SRA Grower Group Innovation Project
Final Report

Sugar Research Australia

Research Funding Unit

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SRA project title:	Effective use of lower mill mud rates in the nutrition program
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Executive Summary:

In 2011 Mackay Sugar changed its mud truck fleet to enable low rates of banded mill mud and mud/ash application on farm. The aim of this was to: make mill by-products available to more growers, lessen the impact of Reef Regulations by introducing an applicator capable of applying mud at rates < 100 t/ha and increase the distance mud is transported away from the mill.

MT Catherine Cooperative (a farmer group in the Wagoora district of Mackay Sugar) set about answering some of the agronomic unknowns associated with this new practice. Replicated trials (fallow plant and first ratoon) were established in 2011 to determine if one application per crop cycle of mill mud banded on the row: would provide enough phosphorus for the crop cycle, needed to be incorporated to ensure early phosphorus access by plant cane and could improve runoff water quality in ratoons relative to traditional application. Another question arose after trial establishment regarding the nutrient content and fate of banded mud residue at harvest. There was concern that the mud residue would either be blown out by extractors or end up in the cane bin.

Leaf tissue tests and cane yields (2012 and 2013 crops) indicated that sufficient phosphorus had been provided from the banded mud for two successive crops (trials are ongoing). Incorporating the mud band prior to planting did not appear to be necessary. Applying lower rates of mud in bands on the stool can reduce potential nutrient losses in runoff events. At 12 months post application mud residue on the stool contained approximately 20 % of the original major nutrients.

There is room for improvement in the commercial application of mill by-products. Firstly the rate applied was significantly different than that requested and the consistency of application was poor. This can be partly addressed by improving driver training/attitude and installing a system to monitor truck payloads. Quality of application has improved since the commencement of our trials.

The grower group uses banded mill mud infrequently because a price rise coincided with the new method of application. The group is over 60 km from the mill and pays the maximum rate which virtually matches the dollar value of phosphorus in the product. Regardless of this, all mud produced by Mackay Sugar in 2013 was utilized on farm.

Background:

Mill mud must be removed from the factory otherwise sugar production will cease. This nutrient rich by-product has been historically recycled onto sugarcane fields at variable yet relatively high rates (average recommended rate being 150 wet t/ha). For logistical and economic reasons farms within about 20 km of mills have been targeted resulting in possible excessive accumulation of nutrients in some localities.

Reef Regulations has made Six Easy Steps nutrient guidelines into law. Blocks with soil BSES P levels >50 mg/kg cannot receive mill mud or mud/ash. The benefits of using lower rates of mud- include financial and environmental but until recently it was not commercially available to a large number of growers.

Mackay Sugar is aiming for more efficient & sustainable use of mill mud which involves encouraging reduced application rates and wider geographic spread. In 2010 a modification to mud trucks enabled “precision” application of product at lower rates in 3 row bands. In 2011 the entire contracting fleet was equipped to band apply.

Growers need confidence in this new practice in terms of nutrient availability so they can “top-up” with the correct amount of fertiliser. Mill mud nutrient availability recommendations are based on extrapolation from broadcast mud at 150 t/ha and not from actual research. MT Catherine Cooperative wanted to resolve some important agronomic questions associated with this new practice and designed trials to find the answers. Questions revolved around: phosphorus availability, the effect of incorporating the product and the influence of stool application on runoff water quality?

Objectives:

The use of banded mill mud at lower rates is a relatively new practice with some unknowns (e.g. nutrient availability) which must be resolved to avoid potential negative financial and environmental consequences.

MT. Catherine Cooperative wanted to determine if one application per crop cycle of 50 wet t/ha of mill mud banded on the “grow zone”:

1. Will provide enough phosphorus for the crop cycle
2. Needs to be incorporated to ensure early P access by plant cane
3. Will improve runoff water quality in ratoons relative to traditional application.

The work undertaken will improve grower’s nutrition knowledge (including contribution to guidelines for banded mill mud use in the Central district), profitability & environmental credentials.

This project has achieved its objectives to date. Due to project lifespan, only two crops have been harvested since mud application so trials have not run for a full crop cycle. However the group will continue to fertilise (according to treatment protocol) and harvest Simpson's trial for the next two years. This will properly address the question as to whether the banded mud's phosphorus supply is adequate for four crops. Collaboration with industry including Mackay Sugar, Farmacist and SRI during the course of Mt Catherine's trial work has resulted in better understanding of banded mill mud usage, including identification of methods to improve the practice and has resulted in formulation of "Banded Mill Mud and Mill Mud/ash Guidelines." These guidelines are used by advisors and growers in the Central district. (See "Communication and adoption of outputs" section in this report)

Methodology:

Farm trials were conducted on low phosphorus soils because the major selling point of low mud rates (e.g. 50 wet t/ha) is that they will cost effectively cover P needs for most of the crop cycle. Trial 1 and Trial 2 soil phosphorus levels were: BSES P 24 mg/kg and PBI 250 and BSES P 19 and PBI 90 respectively. According to Six Easy Steps (6ES) recommendations Trial 1 should receive 20 kg P/ha in fallow plant and in each ratoon. Trial 2 should receive 15 kg P/ha in each ratoon crop.

All trials consisted of randomised, replicated (x 4 for Trial1 & x 3 for the others) strips. In those treatments receiving mud, the balance of nutrients required to meet 6ES recommendations were applied using Sucrogen Bioethanol Agservices products (dunder fortified with other nutrients). Mud was applied by Mackay Sugar mud contractors from Farleigh Mill.

Treatments which received NO fertiliser phosphorus at planting will be treated the same for the rest of the crop cycle. Treatments which received P fertiliser at planting will receive P according to soil test requirements (ignoring the mud contribution) for the rest of the crop cycle. Other nutrient needs were governed by their expected availability in mud and Six Easy Steps guidelines.

Samples of mill mud were taken within half to1 hour of application in all trials. This was achieved by pegging out 1 m2 plastic sheets (two/rep) prior to application. The "fresh weight" of mud was measured in the field (to calculate wet application rate/ha) and sub-samples taken from each sheet for fibre content, moisture content and nutrient analyses.

<u>Trial 1: JW & SW Simpson's farm 1302A, blocks 5-1, 5-2 and 6-3</u>

This trial contained 5 treatments:

T1-banded mud planted with no P fertiliser;
T2-banded mud planted with P fertiliser;
T3-banded mud, incorporated and planted with no P fertiliser;
T4-banded mud, incorporated and planted with P fertiliser
T5-and no mud control fertiliser.

Row position in the fallow was marked out using GPS guidance. Mud treatments were applied by the contractor starting on 14/7/11. Rotary hoe treatments (T3 and T4) were applied on 2/8/11. Following lime application (9/10/11) to the entire trial, it was planted to KQ228 on 11/8/11. At planting T1 & T3 received Granam at 170 kg/ha while T2, T4 & T5 received DAP at 170 kg/ha. "Top-up" nutrient application occurred on 9/11/11: treatments 1, 2, 3 & 4 received MKY100 @ 3.8 m3/ha and treatment 5 received MKY110 @ 4 m3/ha. Overhead irrigation was required to successfully establish the crop.

In 2012, fertiliser was applied to Simpson's 1R on 27th September.
T1 & T3 (mud & mud + hoe, respectively) received Econo Los at 3.6 m3/ha which supplied the following nutrients (kg/ha): N153, P0, K98 & S16 and the rest of trial received Spring 1 at 3.6 m3/ha: N152, P18, K96 & S26.

Simpson's 2R was fertilised on 19/9/13. Treatments 1 & 3 (mud & mud + hoe, respectively) received Econo LOS @ 3.8 m3/ha, which supplied the following kg/ha of nutrients: N155, P0, K98 & S16. Treatments 2, 4 & 5 (mud + P, mud + hoe + P & control respectively) received Spring 1 @ 3.8 m3/ha, which supplied the following kg/ha of nutrients: N155, P19, K97 & S27. (Note: Wilmar AgServices liquid fertiliser products had lower nitrogen content than recorded in 2012, hence higher rates were used to compensate).

Trial 2: BA & J Zamparutti's farm 1331B, block 1-3

This trial was conducted in 1R Q138 and contained 3 treatments:

T1-banded mud applied on the stool + ratooning fertiliser excluding P;
T2-banded mud applied on the stool+ ratooning fertiliser including P
T3-and no mud control fertiliser

The trial received LOS @ 3.7 m3/ha straight after harvest and then treatments 2 & 3 received superphosphate banded on the row @ 440 kg/ha on 26/9/11.
Mud treatments were applied starting on 7/9/11.

Fertiliser (MKY 170 at 4.4 M3/ha) was applied to Zamparutti's 2R on 17/10/12.
This supplied the following nutrients (kg/ha): N166, P0, K120 & S18. Although this fertiliser contained no P; there was sufficient applied as superphosphate (39 kg P/ha) in 1R to meet the needs of 2R in treatments T2 and T3. The soil test showed P requirements for each ratoon was 15 kg/ha.

3R was fertilised on 18/10/13. Treatment 1 (mud) received MKY 170 @ 4.5 m3/ha, which supplied the following kg/ha of nutrients: N163, P0, K117 & S18. Treatments 2 & 3 (mud + P & control, respectively) received MKY 190 P @ 4.3 m3/ha, which supplied the following kg/ha of nutrients: N165, P16, K111 & S27.

Trial 3: LI & JG Fox's farm 1480A, block 10-1

This trial was conducted in 2R Q208 and contained 3 treatments:

T1- mud at 150# t/ha applied conventionally (to interspace)
T2-no mud control fertiliser
T3-banded mud applied on the stool

Although 150 t/ha of mud was a "superseded" practice in Mackay Sugar, this treatment was included to show how water quality may improve with the new practice.

The entire block, in which the trial was located, was fertilised post-harvest with LOS + P @ 3.7 m3/ha (N174, P18, K98 & S27 kg/ha)

Mud treatments were applied on 4/10/11. Furrow irrigation application occurred on 22/10/11 and was designed to cause runoff as quickly as practical. V-notch weirs were installed at the ends of the trial and water samples taken when first runoff occurred and then approximately 1 hour later. An estimation of flow rate over the weir was achieved using a bucket and stop-watch. Water samples were initially stored in an esky and then frozen prior to overnight transport to laboratory for nutrient analyses.

Methodology Issues:

All three trials relied on cooperation with Mackay Sugar and the mill mud contractor for Farleigh Mill. Mud application in trials is done according to commercial practice occurring on farms.

Trial 1

The process of applying mud on Trial 1 exposed some deficiencies with the current system of which Mackay Sugar and the contractor were largely unaware. As a consequence of our trial work all parties are now aware of some important application and product consistency issues and are working to improve the system.

During the course of establishing the banded mill mud trial at John Simpson's farm (in July 2011) several important issues were discovered with respect to application. Firstly the rate applied was significantly below that requested and the consistency of application was poor. We required 50 wet tonnes per hectare but received from 26-73 t/ha (Tables 1 & 2).

The farmer was also disappointed with some of the truck driver's performance in the field. The fallow block had been marked out using GPS guidance and the drivers had been instructed to drive in the tractor wheel marks to apply the mud to the area where the cane would be planted. Some of the problems encountered included driving on the cane row area, crossing over rows, missing rows, doubling up on rows and turning well before exiting the end of the paddock.

Table 1- Trial 1: Wet Weight Mud Applied x Treatment

Treatment	Average Rate (t/ha)	Rate Range (t/ha)
T1	41	31-57
T2	36	26-47
T3	33	26-46
T4	45	28-73

Table 2- Trial 1: Wet Weight Mud Applied x Date of Application

Date of Application	**Average Rate (t/ha)**	**Rate Range (t/ha)**
14/7/11	30	26-35
15/7/11	37	28-47
20/7/11	44	26-73
23/7/11	43	28-57

Mackay Sugar (John Markley) suggested that if the drivers were travelling the “normal distance” to apply the mud then their payloads must have been lighter to give reduced rates/hectare. He suggested that fibre analyses be undertaken on the mud samples we had retained. Mackay Sugar Farleigh Lab carried out the analyses (Table 3) which show that mud fibres from the trial were well in excess of what is considered “normal” (i.e. approximately 6%).

Table 3- Trial 1: Fibre Analyses of Mud

Date	**Sample ID**	**% Fibre**
14/07/2011	T1 R1	11.36
14/07/2011	T2 R1	12.39
14/07/2011	T4 R1	11.45
15/07/2011	T4 R2	11.52
15/07/2011	T1 R2	9.84
15/07/2011	T3 R2	9.62
15/07/2011	T3 R1	10.63
15/07/2011	T2 R2	9.94
20/07/2011	T3 R3	9.10
20/07/2011	T4 R3	8.39
20/07/2011	T1 R3	8.95
20/07/2011	T2 R3	9.58
23/07/2011	T4 R4	8.32
23/07/2011	T1 R4	8.57
23/07/2011	T2 R4	9.51
23/07/2011	T3 R4	9.70
Average		**9.93**

Further evidence of the light payload problem came from the measurement of a truck load which was delivered in a pile to the farm on 26th July. A week after delivery the mud was loaded into a spreading unit (equipped with load cells) to be applied to part of the trial which had missed receiving mud. The total weight of the truck load was 8.7 tonnes (obviously some moisture loss had occurred but it's highly unlikely it was 3.3 tonnes) but Mackay Sugar works on a 12 t load being the norm. There was no system at Mackay Sugar to inform drivers of their actual payloads which is a shortcoming given the variability of mud produced.

For trial 1; using information on wet mud application rate, moisture content and nutrient content; an estimation of total nutrients (N & P) applied is achieved (Table 4). BSES 6 Easy Steps program states that 150 wet t/ha of mud/ash contains sufficient P for two crop cycles (approximately10 crops). The BSES "Australian Sugarcane Nutrition Manual" states that mud/ash contains about 300 kg P/ha. If we assume 30 kg/ha of P/crop (higher figure accounts for some inefficiencies of P uptake), then the lowest P replicates in Simpson's trial should have enough phosphorus for 3 crops.

Table 4- Simpson moisture content and nutrient analysis (Total N & P) of mud

Simpson	Moisture	N	P	Wet mud	Dry mud	Total N	Total P	Av./treatment (kg/ha)	
Treatment/Date	**%**	**%dm**	**%dm**	**kg/ha**	**kg/ha**	**kg/ha**	**kg/ha**	**N**	**P**
T1R1, 14/7/11	74.31	1.067	1.023	31000	7964	85	81	97	116
T1R2, 15/7/11	73.52	1.075	1.201	30000	7944	85	95		
T1R3, 20/7/11	76.65	1.163	1.514	39000	9107	106	138		
T1R4, 23/7/11	79.44	1.040	1.370	53000	10897	113	149		
T2R1, 14/7/11	74.77	1.047	1.080	29000	7317	77	79	102	110
T2R2, 15/7/11	74.63	1.052	1.147	44000	11163	117	128		
T2R3, 20/7/11	76.18	1.330	1.467	40000	9528	127	140		
T2R4, 23/7/11	80.00	1.035	1.088	42000	8400	87	91		
T3R1, 15/7/11	74.76	1.116	1.181	34000	8582	96	101	100	116
T3R2, 15/7/11	75.96	1.168	1.274	36000	8654	101	110		
T3R3, 20/7/11	76.96	1.203	1.523	31000	7142	86	109		
T3R4, 23/7/11	77.42	1.119	1.378	46000	10387	116	143		
T4R1, 14/7/11	74.37	1.095	1.124	32000	8202	90	92	117	133
T4R2, 15/7/11	73.82	1.054	1.164	43000	11257	119	131		
T4R3, 20/7/11	77.74	1.273	1.480	65000	14469	184	214		
T4R4, 23/7/11	78.01	1.061	1.372	32000	7037	75	97		

Trial 2

The mud was applied where requested and on the top of the stool. Although there was still considerable variation in rate applied, at least it never fell below the minimum requirement of 50 t/ha (Table 5). Fibre content of the mud was still higher than normal (Table 6) although not as variable or as high as that in Simpson's trial. Truck drivers did not want to make the same mistake (i.e. under-apply the mud) and probably overcompensated with rate. Using information on wet mud application rate, moisture content and nutrient content; an estimation of total nutrients (N & P) applied is achieved (Table 7). The lowest P replicates in Zamparutti's trial should have enough phosphorus for 6 crops (given the same reasoning as used in Simpson's trial).

Table-5 Trial 2: wet weight mud applied x treatment

Treatment	Average Rate (t/ha)	Rate Range (t/ha)
T1	63	50-75
T2	74	60-98

Table- 6 Trial 2: fibre analyses of mud

Date	Sample ID	% Fibre
7/09/2011	T1R1	9.04
7/09/2011	T1R2	7.95
7/09/2011	T1R3	8.75
7/09/2011	T2R1	9.13
7/09/2011	T2R2	8.73
7/09/2011	T2R3	8.85
Average		**8.74**

Table- 7 Trial 2: moisture content and nutrient analysis (Total N & P) of mud

Zamparutti	Moisture	N	P	Wet mud	Dry mud	Total N	Total P	Av./treatment (kg/ha)	
Treatment/Date	**%**	**%dm**	**%dm**	**kg/ha**	**kg/ha**	**kg/ha**	**kg/ha**	**N**	**P**
T1R1, 7/9/11	73.95	0.939	1.254	60500	15759	148	198	154	203
T1R2, 7/9/11	74.09	0.921	1.218	57500	14898	137	181		
T1R3, 7/9/11	75.98	1.020	1.322	72500	17415	178	230		
T2R1, 7/9/11	77.08	1.040	1.346	79000	18107	188	244	179	237
T2R2, 7/9/11	70.25	0.842	1.160	85000	25288	213	293		
T2R3, 7/9/11	75.80	0.975	1.240	57500	13915	136	173		

Trial 3

Trial 3 includes a conventional mud application treatment which is 150 wet t/ha applied to the interspace of ratoons. All Mackay Sugar contractor trucks are modified to apply mud in bands on the row. We made two failed attempts to establish the trial using the Plane Creek mud contractor (conventional truck set-up). As our mud source was close to finishing for the season (Farleigh Mill had a week's crushing remaining) we decided to apply the "conventional" mud treatment using the Mackay contractor's trucks. This was not ideal but an acceptable compromise. The difference being that mud was not confined to the interspace but was also spread across the straddled row. The "rate control" achieved by conventional application was never great but may have been slightly better than our compromised effort.

The mud application rate of T1 (conventional) did vary across the three reps and also within each rep (Table 8a). Regardless of this issue it did not compromise our trial because it did represent the variability of application experienced by growers. The important factor was that most of the mud was applied to the interspace. The application rate of T3 (banded) was also variable (Table 8b) which again is not

surprising given previous experience (variation in mud spread-ability and driver experience). The important factor was that the mud was banded on top of the stool. In the process of application a small amount of mud does splatter on the interspace. Mud samples were taken from the trial and analysed for fibre content by Mackay Sugar. They were consistent- averaging about 8% (Table 9) which is marginally higher than the norm. High fibres can mean that truck payloads are lighter and mud is applied at a lower rate than expected.

Mud samples were taken from the trial and analysed by BSES for moisture & nutrient content (Table 10). Nitrogen and phosphorus content was typical of mill mud. For the conventional treatment which averaged 112 wet t/ha (24 dry t/ha); this would contain about 320 kg/ha N and 300 kg/ha P. For the banded treatment which averaged 33 wet t/ha (7 dry t/ha); this would contain about 100 kg/ha N and 90 kg/ha P.

The trial was furrow irrigated with the intent to cause runoff in a relatively quick time-frame. Due to equipment limitations, only one replicate could be irrigated at a time. V-notch weirs were installed at the end of the block in each treatment and water samples taken from the first runoff (A sample) and then approximately one hour later (B sample). Samples were analysed for Total N & P by Queensland Health Forensic and Scientific Services.

Table-8a Fox wet weight "conventionally" applied mud

Date	Treatment & Rep	Wet Weight (t/ha)
4/10/11	T1R1A	78
	T1R1B	150
	T1R2A	117
	T1R2B	169
	T1R3A	72
	T1R3B	86

Table-8b Fox wet weight banded applied mud

Date	Treatment & Rep	Wet Weight (t/ha)
4/10/11	T3R1A	40
	T3R1B	38
	T3R2A	14
	T3R2B	42
	T3R3A	26
	T3R3B	39

Table- 9 Fox fibre analyses of mud

Date	Sample ID	% Fibre
4/10/2011	T1R1	7.88
4/10/2011	T1R2	8.12
4/10/2011	T1R3	8.23
4/10/2011	T3R1	7.03
4/10/2011	T3R2	8.11
4/10/2011	T3R3	8.73
Average		**8.02**

Table- 10 Fox moisture content and nutrient analysis (Total N & P) of mud

Fox	Moisture	N	P	Wet mud	Dry mud	Total N	Total P	Av./treatment (kg/ha)	
Treatment/Date	**%**	**%dm**	**%dm**	**kg/ha**	**kg/ha**	**kg/ha**	**kg/ha**	**N**	**P**
T1R1 conv.	79.84	1.401	1.307	114000	22985	322	300	319	296
T1R2 conv.	80.51	1.395	1.281	143000	27872	389	357		
T1R3 conv.	78.36	1.447	1.348	79000	17095	247	230		
T3R1 banded	79.58	1.422	1.305	39000	7966	113	104	99	92
T3R2 banded	78.49	1.419	1.306	28000	6022	85	79		
T3R3 banded	79.44	1.434	1.378	33000	6785	97	94		

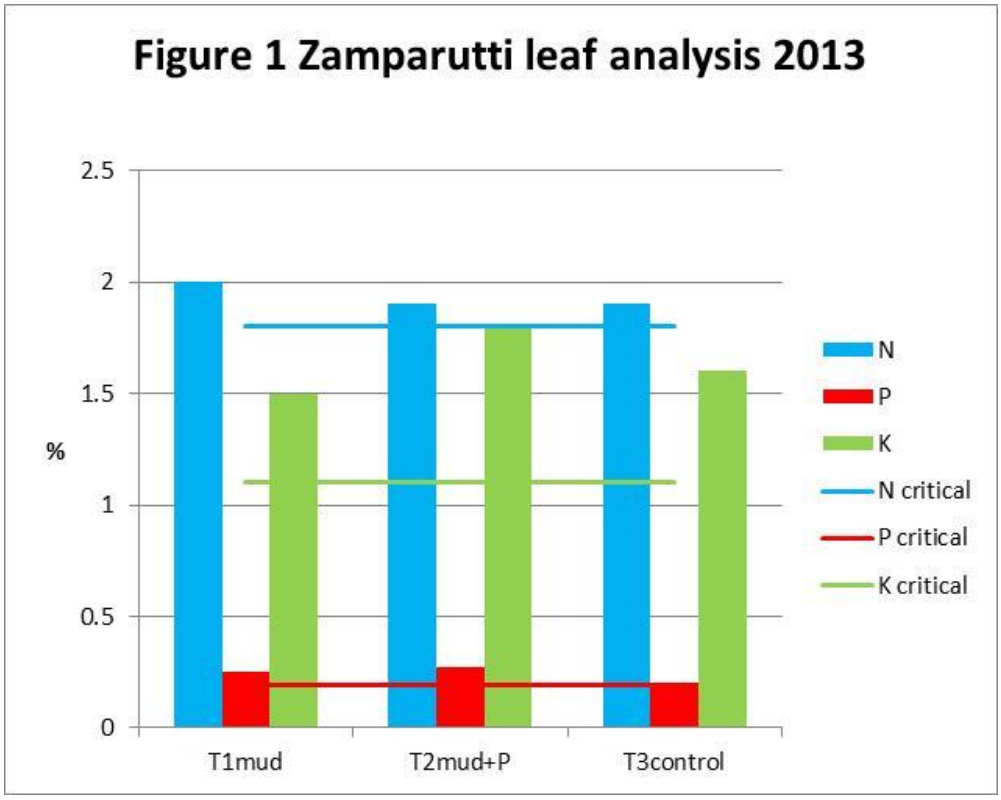
Results and Outputs:

Leaf Sample Results

All treatments in Simpson's (Trial 1) and Zamparutti's (Trial 2) were leaf sampled according to 3rd leaf protocol. Each replicate was subsampled and a combined sample representing each treatment was submitted to Incitecpivot for analysis. Results indicated that all nutrients (including phosphorus) were in adequate supply in the crops (Table 11 and Figures 1 & 2 for 2013 & 2014). Only N, P & K are displayed in Figures 1 & 2, however all nutrients in leaf samples were in adequate supply in both trials and in all treatments.

Table 11- Leaf Analyses Zamparutti (T2) and Simpson (T1) Trials March 2012

Trial	Treatment	N	P	K	S	Ca	Mg	Cu	Zn
2	T1 mud	2.1	0.25	1.6	0.18	0.42	0.2	6.3	15
2	T2 mud + P	2.2	0.27	1.6	0.21	0.42	0.2	7.2	16
2	T3 No mud	2	0.23	1.6	0.19	0.38	0.19	3.5	14
	Critical level	**1.8**	**0.19**	**1.1**	**0.13**	**0.2**	**0.08**	**2**	**10**
1	T1 mud	2.2	0.35	1.5	0.19	0.33	0.21	12	20
1	T2 mud + P	1.4	0.38	1.4	0.18	0.3	0.2	7.5	18
1	T3 mud + hoe		2.3	0.34	1.5	0.18	0.29	0.2	7.7
1	T4 mud + hoe + P		2.3	0.38	1.4	0.17	0.3	0.21	7.6
1	T5 No mud	2.2	0.33	1.5	0.17	0.29	0.19	7.3	17



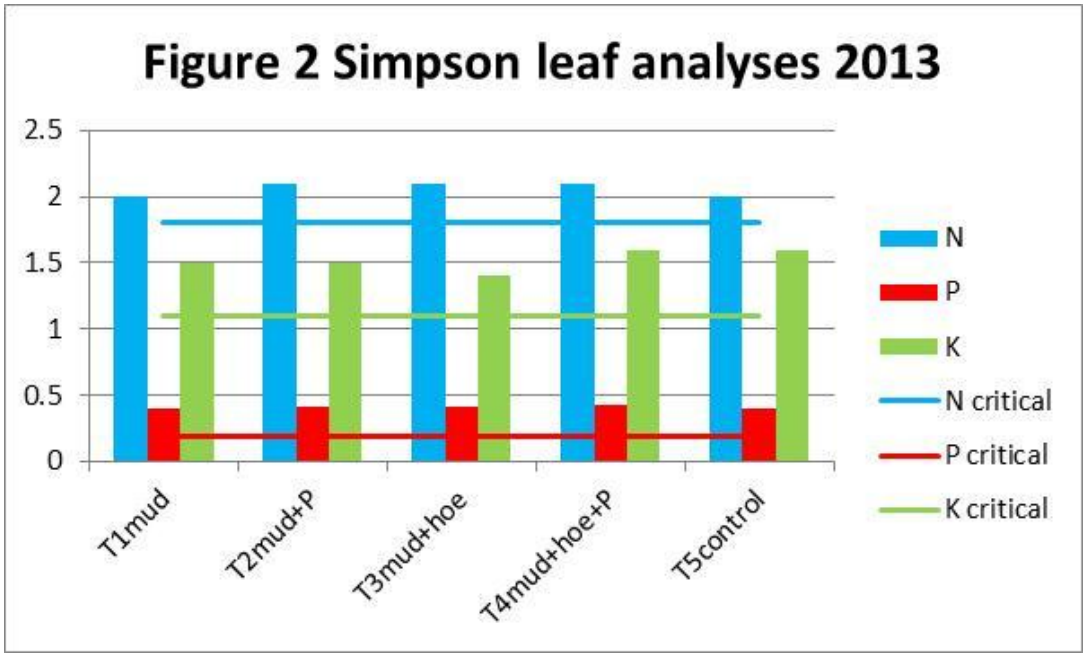


Figure 2 Simpson leaf analyses 2013
2.5
2
1.5
1
0.5
0
T1mud
T2mud+P
T3mud+hoe
T4mud+hoe+P
T5control
N
P
K
N critical
P critical
K critical

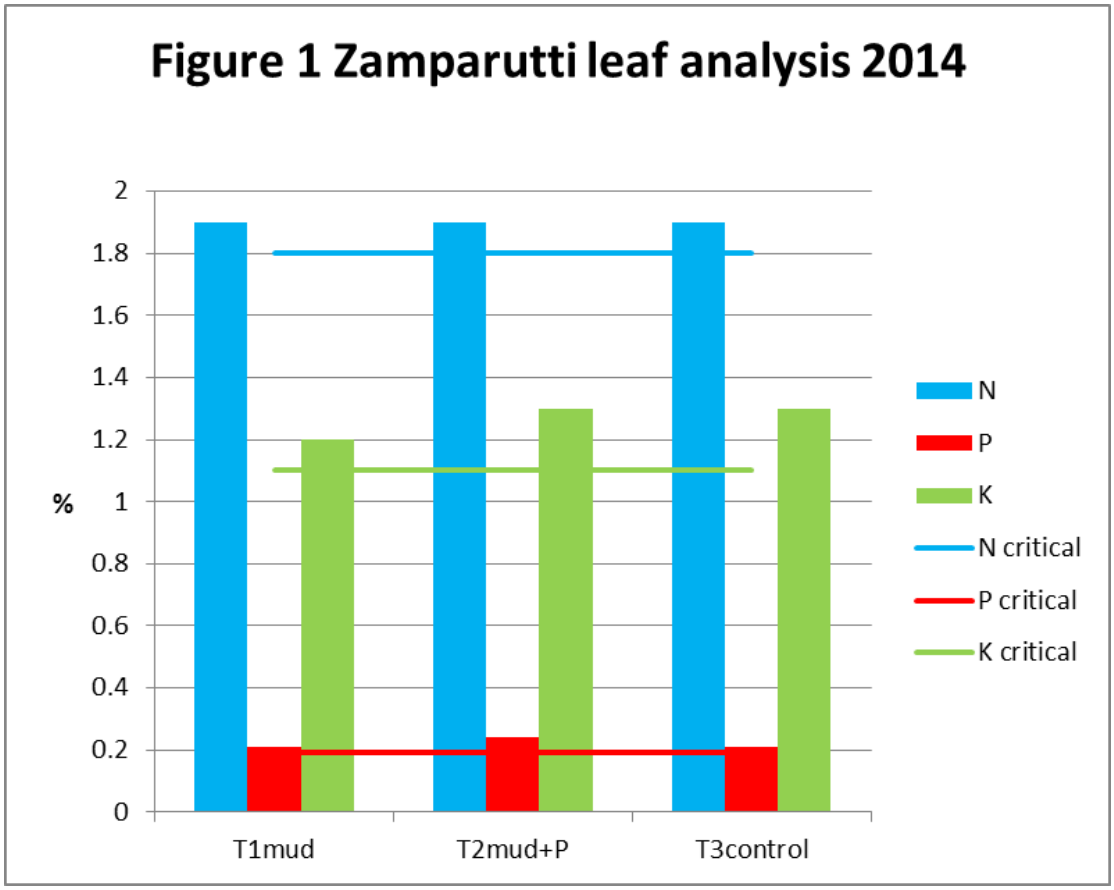
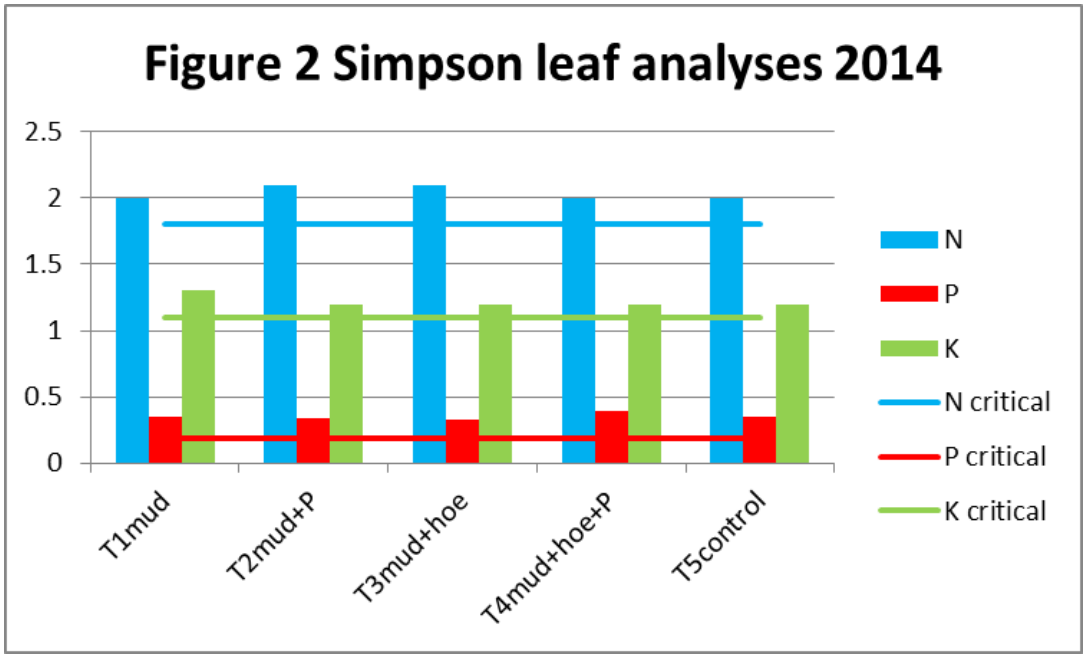


Figure 1 Zamparutti leaf analysis 2014
%
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
T1mud
T2mud+P
T3control
N
P
K
N critical
P critical
K critical



Commercial harvest

2012

Simpson's plant cane trial was harvested on 24/9/12 (Table 12)

Table 12-Cane yield, PRS and sugar yield from Simpson's trial in 2012

Treatment	Tc/ha	PRS	Ts/ha
T1 Mud	87.5	15.07	13.19
T2 Mud + P	86	15.24	13.1
T3 Mud + Hoe	90.2	15.06	13.58
T4 Mud + Hoe + P	89.5	15.22	13.62
T5 No mud control	85	15.62	13.28

Cane yield was determined using bin weights and plot area; while PRS was determined by Mackay Sugar. There was NO significant difference between any of the treatments when comparing tonnes cane per hectare, PRS or tonnes sugar per hectare. Analysis of variance tables were created for each variable using statistics software (Statistix 7.1). BSES assisted with statistical design of trial and Jo Stringer (BSES Biometrician) checked the input of harvest data, output of AOV tables and confirmed our conclusion.

Zamparutti's 1R trial was harvested on 9/10/12 (Table 13).

Table 13-Cane yield, PRS and sugar yield from Zamparutti's trial in 2012

Treatment	tc/ha	ccs	ts/ha
T1 mud	57.4	15.4	8.8
T2 mud+P	69	15.0	10.3
T3 control	55.5	14.6	8.1

Cane yield was determined using bin weights and plot area; while CCS was determined by hand sampling whole stalks which were analysed by BSES using their Spectracane unit. Mill PRS could not be determined as plot yields were generally low and produced insufficient bins. Due to selective climbing-rat damage; plots near the top of the paddock (closest to the harbourage area) suffered a greater yield reduction. An equipment malfunction on the spray-rig caused glyphosate drift which also selectively affected the plots near the top of the paddock.

Figure 3 shows trial layout and identifies plots impacted worse by rats and glyphosate drift. This figure also indicates that soil quality improves moving from the top to the bottom of the slope.

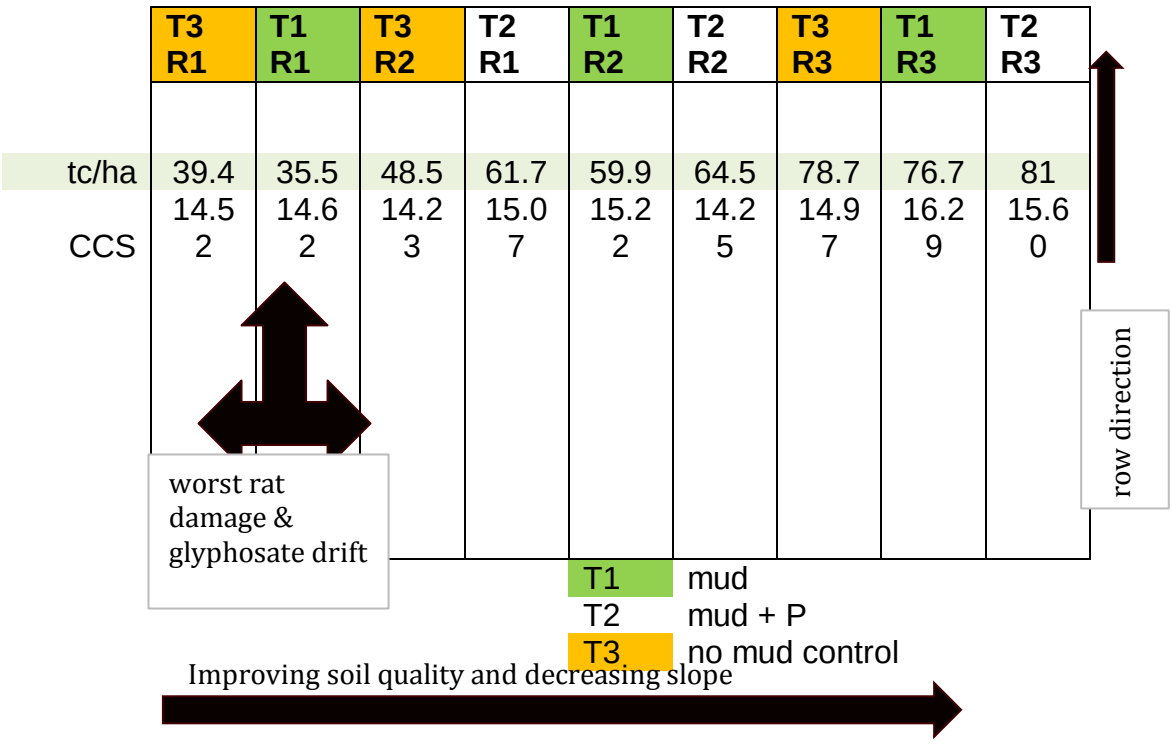


Figure 3- Zamparutti trial layout showing 2012 production per plot and selective impact of rats, glyphosate drift and soil quality.

There was NO significant difference between any of the treatments when comparing tonnes cane per hectare, CCS or tonnes sugar per hectare. Analysis of variance tables were created for each variable using statistics software (Statistix 7.1). BSES assisted with statistical design of trial and Jo Stringer (BSES Biometrician) checked the input of harvest data, output of AOV tables and confirmed our conclusion.

2013

There was NO statistically significant difference between any of the treatments (in either Simpson's or Zamparutti's trials) when comparing tonnes cane per hectare (Figures 4 & 5).

Simpson's trial was commercially harvested on 16/9/13. Only cane yield could be recorded. Due to the need for road and rail transport, some rakes from different plots were "unwittingly" split and joined with other plot bins in transit and hence PRS data was mixed up. This occurred despite correct consignment details and pre-warning Mackay Sugar of the trial harvest date, time and siding.

Zamparutti's trial was commercially harvested on 25/9/13 and due to dry seasonal conditions (in conjunction with low PAWC & no irrigation) its yield was poor. Consequently only cane yield could be collected as there were insufficient bins per rep to enable PRS testing at the mill.

It must be noted that in each trial all bin numbers were recorded and assigned correctly to each treatment/rep as they were harvested such that complete confidence is achieved in cane yields.

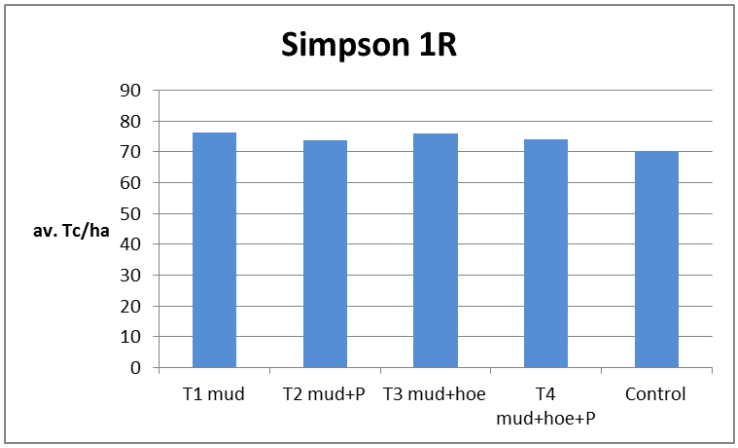


Fig. 4-Simpson banded mill mud trial cane yield 2013

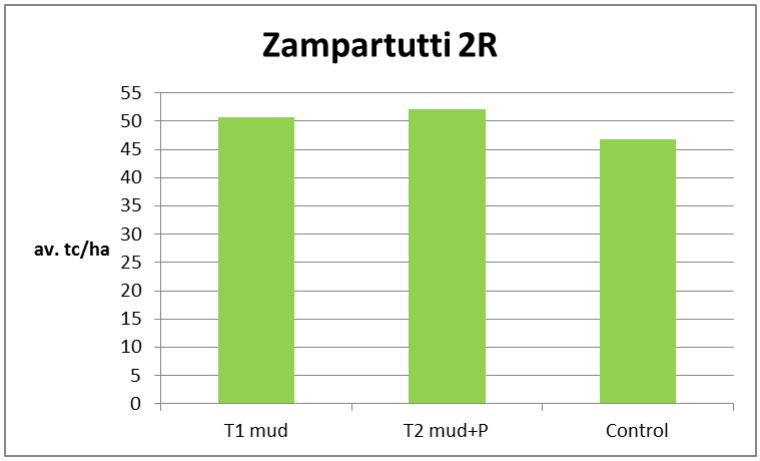


Fig. 5-Zamparutti banded mill mud trial cane yield 2013

Change in nutrient content of banded mill mud residue over time

Mud from Zamparutti's trial was sampled twice in crop to determine fate of its nutrients over time (Table 14).

Table 14-Zamparutti mill mud degradation over time within 1R (dry matter, N, P & Ca)

	At Application 7/9/11	31/05/12 (8 mths)	6/9/12 (12 mths)
	kg/ha	kg/ha (% of original)	Kg/ha (% of original)
Dry Mud	16024	4465 (28)	2966 (19)
Nitrogen	154	49 (32)	35 (24)
Phosphorus	203	57 (28)	42 (22)
Calcium	416	120 (29)	90 (23)

The mud was sitting in the paddock for about 12 months. It experienced a dry 2011 spring but over the period between application and final sampling received about 2000 mm. Although there appears to be a significant quantity of nutrients remaining in the mud residue after 12 months in the paddock (approximately 20% of original), the bulk is expected to be in the soil. At sampling, there was some contamination of the mud with worm casts, soil, trash and roots. Even though the mud samples were dried and sieved before sending to the lab it's likely that there is still some contribution of nutrient from soil and worm casts. These results concur with similar work done by Farmacist in 2011. One year after application of 100 t/ha mill mud there was approximately 15% nitrogen and 9% phosphorus remaining in the residue on stool. These results give confidence that at harvest; only low levels of nutrients remain in any mud residue on the stool. If this residue is moved in the harvesting process, then it's unlikely to have a significant impact on crop nutrition. Analysis of dirt levels in Mackay Sugar cane supply in 2012 by Farmacist found no difference between ratoons which had received banded mud and those without.

Trial 3 Results

As expected the conventional treatment samples had significantly higher nutrient levels compared to the banded and no mud treatments which were relatively similar. Results also show that nutrient load in the first flush is the highest before a tapering off occurs (Table 15).
A measurement of water flow rate over the weir was made at first runoff and approximately 1 hour later. Using this information combined with N & P concentration and extrapolating over a hectare gave a snap-shot (over two x one hour periods) estimate of nutrient loss (Table 16).
It is important to note that the magnitude of the N & P in the conventional samples may not be typical for this practice. The trial received no significant rainfall or overhead irrigation prior to the furrow irrigation (which was designed to cause runoff) and would have been a worst case scenario.

Table-15 Fox total nitrogen & phosphorus in runoff created by furrow irrigation

	Average of three reps	
	Total Nitrogen	Total Phosphorus
Treatment #	mg/L as N	mg/L as P
No mud A	2.06	0.99
No mud B	1.2	0.37
Banded Mud A	1.4	1.12
Banded Mud B	1.02	0.53
Conventional Mud A	11.93	18.5
Conventional Mud B	8.3	15.5
Irrigation Source*	0.04	0.40

 # A = first runoff, B = runoff after 1 hour
*** Irrigation source = recycling pit**

Furrow irrigation applied 18 days after mud application. No significant rain was received in the interim.
Note: entire trial fertilised post-harvest with LOS + P @ 3.7 m3/ha (N174, P18, K98 & S27 kg/ha)

Table-16 Fox estimated nitrogen & phosphorus loss in runoff

	Runoff water flow rate #		Sample concentration		Est. nutrient loss (kg/ha/hr)	
Treatment	Av. l/sec	l/ha/hr	mg/L as N	mg/L as P	N	P
No mud A	0.21	32664	2.06	0.99	0.067	0.032
No mud B	0.30	45994	1.18	0.37	0.054	0.017
Banded Mud A	0.33	50570	1.4	1.12	0.071	0.057
Banded Mud B	0.61	94932	1.02	0.53	0.097	0.050
Conventional Mud A	0.18	28394	11.93	18.5	0.339	0.525
Conventional Mud B	0.12	17832	8.3	15.53	0.148	0.277

# NOTE: furrow irrigation was applied strictly to cause runoff
A = first runoff, B = runoff after 1 hour

Intellectual Property and Confidentiality:

N/A

Capacity Building:

The groups skills in theorizing, planning, establishing, monitoring, harvesting, analysing and reporting on farm trials has improved since the commencement of GGP061. They have also been involved in formal (e.g. GIVE & shed meetings) and informal presentations and discussions about the trials workings and outputs to other growers. All group members have used commercial banded mill mud on their farms and have accounted for the value of N, P and K in calculating additional fertiliser needs.

What things have gone well in this project to date?

Excellent team work and communication of trial results have been demonstrated. As a result of our findings, Mackay Sugar representatives attended most of the AgriServ farmer shed meetings to announce improvements to banded mill mud application process in 2012 including: pro-active satisfaction surveying of mud recipients, investigation of a suitable payload monitoring system, truck driver training pre-season,

investigation of GPS guidance feasibility for trucks in paddock and feasibility of creating “out-lying” mud pads.

Environmental and Social Impacts:

The project methodology issues and results, which have already been discussed, have enhanced application practices and grower understanding of banded mud benefits to the industry and the environment.

Outcomes:

Benefits from this project include:

- Mackay Sugar was made aware of and has the opportunity to improve upon shortcomings identified during this project in the commercial application of banded mill mud

- Information generated by this project and that from a complimentary project by Farmacist; with the endorsement of SRA agronomists led to the production of “Banded Mill Mud & Mud/Ash Guidelines.”

- Knowledge that sufficient phosphorus is provided from the banded mud (av. rate <40 wet t/ha) for two successive crops; that incorporating the mud band prior to planting does not appear to be necessary; that applying lower rates of mud in bands on the stool can reduce potential nutrient losses in runoff events compared to conventional inter-row application and that after one year the mud band residue on the stool only contains about 20% of the original nutrients.

The expected benefits compare favorably with predicted. However the trial work must continue for at least two more seasons to be able to confidently claim that banded mud supplies sufficient phosphorus for a crop cycle. Simpson’s trial is robust and uniform where as Zamparutti’s is more variable due to marginal soil, without the ability to irrigate and is probably not worth continuing.

Communication and Adoption of Outputs:
(Outline any communication activities that have been conducted and any that are planned. How has SRA been acknowledged or involved? Have any lessons from the project been applied by members of the Group, or others?)

Major communication activities conducted during the project are as follows:

2012

Specific project awareness activities have been conducted between December 2011 and April 2012 including: article in AgriServ Cane News (Dec 2011) which is posted to all Mackay Sugar growers; Presentation made to Central district advisors/extension officers and industry resellers and representatives at AgriServ Trial Information day in February 2012; Presentation to growers attending GIVE Conference in Yamba (March 2012) at which our group won "Best Presentation"; Information from our trial results included in AgriServ Shed Meeting Booklet 2012 (600 copies) and presented at Mackay shed meetings during March/April 2012 (approximately 50% of Mackay Sugar growers attended the meetings) and Presentation given at CANE2U Grower Information day held at Giru in April 2012.

2013

Trial Information Day: This annual event was attended by most of the central district advisors as well as relevant government agencies. The aim was to get everyone "up-to-speed" on relevant research and development. The agenda included presentation and discussion of the GGIP mill mud trials.

Shed Meetings: John Agnew presented/discussed Mt Catherine Coop's mill mud trial results (& Farmacist's mud trial results) at 10 shed meetings. There were 133 growers in attendance. A total of 40 shed meetings were held by MAPS with an estimated attendance of 400 growers (approx. half of the farm managers in Mackay).

Shed Meeting Booklet:
Information from the GGIP was included in the Shed Meeting Booklet. Every grower at shed meetings received a copy of the booklet.

2014

The following is a list of the significant methods used to convey the trial results to industry service providers and growers:

<u>Banded Mill Mud & Mud/Ash Guidelines</u>

NOTE: Information contained in this document is based on research as well as our best predictions. It must be used as a guideline only because further work is ongoing. This information must NOT be used as part of any Government regulations.

Mud (Racecourse & Farleigh Mills)

Table 1: Typical nutrient content of mill mud & estimated available nutrients when applied at 50 t/ha banded on the row

MUD	**50 t/ha**	Estimated **available** nutrients (kg/ha)		
Nutrients	Typical nutrient content (kg/ha)	1st crop	2nd crop	3rd & 4th crop
Nitrogen	140	25	15	0
Phosphorus	140	sufficient	sufficient	sufficient
Potassium	40	10	0	0
Sulfur	15	0	0	0
Calcium (0.7 t/ha lime)	240	Calcium needs met	Calcium needs met	Calcium needs met

Table 2: Estimated $ value of mill mud applied at 50 t/ha banded on the row

	Nutrient cost	Estimated **available** nutrients & their value in **50 t/ha** mud	
Nutrient	$/kg	kg/ha	**value $/ha***
Nitrogen	1.57	40	63
Phosphorus	2.91	140	408
Calcium	0.36	240	86
Potassium	1.64	10	16
Total			**573**

* Nutrient costs are correct as of February 2012. Mud also contains smaller amounts of other nutrients & trace elements which have not been costed.

Mud/Ash (Marian Mill)

Table 3: Typical nutrient content of mud/ash & estimated available nutrients when applied at 50 t/ha banded on the row

MUD/ASH	**50t/ha**	Estimated **available** nutrients (kg/ha)		
Nutrients	Typical nutrient content (kg/ha)	1st crop	2nd crop	3rd & 4th crop
Nitrogen	100	15	0	0
Phosphorus	100	sufficient	sufficient	Check with leaf test in 3rd crop
Potassium	60	40	0	0
Sulfur	15	0	0	0
Calcium (0.5 t/ha lime)	180	Calcium needs met	Calcium needs met	Calcium needs met

Table 4: Estimated $ value of mud/ash applied at 50 t/ha banded on the row

	Nutrient cost	Estimated **available** nutrients & their value in **50 t/ha** Marian mud/ash	
Nutrient	$/kg	kg/ha	**value $/ha***
Nitrogen	1.57	15	24
Phosphorus	2.91	100	291
Calcium	0.36	180	65
Potassium	1.64	40	66
Total			**446**

Guidelines: when using **50** t/ha mill mud or mud/ash banded on row:

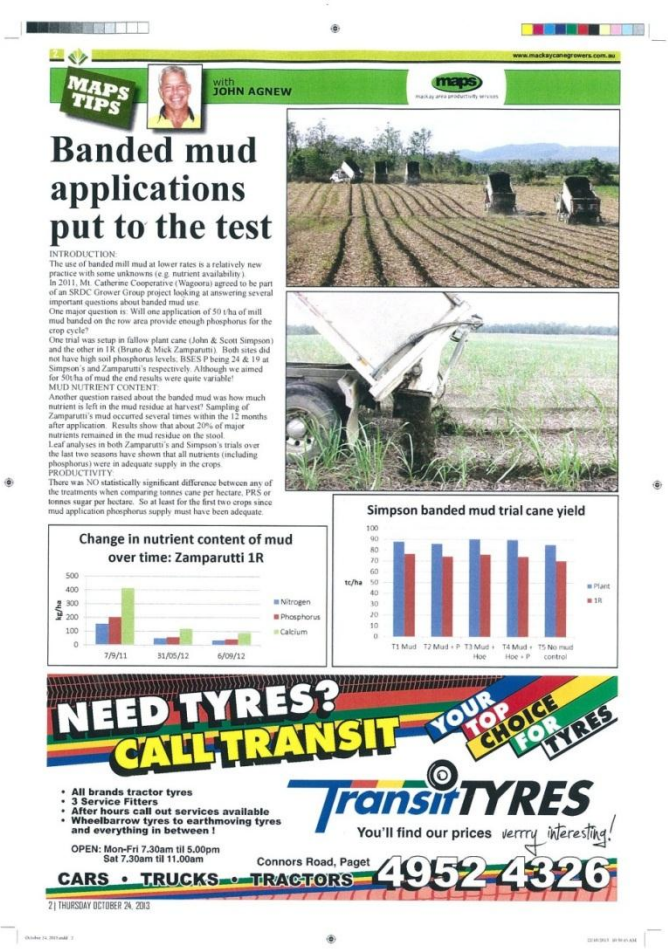
- No phosphorus is needed at planting or in 3 ratoons following mud application
- Leaf testing is recommended in 3rd crop after mud/ash application to check P adequacy in the crop
- If soil BSES P is less than 20 mg/kg seek advice prior to planting #
- If soil BSES P is greater than 50 mg/kg, do NOT apply phosphorus fertiliser , mill mud or mud/ash
- This rate supplies approximately 0.5-0.7 t/ha of lime & the calcium needs for the crop cycle
- If calcium levels are deficient (less than 1.1 meq %) or soil pH < 5.5, extra lime is needed
- Reduce fertiliser nitrogen rate (10- 15%) in the first crop after application

In low phosphorus soils: planting with 10 kg/ha of P fertiliser is advisable under the following conditions:

- If the planted row is off-set from the mud or mud/ash band
- If the mud or mud/ash is not incorporated prior to planting directly into the bands
- If the band is inconsistent

- **CANEGROWERS Newsletter (Oct. 2013)**

  An article on the trial results was published in the Mackay CANEGROWERS newsletter which is circulated to most Mackay cane farmers.



www.mackaycanegrowers.com.au

MAPS TIPS with JOHN AGNEW

maps

Banded mud applications put to the test

INTRODUCTION:
The use of banded mill mud at lower rates is a relatively new practice with some unknowns (e.g. nutrient availability).
In 2011, Mt. Catherine Cooperative (Wagoora) agreed to be part of an SRDC Grower Group project looking at answering several important questions about banded mud use.
One major question is: Will one application of 50 t/ha of mill mud banded on the row area provide enough phosphorus for the crop cycle?
One trial was setup in fallow plant cane (John & Scott Simpson) and the other in 1R (Bruno & Mick Zamparutti). Both sites did not have high soil phosphorus levels. BSES P being 24 & 19 at Simpson's and Zamparutti's respectively. Although we aimed for 50t/ha of mud the end results were quite variable!
MUD NUTRIENT CONTENT:
Another question raised about the banded mud was how much nutrient is left in the mud residue at harvest? Sampling of Zamparutti's mud occurred several times within the 12 months after application. Results show that about 20% of major nutrients remained in the mud residue on the stool.
Leaf analyses in both Zamparutti's and Simpson's trials over the last two seasons have shown that all nutrients (including phosphorus) were in adequate supply in the crops.
PRODUCTIVITY:
There was NO statistically significant difference between any of the treatments when comparing tonnes cane per hectare, PRS or tonnes sugar per hectare. So at least for the first two crops since mud application phosphorus supply must have been adequate.

2 | THURSDAY OCTOBER 24, 2013

- **Trial Information Presentation Day (February 2014)**

  This annual event was attended by most of the central district advisors as well as agribusiness, consultants and relevant government agencies. The aim was to inform and enable discussion on current research and development. Following is the agenda which shows that the GGIP banded mill mud trials were discussed.

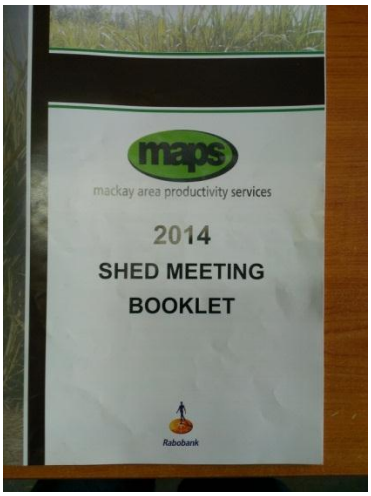
Trial Information Presentation Day Agenda
Thursday 20th February 2014:

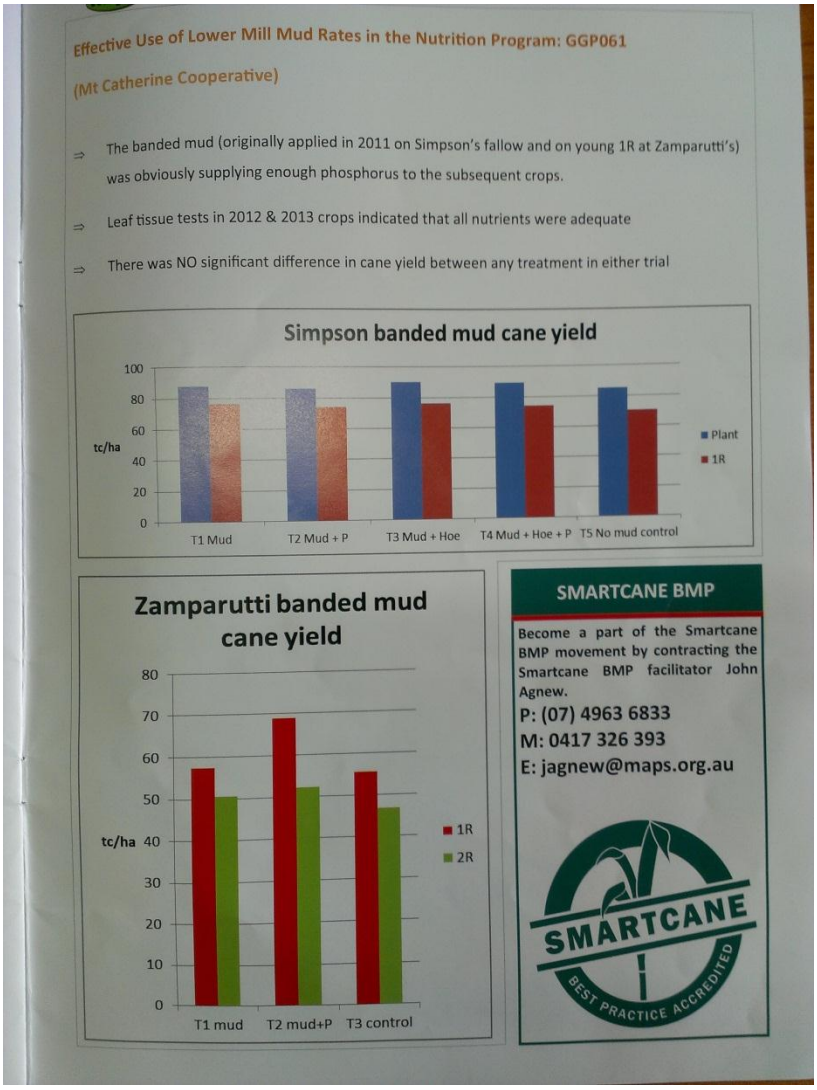
Presenter	Time	Topic
Rob Eccles (MAPS)	8:30-8:35	Welcome
John Agnew (MAPS)	8:35-9:00	Banded mud & Split N
Rob Sluggett (Farmacist)	9:00-9:30	Nitrogen use efficiency
John Markley (Farmacist) & John Hughes (DAFF)	9:30-10:00	Allocation of N rates based on block yield potential
MORNING TEA	**10:00-10:30**	**Provided**
Ken Rohde (Reef catchments)	10:35-11:05	P2R water quality trials: Mackay
Alan Royal (MAPS)	11:05-11:35	Imidicloprid, basecutter trials & gibberellic acid on cane growth
Jayson Dowie (Farmacist)	11:35-12:00	Agricoate Burdekin and Mackay
Rob Dwyer (Incitecpivot)	12:00-12:30	Entec and controlled release N
LUNCH	**12:30-1:30**	**Provided**
Davey Olsen (SRA)	1:30-2:00	Yellow Canopy Syndrome update
Barry Salter (SRA)	2:00-2:20	Agronomy trials update
Finish	2:25	

Venue: Shamrock Hotel, Pavilion Room, Nebo Road Mackay

- **MAPS Shed Meeting Booklet 2014**

  Information from the GGIP was included in the Shed Meeting Booklet (photos of front cover and page showing trial results included). Every grower at shed meetings received a copy of the booklet.





- **MAPS shed meetings (March/April 2014)**

  John Agnew presented/discussed Mt Catherine Coop's 2nd year banded mill mud trial results at 7 shed meetings. There were 86 growers in attendance. A total of 20 shed meetings were held by MAPS with an estimated attendance of 250 growers (approx. 30% of the farm managers in Mackay).

- **GIVE Conference (March 2014)**

  Project results were presented to over 130 growers and advisors from QLD and NSW.

Major Sponsor

INNISFAIL
18th-19th March, 2014
Innisfail Growers in Action

Program
(Day 1)

Monday 17th March, 2014

5.00 pm –	**Conference Registration Opens** *Innisfail Showgrounds*
6.00 pm –	**Welcome BBQ** *Innisfail Showgrounds*

Tuesday 18th March, 2014

8.00 am –	**GIVE Opening**
8.15 am –	***Welcome***
8.30 am –	***Presentation 1 – Assessing the impact of biochar in the Herbert cane Industry*** Group: The Biochar Grower Group of Lannercost. Presenter: Lawrence Di Bella.
9.00 am –	***Presentation 2 – Developing prescription compost to suit specific soils in Maryborough district.*** Group: Driving Agricultural Goals Group (DAG Group) Presenter: Andrew Dougall
9.30 am –	***Presentation 3 – Effective use of lower mill mud rates in the nutrition program*** Group: Mt Catherine Cooperative Presenter: John Agnew
10.00 am –	***Morning Tea* (Sponsored by QDAFF)**
10.30 am –	***Presentation 4 – Cross Regional Soybean Variety Trials*** Group; The United Soybean Growers Group Presenter: Adam Royle
11.00 am –	***Presentation 5 – Investigating the Role of Microbes, Carbon in Soil-Plant Interaction in Burdekin Sugarcane Soils***. Group: Advance Burdekin Collective Research Group Presenter: Tom McShane
11.30 am –	***Presentation 6 – Next step in Precision Agriculture*** Group: Farmacist Presenter: John Markley.
12.00 pm –	***Field Tour (Day 1)*** Lunch will be at first stop
4.30 pm –	Arrive back at Johnstone Shire Hall
6.30 pm –	***Dinner*** Brothers Rugby Leagues Club.

- **ASSCT Conference poster (April 2014)**

  A poster was produced and was displayed at ASSCT Conference. A five minute presentation on the project results was also given to delegates.

Poster Proc Aust Soc Sugar Cane Technol Vol 36 2014

EFFECTIVE USE OF LOWER MILL MUD RATES IN THE NUTRITION PROGRAM

By

JOHN AGNEW[1], JOHN FOX[2], JOHN SIMPSON[2], MICHAEL ZAMPARUTTI[2]

[1]*MAPS, Mackay*
[2]*MT Catherine Cooperative, Wagoora*

IN 2011 MACKAY Sugar changed its mud truck fleet to enable low rates of banded mill mud and mud/ash application on farms.

The aim of this was to: make mill by-products available to more growers, lessen the impact of reef regulations by introducing an applicator capable of applying mud at rates < 100 t/ha and increase the distance mud is transported away from the mill.

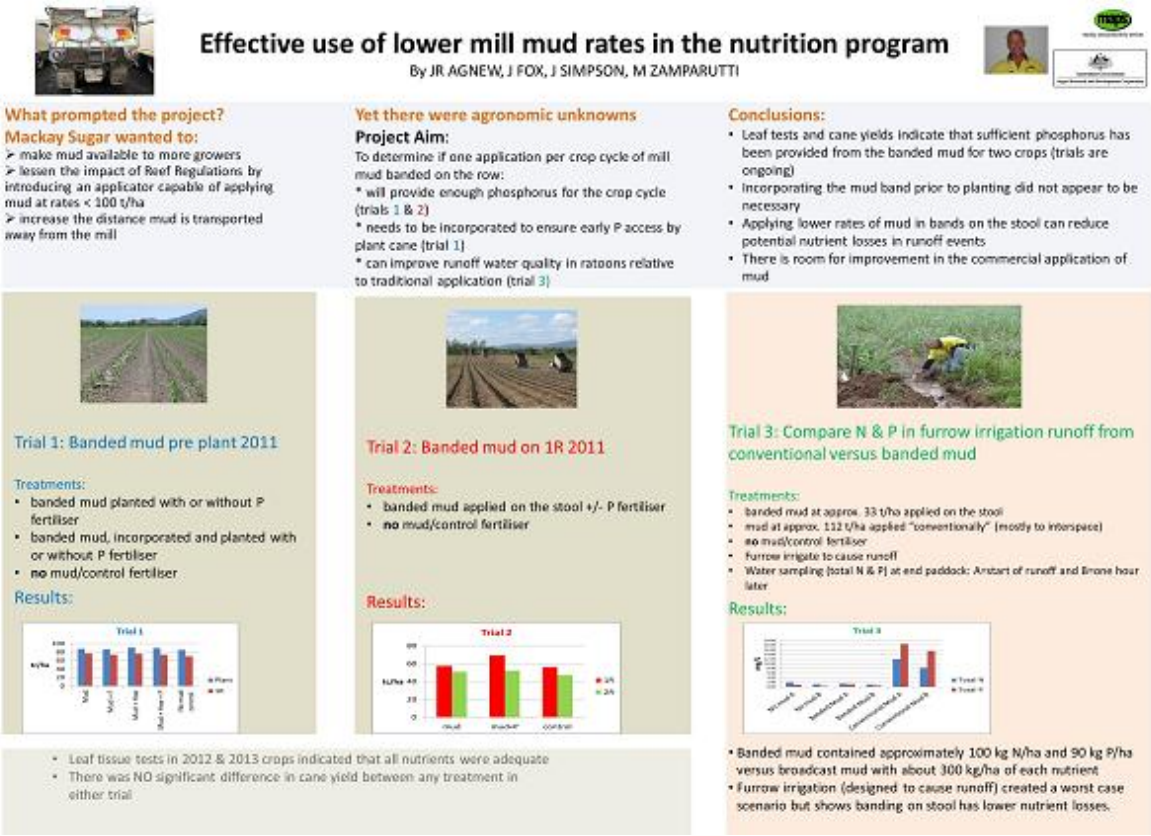
MT Catherine Cooperative (a farmer group in the Wagoora district of Mackay Sugar) set about answering some of the agronomic unknowns associated with this new practice.

Replicated trials were established in 2011 to determine if one application per crop cycle of mill mud banded on the row would: provide enough phosphorus for the crop cycle; need to be incorporated to ensure early phosphorus access by plant cane; and improve runoff water quality in ratoons relative to traditional application.

Leaf tests and cane yields (2012 and 2013 crops) indicated that sufficient phosphorus had been provided from the banded mud for two successive crops (trials are ongoing).

Incorporating the mud band prior to planting did not appear to be necessary. Applying lower rates of mud in bands on the stool can reduce potential nutrient losses in runoff events.

There is room for improvement in the commercial application of mill by-products.



This poster was awarded best agricultural poster at the 2014 ASSCT conference:

- **CANEGROWERS magazine article (April 2014)**

  An article was included in the CANEGROWER magazine which is circulated to the bulk of Australian cane farmers.

WHAT'S NEW

Growers trial lower mill mud rates

Trial 1: Banded Mud Cane Yield

A project of the Mt Catherine Cooperative presented by John Agnew at the recent G.I.V.E. expo in Innisfail.

This project was triggered by Mackay Sugar wanting to make mill mud available to more growers and increase the distance it's transported from the mill. There was also the desire to lessen the potential for nutrient run off by using an applicator capable of applying mud at rates less than 100 tonnes per hectare.

A series of trials were developed to determine if one application per crop cycle of mill mud at a rate much lower than is common practice and banded on the row, would provide enough phosphorus for the crop cycle. The trials also sought to find out if the mud needed to be incorporated into the soil to ensure the release of that phosphorus for the plant and if banding on the stool could improve mud water quality in a process relative to traditional high rate in the interspace application. The trials aimed for an average 50 t/ha, but due to consistency issues with the applicator and application rates, the actual rates were different and these are outlined below.

Trial 1: Banded mud application on fallow plant cane 2011

This trial blocks were located on properties of members of the Mt Catherine Cooperative, a grower group at Wagaboe. MAPS assisted the group.

This trial involved five treatments:

- *banded mud on average 28 t/ha (mixed with DAP without P fertiliser)*
- *banded mud on average 28 t/ha (mixed with DAP without P fertiliser and no mud control fertiliser)*
- *mud on approximately 222 t/ha (it was applied 'conventionally' mostly in the interspace)*
- *there was a no mud control fertiliser treatment.*

For this trial:

- *Banded mud on approximately 28 t/ha was applied on the stool.*
- *mud on approximately 222 t/ha was applied 'conventionally' mostly in the interspace.*

Trial 2: Banded mud application

This trial involved three treatments:

- *banded mud applied at an average 68 t/ha on the stool with OR without P fertiliser and*
- *no mud/control fertiliser.*

Leaf tissue tests in the 2012 and 2013 crops indicated that all nutrients were adequate and there was no significant difference in cane yield between any treatment method in either trial.

Trial 2: Banded Mud Cane Yield

Trial 3: Component nitrogen and phosphorous in furrow irrigation runoff from conventional versus banded mud applications

For this trial:

- *Banded mud applied on the stool.*
- *mud applied 'conventionally' mostly in the interspace.*
- *there was a no mud control fertiliser treatment.*

- *the trial blocks were furrow irrigated at a rate to cause runoff; and*
- *water sampling was undertaking at paddock ends both when the runoff started and after a one hour interval (total N & P).*

Banded mud contained approximately 100 kg N/ha and 90 kg P/ha versus broadcast mud with about 300 kg/ha of each nutrient. The trial received no rainfall or other irrigation prior to the furrow irrigation when the runoff was tested. This produced the worse possible scenario for potential nutrient losses. As expected, the conventional treatment had far higher levels of N & P in runoff. The banded, on stool treatment was no worse than the 'no mud control' treatment.

How much nutrient remains in mud residue on the stool?

There had been concern that mud residue sitting on top of the stool would either be harvested into the bin or be generally broadcast by the harvesters primary extractor fan. The main nutrient in the mud is phosphorus and this needs to be in adequate supply for the crop cycle and be close to the plant.

The project's work showed that if the worst happened at harvest, most of the mud nutrients should have already moved into the surface soil rather than just be sitting in residue on top of the stool. Mackay Sugar studies of dirt levels in cane supply showed no difference between blocks treated with banded mud and unwanted blocks. MAPS will run a trial this season evaluating the effect of banded mud with no dirt in cane supply ▶

WHAT'S NEW

National soils strategy

Australia has its first national and coordinated approach to managing soils with the release of a soils strategy and the appointment of soil health advocate.

Agriculture Minister Barnaby Joyce says the strategy is a road map, and 130 different organisations from across Australia will be involved in rolling it out over the next five years.

It's called the National Soil Research, Development and Extension Strategy. Securing Australia's soil for profitable industries and healthy landscapes.

This strategy will ensure soils research will become more targeted and collaborative and that research will better meet the needs of farmers, contributing to the long term viability and productivity of their businesses," Mr Joyce says.

"It's all about providing better information and tools to our farmers, scientists and policymakers on soil use and management to assist them into the future."

Former Governor-General, Major General the Hon Michael Jeffery, AC AO, MB, CVO, MC (Retd), has been reappointed as the Advocate for Soil Health in 2014.

Mr Joyce says he will provide strong leadership and advocacy and promote the benefits of looking after soils to farmers and all Australians.

The National Soil Research, Development and Extension Strategy is at: daff.gov.au/soilstrategy.

CONCLUSIONS

The project was originally funded by SRDC and its final report is due at the end of this financial year, however the team plans to keep up the trials until the 2015 harvest to ensure four crop harvests post mud application are taken into account.

So far the team has found that leaf tests and cane yields indicate that sufficient phosphorus was provided by banded mud for two crops and that incorporating the mud band prior to planting cane did not appear to be necessary. Also, applying lower rates of mud in bands on the stool reduced potential nutrient losses in runoff events.

In terms of the commercial application of mud, the project found there is room for improvement. ■

Recommendations:
(What recommendations would you make as a result of the project, including suggestions for further research and development?)

Recommendations Mt Catherine Cooperative would make as a result of this project include:

- That Mackay Sugar adopt suggestions (by local industry) for improving the commercial application of mill mud and mill mud/ash
- As new information becomes available, as a result of this and other banded mill by-product projects, that "Guidelines for Use" be updated
- That trials to examine the effect of banded mud/ash in ratoons on dirt in cane supply be conducted
- That Simpson's banded mud trial be managed according to trial protocol and be leaf sampled and harvested for at least two more crops

Publications:
(List and attach copies (electronically if possible) of all articles, newsletters and other publications from the project.)

See Communication and Adoption of Outputs section of this report.

Acknowledgements:
(List people and organisations that assisted and/or supported you, to enable you to complete this project.)

Mt Catherine Cooperative would like to thank the following organisations for their assistance during the life of this project:

MAPS, Mackay Sugar, Trevor Magnusson Mud Contracting, SRI Mackay and Farmacist.

Photos:
(Include photographs or images related to your project they may be useful for future publicity or promotion).

Selected photos of trial activities:

Simpson’s trial: mud application

Simpson’s trial: mud sampling

Simpson’s trial: unincorporated mud v no mud

Zamparutti’s trial: mud application


Zamparutti's trial: superphosphate banded on mud in T2 & T3


Fox's trial: banded mud application

Fox's trial: "conventional" mud application

John Fox installing a v-notch weir (note: rare photo of him holding a shovel)

Fox's trial: sampling runoff water

John Agnew presenting information from Mt Catherine Co-op's work at AgriServ Trial Information Day 2012

Part of the project team attending a field walk at GIVE Conference in Yamba 2012

Commercial harvest of Zamparutti's trial 2012

Fertiliser application in Simpson’s Trial 2012

Harvesting in Simpson’s Trial 2013

Fertilising Simpson’s trial 2013