Case Study 5: Dennis Werner, Septimus

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Action on the Ground - Carbon Farming Futures

Trial 1: Assessment of sub-surface applied mill mud as a component of seasonal nutrient program in sugar cane.

BACKGROUND TRIAL 1

Annette and Dennis Werner and their son John are third and fourth generation farmers, who grow 112-hectares of sugarcane in the Septimus area, west of Mackay in central Queensland. The 330ha property is home to breeding Brahman, Romagnola and Bramagnola crossbred cattle. As part of their integrated pest management they also have a small herd of 12 camels to assist into control of woody weeds. The property is in the Cattle Creek sub-catchment and Seven Mile Creek runs through the property before joining Cattle Creek and the Pioneer River.

The family embraces new ideas and technology and is involved with a number of research programs, often providing their property, time and machinery for trials. "There are two types of farmers," says Dennis, "those who watch and wait and those who try things. Those who try things are the ones who can move forward. You need to change yourself before change changes you."

In 1988 the Werner's were among the earliest adopters of green cane harvesting in the region, moving The Werner's are renowned for their work with compost and mill mud, using these 'waste' products as a natural source of fertiliser and a soil improver. In the past the Werner's have been involved in projects looking at creating the perfect compost and compost applicator. The family helped design a compost applicator that measured and banded the compost mix, placing it under the soil and cane trash. They have used their learnings from this project to build their own sub-surface mill mud applicator, which was funded through the Reef Rescue program.

"We believe that sub-surface application of all nutrients is vital," said John, explaining that by placing products like compost, mill mud and fertiliser under the surface of the soil it was less available for runoff and in the root zone, making it available for uptake by the plant.

TRIAL 1 OBJECTIVES

There are two main objectives of this trial, they are:

- Assess the potential of incorporating banded mill mud applications at low rates as part of seasonal nutrient program for sugarcane,
- Assess the potential for mill mud to supply organic nitrogen and other macronutrients while reducing granular nitrogen inputs.

TRIAL 1 DESIGN

The trial design incorporated two nutrient treatments with 4 replications. Randomised treatment strips are block length and 6 x 1.8m rows wide.

Tables below detail the applications.

Table 1: Treatments and descriptions

T1	Mud applied sub surface @33t / ha plus top up nutrients
T2	Control – 6 Easy steps Nutrient rates

Table 2: Nutrients applied

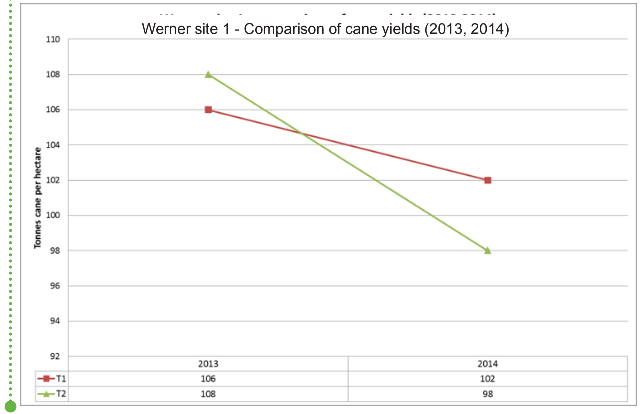
	Nutrients applied from mud application (kg / ha)				Nutrients applied from top – up application (kg / ha)				Total nutrients applied (kg /ha)			
	N	P	K	S	N	P	K	S	N	P	K	S
T1	25	25	20	8	133	0	76	16.5	158	25	101	24.5
T2	0	0	0	0	157	22	127	45	150	22	127	45

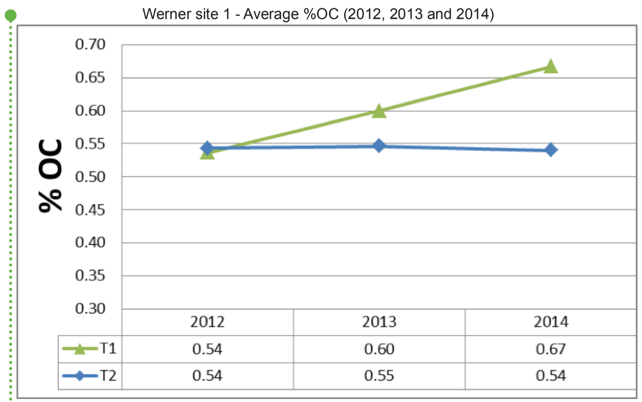
Trial: Top left - Dennis Werner (left) with son John (right) and John Hughes from DAFF. The Werners are assessing the potential of incorporating mill mud applications as part of the seasonal nutrient program for sugarcane. **Top right** - Lime vs un-limed trash (see Trial 2).

OUTCOMES TO DATE

Results for the trial so far are as follows:

- Cane and sugar yields for both treatments are significantly higher than the region average.
- Whilst both treatments have shown yield decline for T1 (mud plus nutrient top-up) is less than that of T2 (control).
- The 2014 result is further validation that reducing nitrogen applications in association with alternative nutrient sources (T1) has no impact on cane and sugar yields when compared to the industry standard applications (T2)
- There appears to be a trend of increasing soil organic carbon levels for T1 when compared to T2. This would indicate that there may be a soil health benefit from applying mud sub-surface. Monitoring of soil organic carbon levels at the site will continue to see if this trend continues.
- Failure to reduce nitrogen applications when used in conjunction with alternative nutrient sources has the potential to reduce water quality, increase Nitrous Oxide emissions and enhance the vigor of weeds.





Trial 2: Effects of fallow tillage operations on organic carbon levels following an extended ratoon cycle

TRIAL 2 OBJECTIVES

The three main objectives of this trial are:

- Determine the potential for increasing/maintaining OC levels through green harvesting of sugarcane
- Measure the effects of different tillage regimes on organic carbon levels and soil biology populations during the fallow phase of the production cycle
- Determine the effects of soil pH on soil biology populations and crop yields over time

TRIAL DESIGN

The site: 10-year green harvested ratoon cycle where cane had been ploughed out following a 10-year green harvested ratoon cycle.

The trial design incorporated four tillage treatments with 4 replications as well as limed and un-limed treatments as per the tables 1 & 2.

Table 1: Four treatments with increasing levels of intensity to determine effects on soil organic carbon levels

• Fallow • Treatment	Spray-out (glyphosate)	Discing	Ripping	Hoeing
T1	2	-	-	-
T2	-	2	-	-
T3	-	2	2	1
T4	-	4	2	2

Table 2: Significant responses to lime application in the ameliorated section of Plot 11 (139 days post application)

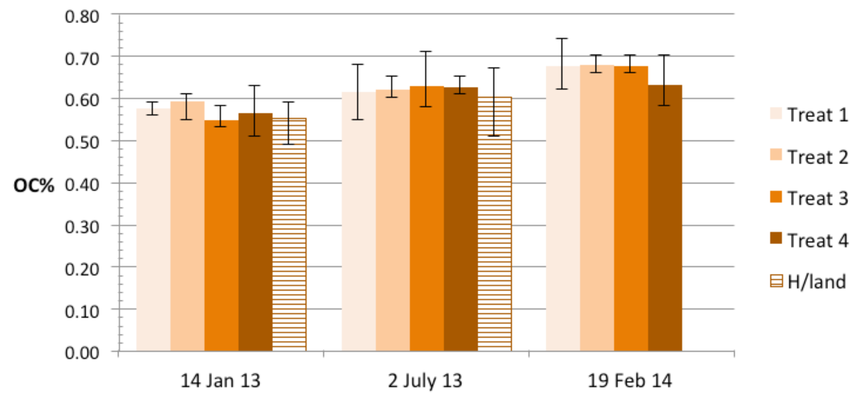
Sample date	Plot	pH (1:5 Water)	Calcium (Amm-acet.) Meq/100g	Cation Exchange Capacity (Meq/100g)	Aluminium Saturation %
2/7/13	11 - Un-limed	4.7	0.46	1.69	67
	11 - Limed	5.9	2.00	2.35	4.3

TRIAL OUTCOMES TO DATE

Organic Carbon

- Geo-referenced OC sampling of all plots was conducted 11 days after sugarcane regrowth was sprayed out with glyphosate (3/1/13) for establishing the base-line OC levels following the 10-year green harvested ratoon cycle. Follow up OC sampling was conducted in a fully tilled situation, post tillage treatments (2/7/13) and in plant cane (19/2/14). Calibrating the average OC levels from all plots against the average OC measurements from the three headland sites showed a small increase in carbon levels (0.02%) following the extended green harvested ratoon cycle **(Figure 1)**. The small incremental increase in average OC levels over the three sampling periods (0.1%) is attributed to:
    - o Excessive scraping away of surface located organic matter in the first sampling regime prior to the incorporation of the green trash blanket and commencement of tillage treatments
    - o The concentration of OC into the cane row with the plant cane hilling-up process
- Only small differences in OC levels were discernible between the different levels of tillage intensity over the fallow period (0.01%). The sampling regime in the plant cane phase showed a 0.05% reduction in OC levels between the most severe tillage treatment and the three other less aggressive tillage treatments. **(Figure 1).**

Figure 1: %OC levels overtime for different treatments



Cane and Sugar Yield

- Hand harvested yield data was collected from the spray-out (Treatment 1) replicated plots and the most aggressively tilled treatment (Treatment 4) plots in the limed and un-limed zones of the respective plots. The limed sections of the plots yielded 7.6% less tons of cane/hectare (TCH) than the average un-ameliorated zones (110 and 119 TCH respectively). The reduced yield from the ameliorated sections of the plots is largely attributed to increased crop lodging (Figure 30). It is likely that increased calcium and pH levels and an associated reduction in aluminium saturation will have positively enhanced the soil mineralisation process as well as the overall root biomass in limed areas. The relatively high N rates applied at planting (170kg N/ha) plus the additional N from improved mineralisation would have increased the propensity for crop lodging in the ameliorated sections of the plots.
- Mulched plant samples collected at harvest from limed and un-limed sections of selected spray-out treatments (Plots 1, 5 and 8) confirmed higher levels of N in both millable stalks (MS) and leaf cabbage (LC) in the limed zones indicating improved mineralisation and/or increased root biomass better able to extract nutrients and utilise moisture **(Figure 4).**
- Aside from the effects of amelioration on improved mineralisation, the tillage treatments conducted during the fallow period is likely to have further stimulated the mineralisation process. The fallow tillage treatments were initiated during the wet season period and a significant amount of mineralised N would have been lost via the leaching and denitrification processes. The higher average yields achieved in the heavily tilled treatments compared to the spray-out in the limed section of the trial is attributed to soil a reduction in soil N through the N loss pathways and reduced lodging. The un-ameliorated spray-out treatments yielded higher than the limed spray-out treatments (121 versus 105 TCH respectively). Again this is attributed to lodging issues with the sprayed out plots remaining relatively erect in contrast to the limed spray-out plots (average lodging levels of 2 and 3.2 respectively). The heavily tilled treatment in the un-ameliorated plots yielded slightly more than the tilled treatments in limed section this also attributed to reduced lodging and lower soil N levels **(Figure 3).**
- CCS sampling results showed that cane lodging influenced both yield and CCS with the un-limed more erect cane having marginally higher CCS levels than the limed sections of the plots **(Table 3)**. This is also attributed to the relative high N application rates at planting and increased mineralised N in the ameliorated areas.

Case Study 5 (continued)

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- A fairly strong correlation between stalk numbers and yield was evident. Average stalk numbers were higher in the un-limed section compared to the ameliorated zones (6.9/m² and 6.2/m² respectively). It is difficult to determine the reasons for difference in stalk numbers but may be related to poorer plant cane strike in the limed sections due to the increased weed populations and reduced soil moisture levels at planting (as indicated through field observations on 3/07/2013). Cane lodging is also likely to have influenced final stalk numbers at harvest.

Figure 2: Cane yield (2014) versus cane lodge rating (lime and un-limed)

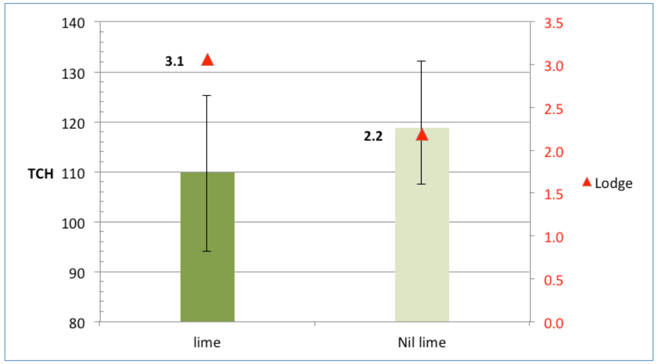


Table 3: Comparison of cane yields, CCS and lodge ratings across tillage treatments for limed and un-limed zones

	TCH		Lodge		CCS	
	Spray-out	Heavy till	Spray-out	Heavy till	Spray-out	Heavy till
Lime	105	115	3.2	2.9	17.1	17.1
Nil lime	121	116	2.0	2.4	18.1	17.4

Figure 3: Variations in yield across tillage treatments and amelioration treatments

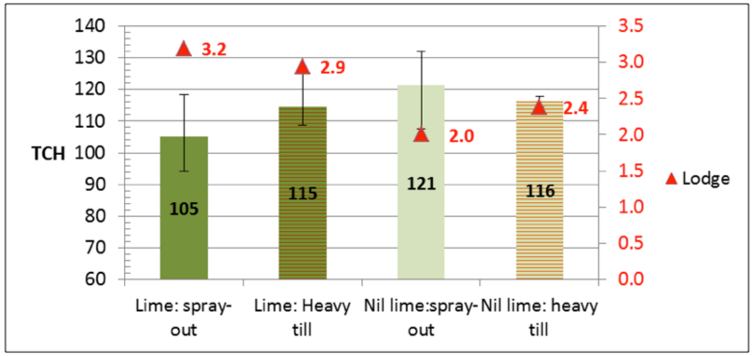


Figure 4: Total N concentrations in the plant stalk at harvest (limed and un-limed)

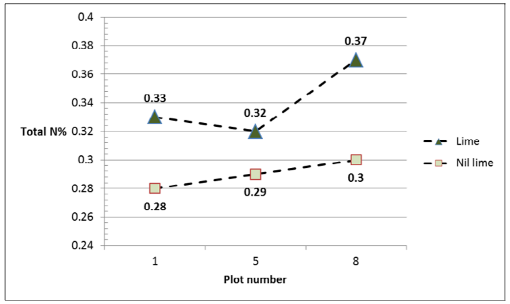
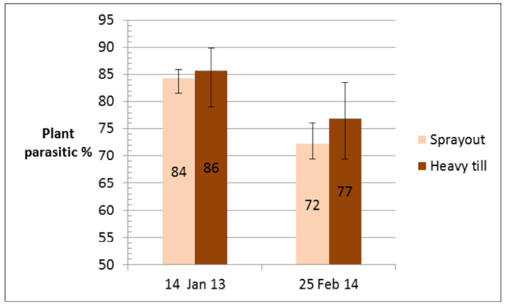
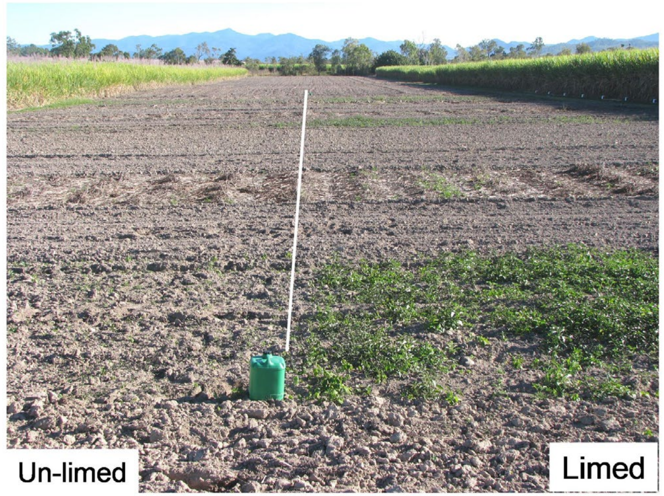


Figure 5: Comparison of plant parasitic nematode populations over time and tillage treatments



Soil Biology

- Samples were collected for biological analysis at the start of the fallow phase from geo-referenced sites in the spray-out plots (1, 5, 8 and 14) and the heavily tilled plots to establish baseline levels. The early January 2013 sampling was conducted prior to any tillage disturbance. Sampling was repeated in the plant cane phase in mid February 2014. Sampling was conducted in the limed and un-limed spray-out and heavy till plots.
- No outstanding biological differences were evident in analysis between the limed and un-limed sections, however, there was a reduction in the break- down of parasitic nematodes in the spray-out plots compared to the heavy till (72% to 77% respectively). Average levels of parasitic nematodes reduced from 84% (baseline levels at the beginning of the fallow phase) to 72% in spray-out plots in the subsequent plant cane crop **(Figure 5)**.
  - o Tony Pattison (Principal Nematologist DAFF) advised that in terms of pH change from lime applications a longer timeframe may be required before significant changes in biological diversity occur and detected in sample analysis.
  - o Parasitic nematode domination reduced by 12% from baseline levels at the start of the fallow to mid plant cane phase in the spray-out plots and 9% in the heavy till treatment
- Soil test results from the limed and un-limed sections of Plot 11 (139 days post application of lime) showed a significant response to lime (Table 9) with a 1.2 unit increase in pH, a 4 fold increase in calcium levels and a large reduction aluminum saturation (57% to 4.3%)



Opposite: Trial site comparison of Limed versus Un-limed area.

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