2014

Developing prescription compost to suit specific soils in Maryborough

Sugar Research Australia

Research Funding Unit

SRA Research Project Final Report

Cover page

SRA project number:	GGP059
SRA Project title:	Developing prescription compost to suit specific soils in Maryborough
Name(s) of the Research Organisation(s):	DAG Group
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A statement of confidentiality (if applicable):	

Executive Summary:
Mineral fertiliser cost and supply represent significant threats to productivity and profitability of the sugar industry. Additionally, the mobility of many mineral fertilisers in surface and ground water represent a potential risk to fresh water ecosystems and the Great Barrier Reef. One way to counter these risks and threats is to utilise alternative organic based fertiliser sources such as compost and mill mud. The nutrients in these fertilisers are released at a slower rate than they are in mineral fertilisers. It is thought that this slower release of nutrients is better matched to the temporally variable demands of the sugarcane crop. This means that the nutrients from an organic based fertiliser are potentially less likely to be lost off the field because the crop can take them up as they are released.

One issue with organic based fertilisers is the variability of the nutrient content, often the amount of nutrients is not enough or too much for the crop. This project sought to solve this problem by producing and trialling compost that has been fortified with mineral fertiliser (soil specific compost) so that it more accurately matches the needs of the crop. To achieve this goal the project had three main components; construct a compost mixer that is capable of achieving mixing mineral fertiliser into the compost, produce soil specific compost and establish a trial to test the concept.

All of these goals were achieved. A technically superior and ingenious compost mixer was constructed and this mixer was capable of producing soil specific compost. Soil specific compost was created using this mixer and a replicated plot trial was established with the following treatments; nil starter fertiliser (control) soil specific fertiliser, soil specific compost and mill mud + fertiliser (the term "soil specific" refers to nutritional recommendations based on the *Six Easy Steps* process).

The trial showed that in the plant crop there was no significant difference between the treatments in cane yield and CCS. There was a significant difference in sugar yield ($p=0.02$) with the "mill mud + fertiliser" treatment producing significantly more sugar than the "nil starter fertiliser" and "soil specific fertiliser treatments". The soil "specific compost treatment" produced significantly more sugar than the "nil starter fertiliser" treatment. In 1st ratoon there were no significant differences in cane yield, CCS or sugar yield.

An economic analysis showed that in this trial the practice of creating soil specific compost and using it as an alternative fertiliser source was uneconomic. However, it is difficult to make any definitive conclusions from the replicated trial because the exact rate of release of organic nutrients was estimated. Therefore the amount of nutrients available to the crop at a particular point in the development of the crop in each treatment is unknown. However it does show that producing soil specific compost and achieving satisfactory yields is feasible.

The long term effects of compost on soil health should be considered. As they are organic based fertilisers they are carbon based and are likely to increase the amount of soil organic carbon (albeit slowly). Soil health improvements take time so yield gains may not be realised for many years.

Finally, the project has led to another project that examines the use of compost to ameliorate sub soil constraints. A pilot trial has shown that yield responses from this amelioration are economically very lucrative.

Background:

The Delivering Agricultural Goals Group (DAG Group) are committed to improving the health of their soils, they believe that this will lead to increased productivity and resilience of their farming systems.

The DAG Group have a goal to develop compost as a standalone nutrition source for their sugarcane. They hope that this will improve soil health, yields and reduce input costs. They already made compost and constructed a novel machine that drills compost through a trash blanket for side dressing cane and soybeans (compost drilling rig). The group believed that tailoring the nutrient composition of compost to match soil requirements was their next step.

To take this next step the group needed to construct a compost mixer that fitted in well with their farming system and was able to mix mineral fertilisers into the compost rill. This would enable them to produce soil specific compost and trial it as the major nutrient source for their crop.

Objectives:

The objectives of the project as written in the project proposal are as follows:

1. Construction of a machine that mixes nutrients into compost as it lifts it into the compost drilling machine
2. A soil and compost testing regime to match the nutritional value of compost to soil requirements
3. A replicated trial to compare the sugarcane yield response and economics of DAG group compost, mineral fertiliser and banded mill mud.
4. A number of demo trials comparing compost to mineral fertiliser.
5. A value chain analysis of the composting process that includes an accurate economic analysis
6. A possible contribution to the development of guidelines for the use of compost in the sugarcane industry.

Methodology:

Construction of the mixer

The design of the mixer evolved through discussions within the DAG Group and field tours to inspect other commercial mixers. As with many "on farm" machinery projects the design was drawn on the work shop floor and filed in the farmer's brain! This does not detract from the quality or professionalism of the build. The completed mixer could easily not look out of place on a show room floor. The following photos (Figures 1,2 & 3) illustrate key components of the design.

Figure 1. *Photo of fertiliser boxes there are baffles inside to split the box into three sections, one large section for macronutrients and two small sections for micronutrients. The fertiliser is deposited on top of the rill during the mixing operation and mixed through.*

Figure 2. *Novel end tow assembly, the ball race allows the tow bar to swing between end tow operation and mixing operation (90^0). Conventional mixers cannot be towed at any speed because the mixer is folded up and is unstable during towing. Note also the castor wheel with hydraulic height control.*

Figure 3. *Hydraulic drive wheel assembly required to keep the machine running straight when mixing.*

Soil and compost testing regime
The soil in the replicated trial site and compost feed stocks were tested. This data was used to determine the nutritional requirements of the crop and to calculate the ratios of ingredients to make the soil specific compost. The composition of the mill mud was estimated from values in the literature.

Replicated trial
The replicated trial was designed and established with the following treatments:

1. Nil planting fertiliser but side-dress applied.
2. Soil specific compost (compost with added fertiliser in line with crop requirements).
3. Soil specific fertiliser
4. Mill mud + planting fertiliser

The soil specific compost was made after the fertiliser requirements for the trial were derived from soil tests and determined using the *Six Easy Steps* guidelines. The nutritional composition of the feed stocks was determined with laboratory testing. The feed stock analysis and estimate of availability (from literature) were used to calculate the amount of mineral fertiliser required for the soil specific compost (Tables 1 & 2).

Table 1. *Table showing the nutrient requirements of the soil specific compost*

Nutrient	Six Easy Steps requirements	% available in first 12 months[1]	Amount in 14 tonne/ha of compost[2]	Amount available in first 12 months	Amount of fertiliser required
Nitrogen	110 kg/ha	20%	102 kg/ha	20 kg/ha	82 kg/ha
Phosphorus	10 kg/ha	70%	27 kg/ha	19 kg/ha	nil
Potassium	120 kg/ha	80%	68 kg/ha	54 kg/ha	66 kg/ha
Sulfur	10 kg/ha	70%	20 kg/ha	14 kg/ha	nil

[1]The per cent availabilities are an estimate based on the literature

[2]The machine was calibrated to apply 14 tonnes/ha, the compost was applied was 50% water by weight

Table 2. *Table showing the nutrient requirements of the soil specific mill mud*

Nutrient	Six Easy Steps requirements	% available in first 12 months[1]	Amount in 75 tonne/ha of mill mud[2]	Amount available in first 12 months	Amount of fertiliser required
Nitrogen	110 kg/ha	20%	171 kg/ha	34 kg/ha	76 kg/ha
Phosphorus	10 kg/ha	12%	97 kg/ha	12 kg/ha	-
Potassium	120 kg/ha	18%	92 kg/ha	16 kg/ha	104
Sulfur	10 kg/ha	18%	9 kg/ha	1.5 kg/ha	8.5

[1]The per cent availabilities are an estimate based on the literature

[2]Our machine was calibrated to apply 75 tonnes/ha, the mill mud was applied was 70% water by weight

Because of the differing nutritional values of the feed stocks it was difficult to match the nutrients applied with the *Six Easy Steps* requirements, the final nutrients applied are shown in Table 3.

Table 3. *Summary of macro nutrients applied to each treatment*

Treatment	Amount applied at planting (kg/ha)		Amount side dressed (kg/ha)	Total applied (kg/ha)	Est. nutrients available in first 12 months (kg/ha)[1,2,3]
Nil planting fertiliser	N - nil P - nil K - nil S - nil		N – 70 P – nil K – 47 S - nil	N - 70 P K – 47 S	N - 70 P K – 47 S
Soil specific compost	*14 t/ha compost* N – 102 P – 27 K – 68 S – 20	*Mixed with compost* N - 30 P - 10 K - 37 S - 20	N – 70 P – nil K - 47 S - nil	N - 202 P - 37 K - 152 S - 40	N - 120 P - 29 K - 138 S – 34
Soil specific fertiliser	N – 36 P – 12 K – 44 S – 24		N – 70 P – K - 47 S - nil	N – 106 P – 12 K – 91 S – 24	N – 106 P – 12 K – 91 S – 24
Mill Mud + planting fertiliser	*Mill mud* N – 171 P – 97 K – 92 S – 9	*With planter* N – 36 P – 12 K – 44 S – 24	N – 70 P – nil K - 47 S - nil	N - 277 P - 109 K - 183 S - 33	N - 140 P - 24 K - 107 S - 26

[1]Estimated available nutrients are derived by adding the available nutrients from tables 1 & 2 with the mineral fertiliser applied.

[2]Potential phosphorus sorption was not subtracted from the available nutrients estimate.

[3]The estimate does not include residual nutrients already in the soil

The replicated trial was billet planted on the 20th October 2011 with the variety KQ228[A]. The trial was randomised and replicated four times. The trial was laid out in a Latin Square design so that the reps appeared with the rows and across the rows. This design increases the likelihood of a significant result.

The fertiliser was mixed with the compost after the compost was produced. The compost was applied to the soil immediately before planting with a machine capable of direct drilling the compost into the soil. See photos below (Figures 4 & 5):

Figure 4. *One the plots treated with compost, most of the compost is buried and placed either side of the cane stool.*

Figure 5. *Compost on the conveyer belt of the compost applicator. Note the blue mineral fertiliser granules evenly spread through the compost.*

The trial plots were 30m long and five rows wide. At harvest the three middle rows of each plot were harvested and weighed with the Sugar Research Australia weigh truck. The large harvested area would have reduced the amount of error.

After harvest of the plant crop the trial was managed in line with the rest of the farm and no further compost or mill mud was added. This farm has a limited water supply so irrigation was supplementary and not meeting the evaporative demand of the crop.

Demo trials
Since construction the mixer has been used to create specific compost for commercial crops. At the time of writing this report there had been no formal extension activities at these sites.

Economic analysis
A sophisticated spread sheet, the *Dagpost Gross Margin Calculator* was constructed to undertake the economic analysis.

Outputs:
Novel and ingenious compost mixer
A novel and ingenious compost mixer was produced that is specifically suited to a cane farming enterprise, it has the following features that are different to commercially available compost mixers:

- Produces large rills – this makes better use of the limited un-cropped land that is typical of a cane farm
- Can be towed at high speed – It is equipped with a novel end tow assembly with a ball race that allows the tow bar to swing between end tow operation and mixing operation (90^0). Conventional mixers cannot be towed at any speed because the mixer is folded up and is unstable during towing. This significantly reduces the time requirement for mixing compost rills between farms and blocks.
- Can "turn on the spot" – The mixer can turn 360^0 in a very small area. This means that better use can be made of the limited amount of un-cropped land on a cane farm.
- Is equipped with a fertiliser box with baffles inside to split the box into three sections, one large section for macronutrients and two small sections for micronutrients. The fertiliser is deposited on top of the rill during the mixing operation and mixed through.

As stated in the second milestone report it was deemed impractical to include the function of lifting the compost into a compost drilling machine with the mixer. Nevertheless the mixer is an amazing piece of engineering.

Soil and compost testing regime
The trial plot soil and compost feed stocks were analysed and the results are published in Appendix 1. The usual testing depth for soil samples is 0-15cm. We tested at this depth as well as 15-30cm. This deep testing showed us that the clay sub soil (20-30cm deep) has chemical properties that restrict root growth.

This observation led to a pilot trial in using compost to ameliorate sub soil constraints. This trial showed significant and economic yield responses so consequently a new Sugar Research Australia project has been established to further investigate this practice.

Replicated trial

The results of this trial are detailed in the tables below (Tables 4 & 5).

Table 4. *Plant crop yield results*

Treatment	Cane Yield (t/ha)	CCS	Sugar Yield (t/ha)
Nil Starter Fertiliser (control)	70.01	17.37	12.14a
Soil Specific Fertiliser	71.72	16.68	11.83ab
Soil Specific Compost	76.03	17.42	13.23bc
Mill Mud + Fertiliser	83.54	16.97	14.18c
	p=0.07	*p=0.44*	*p=0.02*

Table 5. *1st ratoon yield results*

Treatment	Cane Yield (t/ha)	CCS	Sugar Yield (t/ha)
Nil Starter Fertiliser (control)	52.6	16.4	8.6
Soil Specific Fertiliser	54.9	16.5	9.1
Soil Specific Compost	56.5	16.1	9.1
Mill Mud + Fertiliser	58.0	16.2	9.4
	p=0.075	*p=0.798*	*p=0.712*

In the plant crop there was no significant difference between the treatments in cane yield and CCS. There was a significant difference in sugar yield (p=0.02) with the “mill mud + fertiliser” treatment producing significantly more sugar than the “nil starter fertiliser” and “soil specific fertiliser treatments”. The soil “specific compost treatment” produced significantly more sugar than the “nil starter fertiliser” treatment. In 1st ratoon there were no significant differences in cane yield, CCS or sugar yield.

The lack of yield difference in the first ratoon crop could be due to two factors; the soil health benefits from the organic carbon may have been exhausted, or the yield was so low that soil health was not limiting yield. The second theory is the most likely scenario as both a lack of and an excess of water limited yield in the 1st ratoon growing season.

Demo trials

Since construction the mixer has been used to create specific compost for commercial crops. At the time of writing this report there had been no formal extension activities at these sites. However we have held a field day at the replicated trial site.

Value Chain and Economic Analysis

There was no value chain analysis performed, in retrospect it was difficult to see the value in this process.

However there has been detailed economic analysis of the new process. The calculation of costs was an extremely difficult task because of price complexities caused by the use of various feed stocks at different moisture contents and ratios to create the compost. To help with this calculation the “Dagpost Gross Margin Calculator” was developed. This calculator can be made available to Sugar Research Australia, it calculates the cost of producing the compost and compares the gross margin with conventional fertiliser use. A screen shot of the calculator is shown below (Figure 6).

DAGPOST GROSS MARGIN CALCULATOR

Intended compost application rate (wet tonnes)	14	t/ha	Expected yield without compost	71.72	t/ha	Compost mixing rate	4400	m^3/hr
Percentage chicken manure	50%		Expected yield increase from compost	4.31	t/ha	Mixes required for a batch	4	
Percentage sawdust	22%		Expected CCS	17.42		Compost spreading rate	40	m^3/hr
Percentage mill mud	29%		Sugar price	$ 400	$/t	Compost produced each year	2000	m^3
Finished compost moisture %	50%		Harvesting costs (including diesel)	$8.50	$/t			
Compost bulk density	600	kg/m^3	Diesel price	$1.20	$/lt			

FEEDSTOCK COSTS

									Cost by dry weight of feedstock: Feedstock ($/t)	Feedstock in compost ($/$m^3$)	Feedstock in compost ($/t)	Cost by wet weight of feedstock: Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
Chicken manure	$28.00	m^3	moisture %	50%	density	290	kg/m^3		$ 193.10	$ 28.00	$ 96.55	$ 48.28	$ 14.00	$ 675.86
Saw dust	$14.50	m^3	moisture %	37%	density	550	kg/m^3		$ 41.85	$ 4.95	$ 9.00	$ 3.33	$ 3.12	$ 46.61
Mill mud	$ -	m^3	moisture %	70%	density	700	kg/m^3		$ -	$ -	$ -	$ -	$ -	$ -
										$ 32.95	$ 105.55	$ 51.60	$ 17.12	$ 722.47

FEEDSTOCK TRANSPORT COSTS

									Cost by dry weight of feedstock: Feedstock ($/t)	Feedstock in compost ($/$m^3$)	Feedstock in compost ($/t)	Cost by wet weight of feedstock: Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
Chicken manure	$ -	m^3	moisture %	50%	density	290	kg/m^3		$ -	$ -	$ -	$ -	$ -	$ -
Saw dust	$ -	m^3	moisture %	37%	density	550	kg/m^3		$ -	$ -	$ -	$ -	$ -	$ -
Mill mud	$ 5.00	m^3	moisture %	70%	density	700	kg/m^3		$ 23.81	$ 4.75	$ 6.79	$ 4.75	$ 1.43	$ 1.02
										$ 4.75	$ 6.79	$ 4.75	$ 1.43	$ 1.02

ADDED FERTILISER COSTS

						Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
Nitraphoska blue	$ 800	$/t	rate applied	1	kg/m^3 of compost	$ 1.33	$ 0.80	$ 18.67
		$/t	rate applied		kg/m^3 of compost	$ -	$ -	$ -
						$ 1.33	$ 0.80	$ 18.67

COMPOST MIXING COSTS

					Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
Fuel use	12	lt/hr			$ 0.022	$ 0.013	$ 0.31
Mixer maintenance	$ 1,000	$/year			$ 0.83	$ 0.50	$ 11.67
Tractor maintenance	$ 1,000	$/year	Percent time used on mixer	20%	$ 0.17	$ 0.10	$ 2.33
Labour costs	$ 30.00	hour			$ 0.05	$ 0.027	$ 0.64
					$ 1.05	$ 0.63	$ 14.64

COMPOST APPLICATION COSTS

					Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
Fuel use	15	lt/hr			$ 0.75	$ 0.45	$ 10.50
Spreader maintenance	$ 1,000	$/year			$ 0.83	$ 0.50	$ 11.67
Tractor maintenance	$ 1,000	$/year	Percent time used on spreader	20%	$ 0.17	$ 0.10	$ 2.33
Labour costs	$ 30.00	hour			$ 1.25	$ 0.75	$ 17.50
					$ 2.25	$ 1.35	$ 31.50

	Completed compost ($/t)	Completed compost ($/$m^3$)	Completed compost ($/ha)
TOTAL COSTS	$ 60.98	$ 21.32	$ 788.29

Cost of mineral fertiliser not used in compost program	$ 274.00	
Gross revenue without yield increase from compost (less harvest costs)	$2,852.51	ha
Gross revenue with yield increase from compost (less harvest costs)	$3,023.93	ha
Extra gross revenue from applying compost	$ 171.42	
Profit or loss from applying soil specific compost	-$ 342.87	

Figure 6. *A screen shot of the Dagpost Gross Margin Calculator.*

The table below (Table 6) shows that in the plant crop the application of soil specific compost was uneconomic.

Table 6. *Economic analysis of the plant crop*

Treatment	Profit or loss compared to conventional fertiliser program ($/ha)
Nil Starter Fertiliser (control)	$208.76
Soil Specific Fertiliser	-
Soil Specific Compost	-$342.87
Mill Mud + Fertiliser	$177.02

For the purposes of this analysis we assumed all yield differences are statistically significant. Using this assumption the results show that there was a net loss of $342.87 per hectare by applying soil specific compost in the plant crop. However, the analysis does not consider the gains made by allowing the grower's allocation of mill mud to be used over a greater area. The practice was also uneconomic in the 1st ratoon crop because there were no significant differences in yield.

Contribution to the development of guidelines for the use of compost in the sugarcane industry
There has been no obvious contribution to the development of guidelines from the replicated trial. However, the mixer design and the "Dagpost Gross Margin Calculator" are useful outputs that can be used throughout the industry.

Intellectual Property and Confidentiality:

There are no Intellectual or confidentiality issues associated with this project. All outputs can be freely used by industry. The DAG Group are always willing to share their ideas with others and host visits to their farms.

Environmental and Social Impacts:

Environmental impacts
The project furthered the awareness of the use of organic based non-mineral based fertilisers on sugarcane farms. Nutrients are released from organic based fertilisers slowly and are therefore less likely to be lost from the farm. The feed stocks for compost are "waste products" such as saw dust, feed lot manure, mill mud and chicken manure, the value adding of these products is an environmentally friendly practice.

Social impacts
The philosophy of the DAG Group is to improve their yields and farming system resilience by improving their soil health. This project was in line with this philosophy. Growers from Maryborough and other areas have seen the machinery and trials, this has furthered their knowledge and offered something different for them to think about.

Expected Outcomes:

Given the functionality and practicality of the compost mixer it is reasonable to expect that the design concept will be repeated in various forms throughout the industry. This could lead to increase use of compost.

The other significant outcome is the project that explores the use of compost for ameliorating sub soil constraints. There has been research on this topic in other agricultural industries in Australia especially the grains industry. The pilot trial showed significant yield responses and we expect that this practice will significantly increase cane supply in the Maryborough area.

Future Research Needs:

Apart from the already mentioned sub soil constraint work there is no obvious additional research needs associated with this project.

Recommendations:
Sugar Research Australia should invite growers via the website to inspect the DAG Group compost mixer and the composting practices of the DAG Group. The Dagpost Gross Margin Calculator should be made available on the Sugar Research Australia website.

List of Publications:
There are no publications associated with this project.

Appendix 1. Soil, and Compost Feed Stock Test Results

Because the land is your life.

Nutrient Advantage

Standard Interpretation Status Report

Trading Name	D A G		**Field Name**	COMPOST 0-15	
Location			**Section of Field**		
Contact Name:		**GPS Latitude**		**Longitude:**	
Work Phone:		**Sample Type**	Soil	**Depth:**	0 - 15 cm
Adviser:	Mitchell Baxter	**Lab Report No:**	390679	**Sample:**	05-Jul-2011
Phone:	07 41221233	**Crop:**			
Interpretation:	25-Jul-2011	**Growth Stage:**			
Chart:	62a	**Planting:**		**Target Yield (t/ha)**	0

SUGARCANE - PLANT, Raingrown and Supplementary Irrigated (excludes Burdekin & Mareeba)

The following information and recommendations are suggested for your consideration and are the opinion of the interpreter.

Analyte	Value	Def (Plant Tests only)	Low	< Opt/Norm or Mod	Generally Satisfactory	> Opt/ Norm	High	Excess or Toxic
pH (1:5 Water)	6.10							
pH (1:5 CaCl2)	5.10							
Organic Carbon %C	1.30							
Nitrate Nitrogen mg/kg	8.10							
Sulfate Sulfur (MCP) mg/kg	8.40							
Phosphorus (BSES) mg/kg	79.00							
Phosphorus (Colwell) mg/kg	75.00							
Phosphorus Buffer Index (PBI)	110.0							
Potassium (Amm-acet.) meq/100g	0.09							
Calcium (Amm-acet.) meq/100g	5.00							
Magnesium(Amm-acet.) meq/100g	1.60							
Aluminium (KCl) meq/100g	0.10							
Sodium (Amm-acet.) meq/100g	0.40							
Chloride mg/kg	33.00							
Elect. Conductivity dS/m	0.07							
Copper (DTPA) mg/kg	0.34							
Zinc (DTPA) mg/kg	0.44							
Manganese (DTPA) mg/kg	5.70							
Iron (DTPA) mg/kg	160.0							
Zinc (BSES-HCl Zn) mg/kg	1.30							
Potassium (BSES-Nitric K) meq/100	0.36							
Liming Estimate t/ha pH 5.5	0.00							
Liming Estimate t/ha pH 6.0	0.00							
Liming Estimate t/ha pH 6.5	2.20							
Cation Exch. Cap. meq/100g	7.19							
Calcium/Magnesium ratio	3.10							
Aluminium Saturation %	1.40							
Sodium % of cations (ESP)	5.60							
Elec. Cond. (Sat. Ext.) dS/m	0.50							
Silicon(BSES) mg/kg	160.0							
Silicon (CaCl2) mg/kg	23.00							

Colour(Munsell)	Yellow-brown
Texture	Sandy Clay

Because the land is your life.

Standard Interpretation Status Report

Trading Name	D A G	**Field Name**	Compost 15-30
Location		**Section of Field**	
Contact Name:		**GPS Latitude**	**Longitude:**
Work Phone:		**Sample Type** Soil	**Depth:** 15 - 30 cm
Adviser:	Mitchell Baxter	**Lab Report No:** 390678	**Sample:** 05-Jul-2011
Phone:	07 41221233	**Crop:**	
Interpretation:	25-Jul-2011	**Growth Stage:**	
Chart:	62a	**Planting:**	**Target Yield (t/ha)** 0

SUGARCANE - PLANT, Raingrown and Supplementary Irrigated (excludes Burdekin & Mareeba)

The following information and recommendations are suggested for your consideration and are the opinion of the interpreter.

Analyte	Value	Def (Plant Tests only)	Low	< Opt/Norm or Mod	Generally Satisfactory	> Opt/ Norm	High	Excess or Toxic
pH (1:5 Water)	4.80		■					
pH (1:5 CaCl2)	4.00							
Organic Carbon %C	0.90			■				
Nitrate Nitrogen mg/kg	3.00		■					
Sulfate Sulfur (MCP) mg/kg	26.00				■			
Phosphorus (BSES) mg/kg	18.00			■				
Phosphorus (Colwell) mg/kg	13.00			■				
Phosphorus Buffer Index (PBI)	310.0					■		
Potassium (Amm-acet.) meq/100g	0.13		■					
Calcium (Amm-acet.) meq/100g	2.00				■			
Magnesium(Amm-acet.) meq/100g	2.00				■			
Aluminium (KCl) meq/100g	7.00							
Sodium (Amm-acet.) meq/100g	1.30					■		
Chloride mg/kg	320.0						■	
Elect. Conductivity dS/m	0.24							
Copper (DTPA) mg/kg	0.09		■					
Zinc (DTPA) mg/kg	0.18		■					
Manganese (DTPA) mg/kg	2.80			■				
Iron (DTPA) mg/kg	140.0				■			
Zinc (BSES-HCl Zn) mg/kg	0.64				■			
Potassium (BSES-Nitric K) meq/100	0.67		■					
Liming Estimate t/ha pH 5.5	4.60							
Liming Estimate t/ha pH 6.0	7.40							
Liming Estimate t/ha pH 6.5	10.00							
Cation Exch. Cap. meq/100g	12.40							
Calcium/Magnesium ratio	1.00			■				
Aluminium Saturation %	56.00					■		
Sodium % of cations (ESP)	10.00					■		
Elec. Cond. (Sat. Ext.) dS/m	1.80					■		
Silicon(BSES) mg/kg	110.0				■			
Silicon (CaCl2) mg/kg	24.00				■			

Colour(Munsell)	Yellow-brown
Texture	Sandy Clay

Analysis Results (DATA ONLY)

Customer GROW AG PTY LTD
UNIT 3 208 LENNOX ST
MARYBOROUGH
QLD
4650

Distributor MARYBOROUGH SUGAR
PO BOX 172
MARYBOROUGH
QLD
4650

Sample Ref DAG 3 WOOD SHAVINGS

Date Received 01/09/2011 (Date Sampled: 31/08/2011)

Sample No B057131C / PL0036

Crop DATA ONLY

Analysis	Result
Chloride* (%)	0.05
Sodium* (%)	< 0.050
Molybdenum* (ppm)	0.82
Iron (ppm)	155
Copper (ppm)	11.9
Boron* (ppm)	5.0
Zinc* (ppm)	39.0
Manganese* (ppm)	71.0
Sulphur* (%)	0.04
Magnesium* (%)	0.07
Calcium* (%)	0.27
Potassium* (%)	0.11
Phosphorus (%)	0.15
Nitrate N (ppm)	13
Nitrogen* (%)	0.33

Additional Comments

Refer to your local agronomist, Yara crop programme and all product labels for application advice. Alternatively visit the Product Information page at www.yara.com.au.

Please Note

Whilst every care is taken to ensure that the Results from Analysis are as accurate as possible, it is important to note that the analysis relates to the sample received by the laboratory, and is representative only of that sample. No warranty is given by the laboratory that the Results from Analysis relates to any part of a field or growing area not covered by the sample received. It is important to ensure that any soil, leaf, silage or fruitlet sample sent for analysis is representative of the area requiring analysis and that samples are obtained in accordance with established sampling techniques. A leaflet containing instructions on how to take soil, leaf, herbage, silage and fruit samples for analysis is available from the laboratory on request.

This report has been generated by Yara's Megalab™ software.

This laboratory has been awarded a Certificate of Proficiency for specific soil and plant tissue analyses by the Australasian Soil and Plant Analysis Council (ASPAC). Tests for which proficiency has been demonstrated are highlighted in this report with an asterisk.

Analysis Results (DATA ONLY)

Customer	GROW AG PTY LTD UNIT 3 208 LENNOX ST MARYBOROUGH QLD 4650	**Distributor**	MARYBOROUGH SUGAR PO BOX 172 MARYBOROUGH QLD 4650
Sample Ref	DAG 2 MILL MUD	**Date Received**	01/09/2011 (Date Sampled: 31/08/2011)
Sample No	B057131B / PL0035		
Crop	DATA ONLY		

Analysis	Result
Chloride* (%)	0.04
Sodium* (%)	0.250
Molybdenum* (ppm)	0.71
Iron (ppm)	3267
Copper (ppm)	20.6
Boron* (ppm)	7.0
Zinc* (ppm)	59.0
Manganese* (ppm)	800.0
Sulphur* (%)	0.04
Magnesium* (%)	0.41
Calcium* (%)	2.01
Potassium* (%)	0.41
Phosphorus (%)	0.43
Nitrate N (ppm)	6
Nitrogen* (%)	0.76

Additional Comments

Refer to your local agronomist, Yara crop programme and all product labels for application advice. Alternatively visit the Product Information page at www.yara.com.au.

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Nursery & Garden Industry Australia PARTNER

AUSTRALIAN FORESTRY STANDARD AFS/01-44-12 CERTIFIED

ASPAC CERTIFIED

Date Printed : 06/09/2011

Analysis Results (MANURE)

Customer GROW AG PTY LTD
UNIT 3 208 LENNOX ST
MARYBOROUGH
QLD
4650

Distributor MARYBOROUGH SUGAR
PO BOX 172
MARYBOROUGH
QLD
4650

Sample Ref DAG 1 CHICKEN MANURE

Date Received 01/09/2011 (Date Sampled: 31/08/2011)

Sample No B057131A / PL0034

Crop DATA ONLY

Analysis	Result
Chloride* (%)	0.71
Sodium* (%)	0.810
Molybdenum* (ppm)	13.00
Iron (ppm)	665
Copper (ppm)	132.0
Boron* (ppm)	38.0
Zinc* (ppm)	369.0
Manganese* (ppm)	535.0
Sulphur* (%)	0.49
Magnesium* (%)	0.72
Calcium* (%)	3.01
Potassium* (%)	2.26
Phosphorus (%)	0.50
Nitrate N (ppm)	40
Nitrogen* (%)	3.08

Additional Comments

Refer to your local agronomist, Yara crop programme and all product labels for application advice. Alternatively visit the Product Information page at www.yara.com.au.

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