RAINFALL SIMULATION REPORT

May 2014

Reef Water Quality Science Program in the Mackay Whitsunday Region

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REEF CATCHMENTS

Queensland Government

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maps
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Project Catalyst

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List of Acronyms

DIN	Dissolved inorganic nitrogen (sum of ammonia and NO_x-N)
DSITIA	Department of Science, Information Technology, Innovation and the Arts
CEC	Cation exchange capacity
CL	Chloride
EC	Electrical conductivity
EMC	Event mean concentration
K	Potassium
N	Nitrogen
NO_x-N	Nitrogen oxides (sum of nitrate and nitrite)
Ortho-P	Ortho-phosphate (inorganic forms of phosphate)
P	Phosphorus
S	Sulphur
TKN	Total Kjeldahl nitrogen (sum of ammonia and organic based nitrogen)
TN	Total nitrogen (sum of TKN and NO_x-N)
TP	Total phosphorus
TSS	Total suspended solids

List of Units

ds/m	deciSiemens per metre
g	grams
g/ha	grams per hectare
ha	hectares
kg/ha	kilograms per hectare
kg N/ha	kilograms of nitrogen per hectare
kg P/ha	kilograms of phosphorus per hectare
m	metres
meq/100g	milliequivalents per 100 grams
mg	milligrams
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
mL	millilitres
mm	millimetres
mm/hr	millimetres per hour
t/ha	tonnes per hectare

EXECUTIVE SUMMARY

The Reef Water Quality Science Program aims to help producers better manage cane growing and grazing lands in the Wet Tropics, Burdekin Dry Tropics and Mackay Whitsunday catchments, and minimise the impacts upon the health of the Great Barrier Reef (http://www.qld.gov.au/environment/agriculture/sustainable-farming/reef-program/; May 2014). A suite of science projects were developed to deliver valuable, knowledge-based and practical tools for landholders. One project was funded in the Mackay Whitsunday region – *Validation and extension of the water quality, productivity and economic benefits of adopting improved nutrient and chemical management in sugarcane in the Central region.* A component of this project, a rainfall simulation study, forms part of an ongoing effort to improve the understanding of the water quality implications of improved sugarcane farming practices in the Mackay Whitsunday region. The study has added to a body of knowledge developed through trial work and paddock scale water quality monitoring conducted over the previous three years, namely;

- Runoff was similar across all 1.8 m solid plant treatments, but reduced in the skip configuration
- Sediment concentrations and loads were similar across all cane rows, but higher in the skip area
- No nitrogen treatment effect evident prior to application, but N concentrations and loads increased in line with increasing N rates after application
- Annual applications of phosphorus doubled runoff concentrations and loads six months after the previous application

In summary, results from this rainfall simulation study support those observed in other studies. All of these practices, which result in improved water quality of runoff, have had little/no impact on crop productivity.

1 INTRODUCTION

Several water quality monitoring and modelling studies in the past decade have shown that regions with sugarcane as a major land use export high concentrations (compared to pre-European or "natural" state) of dissolved inorganic nitrogen (DIN or NO_x-N, consisting primarily of nitrate). In a modelling study, estimates show that DIN exports from the Mackay Whitsunday region have increased 4.6 times since pre-European condition, and the Wet Tropics increased 6.4 times, with increases in other regions of 1.8-2.2 times (Kroon *et al.* 2012). Catchment scale monitoring during the 2009/10 wet season showed the load of DIN in the high rainfall coastal catchments (Pioneer, Plane, North Johnstone, South Johnstone and Tully catchments) ranged from 245-321 kg/km^2 (Turner *et al.* 2012) and 260-740 kg/km^2 in the much wetter 2010/11 wet season (Turner *et al*. 2013). These catchments also contain a high proportion of irrigated cropping (mainly sugarcane). The load from all other catchments was lower (<1-160 kg/km^2) except 290 kg/km^2 from Tully Gorge in 2010/11). Sediment fluxes from sugarcane farming land-use has been shown to be relatively low (Prove *et al.* 1995), which is a result of the industry adopting improved management practices (e.g. green cane trash blanketing) over the past twenty years.

To address the issue of declining water quality entering the GBR lagoon, the Reef Water Quality Protection Plan (Reef Plan) was first endorsed by the Prime Minister and Premier in 2003. It was updated in 2009 to provide clear and measurable targets, improved accountability and more comprehensive and coordinated monitoring and evaluation. A key action and outcome of the Reef Plan 2009 was the development and implementation of the *Paddock to Reef Integrated, Monitoring, Modelling and Reporting (P2R) Program*. The P2R program uses multiple lines of evidence to report on the effectiveness of investments and whether targets were being met (Carroll *et al.* 2012). Results from the paddock monitoring component of the P2R Program in the Mackay Whitsunday region have been reported previously (Rohde *et al.* 2013), with further funding for the 2012/13 wet season provided as part of the *Reef Water Quality Science Program (RWQSP)*.

The RWQSP aims to help producers better manage cane growing and grazing lands in the Wet Tropics, Burdekin Dry Tropics and Mackay Whitsunday catchments, and minimise the impacts upon the health of the Great Barrier Reef (http://www.qld.gov.au/environment/agriculture/sustainable-farming/reef-program/; May 2014). A suite of science projects was developed to deliver valuable, knowledge-based and practical tools for landholders. One project was funded in the Mackay Whitsunday region – *Validation and extension of the water quality, productivity and economic benefits of adopting improved nutrient and chemical management in sugarcane in the Central region.* One component of this project, a rainfall simulation study, forms part of an ongoing effort to improve our understanding of the water quality implications of improved sugarcane farming practices in the Mackay Whitsunday region. The study has added to a body of knowledge developed through trial work run over the previous three years.

The key objectives of the rainfall simulation study were to:

- Assess the runoff and water quality benefits of differing nutrient management practices
- Compare and contrast the simulation study results with previous water quality monitoring undertaken as part of the Paddock to Reef program

2 METHODOLOGY

2.1 Site description

The selected block (Farm 3120, Block 2-2; Figure 1) is located near North Eton, SW of Mackay (21° 13' 37"S 148° 58' 17"E). Slope is 0.4%, draining to the north. The soil is a duplex derived from quaternary alluvium and has been previously mapped as mapping unit "Ma1" (Marian, yellow B horizon variant) (Holz and Shields 1984), which is a Brown Chromosol (Great Soil Group) (Isbell 1996). Duplex soils (of the alluvial plains) comprise 28% of the sugarcane growing area in the Mackay district, with Marian soils (Ma and Ma1) occupying 6% (Holz and Shields 1985).

The soil across the monitoring site can be generally described as a 0.3 m deep, very dark brown (sometimes greyish) to black sandy or silty clay loam A horizon; there is a sharp change to a dark to yellowish or black medium clay B horizon with a generally strong prismatic structure. The surface of the soil is hard setting, imperfectly drained and slowly permeable. Details of selected soil properties are shown in Table 1.

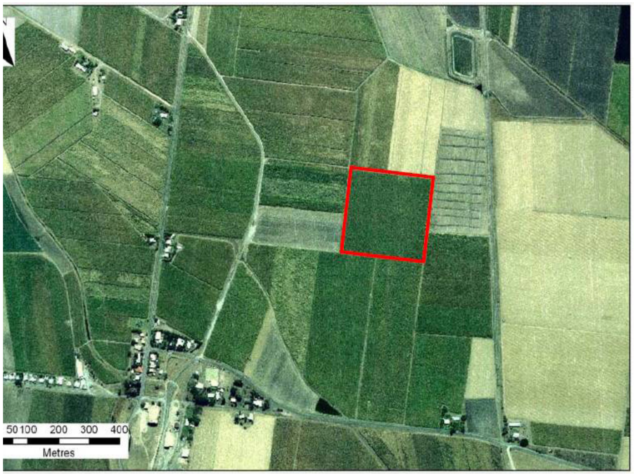

Figure 1 Location of the sugarcane block used for the rainfall simulation trial

Table 1 Selected soil properties of the Marian site

Depth	pH	EC (ds/m)	Coarse sand (%)	Fine sand (%)	Silt (%)	Clay (%)
0-0.1m	6.70	0.13	27.2	42.4	14.4	19.6
0.2-0.3m	6.88	0.09	28.4	38.8	12.0	24.2
0.5-0.6m	7.74	0.12	25.8	32.8	7.2	37.8
0.8-0.9m	7.90	0.14	23.0	40.0	7.0	34.0
1.1-1.2m	7.94	0.12	22.6	35.6	10.2	34.6
1.4-1.5m	8.02	0.12	22.4	35.8	14.8	30.2

Depth	CEC (meq/100g)	Total Organic Carbon (%)	Cl^- (mg/kg)
0.0-0.1m	12.2	1.35	83.8
0.2-0.3m	10.0	0.86	47.2
0.5-0.6m	13.8	0.34	43.2
0.8-0.9m	13.4	0.20	56.0
1.1-1.2m	15.4	0.13	65.8
1.4-1.5m	15.0	<0.15	71.0

Prior to cane being planted in August 2009 (when row spacing treatments were established), this block was in its final ratoon from a previous cane rotation which was subsequently ploughed out and replanted, with no fallow. Trash from the previous cane crop was burnt before replanting for ease of cultivation. This is not typical of current cane practice in the Mackay region with most growers choosing to fallow between crop cycles; however suitable sites and co-operators for this level of study were limited. The block was divided into five treatments (Table 2) of 18 rows each with an approximate row length of 260 m.

Table 2 Summary of treatments applied at the Marian site

	ABCD Classification	Soil Management	Nutrient Management	Herbicide Management
Treatment 1	CCC[1]	1.5 m current practice	Generalised recommendation	Non-regulated[6]
Treatment 2	BCC	1.8 m controlled traffic[2]	Generalised recommendation	Non-regulated
Treatment 3	BBB	1.8 m controlled traffic	Six Easy Steps[4]	Non-regulated
Treatment 4	BAB	1.8 m controlled traffic	Six Easy Steps[5]	Non-regulated
Treatment 5	ABB	1.8 m controlled traffic, skip row[3]	Six Easy Steps	Non-regulated

[1] – ABCD classifications for soil/sediment, nutrients and herbicides, respectively

[2] – Controlled Traffic: matching row spacing to machinery wheel spacing to limit area of compaction

[3] – Skip row farming of sugarcane (in this situation) is where two rows of cane are planted, and then two rows not planted (skipped). Peanuts (or other crops) can then be planted in the skipped area

[4] – Farm-specific nutrient management plan designed by BSES

[5] – Nutrient management in this treatment was Nutrient Replacement until this season

[6] – Herbicides not identified in the Chemical Usage (Agricultural and Veterinary) Control Regulation 1999

2.2 Prior treatment management practices

All treatments were harvested on 7th October 2013 (third ratoon). The cane was harvested green, the trash left on the soil surface and no cultivation was undertaken. Nutrient treatments were applied on 12th October 2013 as a liquid mix (Table 3) to the cane stool using a contractor tractor and boom.

Overhead low pressure irrigation was applied to the block prior to the onset of the wet season. In the ten days prior to the rainfall simulation taking place, 196 mm of rainfall was recorded at the site.

Table 3 Nutrient treatments applied in October 2013

Treatment	Product	Nutrient analysis (%)				Nutrient applied (kg/ha)			
	(rate applied)	N	P	K	S	N	P	K	S
1-2	LOS+P (4200 kg/ha)	4.7	0.48	2.66	0.73	197	20	112	31
3-5	MKY170 (4200 kg/ha)	3.78	0	2.74	0.41	159	0	115	17

(Note – Products applied are from the Wilmar BioEthanol AgServices liquid fertiliser range of products http://wilmarbioethanol.com/sugar-cane)

2.3 Rainfall simulator and plot setup

Cane was hand cut from the rainfall simulation plot areas on 24th March 2014. Plots (1.8 m wide and 2 m long) were centred over the cane row (bed) and extended to the furrow centres on either side (Figure 2). The edges of the plots were bound by 3 mm thick metal plates driven approximately 75 mm into the soil (leaving 75 mm above the soil surface). Runoff from each furrow was directed to the middle of the plot front via a metal gutter cut into the top of the bed (approximately level with the bottom of the furrows).

Rainfall simulations were undertaken on Treatments 2, 3 and 4 on 3rd April 2014 (referred to as "pre-application"). Nutrient treatments (Table 4 and Figure 4) were hand applied to the same plots the following day. On 7th April 2014, simulations were again undertaken on the same plots (referred to as "post-application"). Less than 2 mm of rainfall was recorded during these four days. Simulations were also undertaken on the crop row and skip area (Figure 3) of Treatment 5 on the same day.

Trash from the previous harvest (except Treatment 5 skip), and resulting from the hand harvesting, was retained on the soil surface as a trash blanket. Cover levels were similar across all treatments (>80% ground cover). Ground cover on Treatment 5 skip was provided by weeds and grasses and was less than that provided by cane trash (~50% ground cover).

Figure 2 Rainfall simulation plot centred over the cane row (hand cut) and extending to the furrow centres

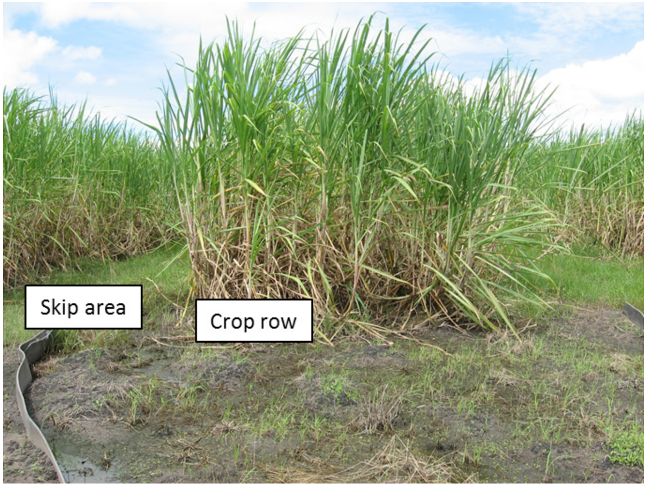

Figure 3 Treatment configuration of Treatment 5 showing the crop row and skip area (photo taken March 2012)

Figure 4 Nutrients were hand applied in liquid form, banded onto the stool (middle of the bed) at the required rate

Table 4 Application of nutrient treatments to the rainfall simulation plots

Treatment	Product (rate applied)	Nutrient analysis (%)				Nutrient applied (kg/ha)			
		N	P	K	S	N	P	K	S
2	MKY170 (5290 kg/ha)	3.78	0	2.74	0.41	200	0	145	22
3	MKY170 (4230 kg/ha)	3.78	0	2.74	0.41	160	0	116	17
4	MKY170 (2250 kg/ha)	3.78	0	2.74	0.41	85	0	62	9

Simulated rainfall was applied at an average rate of 83-86 mm/hr until runoff was generated, then for a further 30 minutes. The rainfall simulator, one module similar to that described by Loch *et al.* (2001), applied rain with drop sizes and kinetic energy consistent with natural rainfall in eastern Australia. Runoff rates were manually measured from the outlet of each plot every five minutes after runoff commenced by recording the time taken to fill a measured volume. These samples were then used for laboratory analyses of sediment and nutrients. Water samples were chilled on collection, and submitted to the Water and Waste Laboratories, Mackay Regional Council for sub-sampling and filtering within 24 hours.

Water for the rainfall simulator was sourced from a rain water tank in East Mackay. Analysis of the source water showed phosphorus concentrations generally below detection limits, and NO_x-N was 0.09 mg/L (Table 5).

Table 5 Nutrient content of the rain water as supplied to the rainfall simulator

Sample	Conductivity (µS/cm)	TN (mg/L)	TKN (mg/L)	Ammonia-N (mg/L)	NO_x-N (mg/L)	TP (mg/L)	Ortho-P (mg/L)
1	35	0.1	<0.2	<0.1	0.09	<0.1	0.01
2	34	0.1	<0.2	<0.01	0.09	<0.1	<0.01

3 RESULTS/KEY FINDINGS

3.1 Runoff was similar across all 1.8 m solid plant treatments, but reduced in the skip configuration

On average, the 1.8 m solid plant treatments (Treatments 2, 3 and 4) produced ~45 mm of runoff (Figure 5) from 48 mm of applied rainfall. There was no difference in runoff pre- and post-application. This was due to the low soil water deficit, even prior to the pre-application simulation runs (196 mm of rainfall was recorded at the site in the previous 10 days). Commencement of runoff was also similar between these treatments – 2-6 minutes from commencement of rainfall (Table 6).

In the skip row treatment (Treatment 5), the row ran off 40% less than the solid plant treatments (Figure 5). This plot took longer to run off (9 minutes) and the peak runoff rate was also lower (66 mm/hr, compared to 75 mm/hr for the solid plant treatments) (Table 7). This is possibly due to the increased stooling and greater root activity in the skip treatment compared to the other cane treatments. The skip area also ran off less, but the decrease was not as marked (29% reduction) (Figure 5). This could be in part due to the flat surface of the skip area compared to the raised bed of the cane row.

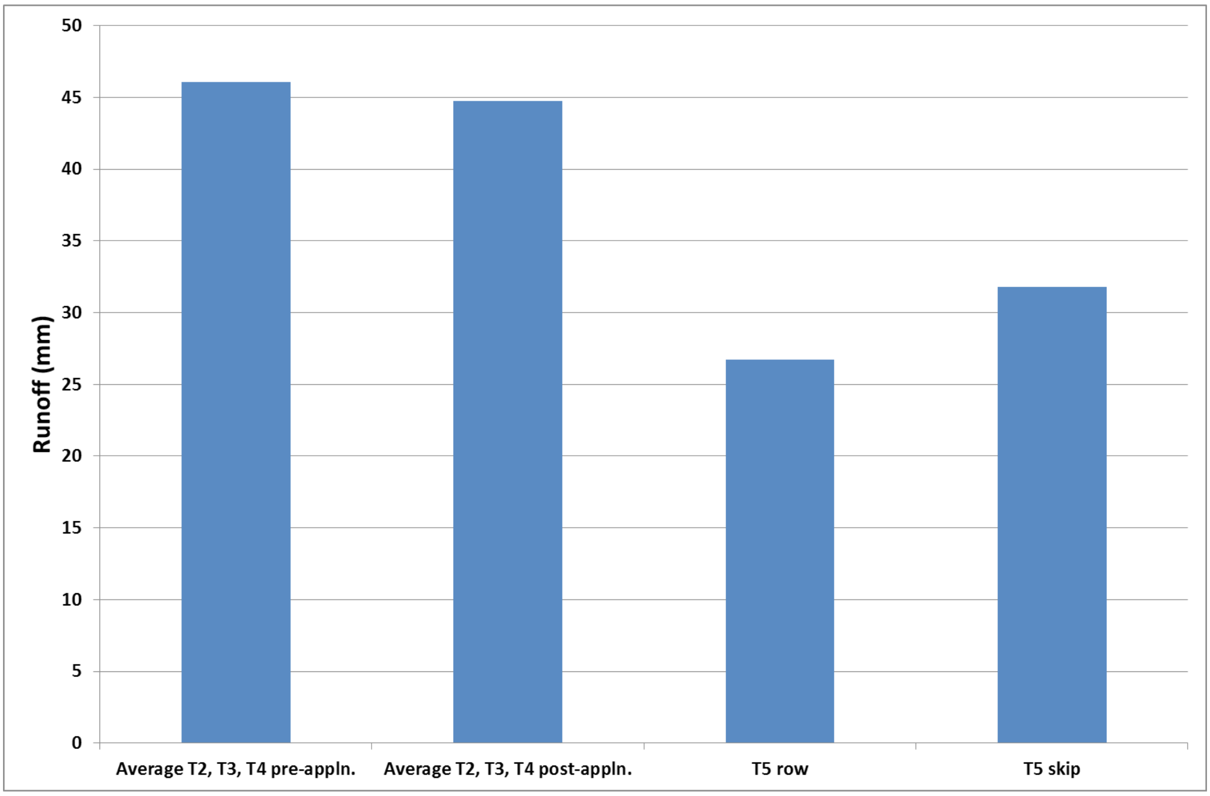

Figure 5 Runoff (mm) from the rainfall simulation plots

Table 6 Runoff and water quality event mean concentration data

	Rain applied (mm)	Runoff (mm)	Peak runoff (mm/hr)	Time to runoff (mins)	TSS (mg/L)	TN (mg/L)	TKN (mg/L)	DIN (mg/L)	TP (mg/L)	Ortho-P (mg/L)
T2 pre	47	43	74	4	240	0.22	0.16	0.14	0.64	0.57
T3 pre	48	53*	86	5	254	0.27	0.25	0.09	0.34	0.31
T4 pre	46	42	72	3	200	0.32	0.25	0.14	0.40	0.30
T2 post	50	43	70	5	217	8.8	8.6	5.6		
T3 post	52	51	75	6	166	7.8	7.6	4.3		
T4 post	46	41	74	2	388	3.3	3.0	2.0		
T5 row	56	27	66	9	323	0.71	0.61	0.15		
T5 skip	52	32	77	6	1047	1.0	0.87	0.31		

* Artificially elevated due to rainfall simulator leaking onto plot

Table 7 Runoff and adjusted water quality loads (based on average runoff from T2, T3 and T4. T5 unchanged)

	Rain applied (mm)	Runoff (mm)	Peak runoff (mm/hr)	Time to runoff (mins)	TSS (kg/ha)	TN (kg/ha)	TKN (kg/ha)	DIN (kg/ha)	TP (kg/ha)	Ortho-P (kg/ha)
T2 pre	47	43	74	4	109	0.10	0.07	0.06	0.29	0.26
T3 pre	48	53*	86	5	115	0.12	0.11	0.04	0.15	0.14
T4 pre	46	42	72	3	91	0.15	0.11	0.06	0.18	0.14
T2 post	50	43	70	5	99	4.0	3.9	2.5		
T3 post	52	51	75	6	75	3.6	3.4	2.0		
T4 post	46	41	74	2	176	1.5	1.4	0.93		
T5 row	56	27	66	9	86	0.19	0.16	0.04		
T5 skip	52	32	77	6	386	0.38	0.32	0.11		

* Artificially elevated due to rainfall simulator leaking onto plot

3.2 Sediment concentrations and loads were similar across all cane rows, but higher in the skip area

All of the cane rows had relatively similar TSS concentrations in runoff (200-388 mg/L) producing similar TSS loads (86-158 kg/ha) (Table 6). These concentrations and loads are much lower than the skip area. Concentrations were more than triple that of the cane rows, and despite lower runoff, the TSS was still more than four times higher (Table 6 and Figure 6). The higher TSS concentrations from the skip area are thought to be a result of the lower ground cover (Figure 7) from the weeds and grass (rather than a cane trash blanket).

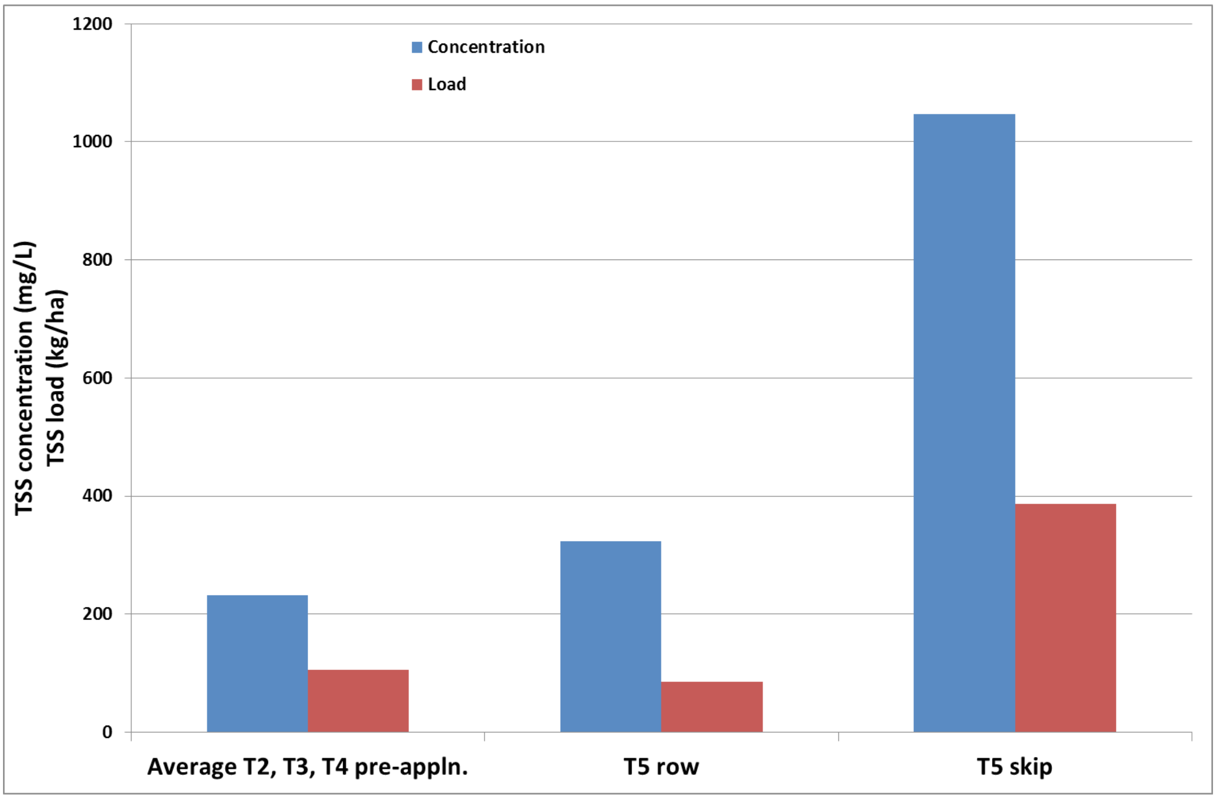

Figure 6 Concentrations of TSS measured in runoff from the rainfall simulator, and calculated TSS loads

Figure 7 The skip area had less ground cover (than the cane rows) resulting in a higher TSS concentration and load

3.3 No prior nitrogen treatment effect evident, but N concentrations and loads increased with increasing N rates after application

Nitrogen concentrations and loads were consistent between the three prior nitrogen treatments (Treatments 2-4; last application 174 days prior). After application, N concentrations and loads followed the same trend as application rates (Table 6 and Figure 8).

In the pre-application treatments, DIN was dominated by NO_x-N (~75-95%). Post-application, DIN was dominated by ammonia-N (85-97%), with the highest proportion recorded with the highest N rate.

In the skip treatment (Treatment 5), N concentration in the row was similar to other treatments, but concentrations and loads in the skip area were approximately double that of the cane row. This is presumably due to the prior crops of peanuts that have been grown in the skip area (volunteer peanuts were still evident at the time of simulating).

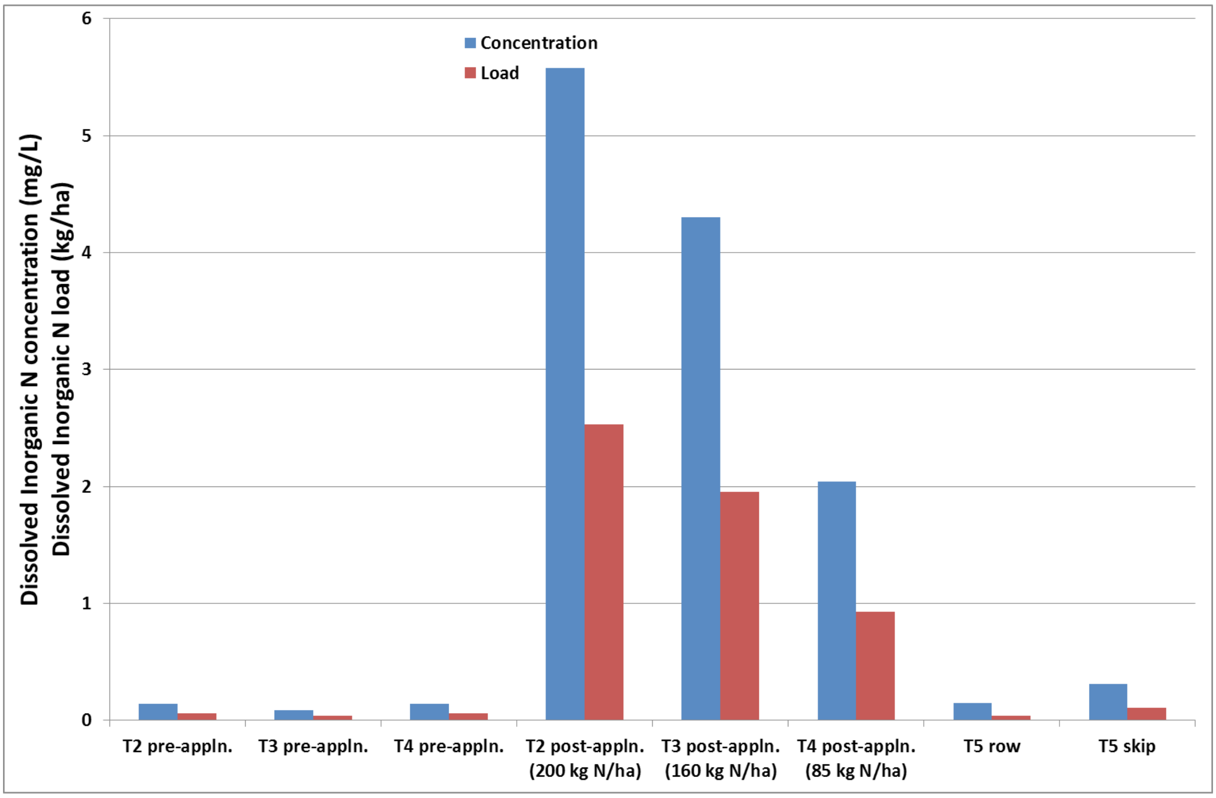

Figure 8 Dissolved inorganic nitrogen concentrations and loads measured in runoff from the rainfall simulation plots

3.4 Annual applications of phosphorus doubled runoff concentrations and loads six months after the previous application

Treatments 3 and 4 have had no phosphorus applied since the cane was planted in 2009 due to the high background soil P concentrations (average 162 mg/kg BSES P at 0-10 cm; unpublished data). As a C-class practice, 20 kg P/ha was applied to Treatment 2 on an annual basis. As a result, higher P concentrations were measured in runoff (Figure 9), six months after the previous application.

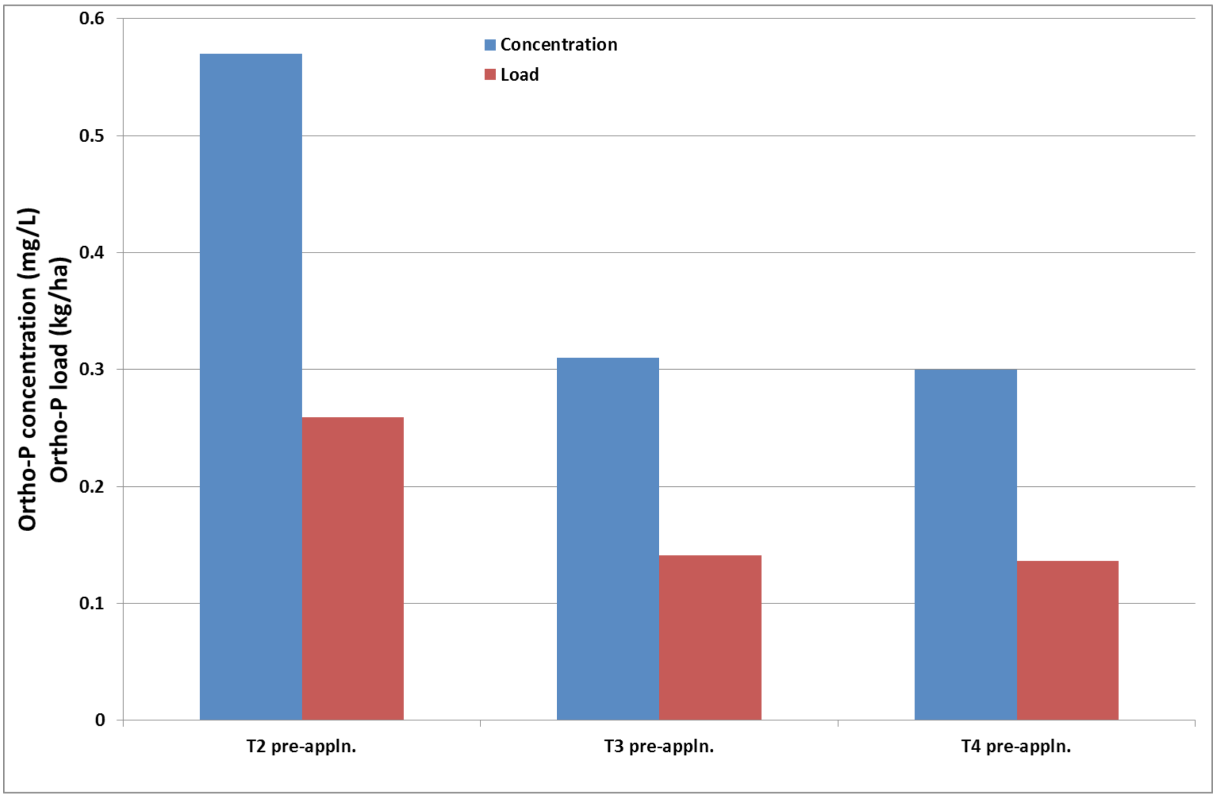

Figure 9 Treatment 2 had higher P concentrations in runoff (and therefore load) six months after the previous annual application

4 DISCUSSION

The results of this rainfall simulation study build on 3-4 years of paddock-scale monitoring of management practices as part of the Paddock to Reef and Reef Water Quality Science Programs. Results were as expected and support the findings of previous monitoring.

Runoff across all of the 1.8 m solid plant treatments (Treatments 2-4), which is not surprising, as there were no soil management differences between these treatments. Row spacing was not studied, as other research has shown consistently lower runoff due to controlled traffic;

- Controlled traffic (1.8 m row spacing) in a cane management system had 14.5% less runoff than unmatched wheel/row spacing (1.5 m row spacing) across three monitored wet seasons on a uniform cracking clay (Rohde *et al*. 2013)
- On a heavy clay soil, wheeling (uncontrolled traffic) in a broadacre grain production system produced a large (44%) and consistent increase in runoff compared with non-wheeling (Tullberg *et al*. 2001)
- Results from a previous rainfall simulation study, conducted on the same soil type as studied in this trial , showed that runoff averaged 43% less from 2 m controlled traffic cane treatments compared to 1.5 m current practice treatments on dry soil, to 30% wetter on wetter soils (Masters *et al*. 2013)

Similar to runoff, sediment concentrations and loads were similar across all cane rows due to no soil management practice differences. The concentrations (~230-330 mg/L) were higher than the average (178 mg/L) of all samples collected from those treatments during the Paddock to Reef program. This may be due to the decaying trash blanket and no canopy cover to intercept the rainfall. Sediment concentrations from the skip area were approximately triple those measured from the cane rows. This may have been due to the lower cover on the skip area (~50% provided by weeds and grass) compared to >80% provided by the trash blanket on the cane rows. Another contributing factor may have been the relatively smooth, loose, friable soil surface of the skip area. This finding is not surprising, as sediment concentrations in runoff are driven by peak runoff rate, ground cover and roughness (Freebairn *et al*. 2009).

In the Paddock to Reef program, three main factors were found to control nitrogen and phosphorus concentrations in runoff; the period of application between application and the first runoff event, the amount of product applied (fertiliser), and background soil nutrient levels (Rohde *et al*. 2013). These findings are supported by the current study. The pre-application simulation runs were undertaken 174 days after the previous nutrient applications. As a result, there was no difference in nitrogen concentrations or loads from these applications. Post-application, Treatment 2 lost more nitrogen to runoff than the other treatments due to the higher application rate, although the percentage loss for each treatment was similar (1.1-1.3% as DIN). These concentrations and losses are lower than those measured three days after application in a natural rainfall event on a uniform cracking clay; ~10% of applied nitrogen (Rohde *et al*. 2013). The natural rainfall event was larger and produced more runoff (131 mm rainfall, 70-74 mm runoff), which may be partly responsible for the increased concentrations.

In contrast to nitrogen where no prior treatment application was evident, the prior application of phosphorus was evident, even 174 days after application. Approximately 20 kg P/ha has been applied to Treatment 2 on an annual basis (C-class practice), whereas no P has been applied to Treatments 3 and 4. As a result of the repeated annual application on Treatment 2, runoff concentrations were almost double those with no prior P applications. Nutrient management guidelines for the Mackay district recommend nil P applications for at least two crop cycles when BSES P is >60 mg/kg (Calcino 2010). The average BSES P for the rainfall simulation site was 162 mg/kg in 2009.

Although no yield or agronomic data is available as part of this rainfall simulation study, Rohde et al. (2013) reported on the 2013 harvest results (third ratoon). Yield and percent recoverable sugar (PRS) information collected during machine harvest (7th October 2013) and processing showed that row spacing (Treatments 1 and 2) had little impact on cane yield (and PRS) and applying higher rates of nitrogen (than Six Easy Steps; Treatment 3) also had no impact on cane yield (cane yield 111-118 t/ha). The lower rate of nitrogen applied to Treatment 4 (N replacement) reduced cane yield by 30%, and the skip row (Treatment 5) yielded 73% of the solid plant (Treatment 3), despite only 56% of the area planted to cane (10 cane rows and 8 “skip” rows).

Although this rainfall simulation study has added value to previous monitoring of sugarcane management practices, it does have some limitations to the interpretation of the data;

- The simulation were undertaken in early April, so the cane had to be hand cut and removed from the plot area.
- Only one simulation (replication) was undertaken on each treatment. More replications would have allowed statistical analyses to be undertaken, but would have also greatly increased the cost.

5 CONCLUSIONS

This Reef Water Quality Science Program rainfall simulation study forms part of an ongoing effort to improve our understanding of the water quality implications of improved sugarcane farming practices in the Mackay Whitsunday

region. The study has added to a body of knowledge developed through trial work run over the previous three years, improving and confirming understanding of the water quality benefits of new and improved management practices in sugarcane.

- Key findings for improving regional sugarcane management practices for water quality benefit include:
- Runoff was similar across all 1.8 m solid plant treatments, but reduced in the skip configuration where there was increased infiltration
- Sediment concentrations and loads in runoff were similar across all cane rows, but higher in the skip area where the reduction in soil cover (reduced plant area and lack of trash blanket) allowed for increased movement of soil despite the reduction in overall runoff
- No prior nitrogen treatment effect was evident when rainfall simulation was applied six months after application of fertiliser
- N concentrations and loads in runoff increased with higher N rates when rainfall simulation was applied one week after application. Prior site productivity data has shown no significant improvement in cane yield with higher applications with the exception of the lowest N replacement rates applied to treatment three in previous years
- Annual applications of phosphorus doubled runoff concentrations and loads six months after the previous application with no significant increase in yield achieved

This study was completed on a site where continuous monitoring of paddock scale runoff was undertaken for three years prior and has produced comparative results, demonstrating that rainfall simulation is a reliable and affordable option for providing much needed data on the water quality implications of sugarcane management practices. This method can be applied with relative speed across a range of soil types, in multiple regions.

IMAGES

Rainfall Simulation demonstration and information provision to a diverse range of stakeholders including landholders, government and community members.

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