475475 5464550
Soil type	Ferrosol
Crop	Processing potatoes grown under contract for McCain Foods (Australia) Pty Ltd
Variety	McCain 1
Trial design	Random design, replicated plots
Replicates	Three
Plot size	100m x 25m
Plant spacing	5 plants per m (approx 200mm spacing between each)
Planting date	28th October 2009
Harvest date	29th April 2010
Irrigation	Supplied by a pivoting linear irrigator. The area where the trial was conducted was watered by the irrigator in linear move operation, which offered a higher degree of uniformity compared to the section of the paddock watered by the irrigator in pivot move operation.

Materials and Methods

Products

The HumaSil™ product used in the trial was supplied by Advanced Crop Nutrition Pty Ltd (APN). It was formulated as a granular product of dark brown to grey colour.

According to APN, HumaSil™ is based upon the proprietary product MaxSil™ which contains highly concentrated levels of silicon. The HumaSil™ was manufactured using 20% MaxSil™ w/w, giving a final soluble silicon content of approximately 1,600ppm. MaxSil™ has been granted certification as an 'allowed input' by the Biological Farmers Association.

Site Details

Ground preparation was undertaken two hours before planting and consisted of a 'one pass' operation involving a rip and power harrow.

Planting of the seed, drilling of the base crop fertiliser and moulding of the rows were undertaken in one pass.

Pre-trial Information for the Site

Previous land use:

2009	Beans (processing) followed by short term ryegrass
2008	Onions
2007	Annual ryegrass
2006	Poppies
2005	Peas (processing)
2004	Potatoes (processing)

Trial Layout

The HumaSil™ treatment was applied over three replicates, and matched by three untreated or 'control' replicates. Each replicate measured 25m wide by 100m long. This gave a total treated area of 7500m^2. At the application rate of 100kg per Ha, a total of 75kg of HumaSil™ was used.

Application to each of the treated replicates was carried out using a hand-operated Maruyama MG10 fertiliser spreader to ensure even distribution of the product prior to planting.

Coordinates for the six replicates are shown in Table 2 (using Australian Map Grid datum).

Table 2. Site locations

Replicate	Southeast corner	Northeast corner	Northwest corner	Southwest corner
1	457419 5434270	457437 5434368	457412 5434373	457394 5434276
2	457394 5434276	457412 5434373	457388 5434378	457368 5434285
3	457368 5434285	457388 5434378	457361 5434386	457345 5434296
4	457437 5434368	457455 5434471	457430 5434475	457412 5434373
5	457412 5434373	457430 5434475	457406 5434479	457388 5434378
6	457388 5434378	457406 5434479	457382 534484	457361 5434386

Treatments

The HumaSil™ product was applied at the rate of 100kg per hectare, as requested by Advanced Plant Nutrition.

Table 3. Treatments

Treatment	Products and active ingredients	Rate of application	Application Details
HumaSil™	Silicon at approx. 8000ppm	100kg / Ha	Applied once as a pre-spread fertiliser, two days before planting. The product was then incorporated into the soil during the one-pass cultivation and planting operation.
Control	No treatment		

Crop Inputs

Table 4 lists all nutrition inputs for the life of the crop.

Table 4. Crop nutrition inputs

Treatment	Products and active ingredients	Rate of application	Application Schedule
Pre-spread fertiliser	Muriate of Potash K: 50%	250kg/ha	25/10/09
Banded fertiliser at planting	9-14-17 N: 9% P: 14% K: 17%	1875kg/ha	27/10/09
Over crop fertiliser	Urea N: 46%	125kg / Ha	14/12/09
Over crop fertiliser	Urea N: 46%	125kg / Ha	4/01/10
Over crop fertiliser	Urea N: 46%	125kg / Ha	18/01/10
Over crop fertiliser	Supa K30 K: 30%	7.5L/ Ha	22/01/10
Over crop fertiliser	Urea N: 46%	125kg / Ha	1/02/10

Assessments

The assessments to be conducted are detailed in Table 5.

Table 5. Assessment components

Type of Assessment	Available levels of key nutrients in the soil-water solution (particularly P, K and Ca)
Date	Pre-planting and post-harvest
Method	Random collection of twelve soil samples per replicate from two treated and two control replicates, aggregated into one sample per replicate and submitted for laboratory analysis
Details	AgVita Analytical's ExpressSoil® test
Type of Assessment	Levels of N, P and K in plant sap
Date	Eight weeks after planting and twelve weeks after planting
Method	Random collection of thirty plant tissue samples per replicate from three treated and three control replicates, aggregated into one sample per replicate and submitted for laboratory analysis
Details	AgVita Analytical's Nu-Test test
Type of Assessment	Pest and disease incidence
Date	Eight weeks after planting and twelve weeks after planting
Method	Visual assessment of twenty plants chosen at random from three treated and three control replicates
Type of Assessment	Yield
Date	End of crop
Method	Lift all potatoes from four 3m plots per replicate and grade according to current McCain specifications
Details	Total weight and tuber count recorded, plus weight and tuber count of different size grades (as per current McCain specifications).

Results and Discussion

Soil nutrients analysis

Soil chemical tests were undertaken prior to planting and bed preparation and again post harvest to compare and contrast differences in the levels of available nutrients of the treated and control plots. All crop fertiliser inputs other than the HumaSil™ were applied equally across the trial site.

The results of the soil tests were averaged and are presented in Table 6. While changes in the levels of some nutrients were comparable for both treatments, changes in the key nutrients phosphorus, potassium and calcium were highly variable and showed no common trend.

Soil calcium levels declined quite considerably in the treated plots (-36.75 mg/kg) compared to the control which increased (+11.5 kg/ha), although no calcium had been applied to the crop over the trial period. The opposite was observed for potassium which increased in the treated area (382.55 to 387.75 mg/kg), and decreased in the control (448.65 to 445.3mg/kg). For both of these nutrients however the differences found are minor when compared to the total amount of nutrients present within the soil and thus site variabilities are likely to have contributed to the results.

The changes in phosphorus levels however, are more considerable with regard to overall nutrient levels. Phosphorous levels showed a small increase in the treated plots (24.15 mg/ka to 26.75 mg/kg) and a slightly larger increase in the control areas (20.75 mg/kg to 27.9 mg/kg). This may be due to the plants in the treated area extracting more phosphorus from the soil than those in the control, which is supported by the higher yield obtained (see “Yield analysis” section), but not supported by the sap test results (see “Plant sap analysis” section).

Table 6. Soil test results

	Phosphorus (mg/kg)	*Potassium* (mg/kg)	*Calcium* (mg/kg)	*Nitrate* (mg/kg)	*Magnesium* (mg/kg)	*Zinc* (mg/kg)	*Boron* (mg/kg)	*Iron* (mg/kg)	*Copper* (mg/kg)	*Sodium* (mg/kg)	*Sulphur* (dS/m)	*Total Carbon* (%)	*pH* (1:5 soil:water)	*Chloride* (mg/kg)
Treated														
Before planting	24.15	382.55	2442.7	19.85	345.8	1.63	1.96	44.64	3.43	91.95	14.25	4.35	6.39	49.6
Prior to harvest	26.75	387.75	2405.95	37.15	310.15	1.51	0.81	47.46	3.26	86.5	15.05	4.21	6.25	68.5
Difference	+2.6	+5.2	-36.75	+17.3	-35.65	-0.13	-1.15	+2.82	-0.17	-5.45	+0.80	-0.14	-0.14	+18.90
Control														
Before planting	20.75	448.65	2383.95	19.85	348.1	1.565	1.87	47.02	3.24	83.25	16.5	4.17	6.34	44.9
Prior to harvest	27.9	445.3	2395.45	30.10	305.1	1.45	0.815	46.49	3.08	80.85	13.65	3.83	6.41	60.25
Difference	+7.15	-3.35	+11.5	+10.25	-43.00	-0.12	-1.05	-0.53	-0.16	-2.40	-2.85	-0.34	+0.08	+15.35

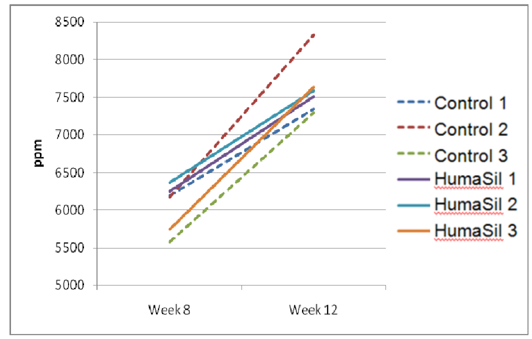
Plant sap analysis

Sap nutrient tests were undertaken for all treated and control plots 8 and 12 weeks after planting. The sap levels for potassium and phosphorus showed similar results and trends for both the control and treated plots and surprisingly had no relationship to the increased yield of the treated plots compared to the control plots (see "Yield analysis" section).

The sap levels for nitrogen were particularly variable for the control plots but much more consistent in the treated plots. This may have contributed to the differences in crop yield and thus further investigation could be useful.

Potassium

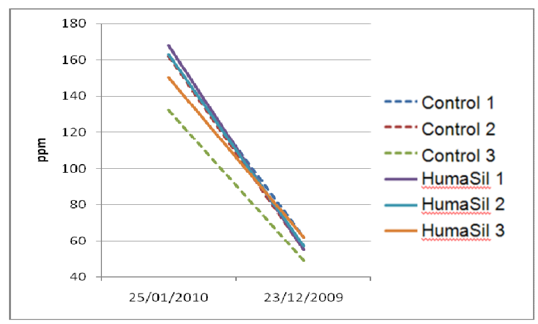
For both the treated and control plots, the sap tests taken at week 8 were below desirable levels. At week 12 all potassium levels were similar with the exception of one of the control plots which was quite high and above the desirable level of 8000ppm.



Graph 1: Sap levels of Potassium 8 and 12 weeks after planting

Phosphorus

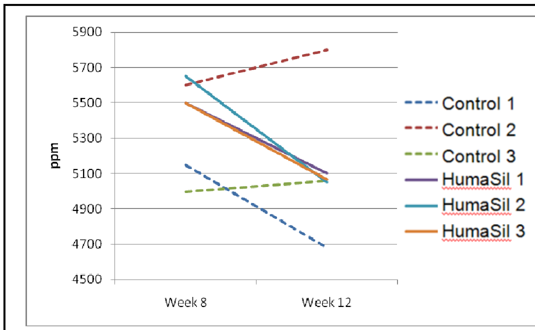
Both the treated and control replicates showed phosphorus levels at week 8 close to the upper limit of the desirable range of 170ppm. At week 12 all results were closely grouped and around the lower end of the desirable range.



Graph 2: Sap levels of Phosphorus 8 and 12 weeks after planting

Nitrogen

The sap tests for nitrogen found very high levels of variability in the control plots at both the week 8 and week 12 assessments. By contract the levels were much more stable for the treated plots at both periods.



Graph 3: Sap levels of Nitrate 8 and 12 weeks after planting

Pests and Disease

Published research has shown that silicon can protect plants from biotic stresses including insect pests and pathogenic diseases. Results from research conducted locally on potatoes (cv. 'Russet Burbank') by the Tasmanian Institute of Agricultural Research suggested that silicon may enhance the resistance of plants to late blight.

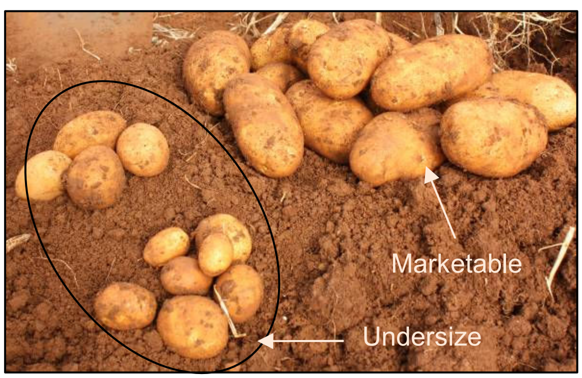
During our frequent site visits and the yield assessments, there were no observed differences in pest or disease damage between treatments on either the potato foliage or tubers. Overall disease pressure throughout the crop was low and incidence of Common and Powdery Scabs on tubers were also low.

It should be noted the McCain 1 variety used in this trial has been bred to exhibit enhanced resistance to a range of diseases, particularly late blight. It is likely this attribute had a significant influence on disease levels throughout the life of the crop and had a different variety been used in this trial a higher disease incidence may have been observed.

Yield response

Potato yields across all plots were determined by harvesting four 3.0m strips in each plot. Plant stem numbers were recorded and all potato tubers were removed from the soil, cleaned, graded, counted and weighed according to McCain's specifications, being:

- Undersize (tubers <100g)
- Marketable yield (tubers >100g).



Stem numbers

Potato stem numbers were counted for each plot as anecdotally it is thought that less stems per plant correlates with fewer tubers with a greater overall weight, whilst a higher number of stems per plant correlates with more tubers with a lower overall weight.

The results showed a significant difference (P=.027) in the mean number of plant stems for the two treatments, with the control plants having a greater number of stems (36.75 per 3.0m strip) compared to the treated plants (32.22 per 3.0m strip). See Table 10.

Tuber numbers and weights

The average number of tubers in the 3.0m strips was comparable between both the control and treated plots. The control plots had slightly higher tuber numbers, however the difference was negligible and not statistically significant.

There was however a significant difference (P=0.033) in the mean weights between treatments, with an overall greater yield of marketable potatoes found in the HumaSil™ treated plots (18.48kg compared to (16.76kg), as shown in Table 7.

Table 7: Yield data (average for 3m strips)

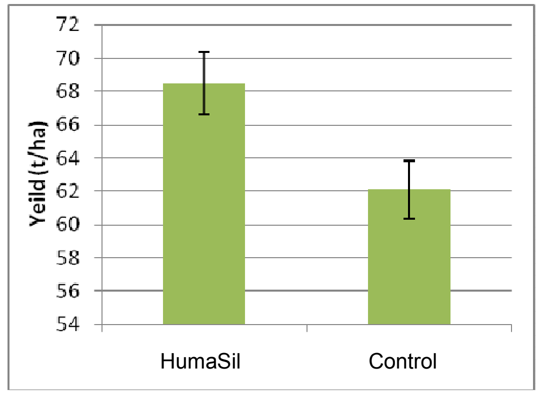
	Control	HumaSil™	P=
No. Stems	36.75	32.33	.027
No. Tubers			
Mean no. tubers	84.00	82.91	ns
Undersize	11.67	10.75	ns
Marketable	72.33	72.17	ns
Weight of tubers			
Mean weight (kg)	17.40	19.09	.033
Undersize (kg)	0.64	0.60	ns
Marketable (kg)	16.76	18.48	.021
Estimated yield (t/ha)	62.09	68.46	.021
Estimated gross return ($/ha)	$18,968.50	$20,915.90	.021

ns=not significant

Estimated gross return

Growers of processing potatoes are paid primarily on yield of marketable potatoes, minus defects and quality parameters such as bruising and specific gravity for frying. No post-harvest assessments of such defects and quality parameters were undertaken in this trial.

The mean weight of the marketable tubers treated with HumaSil™ in this trial was 1.72kg greater than the control per 3.0m strip. This equates to an estimated yield increase of 6.37 tonnes per hectare compared to the control, which is a very positive result.



Graph 4: Estimated marketable yield. Bars represent the Standard Error.

Based on the 09/10 contract price offered by McCains of $305.50 per tonne, the 6.37 tonnes per hectare difference in the estimated yield for the HumaSil™ treated potatoes equates to an increased gross return of $1947.40 per hectare to the grower compared to the control.

As the HumaSil™ product was still under development at the time of this trial, retail pricing was not confirmed and thus it was not possible to calculate an accurate cost:benefit analysis. As an indication however, Advanced Plant Nutrition suggest a retail cost in the order of $40 per hectare is likely to apply when the product is released for sale, thus the nett benefit of using the product in this trial would have been $1907.40 per hectare. No additional cost to apply the product has been included in this figure as whilst the HumaSil™ was applied by hand for the purposes of the trial, it is envisaged application would normally be carried out as part of pre-crop fertiliser spreading and thus incur negligible additional cost.