

# SRDC Grower Group Innovation Project

## Final Report

**SRDC project number:** GGP012

**Project title:** Researching soil health and economics of two farming systems in the Herbert River district

**Group name:** New Farming Initiative Group

**Contact person:** Michael Waring

**Due date for report:** 20<sup>th</sup> of April 2009

This project was conducted by New Farming Initiative Group in association with the Sugar Research and Development Corporation (SRDC).

**Funding Statement:**

SRDC invests funds for sugar R&D derived from the sugar industry and the Australian Government.

The NFIG is not a partner, joint venturer, employee or agent of SRDC and has no authority to legally bind SRDC, in any publication of substantive details or results of this Project.



**Australian Government**

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**Sugar Research and  
Development Corporation**

## **Executive Summary:**

The New Farming Initiative Group (NFIG) consists of six members and has approximately 600ha of sugarcane farming land in the Herbert region. Comparison of soil health of the two farming systems is the primary objective. This project will increase the uptake of several best management practices which are considered to reduce the loss of sediment, chemicals and nutrients from cane lands as well as significantly improve soil fertility due to a healthier soil in terms of its physical, chemical and biological components.

The primary aim of the New Farming Initiative Group includes:

- Comparison of soil health of the two farming systems. These soil tests have not previously been undertaken in the Herbert and will provide a benchmark of current soil health. The test includes physical, biological and chemical components:
- Demonstrate the economics of two farming systems (regional standard and 1.9m dual row/break crop fallow)
- Development of group skills through shared knowledge, utilizing the expertise of consultants, building organisation skills and through first hand participation.

The trial site consists of three replications, two treatments and one variety. The trial was marked out with GPS to include 9 rows of pre-formed mounds at 1.9m and 11 rows of conventional at 1.55m spacing.

The key outcome of this project was the similar average gross margins for the conventional and new farming system treatments. Potentially higher future input costs will favour the new farming system economically, with greater average gross margins expected compared to a conventional farming system. The new farming system produced an average 0.5 unit CCS less sugar than conventional farming. The cause of this statistically significant difference is unclear and warrants further investigation.

Essentially, no significant difference was observed in soil health parameters (biological, physical and chemical) between treatments over the 14 month testing interval. Of interest, the new farming system displayed positive trends of increasing pH, increasing organic carbon and higher cation exchange capacity. The project had a relatively short testing interval and longer term soil testing would likely create more meaningful soil health results. Continued soil health testing and economic analysis is needed to achieve the full benefit from this project. It would be inappropriate to draw any firm conclusions on the comparison of these two farming systems from this study of only two years.

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## 1.0 Project Background

The New Farming Initiative Group (NFIG) consists of six members and has approximately 600ha of sugarcane farming land in the Herbert region. Comparison of soil health of the two farming systems is the primary objective. This was measured using soil tests that have not previously been undertaken in the Herbert and will provide a benchmark of current soil health. The test includes physical, biological and chemical components:

- Bulk Density
- Porosity
- Aggregate stability
- Shannon-Weiner Diversity Index (biological diversity)
- Enrichment Index (enrichment of soil eco-system)
- Structure Index (number of steps in food web)
- Channel Index (decomposition channel of nutrients)
- B:F Ratio (bacterial to fungal feeding nematodes)
- P:F Ration (parasites to free livers)
- Chemical properties

This project will increase the uptake of several best management practices which are considered to reduce the loss of sediment, chemicals and nutrients from cane lands as well as significantly improve soil fertility due to a healthier soil in terms of its physical, chemical and biological components. Improved soil fertility will reduce the amount of inputs (such as fuel for working the land, chemicals and fertilisers) required by farmers which will, in turn, further reduce the amount of sediment, chemicals and nutrients in run-off.

## 2.0 Project Aims

The regional standard farming system is based on cane planted with a furrow opener planter on single row at 1.5m spacing with numerous cultivations for ground preparation. Issues with conventional cane farming in the Herbert include soil degradation from compaction under wet harvest conditions and from intensive soil tillage prior to planting. The enhanced farming system is dual row cane planted with a double disc opener at 1.9m spacing with a break crop fallow. There is currently a paucity of information on the economic and soil health effects of an enhanced farming system in the Herbert river district. This project will also add to the experience local farmers have with the new farming system and working in groups.

The aim of the New Farming Initiative Group includes:

- Group collaboration - this will aid the acquisition of the necessary infrastructure and enable the full utilization of existing equipment and knowledge resources
- Comparison of soil health of the two farming systems. These soil tests have not previously been undertaken in the Herbert and will provide a benchmark of current soil health. The test includes physical, biological and chemical components:
- Determine which aspects of the 1.9m dual row farming system suit the Herbert district

- Demonstrate the economics of two farming systems (regional standard and 1.9m dual row/break crop fallow)
- Development of group skills through shared knowledge, utilizing the expertise of consultants, building organisation skills and through first hand participation.

### **3.0 Methodology**

#### **3.1 Literature Review**

A literature review was conducted to investigate the previous work undertaken on new farming systems and soil health. The reports provided details on the adoption of the principles promoted by the Sugar Yield Decline Joint Venture project. These include controlled traffic, crop rotation and minimal tillage. These new systems provide enhanced economic benefits by reducing inputs (fertilizer and pesticide application, labour, energy costs), lowering capital cost, improving soil health and reliance upon single cropping systems. Similar minimum tillage practices have been adopted in other industries throughout Australia, particularly in dry land grain cropping where moisture conservation and minimal soil disturbance is essential for sustainable farming. Research conducted by the “Sugarcane Yield Decline Group” has displayed that the use of minimum tillage systems with the addition of legume crop rotations is beneficial for reducing potential sediment, nutrient runoff and improving soil fertility.

The Sugarcane Yield Decline Group consisted of BSES Limited, SRDC, DPI&F and CSIRO. The initial farming systems program was conducted on a trial basis throughout Queensland. Following the successful development of the system several commercial size trials were established in Queensland, including the Herbert River District.

The findings documented that the use of a disc opener sugarcane planter is superior to the current practice because of minimal soil disturbance and the ability to maintain a trash cover. Trash retention is also beneficial for reducing weed pressure and therefore minimizing the amount of herbicide used in an integrated weed management program. The reports also indicated that Soybeans grown on pre-formed mound in a controlled traffic system can improve soil health and reduce compaction. Trials established in the Herbert region have mainly focused on the agronomy aspects of the new farming system, with a much smaller emphasis on soil health and economics. Some aspects of the new farming system still need to be refined such as planting depth, press wheel set-up, establishing pre-formed beds in a GCTB system and harvesting.

#### **3.2 Harvester Modifications and Mound Profile Discussion Group**

A roving field tour was held on the 13<sup>th</sup> of February 2007 to assess the harvester modifications required in the 1.9m dual row system and a suitable mound profile. Gary Sandell (Harvesting Consultant) attended the field tour to provide professional and independent advice on harvesting aspects. The first visit was to the Poggio farm where the mound profile was inspected (Figure 1). The profile was approximately 100 mm high with a relatively flat top. Two rows of Q200pbr were planted 500 mm apart and rows were spaced at 1.9 m centres. The contractors commented that the profile was good and could have more of a triangular or domed peak in the middle. Discussion on harvesting centered on removing, modifying or replacing the floating shoes as these were too narrow for the bed. Options that were discussed to improve the base-cutters

included wider base-cutters from EHS Engineering, automatic base-cutter height control and GPS guidance.

The rows are now 400 mm wider than standard, haul-outs are 800 mm further from the harvester than usual and the elevator has difficulty filling the further side of the bin. The harvesting contractor intends to increase the speed of the elevator so that the trajectory of the cane is increased so to properly fill the further side of the haul-out bin and to have this speed variable so that it can be reduced to normal for cutting 1.5 m rows. Other ideas discussed were: a belt-type elevator extension, which was seen as prone to impact damage from haul-outs and time consuming to fit; a flipper roller at the end of the elevator, which was seen as uneconomical because of the potential for cane loss; and, a tin slide fitted to the end of the harvester to assist the cane to travel the required 800 mm further, which was seen as impractical.

The second visit was to the farm of Michael Waring where the group inspected a crop of Q174pbr planted in rows 500 mm apart in beds at 1.9m centers. The profile was flat and was lower than the previous profile; the profile could have been filled in a little more along the plant lines. The profile could have had more of a triangular or domed shape. However, the contractor (Anthony Bogotto) intends to use a much flatter base-cutter angle (to match the lower profile), thus a centre peak was less of an issue in this case.

Issues to do with elevating and correct placement of the haul-outs were discussed. In this case Anthony intends to harvest this plot by moving the haul-out one row closer to the harvester (i.e. 1.1 m closer than normal) and compensate for this by angling the elevator towards the back of the harvester. While Anthony sees that other options are a better solution he views this method as an easy way to achieve controlled traffic for this plot. The contractors were generally happy with the profile and could see no significantly detrimental issues in harvesting this dual row cane.

The following two visits were to the sheds of the contractors to inspect their machines (Figure 2). Anthony has a 1998 model Cameco and Dwayne Morelli has a 2006 model Cameco. The inspections were used to measure track widths and distances and clearances in the fronts of the machines (Figure 3). Both machines, with the solutions discussed above are admirably capable of harvesting the plots of dual-row.

The consultant held a discussion on compromises in base-cutter rpm, base-cutter width and ground speed in dual row cane: In single-row cane, the row of cane is harvested in the centre of the base-cutter where cutting is affected by two blades. In dual row cane most cutting occur on the periphery of the discs [rows are 500 mm apart and base-cutter centers are 600 mm] where cane stalks are cut by only one blades from only one disc. This makes stalks more likely to be severed by the disc rather than being cut by a blade, which has a very detrimental affect in stool health and stool removal. Low ground speeds are critical in harvesting dual row cane.

Secondly, it is important to reduce the knock-down angle of the harvester as much as possible if the cane is harvested erect. Most harvesters have excessive knock-down angles, that is, they push the cane stalk over too much before the stalk is cut. This leads to stool tipping and removal, stool splitting and increased base-cutter loss.

**Figure 1. Group inspecting mound profile of Q200pbr**



**Figure 2. Inspection of 2006 Model Cameco Harvester**



**Figure 3. Standard harvester fronts with floating shoes**



### **3.3 Working Together Forum**

A working together forum was held at Fiorelli's Café on the 29<sup>th</sup> of January. The forum was attended by 15 farmers from several grower groups in the Herbert region. Chris Baker, a psychologist from Centacare Townsville, delivered a very informative presentation on various aspects of group dynamics.

Chris described the various stages of group development. The importance of understanding each phase was discussed between participants. Growers completed a questionnaire to help identify their own personal strengths and weaknesses. Understanding these characteristics will assist members to function within a group. The forum concluded with discussion on several models of conflict resolution.

A participant survey was conducted at the end of the forum. The results suggest that the forum impacted positively on their views and understanding of group dynamics. A copy of the survey form is attached in Appendix B.

### **3.4 Burdekin and Proserpine Field Tour**

The NFI group went on a two day field tour to the Burdekin and Proserpine districts in March 2007. The group visited farms in the MAFIA group to discuss mound profiles and planting techniques. Chris Hesp and Paul Hatch explained the methodology of their new farming system and important issues they have uncouncted since adopting the system. The influence of climatic variations between the Herbert and Burdekin areas was highlighted during the visit.

Following the Burdekin visit, the group travelled to Proserpine to meet with Tony Jeppessen (OCPS group). The OCPS group have invested in GPS mapping technologies and EM mapping to determine soil variations. The New Farming Initiative Group identified the need for GPS to minimise compaction and achieve real controlled traffic. GPS would be ideally suited to harvesting, particularly in a dual row planting system. The group also visited Mark Orr who is currently growing peanuts on pre-formed mounds in rotation with cane (Figure 6). From the visit it appears that Peanuts would not be a suitable crop for our situation because of soil type and environmental limitations. Our early impression is that Soybeans or Cowpeas are better suited to the Herbert district as a green manure crop because of their tolerance to water logging.

**Figure 6. NFIG investigate peanuts at Mark Orr's farm**



### **3.5 Machinery Modifications**

A mound former was constructed in one of the group members shed. The design was loosely based on the BSES Limited mound former. The mound former is capable of making mounds between 1.5m – 2.0m. The crumble roller, wings and frame were modified to allow easier conversion to triple row in the future. A local boiler maker was contracted to assist with the construction. Figure 4 displays the completed mound



former. The mound former was tested in 2006 during the trial site establishment. Following some small modifications to the angle of the wings it proved to be very successful.

A dual row double disc opener planter was modified to suite the groups planting requirements. Modifications included:

- Altering the shute design to reduce billet blockage;
- An alternative set of press wheels were made for varying soil conditions;
- Altered fertiliser box to allow accurate flow of fertiliser.

Three tractors were also widened to 1.9m tracking width. The spray boom was extended to 9.5m to continue spraying five rows at a time. The plant cutter was modified to allow the cutting of a single row from dual row cane. Four cane trailer drawbars were made adjustable to improve feeding efficiency. In addition to the farm machinery modifications, the contract harvester elevator speed was increased to better fill the tipper in dual row cane.

**Figure 4. Completed mound former**



### 3.6 Trial Site Preparation and Design

The trial site consists of three replications, two treatments and one variety (Appendix A). The trial was marked out with GPS to include 9 rows of pre-formed mounds at 1.9m and 11 rows of conventional at 1.55m spacing (Figure 5).

**Figure 5. Conventional (left side) and pre-formed beds with Soybeans (right side)**



The pre-formed mounds were established in November 2006 with a crop of Soybeans planted on the 20<sup>th</sup> of December. Ground preparation consisted of three discing and one ripper/moulder pass. Lime was applied across the entire trial block at a rate of 2.5 tonnes per hectare prior to mounding. The legumes were sprayed out in February 2007 using Glyphosate (4L/ha) + Starane (1L/ha) + 2,4-D (1.5L/ha). A follow up spray of Glyphosate (3L/ha) + 2,4-D (1.0L/ha) was needed prior to planting to control new weed growth.

The conventional treatments were disced three times in November and sprayed with Glyphosate (4L/ha) + 2,4-D (1.5L/ha) to control weed growth. Prior to planting ground preparation consisted of two discing and one ripper pass.

Both treatments were planted with Q200pbr over three days from the 16<sup>th</sup> to the 18<sup>th</sup> of July 2007 (Figure 6). The conventional treatment was slightly more advanced in growth during the early stages of growth, with the cane in the conventional system spiking on the 8<sup>th</sup> of August 2007 versus the 18<sup>th</sup> of August 2007 for the new farming system. The work rate for conventional planting was calculated at 1 acre/hour compared with 0.75 acres/hour for dual row planting.

**Figure 6. Trial site**



The conventional plant cane treatments were fertilized with 187.5Kg/ha of DAP at planting and 375kg/ha of 51/51(s) at out-of-hand stage. The new farming system treatments were fertilized with 187kg/ha of DAP at planting and 312kg/ha of Sulphate of Potash at out-of-hand stage. Table 1 displays the total amount of nitrogen, phosphorus, potassium and sulphur applied to each treatment. The phosphorus, potassium and sulphur levels are not exactly equal between treatments because of limitations in finding a product with a suitable analysis.

**Table 1. Nutrient Comparison of Treatments (Kg/ha of element)**

<b>Kg/ha of each element</b>	<b>N</b>	<b>P</b>	<b>K</b>	<b>S</b>
New Farming System with Soybeans	33	37	126	51
Conventional	136	37.5	109	24

Weed control included an application of Gramoxone + Stomp + Atrazine post planting and Gramoxone + Diuron + Atrazine at the out-of-hand stage for both treatments. Additional cultivation was used in the conventional treatment plot, this included 1 x weeder, 1 x ripper/grubber and 2 x hilling up.

### **3.7 Chemical, Physical and Biological Soil Tests**

Soil tests were collected and sent off for analysis on the 26<sup>th</sup> of February. Bulk density samples were also collected from each plot on the 1<sup>st</sup> of March 2007. Samples were taken from each plot for biological, chemical and physical analysis. A total of 24 samples were taken from the trial site. The samples were sent to DPI&F South Johnston (biological) and Incitec (chemical) for analysis. A follow up soil test was done on the 5<sup>th</sup> May 2008 to determine if any significant changes in the biological and chemical characteristics had occurred over the 14 month period.

### **3.8 Harvester Contract Forum**

A harvester contract forum was held Aquallini's shed on the 2<sup>nd</sup> of May 2008. Ten farmers and harvester operators attended the forum, including a Tech Agro representative (Figure 7). The aim of the forum was to discuss elevator extension, width of harvester fronts, base cutter angles and height control, along with mound profile when harvesting dual and single row cane.

*Elevator extension:* NFI harvesting contractor has a 300mm factory made elevator extension and alterations were made to speed up elevator chain. This combination worked very well with harvesting single and dual row by adjusting the bin flap. Other contractors currently use detachable elevator extensions which were fairly cumbersome and time inefficient. Some difficulties were also experienced on undulating blocks with the elevator extension contacting the tipper bin.

*Width of fronts:* All contractors agreed that removing the floating shoes were beneficial when cutting dual row cane. Some contractors noted that more recent harvesters were manufactured with wider fronts.

*Base cutter angles and height control:* Reducing the pitch more towards horizontal was thought to reduce stool damage, particularly with a flatter mound profile. NFI harvester contractor has installed six blade base plates to further reduce stool damage. The Tech Agro representative presented information on the automatic base cutter height control system and recent developments. The NFI contractor highlighted the need for more training on the use of the computer adjustment settings.

*Mound profile:* A large amount of variation existed between mound profiles used in each harvesting group. Mound shapes were discussed and drawn on a white board. The group consensus was that the profile drawn below was ideal for efficient harvesting on a wide row 1.8 – 2.0m system. The use of GPS was also considered to be an important component of the new farming system and the contractors agreed that it will be a standard feature in the next 3 – 5 years.



**Figure 7. Participants discuss harvester elevator extension**



### 3.9 Roving Field Tour

The NFIG trial site was one of the sites visited during the FutureCane roving field tour held on the 31<sup>st</sup> of March 2008. The group viewed the SRDC NFIG trial at Poggio's farm (Figure 8). Alan Poggio presented information on the aim of the trial to growers. Issues discussed included DDO planting, harvesting, legume fallow and fertilizer rates. Handouts were given to the growers detailing the economic results of the trial to date and the results from the soil biology test.

**Figure 8. Mark and Alan Poggio presenting at NFIG trial site**



### 3.10 Additional Items

The NFI group purchased a Cuban automatic base cutter height controller. The group believe that this is a valuable addition to improve the dual row harvesting ground job. The equipment was tested on group member's farms and has proven to be a worthwhile purchase. The group has also had further discussions with the harvester contractor about additional modifications for the 2008 harvest. The contractor has agreed to

change to base cutter height angle and add an additional blade to the base cutters. It is hopeful that this will assist in minimising stool damage and cane losses.

The group has also identified GPS as an important component of making the new farming system work successfully. At this stage the group has decided to delay the purchase of GPS equipment until a later date.

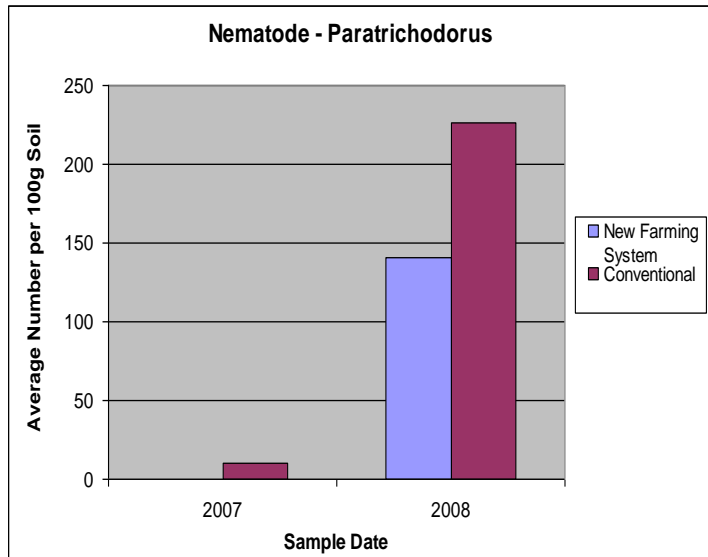
## 4.0 Results and Outputs

### 4.1 Soil Health Test and Interpretation

The initial soil test was taken on the 1<sup>st</sup> March 2007. A follow up soil test was done on the 5<sup>th</sup> May 2008 to determine if any significant changes in the biological and chemical characteristics had occurred over the 14 months period. Appendix C contains the raw data from the biological soil tests undertaken by the Department of Primary Industries and Fisheries (South Johnston). A summary of the chemical results received from Incitec and the bulk density results is included in Appendix D. Glen Park (BSES Limited Researcher) conducted a statistical analysis of the raw data to determine if a significant difference occurred between treatments.

The results revealed a significant difference between treatments in the plant parasite *Paratrichodorus*. It was significantly higher at both sample dates in the conventional treatment. Figure 9 displays a graph of the *Paratrichodorus* results.

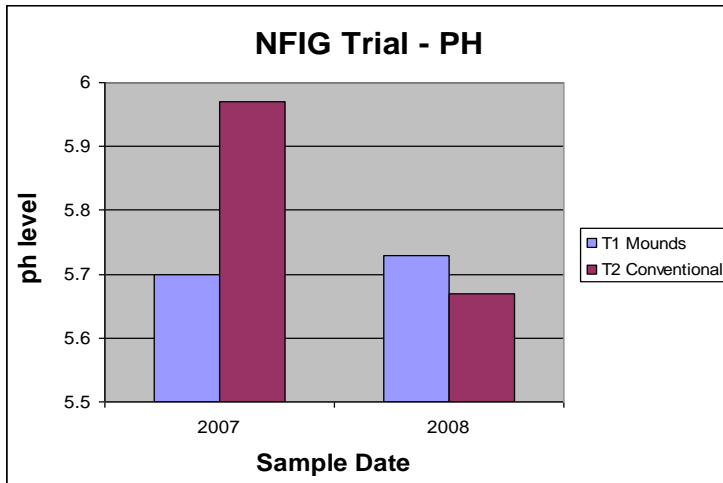
**Figure 9. Plant parasite numbers for *Paratrichodorus***



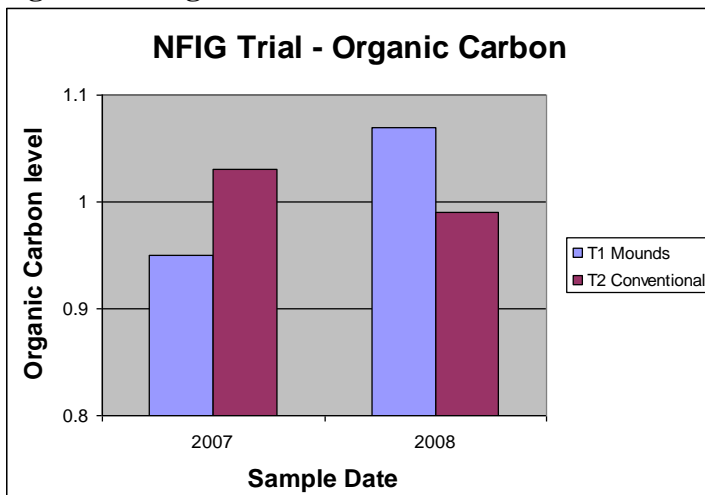
The remaining results displayed no significant difference in the biological, chemical and physical tests undertaken by the NFI group. This result was expected because of the short time frame of 14 months between the tests. The group agreed that long term monitoring is required to determine the impact of a new farming system on soil health and to develop some parameters as to what constitutes a healthy soil. Figures 10, 11 & 12 show the chemical results across each treatment over time. Although no statistical difference was found, the chemical results showed some improvement in average pH,

organic carbon and cation exchange capacity over time in the pre-formed mound treatments.

**Figure 10. Soil pH levels in mounds and conventional treatments**



**Figure11. Organic carbon levels in mounds and conventional treatments**



**Figure 12. Cation exchange capacity in mounds and conventional treatments**

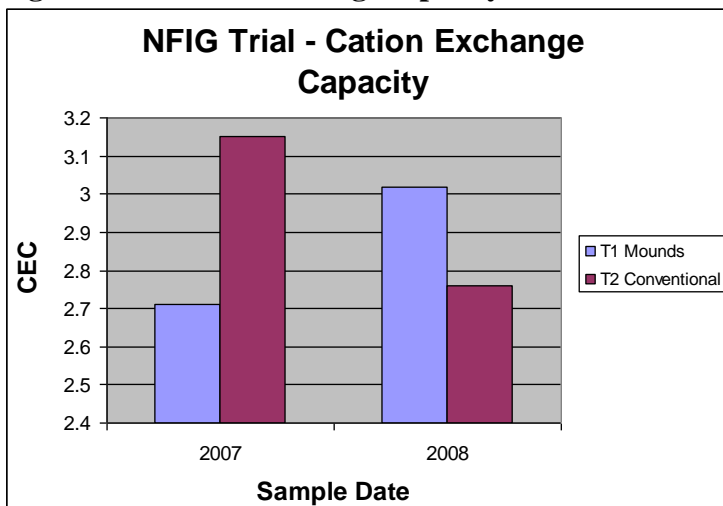
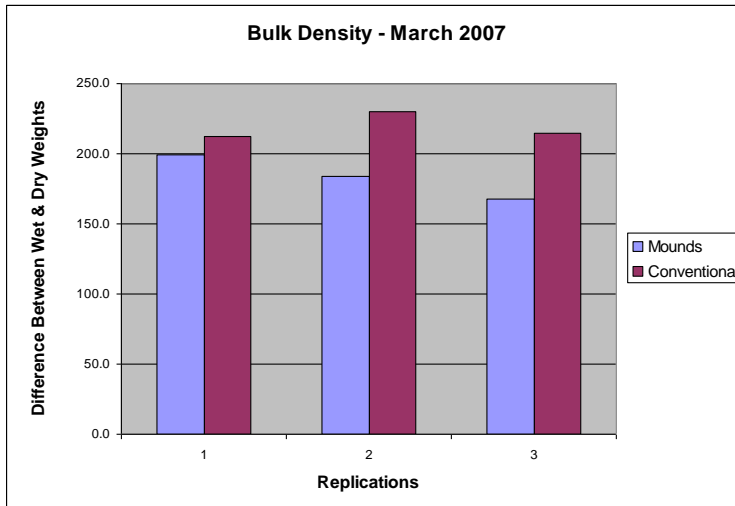


Figure 13 displays the bulk density results from the sample taken in March 2007. In each replication the conventional treatment had a greater difference between wet and dry weights. The difference in results may be attributed to the pre-formed mounds consolidating over the wet season versus the conventional treatment where additional cultivation had resulted in greater aeration and moisture holding capacity in the short-term. Another likely factor is the dryer soil in the pre-formed mound treatments because of the raised beds and moisture demand from the Soybean crop.

**Figure 13. Bulk density results at March 2007**



## 4.2 Production Results

The trial was harvested in September 2008 and samples were sent to the mill for analysis (Table 2). Unfortunately, a mill break-down resulted in part of the trial being harvested on the 3<sup>rd</sup> of September and the remaining part on the 4<sup>th</sup> of September. A statistical analysis of the results revealed a significant difference in CCS between the treatments. The lower CCS in the pre-formed mound treatment may be attributed to the variation in harvest time or a greater amount of nitrogen being supplied by the Soybean fallow crop. Because of the variation in the Soybean crop size, the group decided to apply 33kg/ha of Nitrogen at planting in the pre-formed mound treatments. Increased levels of nitrogen may have caused a decline in CCS. There was no significant difference in yield between the pre-formed mound and conventional treatments.

**Table 2. Trial Production Data**

HARVEST RESULTS							
Treatment	Replication	Date	Actual CCS	t/ha	ts/ha	Average t/ha	Average ts/ha
Mounds	1	3/09/2008	16.10	94.08	15.15	95.99	15.13
Mounds	2	4/09/2008	15.70	93.01	14.60		
Mounds	3	4/09/2008	15.50	100.86	15.63		
Conventional	1	3/09/2008	16.70	92.99	15.53	96.74	15.82
Conventional	2	3/09/2008	16.50	95.82	15.81		
Conventional	3	4/09/2008	15.90	101.42	16.13		

### 4.3 Economic Analysis

Paddock records were maintained for each farming system to allow for an accurate assessment of all input costs and revenue. Gross margins were calculated using the DPI&F FEAT program. Figure 14 displays the gross margin of fallow and plant cane in the mounds and conventional treatment. As expected, the fallow costs were higher (\$235/ha) in the mound treatment because of the additional cost of growing a Soybean crop for green manure. The plant cane gross margin was higher in the mound treatment because of lower fertiliser, weed control and land preparation costs. The plant cane variable costs (including harvesting) were \$1788/ha and \$2187/ha for the mounds and conventional treatment respectively. Although there was a \$398/ha saving in plant cane variable costs, the reduced CCS in the mound treatment and the additional costs of growing the Soybean crop resulted in the average gross margin being very similar.

**Figure 14. Fallow and Plant Gross Margin (2007 input costs)**

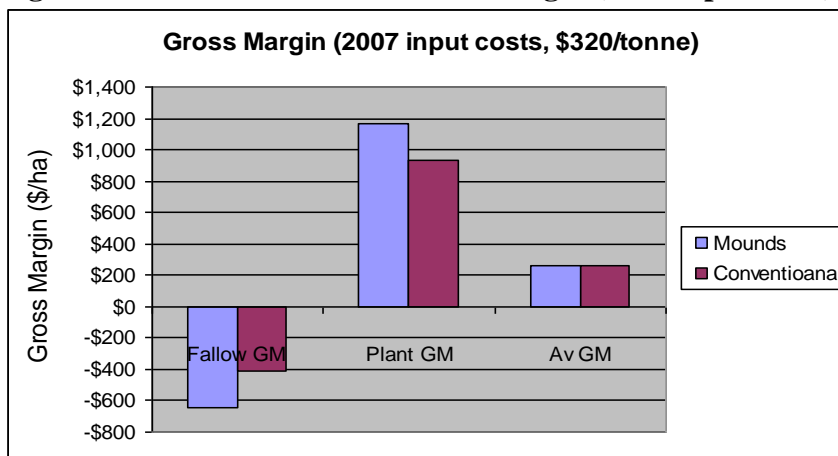
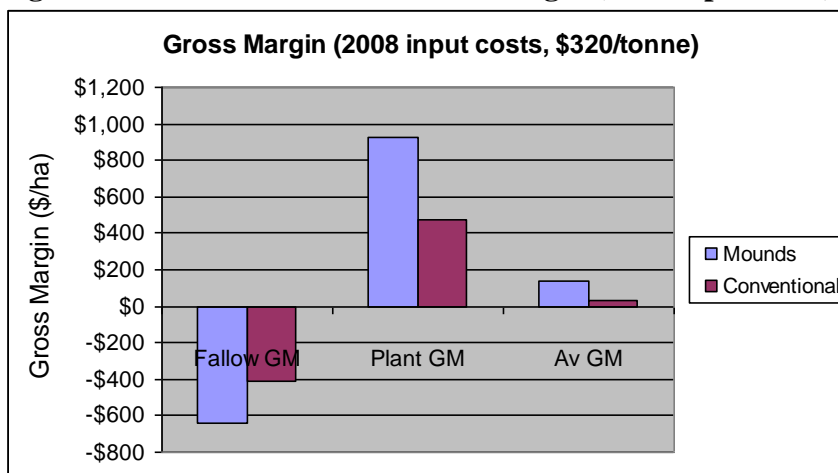


Figure 15 displays the treatment gross margins if 2008 input costs were used in the calculations. The increased input costs in 2008 would cause a greater impact on the high input system (conventional) mainly due to increased fuel and fertiliser costs. As a result in increased input costs, the average gross margin would be \$109/ha higher in the mound treatment. With a long-term trend of increasing input costs, the importance of reducing input costs whilst maintaining/improving production is highlighted in the graph.

**Figure 15. Fallow and Plant Gross Margin (2008 input costs)**





## **5.0 Intellectual Property and Confidentiality**

No intellectual property applicable to this project.

## **6.0 Capacity Building**

Our capacity to conduct R&D has greatly improved after working through each step of our project, learning how to plan a replicated trial, coordinate all the activities associated with establishing the trial, collecting samples and interpreting results and working together as a team.

After establishing this trial, group members have gained the confidence and knowledge to convert their farms to the new farming system. Harvester operators and growers have experienced the benefits like time savings without loss of productivity.

## **7.0 Outcomes**

1. The key outcome of this project was the similar average gross margins for the conventional and new farming system treatments.
2. Potentially higher future input costs will favour the new farming system economically, with greater average gross margins expected compared to a conventional farming system.
3. The new farming system produced an average 0.5 unit CCS less sugar than conventional farming. The cause of this statistically significant difference is unclear and warrants further investigation.
4. Essentially, no significant difference was observed in soil health parameters (biological, physical and chemical) between treatments over the 14 month testing interval. Of interest, the new farming system displayed positive trends of increasing pH, increasing organic carbon and higher cation exchange capacity.
5. The project had a relatively short testing interval and longer term soil testing would likely create more meaningful soil health results.

Continued soil health testing and economic analysis is needed to achieve the full benefit from this project. It would be hazardous to draw any firm conclusions on the comparison of these two farming systems from this study of only one crop cycle.

## **8.0 Environmental Impact**

(Outline any adverse or beneficial environmental impacts of conducting the Project and/or implementing its findings)

This project addresses the issues of reduced soil fertility and the loss of soil and nutrients from cane lands in the Herbert River district and maintaining a sustainable sugar cane industry. Increased sediment and nutrients in run-off from cane lands is considered to have a significant impact on the biodiversity and ecology of downstream waterways, wetlands and the Great Barrier Reef lagoon.

This project will increase the uptake of several best management practices which are considered to reduce the loss of sediment, chemicals and nutrients from cane lands as well as significantly improve soil fertility due to a healthier soil in terms of its physical,

chemical and biological components. Improved soil fertility will reduce the amount of inputs (such as fuel for working the land, chemicals and fertilisers) required by farmers which will, in turn, further reduce the amount of sediment, chemicals and nutrients in run-off.

## 9.0 Communication and Adoption of Outputs

- Working Together Forum for 15 growers was held on the 29<sup>th</sup> of January 2007. Andrew Lashmar (SRDC) attended forum.
- Progress report displaying results for soil analysis provided to growers in December 2007 through the Herbert Soil Health Forums. Acknowledgement of SRDC contribution to project.
- Presentation at the SRDC regional workshop in 2008.
- BSES Limited Quarterly Newsletter article in September 2007. Acknowledgement of SRDC contribution to project.
- A contract harvester forum was held at Aquallini's shed on the 2<sup>nd</sup> of May 2008. Ten farmers and harvester operators attended the forum, including a Tech Agro representative. The forum discussed elevator extension, width of harvester fronts, base cutter angles and height control, along with mound profile when harvesting dual and single row cane.
- Roving field tour was held on the 31<sup>st</sup> of March 2008 in conjunction with FutureCane. The NFIG trial was one of the sites visited.
- Presentation at GIVE Mackay 2008 on project and outcomes to date.
- Presentation at GIVE Ingham 2009 on project and results.

## 10.0 Recommendations

- 1 Progress soil health tests and economic analysis are required to provide more evidence on any benefits of a new farming system that has been suggested by previous studies. NFIG plans to continue collecting data from this trial site.
- 2 Future studies may help clarify if the new farming system does result in CCS loss and the reasons underlying this. The authors postulate that the CCS loss observed in this study may be the result of several factors: Nitrogen from soybean fallow crop, study bias from the trial plot being harvested over two successive days, differing extraneous matter when harvesting single/dual row cane.

## 11.0 Publications

- Progress report displaying results for soil analysis provided to growers in December 2007 through the Herbert Soil Health Forums. Acknowledgement of SRDC contribution to project.
- BSES Limited Quarterly Newsletter article in September 2007. Acknowledgement of SRDC contribution to project;
- GIVE Day handout (Ingham 2009)

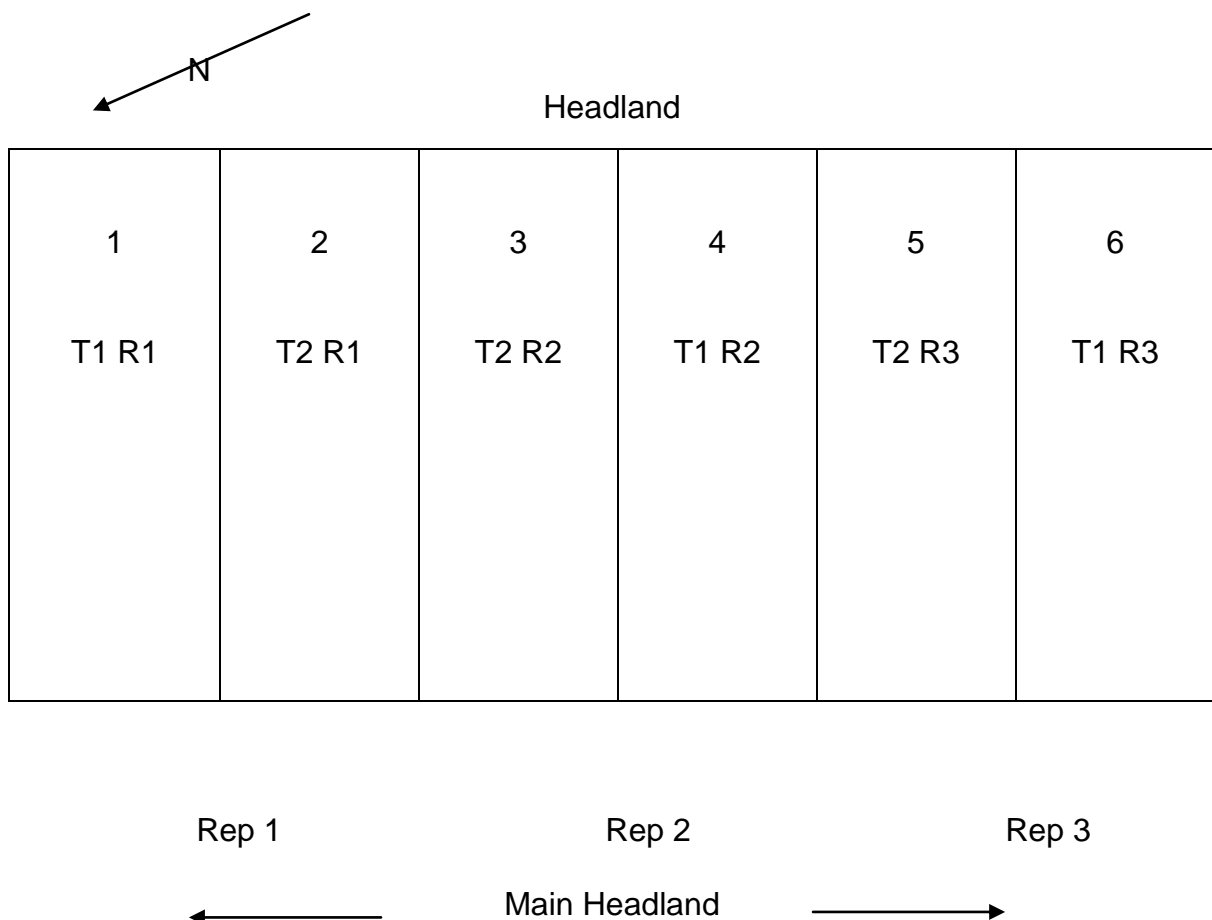
## Appendix A

### Trial Design

Location – Poggio Farm, Stone River Rd, Trebonne (10km west of Ingham)

Size – 2.6 ha

Soil Type – Terrace Silty Loam



Treatment 1 = 1.9m dual row DDO planted cane

Treatment 2 = 1.52m single row furrow opener planted cane

## Appendix B

### Working Together Forum - Survey

#### Workshop Evaluation

*Please provide some comments to help us incorporate your thoughts into future events*

**1) What do you think worked well during this workshop?**

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**2) What improvements would you suggest?**

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**3) What were your key learnings from the “Working Together” workshop?**

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**4) What will you implement because of the “Working Together” workshop?**

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## Appendix C

### SOIL HEALTH TESTS

#### Sample 1 – March 2007

#### Nematode Diversity Analysis

**The Shannon-Weiner diversity index (H')** is used to characterise species diversity in a community. A higher value indicates greater diversity.

**The enrichment index 0-100 (EI)**, (a measure of resource availability) is a measure of the resources available to the soil food web and response by primary decomposers to those resources. A high value indicates high resource availability.

**The structure index 0-100 (SI)**, (the complexity of the food web) is a measure of the number of trophic layers in the soil food web and the potential for regulation by predators. A high value indicates a complex food web.

**The channel index 0-100 (CI)**, is an indication of the decomposition channel of nutrients. A low value suggests a primary bacterial decomposer community and high value, a fungal dominated decomposer nematode community.

The calculation of the Shannon-Weiner diversity index (H') is made with the inclusion of plant parasites nematode numbers, but the calculation of the enrichment, structure and channel indices does not include the plant parasitic nematode numbers.

Table 1. Trophic groups of nematodes recovered from soil samples submitted March 2007.

Nematodes per 100g soil																			
Soil Sample	Plant parasites					Fungal Feeding		Bacterial Feeding				Omnivores		Total nematodes					Total Nematodes
	Pratylenchus	Helicotylenchus dihystera	Rotylenchulus	Paratrichodorus	Tylenchorhynchus	Tylenchus 1	Tylenchus 2	Rhabditis	Cephalobus	Teratocephalus	Prismatolaimus	Dorylaimus	Eudorylaimus	Total Plant-parasites	Total Fungal feeding	Total Bacterial feeding	Total Predatory	Total Omnivores	
T1R1	0	0	0	0	4	160	12	21	123	0	4	0	45	4	173	148	0	45	370
T1R2	9	0	0	0	0	29	15	0	27	0	69	7	36	9	44	96	0	44	193
T1R3	5	0	5	0	5	148	0	29	110	5	57	5	133	14	148	200	0	138	500
T2R1	7	2	0	3	3	62	15	0	72	0	20	15	37	15	77	92	0	52	236
T2T2	0	0	0	0	3	53	0	0	65	0	25	10	50	3	53	90	0	60	206
T2R3	0	0	0	0	4	66	0	0	63	0	37	0	50	4	66	100	0	50	220

Table 2. Indices and ratios calculated from nematode data from soil samples submitted March 2007 2006.

Soil Sample	Shannon-Weiner diversity index (H')	Enrichment index (EI)	Structure index (SI)	Channel index (CI)	Bacterial:Fungal	Parasites:Free livers
T1R1	1.36	46.3	39.1	67.7	0.46	0.01
T1R2	1.71	38.1	82.3	100.0	0.69	0.05
T1R3	1.68	50.5	72.9	56.4	0.58	0.03
T2R1	1.82	34.1	63.0	100.0	0.54	0.06
T2T2	1.51	30.9	71.6	100.0	0.63	0.01
T2R3	1.43	34.0	68.8	100.0	0.60	0.02

## Chemical, Physical and Biological analyses

Table 3. Chemical and physical characteristics of soil sampled March 2007

Soil Sample	EC (dS/m)	pH	NO <sub>3</sub> <sup>-</sup> (mg/l)	Labile carbon (mg/kg)	Flourescein (ug/ml)	Aggregate stability	Particle distribution % silt ,clay, sand		
							Silt	Clay	Sand
T1R1	0.01	6.2	9	443	6.87	4.04	95	4	1
T1R2	0.01	6	9	429	6.88	4.08	94	4	2
T1R3	0.01	5.8	11	383	6.87	12.12	87	12	1
T2R1	0.02	5.8	1	411	7.25	9.18	89	9	2
T2R2	0.03	5.8	9	436	4.12	4.04	95	4	1
T2R3	0.03	5.9	10	405	5.87	7.14	91	7	2

### Electrical conductivity EC (0-6.07 dS/m)

Electrical conductivity (EC) is the most common measure of soil salinity. By agricultural standards, soils with an EC greater than 4 dS/m are considered saline.

### pH (0-14)

Soil pH is a measure of the acidity or alkalinity of the soil which affects the availability of the plant nutrients, the activity of soil micro-organisms and the solubility of minerals. 1-7 is acidic, and 7-14 is alkaline.

### Estimated Nitrate (mg/l)

Soil nitrate is a form of inorganic nitrogen that is available for use by the plants. Soil nitrates are a good measure of plant available nitrogen but they can be easily lost by leaching and volatilization.

### Stable Aggregates (%)

This is a measure of the vulnerability of soil aggregates to external destructive forces. Aggregates consist of several particles bound together usually by organic matter. Aggregate stability is affected by; organic content, clay content, aluminium and iron oxide content, calcium carbonate content and exchangeable sodium content.

### Flourescein Diacetate FDA (ug/ml)

FDA is a measure of the microbial activity of the soil. A higher value indicates greater microbial activity.

### Labile C (measured at 550nm)

Labile carbon is a measure of the active fraction (or more immediately broken down fraction) of organic matter in the soil. Labile carbon levels are often reduced under conventional production systems.

## Sample 2. April 2008

### Nematode Diversity Analysis

**The Shannon-Weiner diversity index (H')** is used to characterise species diversity in a community. A higher value indicates greater diversity.

**The enrichment index 0-100 (EI)**, (a measure of resource availability) is a measure of the resources available to the soil food web and response by primary decomposers to those resources. A high value indicates high resource availability.

**The structure index 0-100 (SI)**, (the complexity of the food web) is a measure of the number of trophic layers in the soil food web and the potential for regulation by predators. A high value indicates a complex food web.

**The channel index 0-100 (CI)**, is an indication of the decomposition channel of nutrients. A low value suggests a primary bacterial decomposer community and high value, a fungal dominated decomposer nematode community.

The calculation of the Shannon-Weiner diversity index (H') is made with the inclusion of plant parasites nematode numbers, but the calculation of the enrichment, structure and channel indices does not include the plant parasitic nematode numbers.



Table 1. Trophic groups of nematodes recovered from soil samples submitted April 2008.

Sample	Nematodes per 100 g soil																					
	Plant Parasites						Fungal Feeding			Bacterial Feeding				Predatory	Omnivores		Total Nematodes					
	Pratylenchus	Helicotylenchus dihystrera	Rotylenchulus	Paratrichodorus	Criconemella	Tylenchorhynchus	Tylenchus 1	Aphelenchus	Aphelenchoides	Rhabditis	Cephalobus	Teratocephalus	Prismatolaimus	Monochus filiform	Dorylaimus	Eudorylaimus	Total Plant-parasites	Total Fungal feeding	Total Bacterial feeding	Total Predatory	Total Omnivores	Total Nematodes
T1 R3	94	33	0	89	0	94	171	0	33	66	22	17	6	0	116	39	310	204	111	0	155	780
T2 R3	221	15	8	206	8	69	297	23	69	145	107	31	0	0	84	69	527	389	283	0	153	1352
T1 R2	122	44	22	133	11	288	89	0	44	133	78	11	22	11	188	44	620	133	244	11	232	1240
T2 R2	94	66	28	198	0	85	207	0	85	179	94	0	0	0	9	85	471	292	273	0	94	1130
T2 R1	97	16	16	275	16	97	146	16	65	129	113	0	16	16	0	81	517	227	258	16	81	1099
T1 R1	203	78	62	203	0	203	234	16	94	281	172	0	62	0	78	203	749	344	515	0	281	1889

Table 2. Indices and ratios calculated from nematode data from soil samples submitted April 2008.

Soil Sample	Shannon-Weiner diversity index (H')	Enrichment index (EI)	Structure index (SI)	Channel index (CI)	Bacterial:Fungal	Parasites:Free livers
T1 R3	2.22	67.5	74.7	43.5	0.35	0.40
T2 R3	2.25	66.1	57.8	40.2	0.42	0.39
T1 R2	2.32	75.9	83.3	20.0	0.65	0.50
T2 R2	2.20	72.3	49.4	29.0	0.48	0.42
T2 R1	2.26	68.7	55.6	30.4	0.53	0.47
T1 R1	2.40	74.0	71.1	23.4	0.60	0.40

## Chemical, Physical and Biological analyses

Table 3. Chemical and physical characteristics of soil sampled April 2008

Soil Sample	EC (dS/m)	pH	Nitrate (ppm) corrected for dilution factor	Labile carbon (mg/kg)	Flourescein (ug/ml)	Stable Aggregates (%)
<b>T1 R3</b>	0.012	6.01	5	455	3.59	21.4
<b>T2 R3</b>	0.010	6.09	5	438	3.94	22.2
<b>T1 R2</b>	0.011	6.06	5	477	3.35	20.4
<b>T2 R2</b>	0.008	5.60	5	423	4.07	17.3
<b>T2 R1</b>	0.009	5.70	5	433	4.00	23.2
<b>T1 R1</b>	0.010	5.73	5	506	2.96	23.2

### Electrical conductivity EC (0-6.07 dS/m)

Electrical conductivity (EC) is the most common measure of soil salinity. By agricultural standards, soils with an EC greater than 4 dS/m are considered saline.

### pH (0-14)

Soil pH is a measure of the acidity or alkalinity of the soil which affects the availability of the plant nutrients, the activity of soil micro-organisms and the solubility of minerals. 1-7 is acidic, and 7-14 is alkaline.

### Estimated Nitrate (ppm)

Soil nitrate is a form of inorganic nitrogen that is available for use by the plants. Soil nitrates are a good measure of plant available nitrogen but they can be easily lost by leaching and volatilization.

### Stable Aggregates (%)

This is a measure of the vulnerability of soil aggregates to external destructive forces. Aggregates consist of several particles bound together usually by organic matter. Aggregate stability is affected by; organic content, clay content, aluminium and iron oxide content, calcium carbonate content and exchangeable sodium content.

### Flourescein Diacetate FDA (ug/ml)

FDA is a measure of the microbial activity of the soil. A higher value indicates greater microbial activity.

### Labile C (measured at 550nm)

Labile carbon is a measure of the active fraction (or more immediately broken down fraction) of organic matter in the soil. Labile carbon levels are often reduced under conventional production systems.

## Appendix D

### Summary of Chemical Properties

# Analysed by Incitec laboratory

20/03/2007								
	Treatment 1 Mounds				Treatment 2 (Conventional)			
	rep 1	rep 2	rep 3	Mean	rep 1	rep 2	rep 3	Mean
ph	6.00	5.40	5.70	5.70	5.60	6.10	6.20	5.97
OC	0.96	0.90	0.99	0.95	0.89	1.10	1.10	1.03
CEC	3.16	2.26	2.72	2.71	2.81	3.34	3.31	3.15

14/05/2008								
	Treatment 1 (Mounds)				Treatment 2 (Conventional)			
	rep 1	rep 2	rep 3	Mean	rep 1	rep 2	rep 3	Mean
ph	5.80	5.90	5.50	5.73	5.40	5.70	5.90	5.67
OC	1.10	1.00	1.10	1.07	0.97	1.00	1.00	0.99
CEC	3.11	3.32	2.63	3.02	2.39	2.78	3.12	2.76