BUREAU OF SUGAR EXPERIMENT STATIONS

QUEENSLAND, AUSTRALIA

FINAL REPORT - SRDC PROJECT BSS176
OPTIMISATION OF NUTRIENT MANAGEMENT OF THE QUEENSLAND SUGAR INDUSTRY

by

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SD02006

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ABSTRACT

In 1996 a comprehensive grower survey was conducted throughout the northern sugar industry to determine fertiliser rate trends which existed for this part of the sugar industry at that time.

It was suspected that rates of fertiliser (in particular nitrogenous fertilisers) were being applied by a percentage of growers above BSES recommended rates, largely as a cheap form of crop production insurance throughout the region.

BSES recommendations are derived after many years of trial work, and aim for an optimum result with productivity, sustainability and profitability to the industry.

These BSES recommended rates for nitrogen for example are:

PLANT CANE	120 kg/ha – 150 kg/ha (fallow plant)
	120 kg/ha – 160 kg/ha (ploughout/replant)
RATOON CANE	160 kg/ha – 200 kg/ha

For the Burdekin, these are slightly different, with plant cane at 135-150 kg/ha and ratoons at 210-250 kg/ha.

This project, BSS176, set out to give the sugar industry an indication of how bringing nitrogen rates back to within BSES recommended levels would not only save production costs, but also improve ccs, thus improving profitability to the grower.

A reduction in nitrogen rates back to within recommended rate range would not only improve profitability and promote best management practice but also provide other important benefits to the sugar industry in the form of positive promotion of agronomic practices to the wider community.

The 1996 grower fertiliser survey was presented as a starting point for the project BSS176, (NUTMAN) which specifically targeted nitrogenous fertiliser rates.

Other nutrient rates are determined by laboratory soil testing, however such testing for nitrogen is not as stable for long-term recommendations for fertiliser usage.

A series of focus groups to pinpoint community, agribusiness, researcher and grower group perceptions of fertiliser usage, rates and off-site impacts were conducted in the early stages of this project throughout the northern sugar industry.

The bulk of the project however was a series of nitrogen strip trials conducted in the major sugar growing centres of north Queensland aimed at providing tangible evidence to growers that applying nitrogen rates within the recommended ranges will provide the most profitable outcomes.

To conclude the project, a grower survey was conducted in 2000-2001 to correspond as closely as possible with the 1996 survey, providing a comparison of fertiliser application rates (in particular nitrogen) in the northern mill areas. Any differences in fertiliser rate trends can then be analysed to see what the driving force is for such changes.

This final report therefore has two distinct functions:

1) *To highlight and document trial work carried out from 1995–2001, which aimed to provide growers with field evidence that keeping to BSES fertiliser recommendations for nitrogenous fertiliser was more profitable and sustainable for the industry, than applying excess rates.*

2) *Comparing the 2000-2001-grower fertiliser rate use against the 1996 benchmark to ascertain if fertiliser rate trends have changed during the lifespan of this project.*

In conclusion, the most profitable fertiliser rates are highlighted, and trends in fertiliser rate use are identified and possible explanations given.

TECHNICAL SUMMARY

The initial grower fertiliser use survey of 1996 indicated a general trend by northern growers to apply fertiliser to both plant and ratoon cane at above BSES recommended rates.

For instance in plant cane, 60% of growers across the northern regions were applying nitrogen at a rate above the recommended 160 kg/ha. The reasons for this trend included:

i) The returns from a tonne of extra cane far outweighed the cost of the extra nitrogen applied.

ii) The producer saw extra nitrogen as a cheap form of insurance, especially as the mid 1990s were generally good sugar cane producing seasons, with average, adequate rainfall, plenty of sunshine, and a strong performance of one variety (Q124). Also a good sugar price enabled growers to put extra inputs into their crop production systems.

Focus groups were conducted in the early stages of this project to gauge the opinions and perceptions of community, grower, agribusiness and researcher groups to fertiliser usage. This coupled with the original fertiliser survey set the background for the project.

The field trial work which then followed involved shed information meetings with growers to discuss the formation of these trials and identify trial co-operators, and replicated strip trials over uniform trial areas were set up. All trials were commercially harvested/processed.

The tonnage and ccs obtained was related back to rates, and a net $/hectare return calculated as for each rate applied.

The final grower survey included close cooperation with northern BSES staff and CPPBS. In all areas except the Herbert, a representative sample of growers was used to determine current fertiliser rates. In the Herbert, the HCPPB surveys the majority of growers annually, with Herbert data coming from 80% of the grower population of the district.

For the final report on BSS176, the 2000-2001 report is tabled, along with comparisons to fertiliser use in 1996. It was indicated in trials over 2-3 years that a reduction in N application, back to within the range of BSES recommendations, increased ccs and overall improved profitability, despite tonnes/ha being slightly reduced. These findings were relayed to the industry as a means of encouraging growers to adhere to current BSES recommendations.

The fact that BSES recommendations were determined in the burnt cane era, and the bulk of the crop is now cut green in the areas sampled, is highlighted. Therefore the results of this project can only add confidence to the current BSES recommendations in green cane, especially for nitrogen.

Demonstrating to growers that applying nitrogen inputs within the range of BSES recommended rates could increase profitability, is an invaluable message to give the industry, especially at a time when the industry is suffering times of low sugar prices on the world market. The industry benefits greatly in seeing that growers are applying recommended rates and not oversupplying the crop with nitrogen, which may cause excess suckering, reduced ccs or off site impacts, if lost to the system.

Cooperation with fertiliser companies throughout the project was paramount, with long term sustainability of sales their concern. A slight reduction in sales of nitrogenous fertiliser back to recommended rates, means the growers spend in other areas including lime to improve overall productivity of the enterprise, or herbicides for fallow management strategies, and surface drainage.

This project has many linkages with other projects.

They include:

- **BSS204 - Development of an educational package for canegrowers on efficient nutrient management.**

Through this project the same message is given to growers that managing nitrogen inputs is an important practice for sustainability and profitability. Funds from BSS176 were used to assist setting up this course as a "Train the Trainer" for fertiliser resellers, extension staff and the growers themselves. This course included the soil test interpretations, fertiliser mixture analysis and fertiliser equipment calibrations.

Two single row electronically controlled fertiliser boxes were purchased through this project for trials and were also used for BSES trials such as *nitrogen * Variety* and *High Density* and *dual row trials.*

One machine is based in the Herbert, the other at Meringa.

- Cooperation with CSIRO nitrogen residue in cane juice work is important to help produce a further tool for recommending nitrogen inputs for a particular situation and crop history, this work is continuing in Bundaberg after first commencing at Macknade Mill, Ingham.

- Environmental considerations such as monitoring of groundwater nitrates were carried out in the Burdekin.

In year one of the field trials, generally all trials conducted showed very little difference in tonnes/ha or ccs where less N was applied. This is explained by the presence of nitrogen reserves stored in the system. The crop is capable of mineralising stored N in the soil, and little response to reduced rates occurs over one season. Some interesting trends began to show in year two. Ccs levels rose slightly, and tonnes were reduced slightly. In some cases, the trials were not continued after 1998 (year 2), however where they were, these trends continued with the lower rates, generally providing better ccs, slightly less tonnes, but overall higher profitability to the grower.

The following report includes trials that lasted two seasons or longer, and the results are graphed to show how ccs and tonnages are affected by nitrogen inputs.

Coupled with these strip trials, the Herbert mills collected cane juice samples in collaboration with CSIRO staff for amino-N determinations from each trial.

Bundaberg began nitrogen strip trials in 1998 and also used the amino-N sampling as another tool to determine the optimum N rate. This work is continuing in Bundaberg.

The work of this project, BSS176, is a continuation of previous trial and survey work done in each district over many seasons on fertiliser inputs into cane production systems.

In particular the work of T J McShane, J R Reghenzani, B G Prove and P W Moody - "*Nutrient Balances and Transport from Sugar Cane Land – A Preliminary Report". ASSCT 1993* served as a platform for this project. *

This report was part of an initiative of Integrated Catchments Management work to identify the fate of applied nutrients to large field plots under commercial sugarcane production. Two management strategies were studied, one conventional, one "best bet", to compare the fate of fertiliser at various rates and placement strategies.

The work of Calcino *et al. "Fertiliser Handbook for Sugar Production"* outlines BSES recommended rates for all major and trace elements and serves as a basis for this trial work.

The corresponding work of Keating *et al.* in amino-N analysis as a further decision-making tool on N application for the sugar industry is also highlighted.

* Project DAQ 35, supervised by Prove, Reghenzani and Moody.

1.0 INTRODUCTION

The objectives of BSS176 are to:

- **Promote adoption of improved fertiliser practices, products, rates, and application methods;**
- **Reduce off site nutrient losses;**
- **Increase industry awareness of environmental considerations;**
- **Increase community acceptance of fertiliser practices.**

Given the situation where the industry is, according to the 1996 grower survey, applying excess amounts of nutrients such as nitrogen in the belief that it is a cheap form of crop production insurance, measures have to be taken to prove in a tangible and real way that reducing these inputs back to within recommended rates will be a classic "win-win" situation. Excess nitrogen can cause lodging of the crop, with excessive suckering and a subsequent reduction in ccs. This coupled with the cost of extra nitrogen, cause a less than optimum financial result. By using slightly less nitrogen, (as long as it is enough - within recommended rates range), then ccs can be improved and input costs slightly reduced, thus overall increasing profitability over several seasons.

The only way to prove to the industry in a practical way that keeping to recommended rates for fertiliser application will give the most profitable result is to have a series of strip trials with a lower, higher and recommended rate on nitrogen, over an even soil type with one sugarcane variety, and to have the trial last at least three years (two harvests) to see which way the profitability trend goes.

Once optimum amounts of nutrient are applied, there is no financial benefit from applying extra amounts, and previous trial work has indicated that there is a balance where both the tonnes cane/ha and ccs of the crop are maximised, to give the most profitable outcome.

The project was therefore developed in several phases.

1) Benchmark nutrient use (1996 season).
2) Identify attitudes and perceptions of all industry stakeholders through a variety of means:
   a) Develop/implement action learning extension program using shed meetings, field trials, media channels, focus groups.
3) Conduct field trials of nitrogen rates for 3-4 years where possible.
4) Benchmark nutrient use for the 2000 season

The 1996 benchmark report was conducted by BSES and CPPBs in the Herbert to Mossman region. The corresponding 2000-2001 survey was conducted by BSES and CPPB from Herbert to Babinda in 2001 for the 2000 crop.

Overall nutrient rates were calculated from the many configurations of fertiliser used.

How the various components of this project were carried out, and the results of each, form the bulk of this report.

2.0 METHODOLOGY

2.1 1996 fertiliser survey

Northern BSES and CPPB staff carried out the initial grower survey; the results were then tabled in the 1996 report.

The areas north of the Herbert were sampled with a representative number of growers, usually between 20–40, and the South Johnstone and Mourilyan mill areas were sampled as "Innisfail".

The Herbert district involved a comprehensive survey of close to 800 sugarcane producing assignments being sampled by the Herbert Cane Protection and Productivity Board staff. This is an annual process for the HCPPB.

2.2 Focus groups formation and location

A series of focus groups were conducted in the major centres.

Each group was asked the same questions, which varied slightly in semantics but essentially asked:

a) What is a fertiliser?
b) Why use fertiliser?
c) How do growers decide on rates to be applied?
d) What happens to fertiliser once applied?
e) Do growers consider off site impacts of fertiliser?
f) What issues about fertiliser need to be addressed?

A snapshot of each region's focus is provided for this final report.

It is interesting to note that in the case of community groups, one was from a regional town where sugarcane is the economic backbone (Innisfail), one from a major centre (Mackay) where sugarcane is the major industry, but tourism, mining, cattle and other crops also exist. The third was from Cairns, a city where tourism is probably considered more important economically than sugarcane, the traditional lifeblood of the city.

Mackay

Four grower groups were conducted, as well as one agribusiness and one community group.

Burdekin

Four grower groups from each mill area were conducted (Invicta, Pioneer, Kalamia and Inkerman).
One community group from Ayr.

Herbert

One grower group.

Northern

Six grower groups.
Two community groups (Innisfail and Cairns).
One researcher group (Northern).

2.3 Nitrogen trial set up

Nitrogen strip trials formed the bulk of this project, with trials set up in all northern growing areas. The results from the 1996 survey for ratoon cane in particular formed the basis for the trial work, as longer term trends are only possible for ratoon cane. To prove a reduction in nitrogen application back to within recommended rates, several season's data is required, therefore ratoon cane has to be used for such trials.

Grower shed meetings were conducted in each district with the results of the 1996 grower survey discussed and compared with local growers' fertilising experience.

Interested trial cooperators were identified and soil tests taken of their blocks set aside for trial work.

The criteria for selecting a trial site was as follows:

→ uniform soil type;
→ one variety of cane, plant or 1st ratoon;
→ trials large enough to secure a mill ccs reading per treatment; and
→ trials were set up typically on the basis of three fertiliser rates, over two replicates.

Typically the fertiliser rates were one lower, one higher and one higher than recommended rates eg 120 kg, 180 kg, 220 kg.

This was repeated twice per trial and the results obtained from commercial harvesting.

→ At harvest time, separate tickets were written out for each strip harvested. Tonnage and ccs figures from the mill were then used to calculate yield and $/ha net return (deducting harvesting and fertiliser cost from gross return).

- BSES staff were always present at time of harvesting to assist with ticket recording and make notes on harvesting conditions. This allowed for a strong rapport with the harvesting sector.

→ Guard rows excluded where practical from calculation to improve reliability of results.

→ Cooperation with CSIRO's Brian Keating, for sampling of amino acids in cane juice. This involves cooperation with juice labs at mills to ensure proper sampling.

→ Net $ return calculated by **Gross $ha – harvesting cost - fertiliser cost.**

Trial number and location discussed for this report

Mackay	1
Burdekin	1
Herbert	6
South Johnstone	2
Babinda	2
Mulgrave	2

2.4 Amino-N work *

Samples were sent to CSIRO, Brisbane for testing as part of Brian Keating's Amino-N work (Project CTAO29).

In the northern case, the trials set up for BSS176 were used.

In Bundaberg trials were set up specifically for the work. Trials were established in the Macknade and Victoria (Herbert) in 1996-7 and used for this work, then in Bingera, Millaquin and Fairymead in 1998-9 specifically for CTAO29.

The Herbert trials were part of CSC21 "N at the mill pilot project".

Trials in Bundaberg were set up in very similar fashion to the BSS176 trials, with higher, and lower rates than recommended, and a recommended rate.

*Refer to Milestone report 8, CTAO29 "Monitoring cane at the mill to improve nitrogen management on farm", Dr B Keating.

2.5 2000 fertiliser survey

The 2000 survey was conducted at the end of 2000 into 2001.

The process was similar to the 1996 survey, with a representative number of growers sampled in all northern districts by CPPB and BSES staff (except Mulgrave). The sample size was 20.

In the case of the Herbert, 800 growers were sampled by the HCPPB as part of their annual grower survey including fertiliser rate usage.

The South Johnstone and Mourilyan mill areas were surveyed separately, and for summary were compared to the 1996 "Innisfail" results.

3.0 RESULTS OF 1996 SURVEY AND FOCUS GROUPS

3.1 1996 fertiliser benchmark report summary

Some findings from the 1996 survey were as follows:

- Sixty per cent of NQ growers are applying excess nitrogen to plant cane (>160 kg).
- This included 75% of growers in Mossman, Mulgrave and 67% of the Herbert.
- However in contrast to this, 97% of Babinda , and more than 75% of South Johnstone, Mourilyan and Tully growers were applying less than or equal to the recommended rates (120-160 kg/ha) for plant cane.
- For ratoon cane, 42% of growers were applying excess nitrogen in 1996.
- Forty-nine per cent of growers were using Phosphorous >40 kg/ha
- Ninety-four per cent of growers were applying Potassium 120 kg/ha
- Sulfur application in Plant cane in the Herbert.

Ratoon cane applications from 1996 Survey - basis for trial work

Nitrogen

42% of growers were applying excess (>200 kg/ha) nitrogen to ratoon cane.

District Breakdown:

Ingham - 54% use more than 200 kg/ha nitrogen.
Tully - 20% " "
Innisfail - 9% " "
Babinda - 3% " "

Average - 42%

Phosphorous

Phosphorous applications above 40 kg/ha is relatively low in ratoons.

District Breakdown:

Herbert - 8% apply more than 40 kg/ha Phosphorous
Tully - 3% " "
Innisfail - 0% " "
Babinda - 2% " "

Average - 3.5%

Potassium

Above recommended rates (>120 kg/ha) were fairly common except in the Herbert.

Herbert - 4 %
Tully - 62%
Innisfail - 64%
Babinda - 20%

Average - 37.5%

Sulfur

Sulfur application in ratoons is common as it is included in fertiliser mixtures.
Above recommended rates (> 25 kg/ha) are as follows:

Herbert - 3%
Tully - 0%
Innisfail - 6%
Babinda - 6%

Average - 4%

Calcium

Babinda - 49%
Innisfail - 84%

Data not available for some areas.

Average of two areas - 66.5 %

Magnesium

Tully - 78%

On average, only 3% of northern areas require Magnesium inputs.

Summary

These results indicated that nitrogen was the most common nutrient applied in excess over all the areas sampled and is also the nutrient hardest to determine from a soil test.

Trials were then set up to pinpoint nitrogen rates. (Results are shown in section 4.0).

3.2 Summary of focus group discussions

3.2.1 Focus group results

In general, the results across all groups are as follows:

QUESTION 1. WHAT IS FERTILISER?			
RESPONSE			
Growers	***Community***	***Agribusiness***	***Researcher***
NPK ratios Organic/inorganic Blends/straights	NPK ratios Different elements essential for plant growth Organic/inorganic	NPK Inorganic/organic	NPK Inorganic/ organic/alternative

Comments - Generally all groups had a sound understanding of what constituted a fertiliser. Grower and researcher groups emphasise more work can be done to improve stakeholder understanding.

QUESTION 2. WHY USE FERTILISER?			
RESPONSE			
Growers	***Agribusiness***	***Community***	***Researcher***
Cannot produce crop without	Cannot grow crop without	Vital for good yield of crop, poor yields affect community negatively	Vital for sustainable growth

Comments - Agreement across the board that fertiliser is essential, and that reduced yields adversely impact surrounding community (not as emphasised in northern community group).

QUESTION 3. HOW DO GROWERS DECIDE ON RATES TO APPLY?			
RESPONSE			
Growers	***Community***	***Agribusiness***	***Researcher***
BSES, CPPB, Agribusiness, past experience, soil samples, economic climate, weather	Advisory groups, scientists, literature	BSES, past experiences, soil samples, economic climate	Past trial work, being refined for GCTB, soil/leaf analysis

Comments - General agreement that growers have access to sound advice, past experience and advanced decision making tools to know about fertilisers and what rates are best. Physical and economic climate considered a factor.

QUESTION 4. WHAT HAPPENS TO FERTILISER AFTER APPLICATION?

RESPONSE

Growers	*Agribusiness*	*Community*	*Researcher*
Most taken up by plant. Some stays in soil. Some volatilises if put on top of ground.	Majority taken up some lost due to volatilisation or gentrification.	Majority taken up by crop. Some lost. Depends on type of fertiliser.	% taken up immediately, % converted in unusable forms for that season. % lost to system.

Comments – All agree that the plant does not utilise all available elements from fertiliser. Greater awareness exists of nitrogen fate than any other nutrient in grower's case.

QUESTION 5. DO GROWERS CONSIDER OFF SITE IMPACTS OF FERTILISER?

RESPONSE

Growers	*Community*	*Agribusiness*	*Researcher*
Definitely, don't want any waste or bad publicity. Want as little volatilisation as possible and want no impact on reef or waterways. No negative publicity or waste of input is wanted.	Perhaps some gets off paddock, but not too much. Pesticides runoff considered more dangerous than fertiliser runoff.	Yes. Sound management required, bad for business if any wasted and has perceived environmental impacts	More research is required.

Comments - All agreed excess runoff from paddock is unacceptable and needs to be avoided.

QUESTION 6. WHAT ISSUES ABOUT FERTILISER NEED TO BE ADDRESSED?			
RESPONSE			
Growers	**Community**	**Agribusiness**	**Researcher**
Need more positive publicity - schools, media outlets. Improve practices of poorly performing growers. Increase soil testing.	More information on how advisory bodies work - BSES, CPPBs. More active role in tourism for agriculture - all need sustainability. Protect fish habitats.	Too much emphasis on N alone, look at other nutrients too.	Effect of GCTB. Education of all stakeholders and community groups.

Comments - Extra work needs to be done on exactly what impacts, if any, fertiliser runoff has on the reef. All agreed tourism and agriculture must both be sustainable for the sake of all northern communities.

FOCUS GROUP SUMMARY

Some observations from these focus group discussions are

- There is general understanding that fertiliser inputs are essential for crop production systems, including sugarcane.
- There is general consensus that a drop in agricultural productivity has adverse affects on both the primary producer, and the surrounding community.
- There is general agreement that growers have access to sound agronomic advice for determining fertiliser rates.
- There is some agreement that the crop does not utilise all the nutrient applied, but some is stored and excess may be removed from the system.
- All sectors, including the growers agree that nutrient runoff from paddocks is detrimental to all sectors of the community.
- There is general agreement that Research and Development work for nutrient fate is required, especially to determine if any nutrient runoff is occurring and if it is affecting the reef in a detrimental way.

4.0 NITROGEN STRIP TRIAL OUTCOMES - RESULTS 1996-2000

Trials were set up following the methodology outlined in section 2.0.

Care was taken to select paddocks with even soil type, and also a crop class of either plant or 1st ratoon so that the trials could last for as long as possible.

The trials reported here are only those that lasted for three or more years (two or more harvests). In general, the first harvest gave inconclusive results, with soil reserves of nitrogen "masking" any effect of a lower rate application. For the trials which lasted for three harvests, all the data is shown, to indicate how the trends changes over the years. For all other trials, only the second year data is shown, as the first years are inconclusive.

Even two harvest results give a less than best idea as to the trends, as the variation is sometimes great, and it takes a third harvest to see if trends set in the second harvest, continue.

For the Mackay and Burdekin trials, only one year's results were available, so these have been put in the Appendix 1.

Trial Location and Distribution

Mackay	**1997-1998**	**(See Appendix 1)**
Burdekin	**1997-1998**	**(See Appendix 1)**

4.1 HERBERT TRIALS

4.1.1	**Lamari**	**1996-1999**
4.1.2	**Adams**	**1996-1998**
4.1.3	**Reid**	**1997-2000**
4.1.4	**Vella**	**1996-1998**
4.1.5	**Girgenti**	**1996–1998**
4.1.6	**Quabba**	**1996-1998**

4.2 SOUTH JOHNSTONE TRIALS

4.2.1	**Zappala**	**1997-2001**
4.2.1	**Cecchi**	**1996-1998**

4.3 BABINDA TRIALS

4.3.1	**Todd**	**1996-1998**
4.3.2	**Nucifora**	**1996-1998**

4.4 MULGRAVE TRIALS

4.4.1	**Hardwick**	**1995-2000**
4.4.2	**Amadio**	**1996-1999**

These 12 trials are reported in the following format:

- **Tables with average tonnes cane/ha, ccs, tonnes sugar/ha and Net $/ha**
- **Graphs of tonnes cane/ha vs ccs for final year of trials**

For long term trials (3 - 4 years duration)

- **Bar Graph of $/ha per rate over each year of trial.**

Note - Year 1 results are not reported for the 2 year trials, but for the longer term trials, all results are shown.

4.1 Herbert

At one stage in 1998 there were 14 nitrogen rate trials which were directly linked to this project in the Herbert.

The wet end to the 1998 season, in which 20% of the crop was left as standover severely depleted this number.

Five trials lasted three years (two harvest results), and one remained for four, (three harvest results), giving some useful data from which trends can be determined.

For all trials: Harvest cost = $6/tonne and fertiliser cost is calculated at $450/tonne average. *

4.1.1 Trial 1 - Lamari

Long term trial - All years results are shown

Sugar price = $330/tonne

Established 1996	1st Ratoon	Sandy Loam	Supplementary Irrigation

Table 1: First ratoon harvest 1997

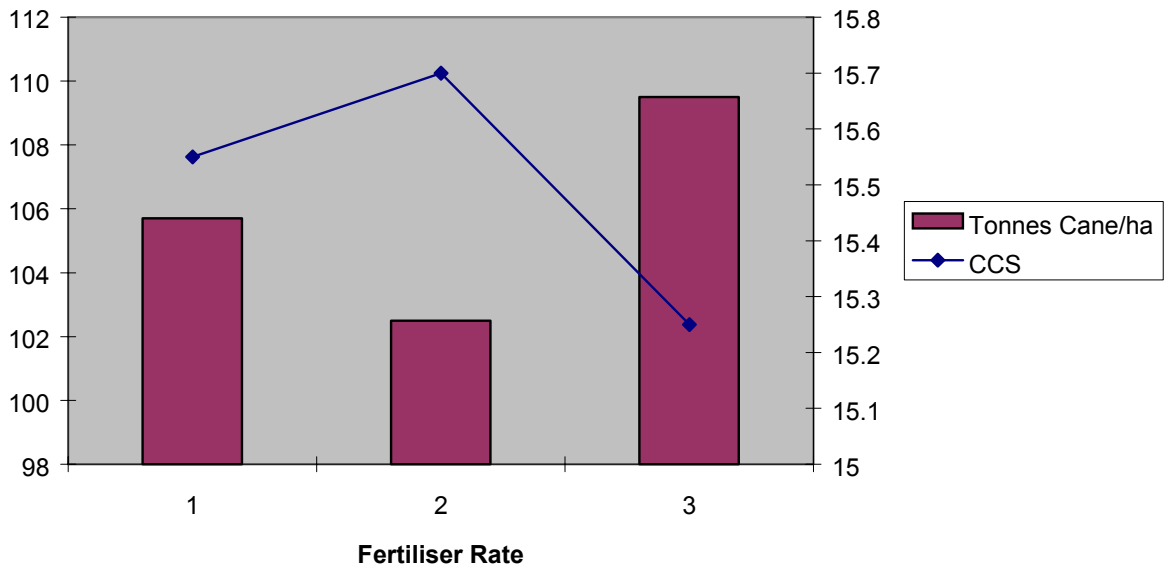
Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha return
160	105.7	15.55	16.4	2901#
180	102.5	15.70	15.7	2830
225	109.5	15.25	16.7	2845

# Indicates most profitable result

Comments – Table 1 shows that the lowest rate of 160 kg/ha provides the best Net return (profitability) after the first season harvest. However these results are inconclusive, as it is only the first year of the trial.

* 1997 fertiliser prices were in fact lower than this.

Graph 1: Lamari trial 1997 tonnes cane/ha vs ccs



Comments - Graph 1 indicates that in the first year of the trial, the lowest rate (160 kg) had a reasonable tonnage and ccs, while the highest rate of 225 kg/ha had the highest tonnage, but lowest ccs. The results for the intermediate rate are inconclusive as the 180 kg/ha nitrogen rate should have a better tonnage. Many factors can account for this result, including pest damage to replicates. This is why more than one replicate is used for strip trials. These results highlight why any such trial should be carried out for several seasons, and not just one growing season, to see if the trends continue and are not just a "one off".

Year 2 – 1998

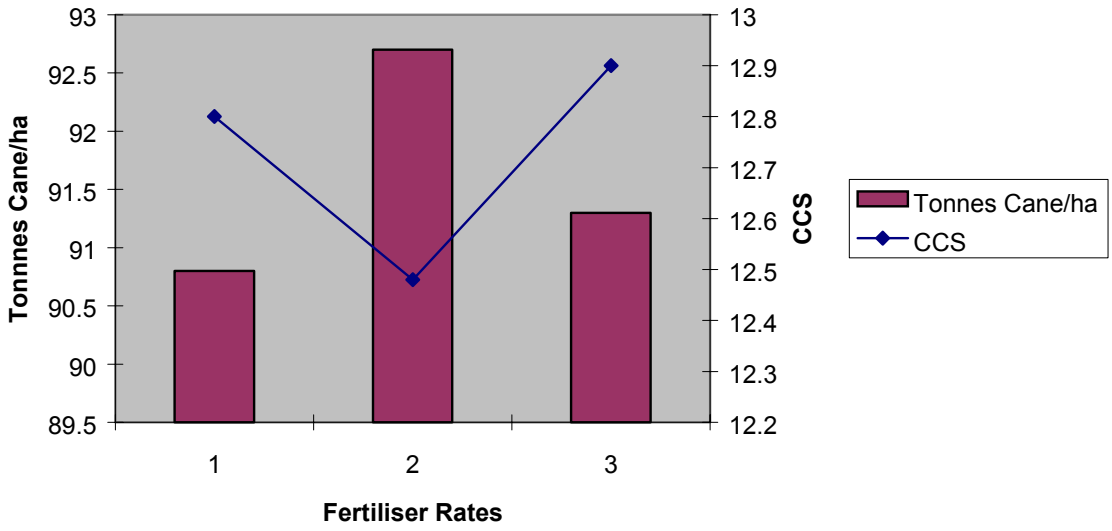
Sugar price = $330

Table 2: Second ratoon harvest 1998

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha return
160	90.8	12.8	11.6	1729#
180	92.7	12.48	11.57	1656
225	91.3	12.9	11.77	1698

Comments – The lower rate of 160 kg/ha is still the most profitable, despite the slightly better tonnage from the other two rates.

Graph 2: 1998 result - tonnage vs ccs in second year of Lamari trial



Comments - In the second year of harvest, ccs improves where nitrogen rate is decreased, however the higher rate still gives good ccs, indicating that the effect of the different rates is starting to cause a definite trend towards greater profitability at the lower end of the BSES recommended rates for ratoon cane 160 kg/ha - 200 kg/ha.

This was a particularly wet year, as opposed to 1997 which was a dry year.

Year 3 - 1999

Sugar price = $280

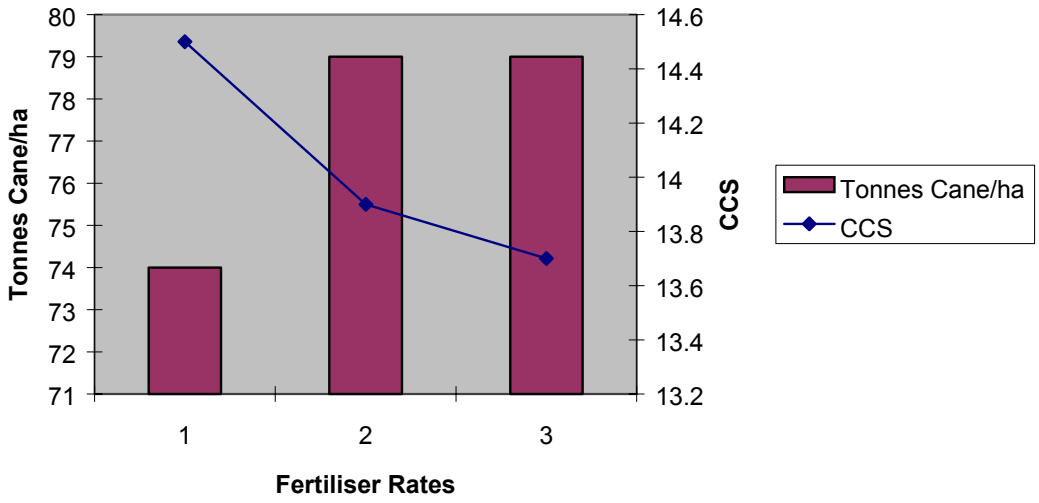
Table 3: Third ratoon harvest 1999

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha return
160	74	14.5	10.73	1712
180	79	13.9	10.9	1719#
225	79	13.7	10.8	1628

Comments - By the third year of this trial, the best return is achieved between 160 kg/ha and 180 kg/ha.

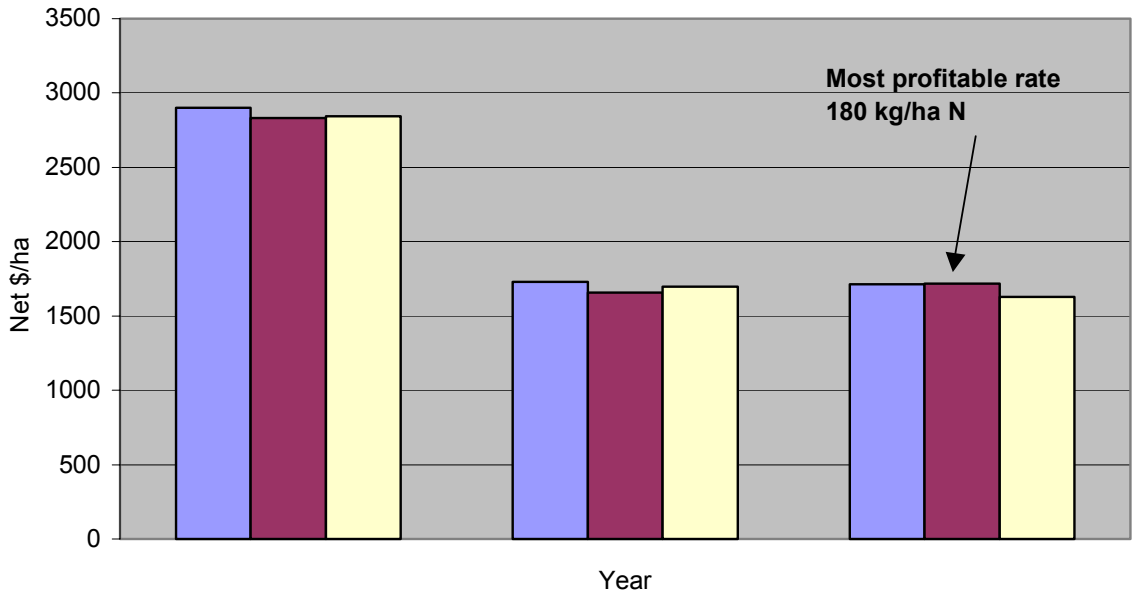
There is no gain in productivity or profitability by exceeding 200 kg/ha after three years in this trial.

Graph 3: 1999 tonnes cane/ha vs ccs in third year of Lamari trial



Comments 1999 results - Definite trends began to occur where the lower rate of nitrogen gave less tonnes, but improved ccs. The higher than recommended rate gave the best tonnes, (only slightly above the intermediate rate tonnes however), but the ccs was reduced. This can occur due to several factors, lodging being the obvious one. This trial is a good indication as to why a third harvest is required to either confirm or deny trends which begin in harvest two.

Graph 4: Comparisons of Net $/ha (Profitability) return for each rate over the three years of the Lamari trial



Comments - In the first two years, the lower and higher rates are more profitable than the intermediate rate, however by year 3 the intermediate is most profitable.

Statistical Analysis - Appendix 2 shows the sample of how the statistical analysis was done for each trial.

Summary of Lamari trial

In years 1 and 2, the lower rate provided better tonnes sugar/ha due to the slightly better ccs, however by year 3, the intermediate rate of 180 kg/ha provided the optimum tonnes sugar/ha. This relates to the profitability. The "trade off" between tonnes and sugar is highlighted here. The ccs for 180 kg/ha was not as good as for the lowest rate (155 kg/ha), however the tonnage was better, thus the optimum tonnes sugar/hectare is achieved in year 3.

This particular trial was in a dry part of the Herbert River where nitrogen application rates were generally high in the mid 1990s. The first year's harvest results showed some response to reduced nitrogen levels, but cannot be considered a trend yet at this stage.

The low tonnage in the intermediate rate is explained by a particularly dry patch in this trial, which occurred in one of the 180 kg/ha replicates.

Graph 2 (1998) shows variable results, and the effect of the reduced N rates starting to take place in the lower rate, but the intermediate rate gives results which are not expected.

Table 3 and Graph 3 show a clear trend for reduced tonnage with increased ccs as the trial enters its third harvest. The $/hectare net return clearly shows a benefit of applying less than 200 kg/ha, and keeping to rates between 160 kg/ha–180 kg/ha nitrogen.

This trial was third ratoon at the time of the 1999 harvest, and was ploughed out after the trial was completed. If it had been possible to collect a further season's data, this trend could be further investigated, however the trial was discontinued after 1999 due to the grower requiring the paddock for fallow rotation.

The results of this trial clearly indicate that a financial benefit is to be gained by the grower by reducing N inputs from 225 kg/ha, which is 25 kg/ha above the top level of the recommended range, to 160-180 kg/ha. Some tonnage in one of the 180 kg/ha trial replicates was lost due to factors outside of nitrogen inputs.

Further comments

This trial was 1st ratoon at commencement in 1996, and was drought damaged in one replicate of 180 kg/ha.

4.1.2 Trial 2 - Adams

Two season trial - only second season results shown

Sugar Price = $330/tonne

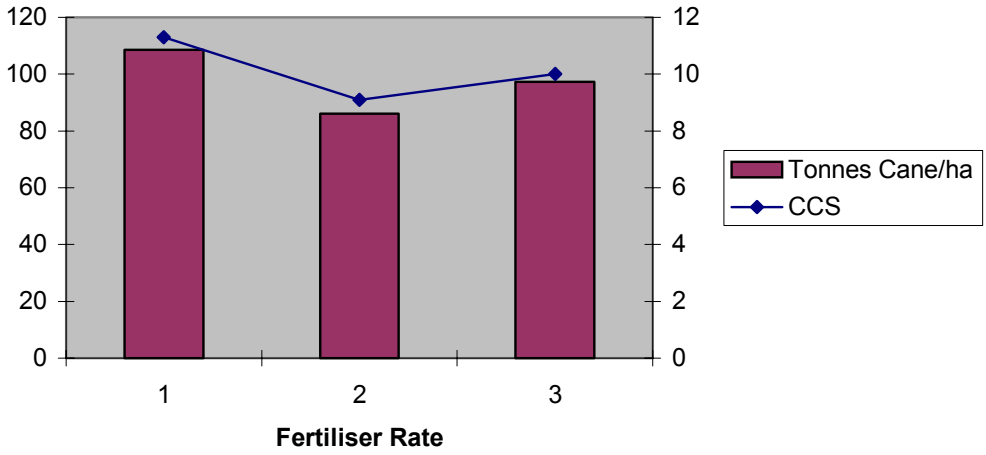
Established 1996	1st Ratoon	Clay loam soil	Q117

Table 4: Second ratoon harvest 1998

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha
130	108.5	11.3	12.3	1647#
170	86	10.6	9.1	1053
230	97.5	10.3	9.5	1071

Comments – The trend toward the lower rate providing the greatest profitability in this particular trial appears to be continuing after the second season harvest. ***However a third season would give a better indication if this trend continues for this soil type.***

Graph 5: 1998 Adams trial results



Comments - After two harvests, the lowest rate resulted in the best ccs and tonnage. However this was only the second year of the trial. The tonnage collected in 1999 was not enough to gain ccs readings from the mill, thus an average ccs was assigned to the cane harvested, rendering the third years data inaccurate.

Summary Adams trial

Over the two seasons' data for this trial, a trend for the lower rate to be more profitable was starting to emerge, ***however these results are not as conclusive as they could have been had the trial lasted another year***.

The lower rate of 130 kg/ha is less than BSES recommendations for ratoon crops, and from two years data the only conclusion that can be made is that the excessive rate , above 200 kg/ha nitrogen is not the most profitable.

Statistics - No significant differences

4.1.3 Trial 3 - Reid

Two year trial - only second year results shown

Set up 1997-2000

This trial was set up on new land, which formerly was an improved pasture paddock used for cattle grazing. There was a history of DAP application for improved pasture prior to cane production.

At the time of the trial set up, the previously harvested crop had low ccs.

Harvested 1998-2000

Sugar price = $250

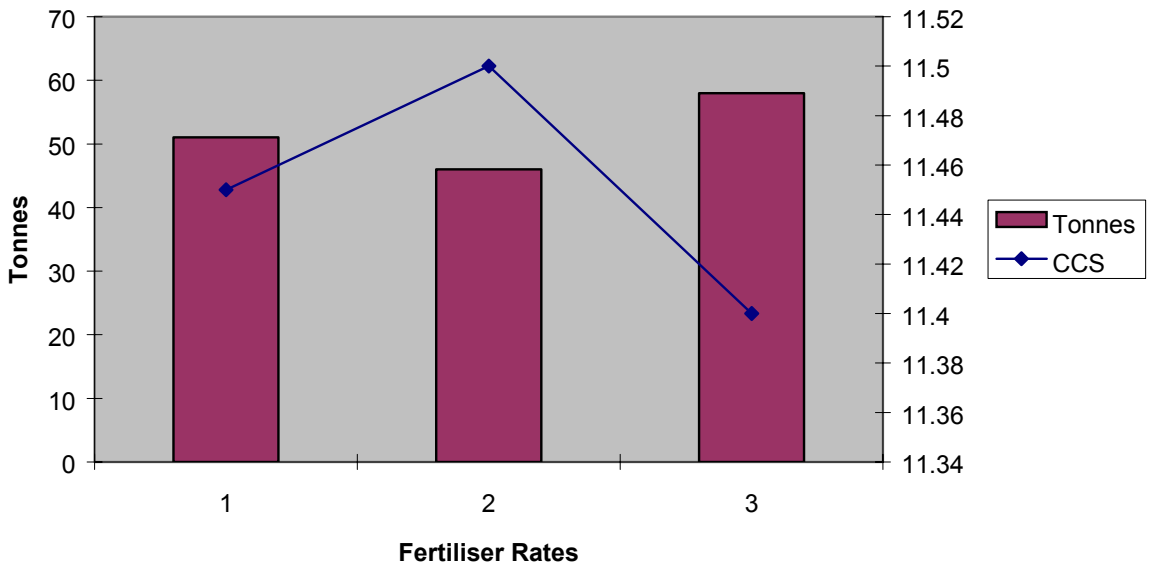
First harvest of trial 1999 - little difference between treatments.

Established 1997	1st ratoon	Improved pasture paddock

Table 5: Second ratoon 2000 harvest

Rate kg/ha	Tonnes/ha	ccs	Tonnes sugar/ha	Net $/ha
100	51	11.45	5.8	491
140	46	11.5	5.29	405
180	58	11.4	6.6	495#

Graph 6: Reid trial 2000 - tonnes cane/ha vs ccs



Comments - The higher nitrogen rates gave greater tonnage, but less ccs than the lower two rates.

Summary of Reid trial

The higher rate of 180 kg/ha was starting to emerge as the most profitable in 2000, which was only the second year of the trial. This trial was instigated initially to look at how the crop would perform on soil which had improved pasture with many years of DAP application.

From these limited results, a trend towards 180 kg/ha being the most profitable, is emerging, ***however as for the Adams trial, a further years results would have given a far greater indication if this is the case***. It is reasonable to suggest that the years of DAP application have resulted in a build up of nitrogen and Phosphorous in the soil, and that the lower rate in time may improve ccs as the mineralisation process takes place and nitrogen reserves are used up.

Statistics - No significant Difference

4.1.4 Trial 4 - Vella

Two year trial - only second year results shown

This trial was one of the first to be established in 1996, and was situated on the rich Abergowrie soil, on a farm where traditionally BSES recommendations are adhered to for ratoon cane. The trial was set up in Q124 plant cane, at the side dressing stage.

Harvested 1997-1998

First year of harvest 1997, results not conclusive.

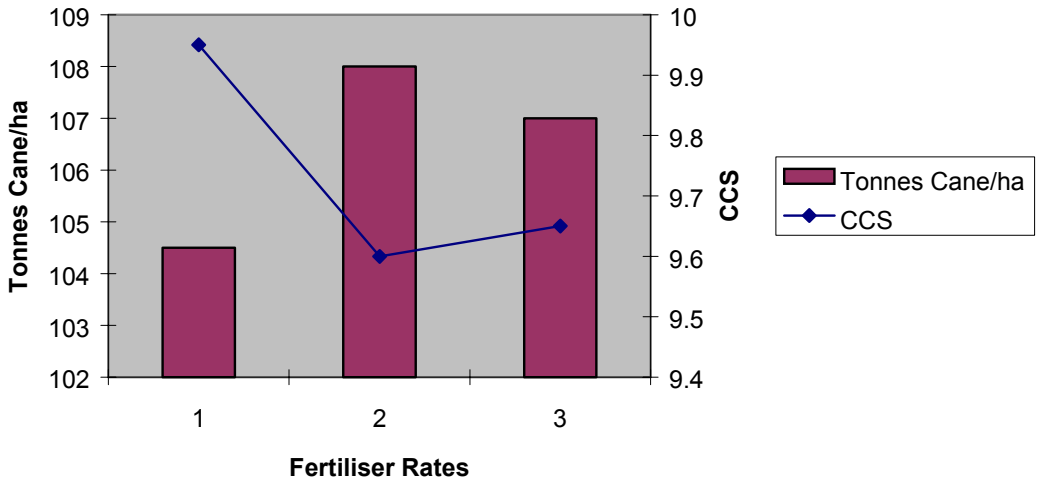
Established 1996	Plant cane	Clay loam

Table 6: Second ratoon 1998 harvest results

Rate kg/ha	Tonnes/ha	ccs	Tonnes sugar/ha	Net $/ha
120	104.5	9.95	10.39	1163#
160	108	9.60	10.37	1074
200	107	9.65	10.32	1020

Comments – After second year of trial harvest, lower rate is most profitable.

Graph 7: Second year Vella trial results



Comments - The lower rate gave the most profitable result after two seasons trials, with a slight improvement in ccs over the other two rates. The slightly reduced tonnage did not negatively affect profitability.

However a third seasons results are needed to confirm if this trend would have continued.

Summary of Vella trial

This trial is in the rich Abergowrie soil, and on a farm where BSES recommendations are traditionally adhered to.

In year two, a trend is starting to emerge that the lower rate of nitrogen is most profitable, ***however as for the Adams trial, another year may have seen this rate "crash", as it is below recommended rates for ratoon cane. The similarity between 120 kg and 180 kg suggests that in another year, the 180 kg may have equalled the profitability of the lower rate.***

Either way the higher rate is the least profitable by year 2 of harvest, and if any conclusion can be drawn from this trial, it is that the grower will benefit financially by keeping to the lower end of the scale, between 120 kg/ha and 180 kg/ha nitrogen.

Statistics - no significant difference between treatments

4.1.5 Trial 5 - Girgenti

Two year trial - only second year results shown.

This trial was in a dry region of the Herbert on a brown sandy earth, where supplementary irrigation is often required. The variety is Q124.

1996 –1998

Established 1996	Plant Cane	Brown Sandy Earth

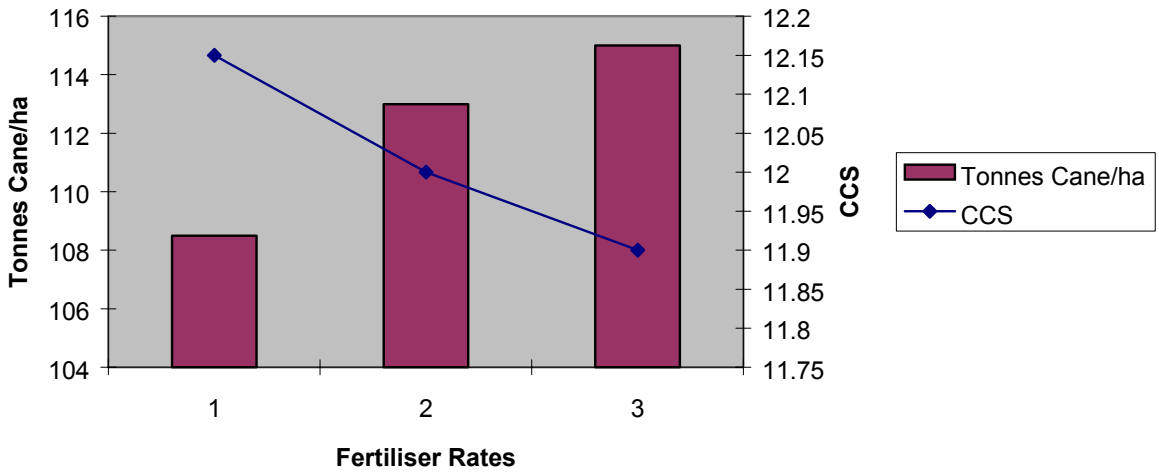
First year results - inconclusive

Table 7: Second ratoon harvest 1998

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha return
130	108.5	12.15	13.2	1910
165	113	12.0	13.6	1911#
215	115	11.9	13.7	1865

Comments – After the second year of harvest, the lower rates achieved the greatest profitability to the grower. ***The only conclusion which can be drawn, since the trial really needs a third season's data, is that the grower would benefit financially by applying between 130 kg/ha - 165 kg/ha nitrogen as opposed to over 200 kg/ha.***

Graph 8: Girgenti trial 1998 harvest tonnes cane/ha vs ccs



Comments - In the second year of the trial, the tonnes and ccs trends followed the expected pattern. As the rate increased, the ccs dropped as the tonnes increased.

Summary of Girgenti trial

This trial was conducted in a dry region of the district, and lasted three seasons. After the third season, a conclusion can be drawn that the lower and intermediate rates were most profitable. The main conclusion is that the excess rate was the least profitable. As for all strip trials, many variables come into play with these results, such as pest damage, and dry patches in certain parts of the paddock.

However, with the second season results, the mid range rate appears to be the most profitable, so any conclusion would consider that 160 kg/ha–180 kg/ha nitrogen is most profitable, only if a third year gave the same results.

4.1.6 Trial 6 - Quabba

Two year trial - only second year results shown

This trial was set up 1st ratoon Q in a wet area of the Herbert, on a farm where traditionally BSES recommended rates are adhered to.

Set Up 1996

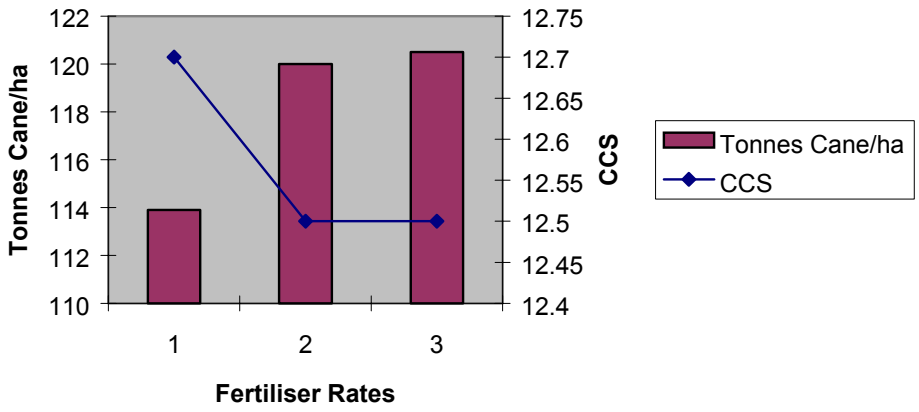
Harvested 1997-1998

Established 1996	1st ratoon	Clay Loam

Table 8: Second year of harvest 1998

Rate kg/ha	Tonnes Cane/ha	ccs	Tonnes Sugar/ha	Net $/ha Return
155	113.9	12.7	14.4	2191
200	120.0	12.5	15.0	2198
230	120.5	12.5	15.1	2189

Graph 9: 1998 harvest tonnes cane/ha vs ccs



Comments - Like the other shorter term trials, this trial began to show some useful trends in year two of harvest. The ccs was highest at the lowest rate of nitrogen, and profitability was greatest at the 200 kg/ha rate. A third year would have confirmed or changed this trend.

4.2 South Johnstone

4.2.1 Trial 7 - Zappala

Long Term Trial – all years reported, except plant cane

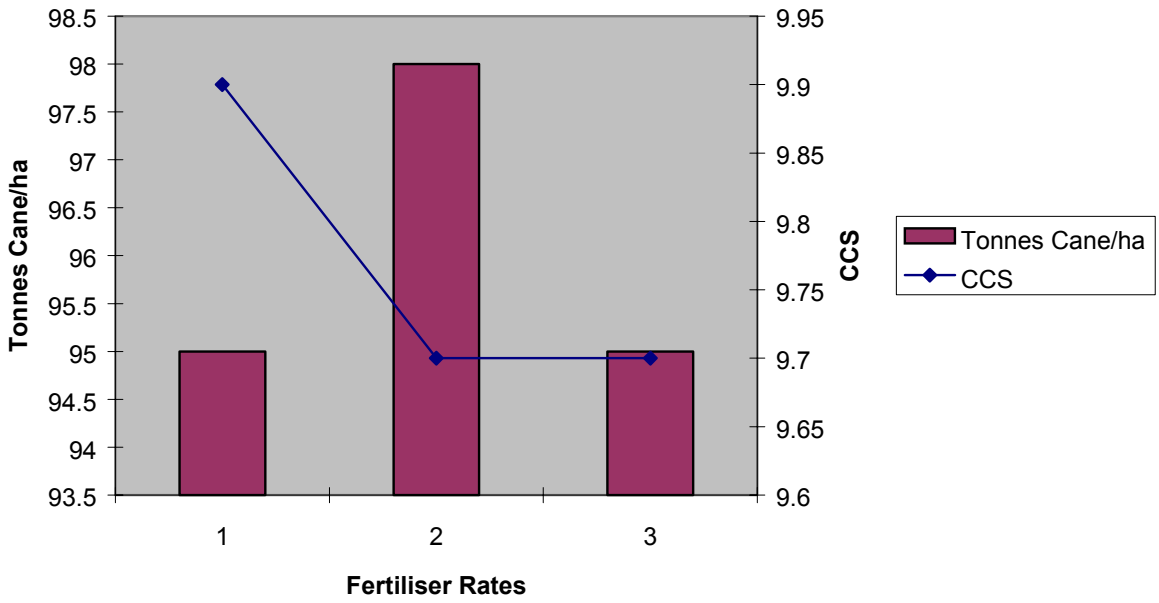
Harvested 1997-2001
First year results no change.

Established 1996	Plant Cane	Red Volcanic Soil

Table 9: 1st ratoon harvest 1998 Zappala trial

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha
60	94.8	9.9	9.4	895
90	98.2	9.7	9.5	878
120	94.9	9.7	9.2	848

Graph 10: Comparison of tonnes /ha vs ccs

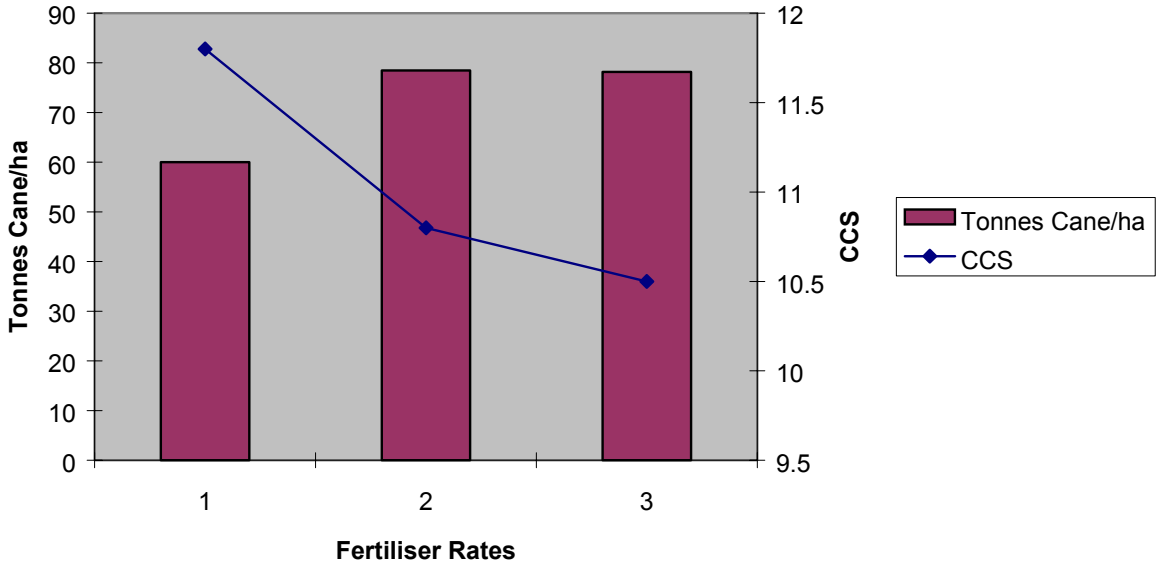


Comments – Initial results show that the 90 kg/ha is the most profitable, but since this is the first year of trials, these results are not considered accurate.

Table 10: 2nd ratoon 1999 Zappala trial

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha
0	60	11.8	7.1	686
60	78.5	10.8	8.4	718#
120	78.2	10.5	8.2	665

Graph 11: Second ratoon Zappala tonnes cane/ha vs ccs

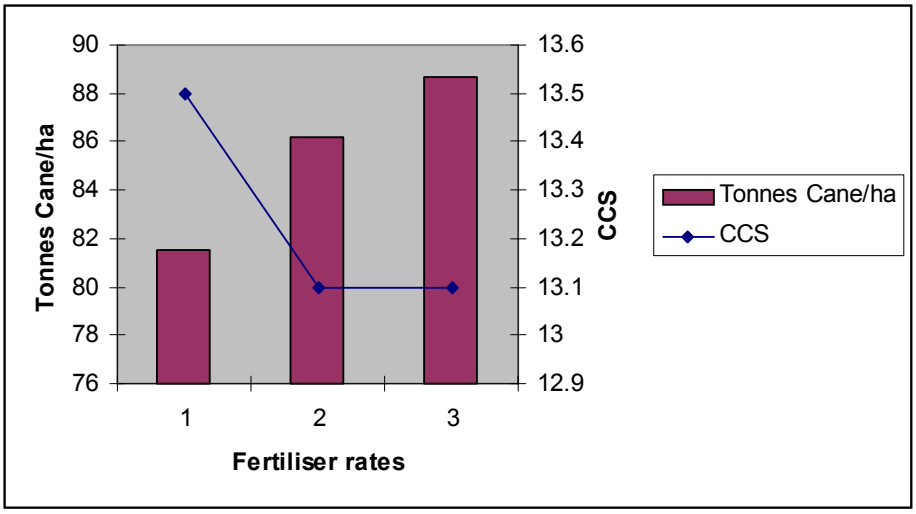


Comments - A trend appears to be developing in the second year of results where the ccs is lowered as the tonnage increases with increasing rates of nitrogen. The 130 kg/ha is now the most profitable. Still, this may only be a one off, and a third season will confirm this if this is a real trend.

Table 11: Third ratoon 2000 Zappala trial

Rate kg/ha	T cane /ha	ccs	T sugar/ha	$/ha
30	81.5	13.5	11	1943
60	86.2	13.1	11.2	1946
130	88.7	13.1	11.6	2010#

Graph 12: Third year harvest of Zappala trial 2000



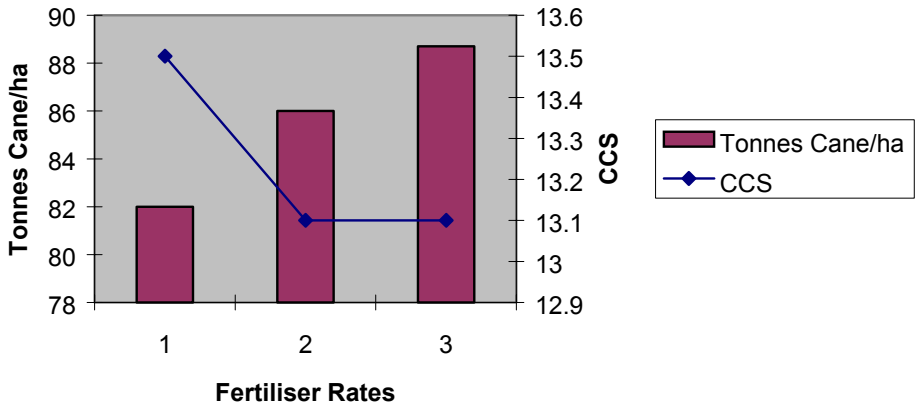
Comments – The soil in which this trial was conducted is very fertile, with a rate of 130 kg/ha most profitable after a third harvest, suggesting that this rate will be the most profitable out of the three trailed.

Table 12: 4th ratoon 2001 harvest Zappala

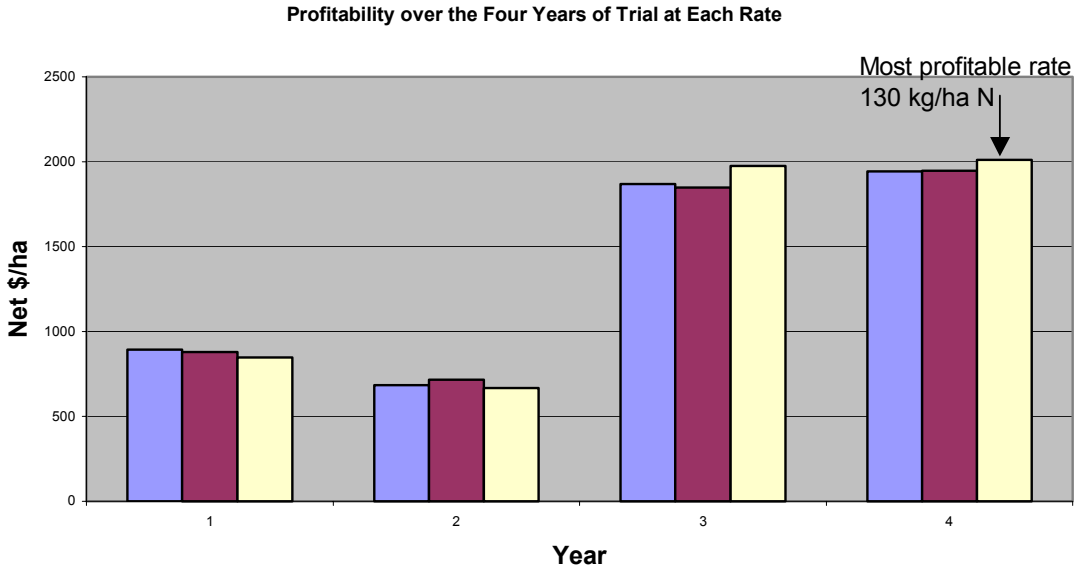
Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha
75	82	13.5	11.07	1869
100	86	13.1	11.27	1849
130	88.7	13.1	11.62	1974#

Comments – Optimum rate in this soil type appears to be 120 kg/ha. This is a particularly rich soil type.

Graph 13: Comparison of tonnes cane/ha vs ccs



Graph 14: Net return $/ha Zappala trial 1st ratoon 1998 to 4th ratoon 2001



Blue = 75 kg/ha Purple = 100 kg/ha Yellow = 130 kg/ha

Comments - The highest rate, while least profitable in years one and two, is most profitable in year 3. This rate is below recommended rates, which indicates that the soil is extremely fertile.

Summary of Zappala trial

This trial was conducted in a very fertile soil, where traditionally lower rates of nitrogen can be applied. The higher rate of 130 kg/ha, which is lower than the general recommended rate for rations in the northern regions, appears to be the most profitable for this soil type. The rates were chosen by local staff and the grower who know the soil type, and know the fertiliser regime employed by growers in the region.

4.2.2 Trial 8 - Cecchi

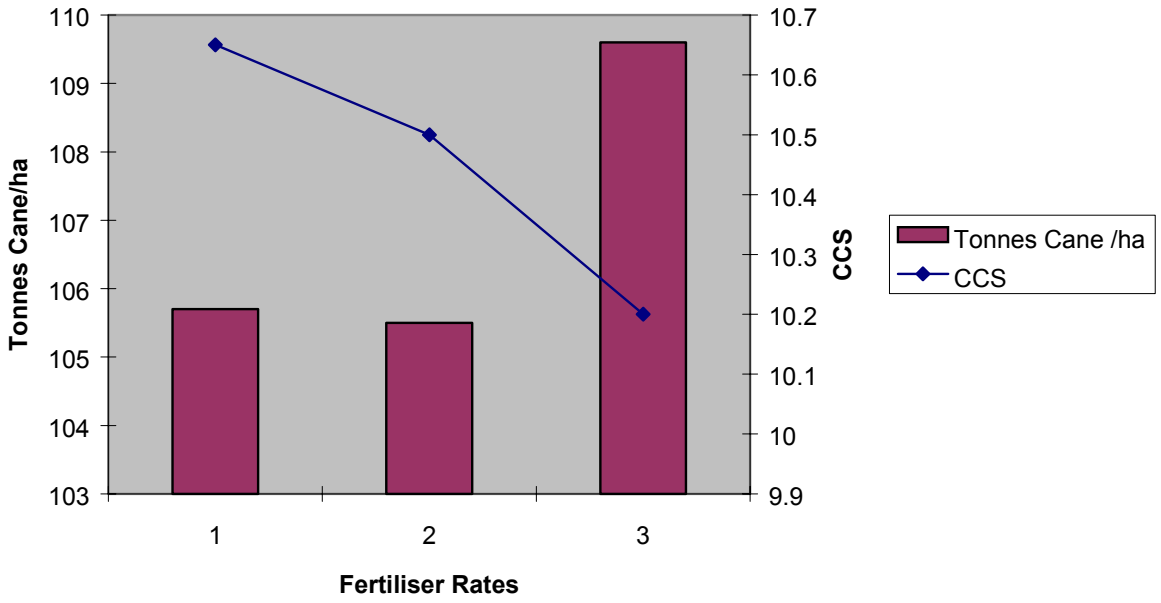
1996 - 1998
First year results no change

Table 13: Second year harvest Cecchi

Established 1996

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	Net $/ha
60	105.7	10.65	11.3	1456
115	105.5	10.5	11.1	1352
170	109.6	10.2	11.2	1258

Graph 15: Comparison of tonnes cane/ha and ccs after second year of harvest



Summary Cecchi trial

This trial follows a similar pattern to the others, with the ccs dropping in the second year with the highest rate, which in this case is 170 kg/ha. This rate is considered to be an average rate for ratoons, with the upper limit of recommended rates at 200 kg/ha. The soil type for this trial can obviously allow lower rates, *however caution is also required when interpreting this trial's results, as the trial was only conducted for two harvests. A third harvest is really needed to confirm or change this trend of lower rates being more profitable.*

4.3 Babinda

4.3.1 Trial 9 - Todd

1996-1998

Established 1996

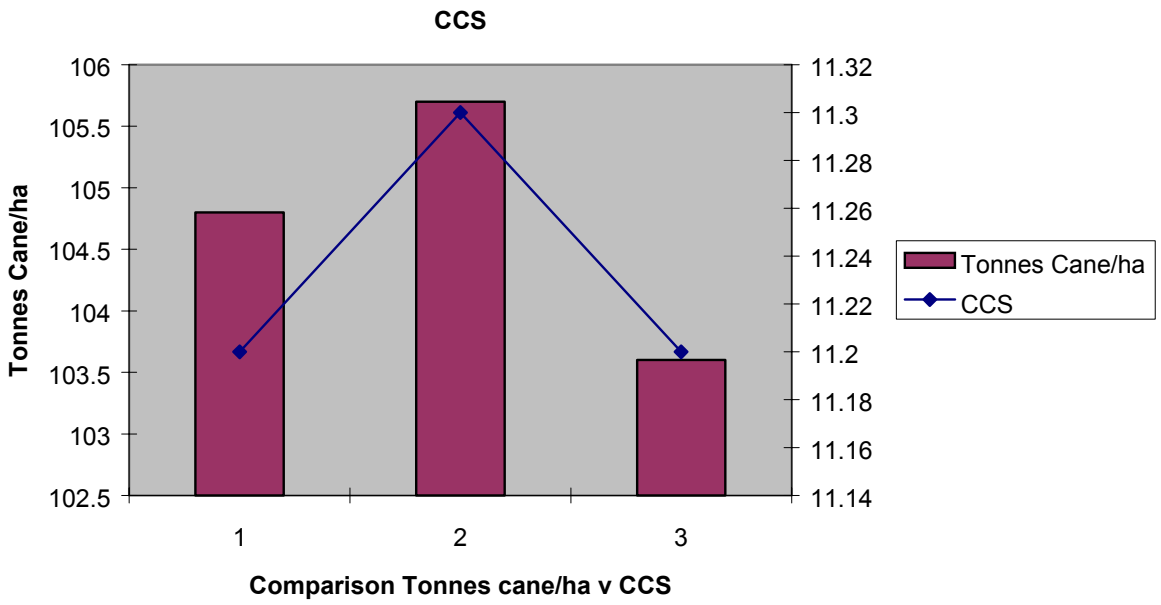
First years results inconclusive.

Table 14: Results from second year (1998) harvest

Rate kg/ha	Tonnes cane/ha	ccs	Tonnes sugar/ha	$ Net Return
100	104.8	11.2	11.85	1575
145	105.7	11.3	11.94	1577
200	103.6	11.2	11.64	1457

Comments - After the second year harvest, the 145 kg/ha rate is the most profitable.

Graph 16: Comparison of tonnes cane/ha vs ccs



Summary

After the second year of harvest, the intermediate rate of 145 kg/ha gave the optimum results. A third harvest would show if this trend continues.

4.3.2 Trial 10 - Nucifora

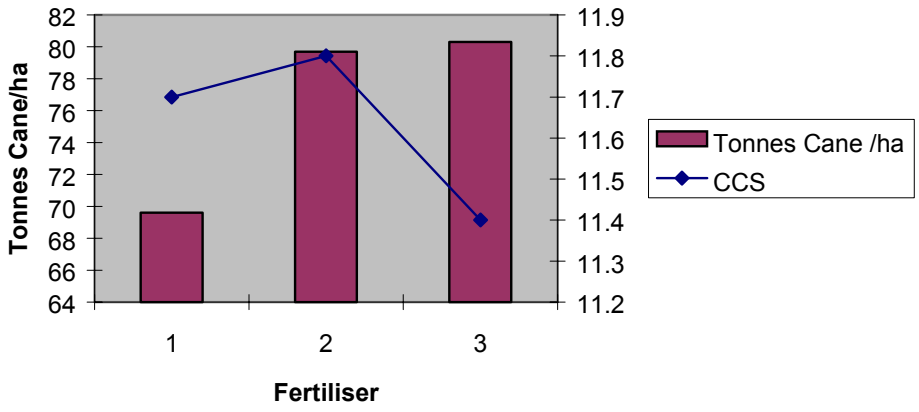
1996-1998

Established 1996

Table 15: Second ratoon harvest

Rate kg/ha	Tonnes Cane / ha	ccs	Tonnes Sugar/ha	$ Net Sugar
0	69.6	11.70	8.2	1214
80	79.7	11.80	9.4	1378
150	80.0	11.35	9.1	1245

Graph 17: Comparison tonnes cane/ha vs ccs



Comments - Like all the other trials reported for this report, this trial, in the second year of harvest showed a trend where the ccs was decreased as the nitrogen rate increased, with similar tonnage achieved for the high and intermediate rates. In this case however the intermediate rate is half the recommended, which raises the question of *whether a third year would have showed a change, where the 80 kg/ha dropped tonnage to where it would be less profitable than the 150 kg/ha. Without another years trial, it is impossible to know if this low rate is economically sustainable.*

4.4 Mulgrave

4.4.1 Trial 11 - Hardwick

Long term trial 1995-2000 - All results shown

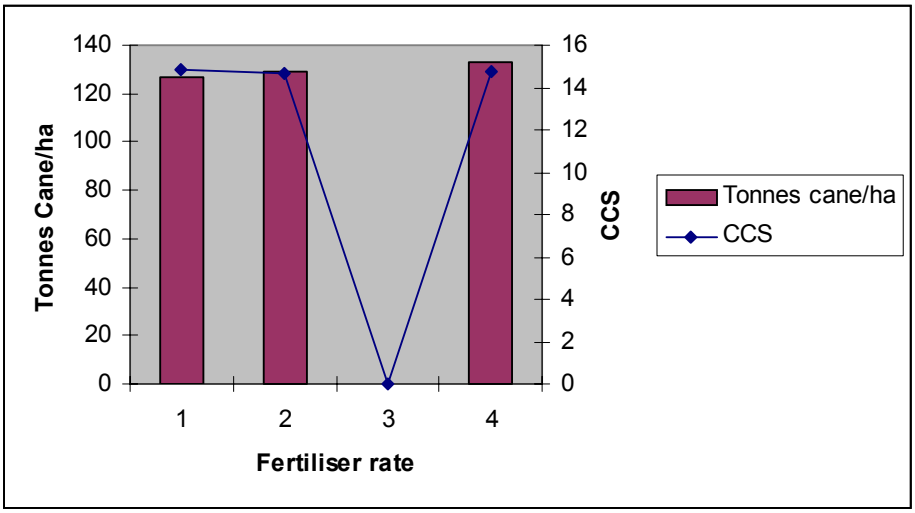
Sugar Price $333/tonne
Harvest cost $6.50/tonne
Urea price $483/tonne

Established 1995	Plant Cane 1995	Q120

Table 16: Results for 1996 harvest (plant cane)

N rate kg/ha	T cane /ha	ccs	T sugar/ha	Net $/ha
68	127.0	14.86	18.9	3391
122	129.5	14.66	19.0	3304
165	0	0	0	0
220	133.0	14.77	19.6	3404#

Graph 18: Comparison tonnes cane/ha and ccs

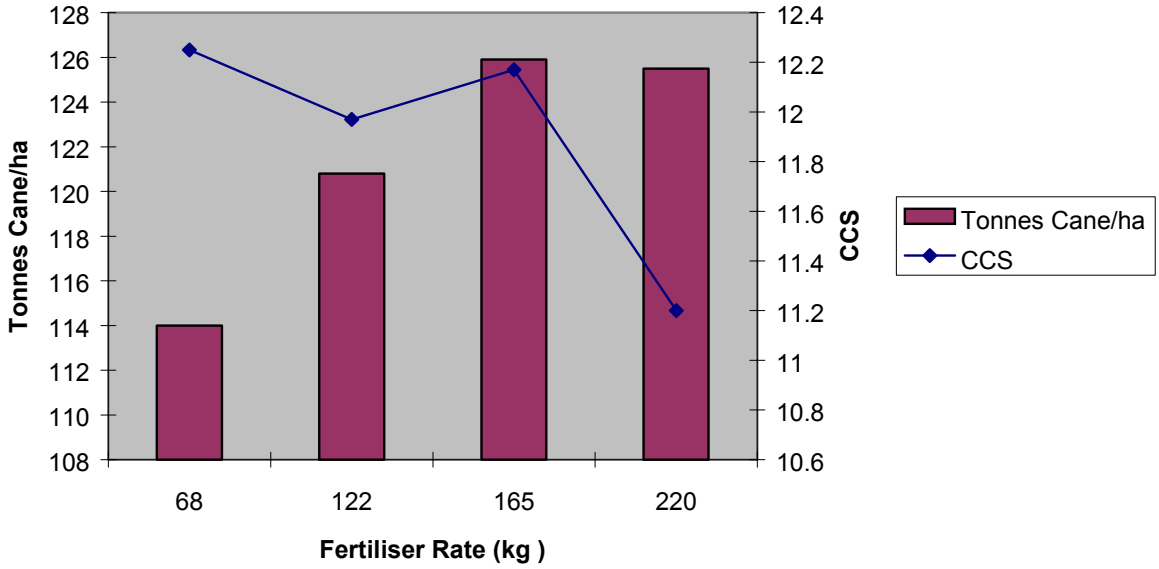


Comments - No results were given for the 165 kg/ha result. Very little difference between the three other rates, which is to be expected after just one seasons harvest.

Table 17: 1997 harvest

Rate kg/ha	T/ha	ccs	Tonnes sugar /ha	Net $/ha
68	114	12.25	14.09	2117
122	120.8	11.97	14.45	2070
165	125.9	12.17	15.33	2205#
220	125.5	11.2	14.07	1786

Graph 19: Comparison of tonnes cane/ha vs ccs

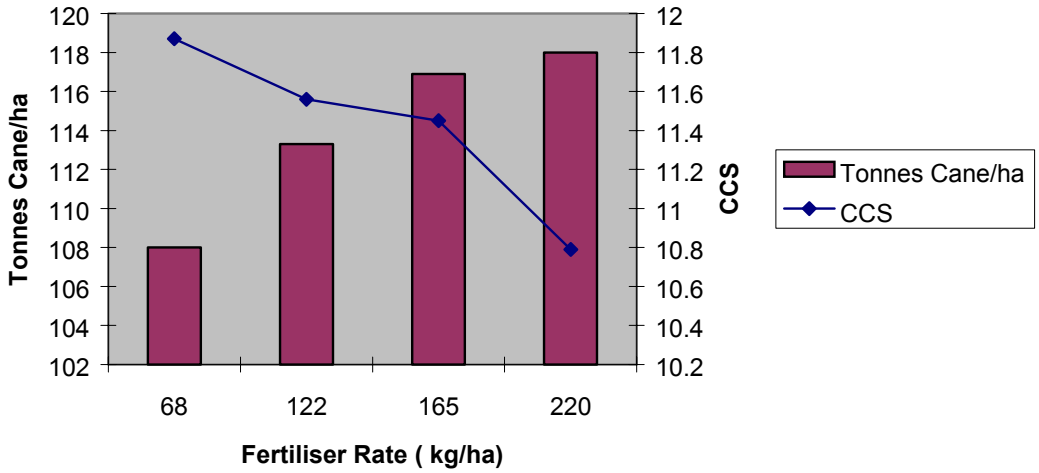


Comments - This second year result illustrates the decreasing ccs as N rates are increased over the recommended rate of 200 kg/ha. *However a third year's results are required to see if this continues.*

Table 18: Results of harvest 1998

Rate kg/ha	T/ha	ccs	T sugar/ha	Net $/ha
68	125	11.2	14	2009#
122	128.5	10.71	13.76	1760
165	132	10.5	13.86	1646
220	135.8	10.02	13.6	1400

Graph 20: Comparison tonnes cane/ha vs ccs

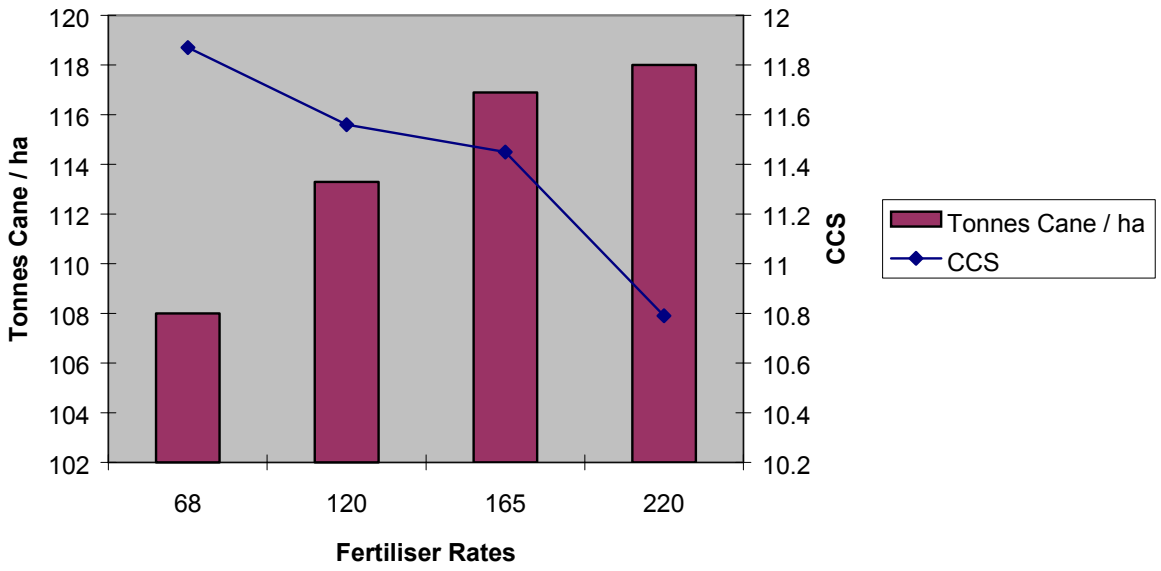


Comments - These results give a good indication that the extra nitrogen applied, over 200 kg/ha is wasted, as the ccs continues to be lower where nitrogen is applied in higher than recommended rates.

Table 19: Results of harvest 1999

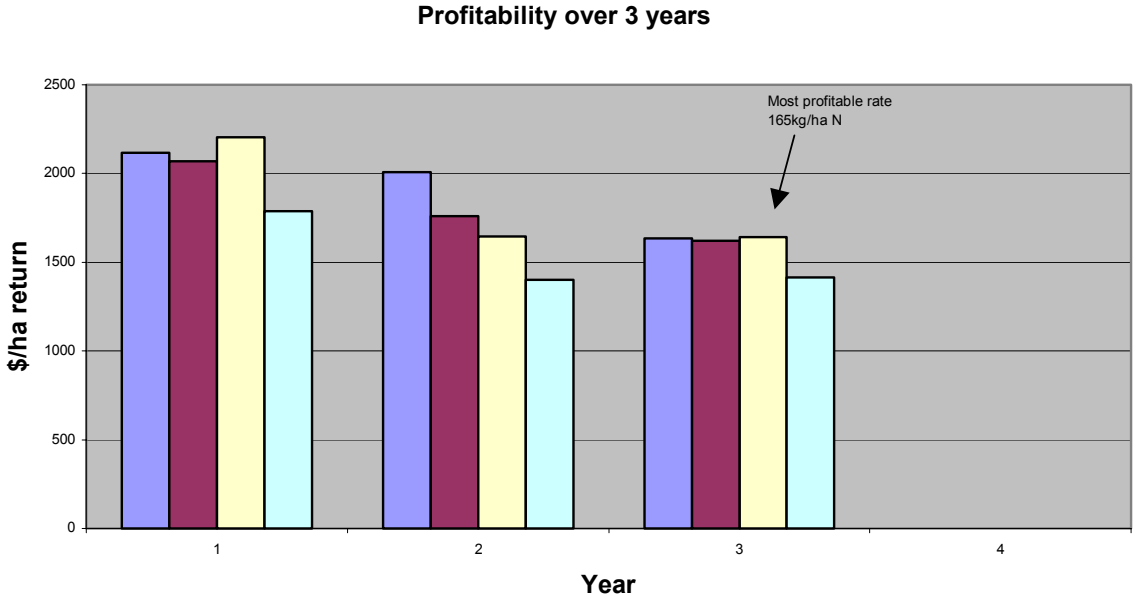
Rate kg/ha	T/Ha	ccs	T Sugar/ha	Net $/ha
70	108	11.87	12.79	1635
120	113.3	11.56	13.00	1620
165	116.9	11.45	13.30	1641#
220	118	10.79	12.68	1414

Graph 21: Comparison tonnes cane/ha vs ccs



Comments - After four years of harvest results, it is possible to conclude that the rate of 165 kg/ha gives the "best of both worlds, with tonnes/ha and ccs optimised without sacrificing either. Table 19 indicates that this equates to the most economical $/ha return to the grower

Graph 22: Summary of trial



Summary of Hardwick Trial

After year 2, the trend is clear that while lower rates give excellent ccs, tonnage is sacrificed, and therefore Net $ reduced. Likewise at the higher rate, ccs is depressed.

165 kg/ha is most profitable after year2. This is in contrast to year 1, where the excessive rate still delivered the most net $/ha return clearly, after years 3 and 4, the intermediate rate (165 kg/ha) is most profitable, and offers the "best of both worlds" to the grower. Considering that the grower can increase from 165kg to 200kg and still be within recommended rate range, this trial is very encouraging for the industry to prove that adhering to current N rate recommendations for ratoon cane can maximize profitability.

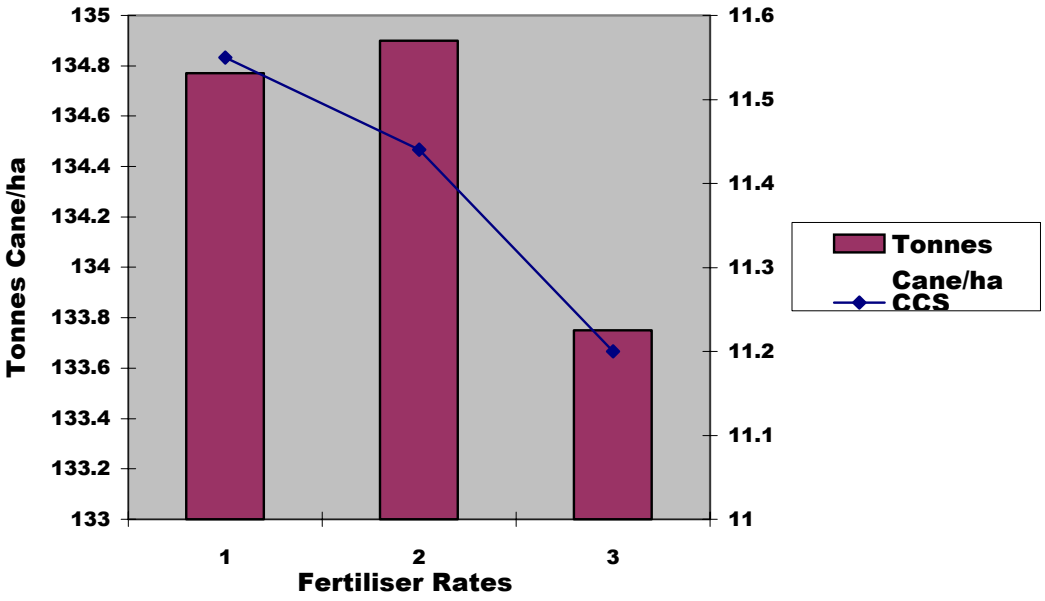
4.4.2 Trial 12 - Amadio

Established 1995

Table 20: Results of 1997 harvest (second year of trial)

Rate kg/ha	T cane/ha	ccs	T sugar/ha	Net $/ha
130	134.77	11.55	15.57	2188
190	134.9	11.44	15.43	2047
240	133.75	11.2	14.98	1941

Graph 23: Comparison tonnes cane/ha



Comments - As for all the trials, the higher rate of nitrogen produced a lower ccs result in year 2. However the tonnes were also lower, which is unusual. *Like all two year trials, a third year results is required to make proper evaluations.*

Summary of Amadio Trial

This trial exhibits the classic trend of ccs being lowered by excess nitrogen over the 200 kg/ha rate, *however as for the other two season harvest trials, a third year is required to see if this trend is maintained*.

4.5 Summary of trial work

A total of 12 field strip trials were conducted in north Queensland, which continued for two or more years. A greater number than these 12 trials were established in 1997, but did not go past the 1999 season, or where not harvested after 1998.

None of these trials gave a statistical difference, being field strip trials conducted over reasonably large areas, where at least 20 tonnes cane per treatment was required to gain mill data.

For the three long term trials, the results were as follows:

Lamari - Most profitable rate 180 kg/ha nitrogen
Zappala - Most profitable rate 130 kg/ha nitrogen (highest rate trailed in this trial).
Hardwick - 165 kg/ha nitrogen.

These results give the clearest view of nitrogen rate vs tonnes/ccs results because of the three successive years data. Ideally, four years worth of data would have been collected if climate etc had allowed this.

For the other nine, trials each with two years data, the results are as follows:

Adams - most profitable rate - 180 kg/ha nitrogen
Vella - most profitable rate - 120 kg/ha nitrogen
Girgenti - most profitable rate - 165 kg/ha nitrogen
Quabba - most profitable rate - 200 kg/ha nitrogen
Cecchi - most profitable rate - 60 kg/ha nitrogen
Todd - most profitable rate - 145 kg/ha nitrogen
Nucifora - most profitable rate - 80 kg/ha nitrogen
Amadio - most profitable rate - 130 kg/ha nitrogen

Caution must be given to nine of these results, which were only two year's worth of data however. Obviously these two year results show a degree of variability, which would be sorted out by a third year's results, if this had have been possible.

The important take home message however, is that in none of these trials did a result occur where the most profitable rate exceeded current BSES recommendations of 200 kg/ha nitrogen for ratoon cane.

With these results, which were all conducted in GCTB cane growing systems, it can be confidentially stated that growers would benefit financially, and there would be beneficial factors involved for the sugar industry if the rate of nitrogen applied to ratoon cane did not exceed 200 kg/ha in all areas trailed. (This does not include the Burdekin where trial data was only available for one year's results).

The challenge for the industry therefore is to ensure that the percentage of growers who apply rates above 200 kg/ha is reduced and ideally that there be no cases of nitrogen application exceeding 200 kg/ha in all areas except the Burdekin, where the current BSES recommendations for nitrogen in ratoon cane is 250 kg/ha.

In three of the cases where below recommended rates were the most profitable, the soil was very rich, and low rates were used for the trial set up, with maximum rates not reaching the recommended range.

For the six Herbert trials, all but one gave best profitability figures with recommended rates. One gave the best results at less than recommended rates.

These results, along with results from the Amino N work can provide growers with the tools to manage nitrogen inputs, to promote sustainability, productivity and profitability.

5.0 FINAL FERTILISER SURVEY REPORT (2000 - 2001)

To gauge the trends of fertiliser application practice in the final stages of this project, a grower survey was carried out from the Herbert to Babinda in January 2001.

RESULTS SUMMARY

NITROGEN IN PLANT CROPS
In contrast to 1996, where more than 50% of growers were applying excess nitrogen, this figure dropped to 32%

NITROGEN IN RATOON CROPS
Where the figure for over application was 42% in 1996, it was under 10% in the 2001 survey.

5.1 Plant crops

5.1.1 Nitrogen

Percentage of growers surveyed is represented.

Table 1: Herbert

Nitrogen kg/ha	% total 1996	% total 2000
<120	16	26.0
*120-160	21	31.0
160-200	29	21.0
>200	38	22.0

Comments – 57% of Herbert growers applied at or below BSES recommended rates of N for plant cane in 2000. This is a 20% increase over 1996 figures. The percentage over-applying nitrogen in plant cane has dropped from 67% to 45%, an overall reduction of 22%.

Average N application rate for plant cane in the Herbert is 169 kg/ha. This is an average of 19 kg over the fallow plant recommendation and 9 kg/ha over the ploughout/replant recommendation.

Table 2: Tully

Nitrogen kg/ha	% total 1996	% total 2000
<120	28	53
120-160	36	21
160 -200	22	16
>200	13	11

Comments - In 1996, 64%of Tully growers were applying nitrogen rates at or below BSES recommendations for plant cane. In 2000, this has increased to 74%, with a large shift to under recommended levels.

Table 3: South Johnstone

- **Figures for South Johnstone, and Mourilyan were combined in 1996 as "Innisfail"**

Nitrogen kg/ha	% total 1996 *	% total 2000
< 120	37	30
120-160	28	20
160-200	24	40
>200	11	10

Comments – Rates have stayed similar, with a 4% increase in N at plant, over recommended rates.

Table 4: Mourilyan

N kg/ha	% total 1996 *	% total 2000
<120	37	35
120-160	28	40
160-200	24	25
>200	11	0

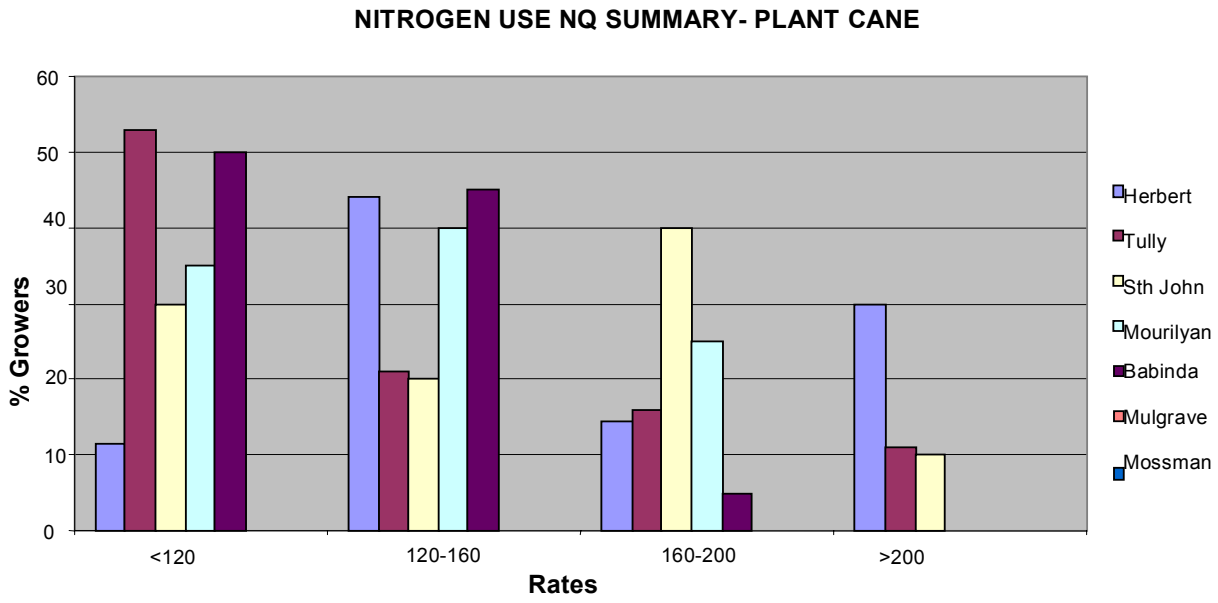
Comments – There has been a 10% increase in applying at or below rates, from 65% to 75%.

Table 5: Babinda

Rate kg/ha	% total 1996 *	% growers 2000
<120	37	50
120-160	28	45
160-200	24	5
>200	11	0

Comments – There has been an increase in percentage using at or below recommended rates from 65% to 95%.

Graph 1: Summary - nitrogen rates for plant cane



Summary

Application rates for plant cane have decreased from the 1996 to the 2000 season. On average 15% apply greater than 160 kg/ha, with the Herbert at 45%, all the rest well below this.

The average application for the Herbert is 169 kg/ha, 9kg/ha more than replant rate of 160 kg/ha and 19 kg/ha more then fallow plant rate of 150 kg/ha.

5.1.2 Phosphorous

Herbert

Phosphorous kg/ha	% total 1996	% total 2000
0	0	7
1-20	2	2
21-40	57	54
>40	43	37

Comments – The percentage using excess P has decreased from 43% to 37%, and significantly a percentage are using no P at planting. The use of DAP at planting increased between 1996 and 2000 plant.

Tully

Rate kg/ha	% total 1996	% total 2000
0	0	0
1-20	9	5
21-40	13	35
>40	77	65

Comments – The high use of P is still evident, but has seen a 12% reduction.

South Johnstone

Rate kg/ha	% total 1996	% total 2000
0	0	0
1-21	5	5
21-40	20	20
>40	75	75

Comments – 75% of growers still over apply P

Mourilyan

Rate kg/ha	% total 1996	% total 2000
0	0	5
1-21	5	60
21-40	20	35
>40	75	0

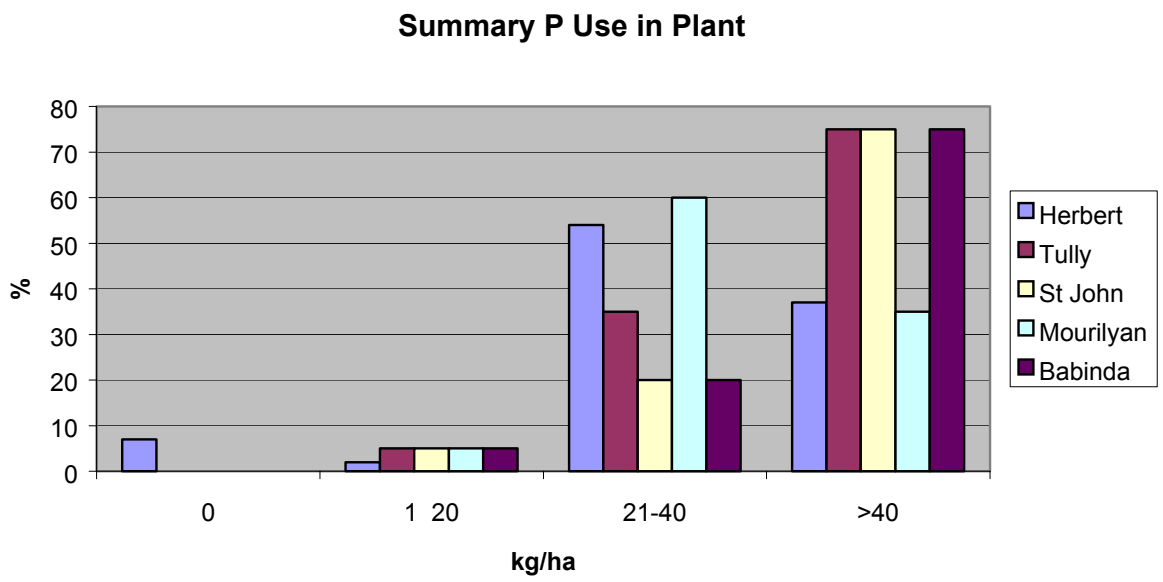
Comments – All growers surveyed were using at or below P recommendations. This is dramatic difference to the results of the 1996 survey.

Babinda

Rate kg/ha	% total 1996	% total 2000
0	0	0
1-20	10	5
21-40	35	20
>40	55	75

Comments -An increase in phosphorous application is evident in Babinda. This would relate to an increase use of DAP a planting.

Graph 2: Phosphorous use in NQ plant cane



Comments - Phosphorous is applied in healthy rates in most areas at planting time. The increase in the popularity of DAP, at planting time may account for this. In Herbert, South Johnstone and Babinda, more than 70% applied excess rates at planting.

5.1.3 Potassium

Herbert

Rate kg/ha	% growers 1996	% growers 2000
0	1	12
1-80	85	81
81-120	13	6
>120	1	1

Comments – No problems with over application in the Herbert. This situation has not altered since 1996. The obvious change has been the increase in percentage of growers who have used no Potassium at planting.

Tully

Rate kg/ha	% growers 1996	% growers 2000
0	2	10
1-80	41	60
81-120	48	20
>120	9	10

Comments – Potassium rates were reduced from 57% over application, to 30%.

South Johnstone

Rate kg/ha	% growers 1996	% growers 2000
0	4	0
1-80	40	55
81-120	17	30
>120	41	15

Comments – The percentage of growers using excess K has dropped from 41% to 15%.

Mourilyan

Rate kg/ha	% growers 1996	%growers 2000
0	4	0
1-80	40	5
81-120	17	65
>120	41	30

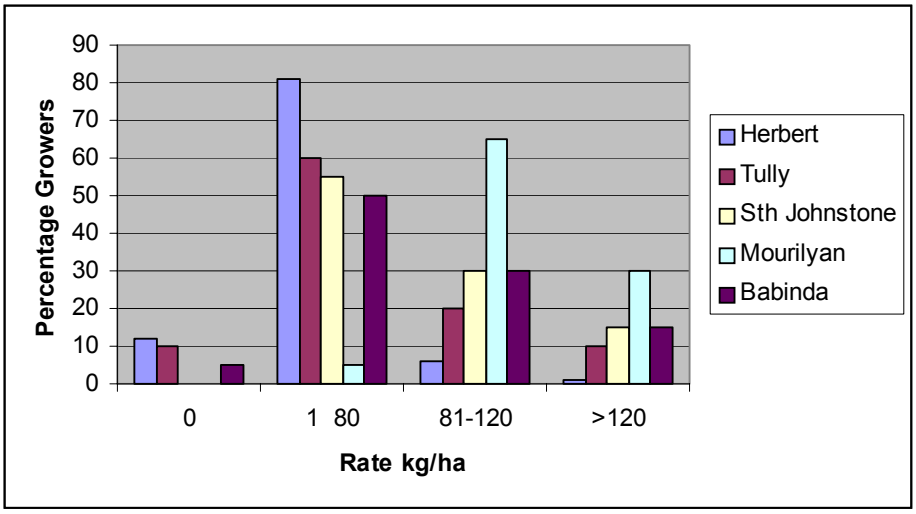
Comments - The percentage of growers using excess K has dropped from 41% to 30%.

Babinda

Rate kg/ka	% growers 1996	% growers 2000
0	0	5
1-80	58	50
81-120	27	30
>120	15	15

Comments – The application trends of K have altered little between surveys, with 15% applying excess in 2000, the same as 1996.

Graph 3: Summary of Potassium plant cane



Comments -Very little excess Potassium is applied at planting.

5.1.4 Sulphur

Herbert

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-10	21	6
11-25	72	87
>25	7	7

Comments - Sulphur rates have not changed dramatically in the Herbert. Most mixtures have some sulphur in them.

Tully

Rate kg/ha	% growers 1996	% growers 2000
0	0	25
1-10	67	50
11-25	15	25
>25	18	0

Comments - Excess Sulphur application was reduced from 18% to 0%.

South Johnstone

Rate kg/ha	% growers 1996	% growers 2000
0	0	15
1-10	80	65
11-25	12	15
>25	8	5

Comments - Only 5% of growers apply excess Sulphur

Mourilyan

Rate kg/ha	% growers 1996	% growers 2000
0	0	30
1-10	80	50
11-25	12	10
>25	8	10

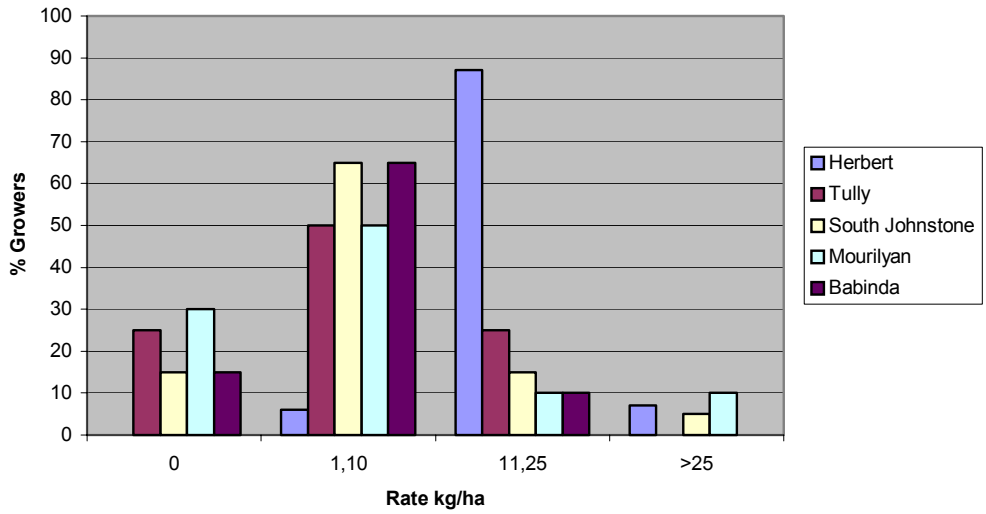
Comments - 10% of growers apply excess Sulphur.

Babinda

Rate kg/ha	% growers 1996	% growers 2000
0	0	15
1-10	50	65
11-25	35	10
>25	15	0

Comments - The percentage of excess Sulphur has dropped from 15% to nil.

Graph 4: Summary of Sulfur in plant cane



Summary

Sulfur is not applied in excess by very many growers in the areas sampled.

In the Herbert, the majority of growers apply Sulfur at a rate of 11-25 kg, while in all other areas the majority of growers apply Sulfur at 10 kg/ha or less.

5.1.5 Calcium

No figures collected for lime application for the Herbert.

Tully

Rate kg/ha	% growers 1996	% growers 2000
0	55	30
1-450	15	25
451-900	25	5
901-1800	5	35
>1800	0	5

Comments - Tully growers continued to apply lime as required.

South Johnstone

Rate kg/ha	% rowers 1996	% growers 2000
0	0	0
1-450	2	3
451-900	14	15
901-1800	72	69
>1800	12	13

Comments - The rate of Calcium applied have remained similar between 1996 and 2000.

Mourilyan

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-450	2	3
451-900	14	12
901-1800	72	74
>1800	12	15

Comments - Results are very similar.

5.1.6 Magnesium

2000 Data not available

5.2 Ratoon crops

5.2.1 Nitrogen

Herbert

Nitrogen kg/ha	% total 1996	% total 2000
<120	1	13
120-160	6	6
160-200	41	54
>200	52	27

Comments - Excess rates of N in ratoon dropped from 52% to 27%.

Tully

Nitrogen kg/ha	% total 1996	% total 2000
< 120	8	0
120-160	19	40
160-200	53	50
>200	20	10

Comments - Generally 90% of growers are applying the correct rates or lower of nitrogen to ratoon cane.

South Johnstone

Nitrogen kg/ha	% total 1996	% total 2000
< 120	9	5
120-160	40	60
160-200	42	35
> 200	9	0

Comments - From sample results, there is no excess nitrogen being applied to ratoon crops.

Mourilyan

Rate kg/ha	% growers 1996	% growers 2000
<120	9	10
120-160	40	45
160-200	42	45
>200	9	0

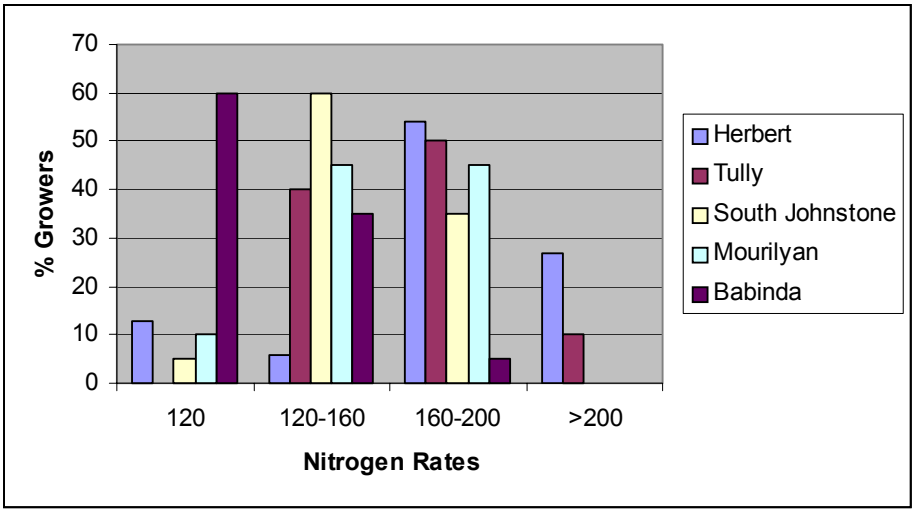
Comments - Little problem with excess nitrogen in ratoon crops.

Babinda

Rate kg/ha	% growers 1996	% growers 2000
<120	38	60
120-160	42	35
160-200	18	5
>200	2	0

Comments - 60% of growers are applying low rates of nitrogen to ratoon crops.

Graph 5: Summary of nitrogen rate use in ratoon cane



Comments - The % of growers applying >200kg N for ratoons has dropped since 1996.

In the Herbert and Tully regions only were excess rates applied, at 28% and 10% of growers in each.

5.2.2 Phosphorous

Herbert

Phosphorous kg/ha	% total 1996	% total 2000
0	2	45
1-20	53	21
21-40	37	28
>40	8	4

Comments -Herbert growers have reduced P in ratoon applications, 45% not applying P to older ratoons. Excess has reduced from 8% t0 4%.

Tully

Phosphorous kg/ha	% total 1996	% total 2000
0	22	35
1-20	26	20
21-40	50	35
>40	2	5

Comments - Tully growers generally do not over apply P in ratoons, and 35% did not apply any, compared to 22% in 1996.

South Johnstone

Phosphorous kg/ha	% total 1996	% total 2000
0	32	40
1-20	39	25
21-40	28	15
>40	0	5

Comments - South Johnstone growers generally do not over apply P in ratoons. 40% applied no P in ratoons, compared to 32% in 1996.

Mourilyan

Rate kg/ha	% Growers 1996	% Growers 2000
0	32	60
1-20	39	15
21-40	28	25
>40	0	0

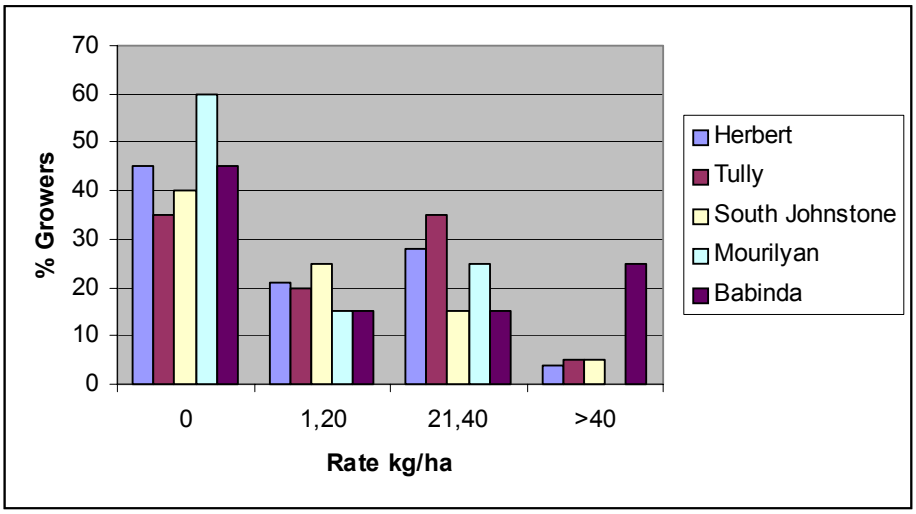
Comments - Growers have opted to apply lower rates of Phosphorous to ratoons.

Babinda

Rate kg/ha	% Gowers1996	% Gowers 2000
0	45	45
1-20	42	15
21-40	11	15
>40	2	25

Comments - Babinda growers were the only northern growers to use excess P in ratoons.

Graph 6: Summary of Phosphorous in ratoon cane



Summary - Most growers are using Phosphorous in ratoon cane at recommended or below recommended rates. Only in Babinda were more than 5% of growers using excess Phosphorous.

COMMENTS - Very few growers are applying excess Phosphorous to ratoon crops according to the 2000 survey. Less than 5% in most areas, and none surveyed in Mourilyan were using >40 kg/ha Phosphorous, 25% of Babinda growers were however using >40 kg/P in ratoons.

5.2.3 Potassium

Herbert

Potassium kg/ha	% total 1996	% total 2000
0	0	4
1-80	53	58
81-120	42	34
>120	5	4

Comments - Potassium rate application is slightly reduced.

Tully

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-80	0	30
81-120	38	35
>120	62	35

Comments - Potassium levels in Tully Ratoons have decreased by 27% where excess amounts were used in 1996.

South Johnstone

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-80	5	40
81-120	32	25
>120	63	35

Comments - The percentage of growers applying excess Potassium has been reduced from 63% to 35%, with 40% applying 1-80 kg/ha K.

Mourilyan

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-80	5	45
81-120	32	40
>120	63	15

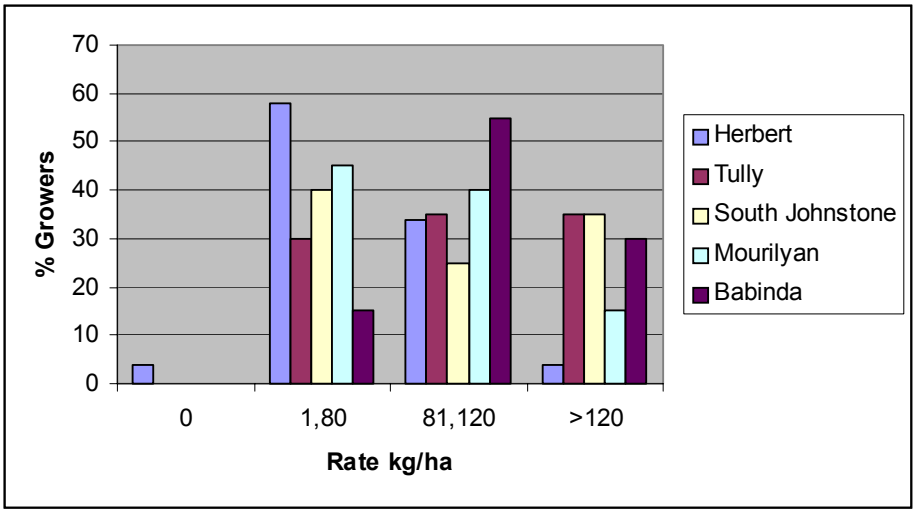
Comments - The percentage of growers who are applying excess Potassium has dropped from 63% to 15% from 1996 to 2000.

Babinda

Rate kg/ha	% growers 1996	% growers 2000
0	0	0
1-80	28	15
81-120	52	55
>120	20	30

Comments - A slight increase in Potassium use in ratoons.

Graph 7: Summary of Potassium use in ratoons



Summary – The majority of growers use potassium at or below the recommended rate. In the wet tropics, approximately 30% of growers could reduce potassium back to recommended rates.

5.2.4 Sulphur

Herbert

Rate kg/ha	% growers 1996	% growers 2000
0	3	5
1-10	40	43
11-25	55	51
>25	2	1

Comments - These figures correspond with an overall reduction in the rates of mixtures, which contain N, P, K, and S for the Herbert.

Tully

Rate kg/ha	% growers 1996	% growers 2000
0	4	5
1-10	45	50
11-20	48	45
>25	3	0

Comments - A slight reduction in Sulfur application.

South Johnstone

Rate kg/ha	% growers 1996	% growers 2000
0	38	20
1-10	49	40
11-20	8	30
>25	5	5

Comments - More growers are applying the 11-20 kg/ha rate in 2000 than in 1996.

Mourilyan

Rate kg/ha	% growers 1996	% growers 2000
0	38	65
1-10	49	15
11-25	8	20
>25	5	5

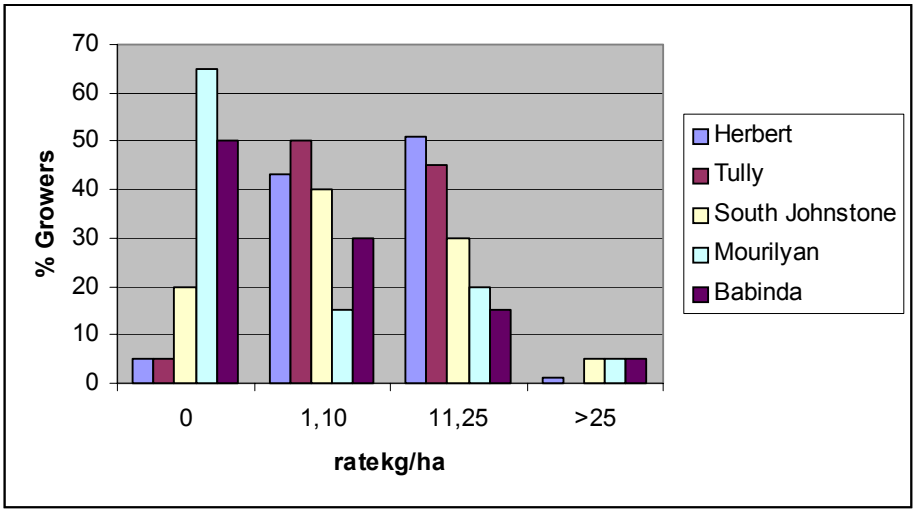
Comments - A larger percentage of growers are applying no Sulfur in ratoons.

Babinda

Rate kg/ha	% growers 1996	% growers 2000
0	43	50
1-10	37	30
11-25	16	15
>25	4	5

Comments - Results very similar.

Graph 8: Summary of Sulfur application rates for ratoons



Summary - Very few growers are applying Sulfur at excess rates in ratoons.

Comments:

Ratoon rate conclusion - The use of mixtures in ratoons means that very little excess of nutrient is applied in ratoons. If growers reduce the rate of mixtures, then automatically rates of S , K, etc are reduced. ***In general, growers sampled are not applying excess fertiliser to ratoon crop rates.***

6.0 CONCLUSIONS

This project attempted to cover a lot of territory in its focus, and was successful in achieving the following:

- Obtaining the perceptions of sectors of the community, including growers and agribusiness, towards fertiliser usage for cane cropping.

- Reinforcing nitrogen trial work for sugar cane in the northern regions.

- Providing some tangible evidence that more nitrogen does not necessarily mean extra profits to the grower, but that a balance between nitrogen rate application, and tonnes/ccs obtained is required.

- Depending on the soil type, a nitrogen rate within the range of 160 kg/ha-200 kg/ha will provide the most profitable result.

- Providing a snapshot of what happened regarding nutrient application rates between 1996-2000.

There has been sufficient trial work undertaken throughout the sugar industry to give growers confidence that adhering to BSES recommendations, especially for ratoon cane, will promote profitability. In cases where excess nitrogen has been applied as a cheap form of crop production insurance, this trial work has shown that over successive seasons, some potential profitability is actually lost by this practice. Reducing back to within the range of BSES recommendations for ratoon will maximise the chances of profitability, as long as other factors, such as climate, comply.

1) There has been a general reduction in fertiliser rate application throughout the northern mill areas. This includes a reduction in plant cane application from close to 60% excess in 1996, to 30% excess in nitrogen. The percentage of growers applying a rate within BSES recommendations has increased, while excess, and insufficient has decreased.

2) A reduction in N application for ratoons has also occurred, with close to 20% in 1996, less than 10% in 2000.

   Anecdotal evidence from resellers supports these findings, with sales reduced accordingly in 2000.

3) Economic factors including the poor sugar price, and environmental factors such as the very wet years (1998-2001) have played some role in reducing the amount of fertiliser applied

The economic/physical climate in 1996 meant that excess N was to be used, it would be in such years. The economic climate of 2000, with poor growing conditions was at the exact opposite extreme, thus was a contributing factor in the reduction.

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Tully CPPB
Herbert CPPB

APPENDIX 1

Many trials were set up, but had to be abandoned due to the excessive wet of 1999.

The following is a list of some of these trials. In the Mackay and Burdekin districts, trials only lasted one year.

Other trials

Mackay
First year results inconclusive
1997 results

Rate kg/ha	T cane/ha	ccs	T sugar/ha	Net $ /ha
150	105	14.83	15.57	1279
200	106	14.77	15.66	1240
250	103	14.8	15.24	1136

Rate kg/ha	T cane/ha	ccs	T sugar/ha	Net $/ha
147	119	14.6	17.37	1538
166	123	14.7	18.08	1653
223	121	14.5	17.55	1485

Burdekin

3rd Ratoon –Jardine

Rate kg/ha	T cane/ha	ccs	T sugar/ha	$ Net /ha
195	110	14.07	15.5	2662
240	117	13.63	15.9	2640
300	115	13.54	15.6	2505

Fallow Plant -Mona Park

Rate kg/ha	T cane/ha	ccs	T sugar/ha	$ Net /ha
130	165	13.06	21.5	3615
230	161	12.9	20.8	3353