SRDC Grower Group Innovation Project
Final Report

SRDC project number:	GGP017
Project title:	**Improving soil health in undulating, dryland farms in the Central region**
Group name:	Coningsby Dryland Farmers group
Contact person:	Rino De Boni
Due date for report:	1 March
Funding Statement:	This project was conducted by Coningsby Dryland Farmers Group in association with the Sugar Research and Development Corporation (SRDC). SRDC invests funds for sugar R&D derived from the sugar industry and the Australian Government.

Australian Government
Sugar Research and Development Corporation

Body of Report

Executive Summary:

The project sought to: Improve the condition of soil for the following cane crop by introducing break crops; Investigate zero tillage options in undulating soil conditions to reduce erosion; Compare the benefits of different rotational crops/legumes to soil health (Nitrogen fixation & Organic Matter); Reduce input costs in the production cycle; and test the suitability of a minimum/zero till planter in various soil types for cane and break crop planting. A series of trials and equipment modifications were undertaken to identify the best way to achieve this.
The break crop trials showed that Leichhardt out performed Ashgrove, Stuart and Bunya varieties with wet weight biomass yields of over 12t/ha and total N of over 250kg/ha in one trial.
In the Plant cane comparison trial, the zero tillage plots proved to be most profitable with the highest yields, lowest input costs, and highest profit of $352/ha compared with the full cultivation plots which returned only $141.00/ha.
A range of zero tillage break crop planters were inspected and trialled, with required modifications identified. This project has assisted Farliegh & Coningsby growers to select, and successfully grow dryland soybean break crops, and has demonstrated the cost savings and improved soil management offered by zero/minimal tillage practices. This project also identified a deficiency in existing minimum tillage cane planter designs when it come to heavy clays and other difficult soil types. Additionally the growers have gained valuable skills in cost comparison trials, and appropriate trial designs, which will be off assistance as they continue to adapt their farming systems.

Background:

Many growers in the Farleigh area have been unable to plant fallow crops due to weather conditions and the fact they have no, or very limited, irrigation. In the past, risks have been taken in preparing ground on undulating country for a legume crop, and the weather has either been too dry to plant, leaving the ground exposed to drying out conditions, or it has been too wet resulting in erosion and scouring of paddocks. Minimum or zero tillage of legumes will provide a bigger window of opportunity in regards to planting time, and decrease the risks associated with dryland farms. Less workings associated with minimum tillage will contribute towards time management benefits and for this reason, minimum tillage cane planting will also be investigated to reduce time and input costs.

Aims:

Project Aims

- Improve the condition of soil for the following cane crop by introducing break crops
- Investigate zero tillage options in undulating soil conditions to reduce erosion
- Compare the benefits of different rotational crops/legumes to soil health
    - Nitrogen fixation
    - Organic matter
- Reduce input costs in the production cycle, and compare costs for different rotational crops/legumes
- Testing the suitability of a minimum/zero till planter in various soil types for cane and break crop planting
- Increasing the flexibility of the breakcrop planting window by reducing the reliance, and associated risks, with weather conditions

Methodology:

Project Activities

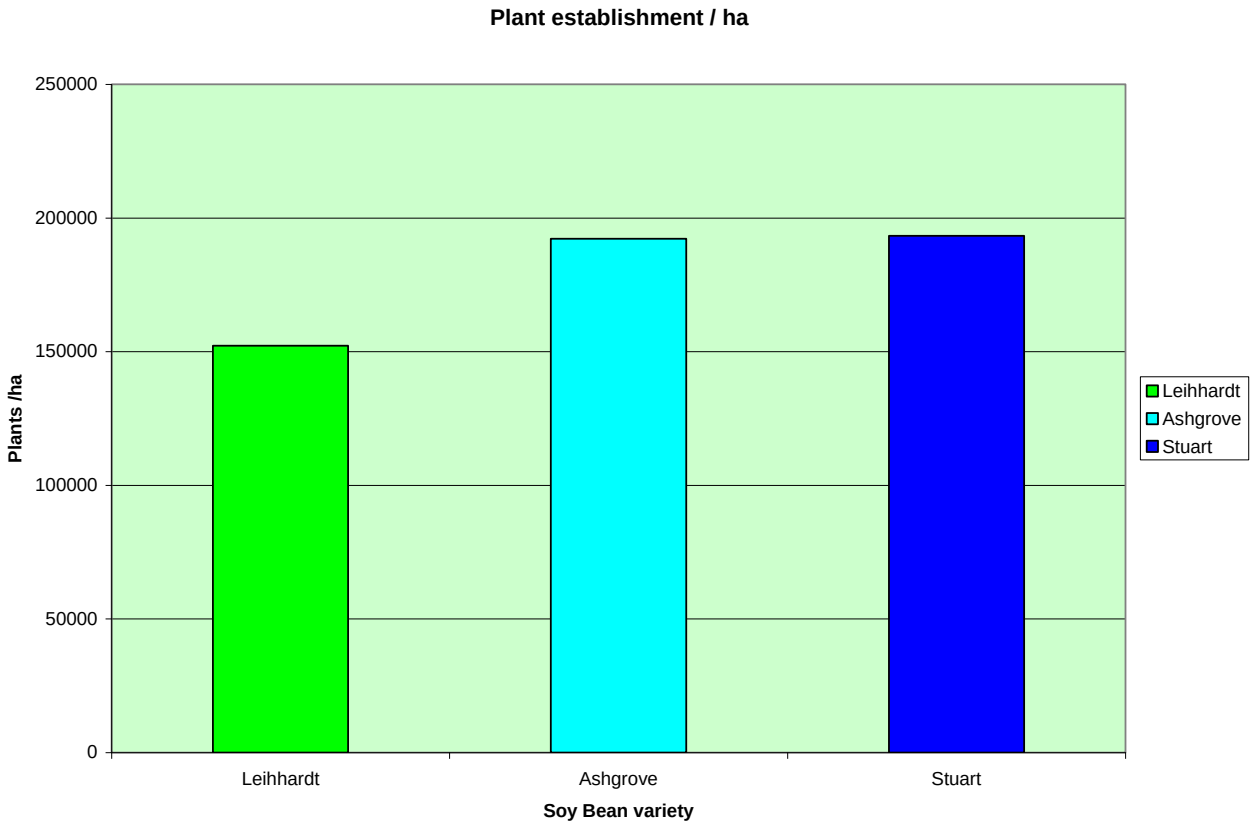
- Investigate the purchase and possible modifications needed for a suitable zero tillage breakcrops/legume planter (which may need modifications to handle the variable soil conditions and different seeds)
- Identify trial sites
- Soil test the sites for – pachymetra, nematodes and current nutrient level
- Identify different legume crops:
    - Soybean - Stuart, Leichhardt, YY
    - Guava
    - Cow peas/meringue
- Plant the break crops
- Hold a field day to demonstrate to other growers in the area the planter, the different rotational crops and the aims of the project
- Determine and implement a weed management plan for the legume break crops
- Investigate and implement the best management practices to capture the benefits of the different legume crops. Talk to other growers and professionals about spraying out, incorporating, timing etc to gain maximum benefit for the soil from the crop.
- Measure:
    - nutrient benefits (nitrogen fixation)
    - Biomass
    - The benefits to the following cane crop – which will be determined based on cane yield and return
    - Economic return
- Establish zero tillage cane planting comparison in dryland farming – conventional vs minimal vs zero till
    - Double discs have been purchased, however some modifications will be required so they can be transferred between billet and whole stick planters.
- Monitor the trials through shoot counts and growth measurements once a week in all trials
- Harvest the trials and measure yield (sugar/ha). Based on recorded input costs and yield, determine profitability

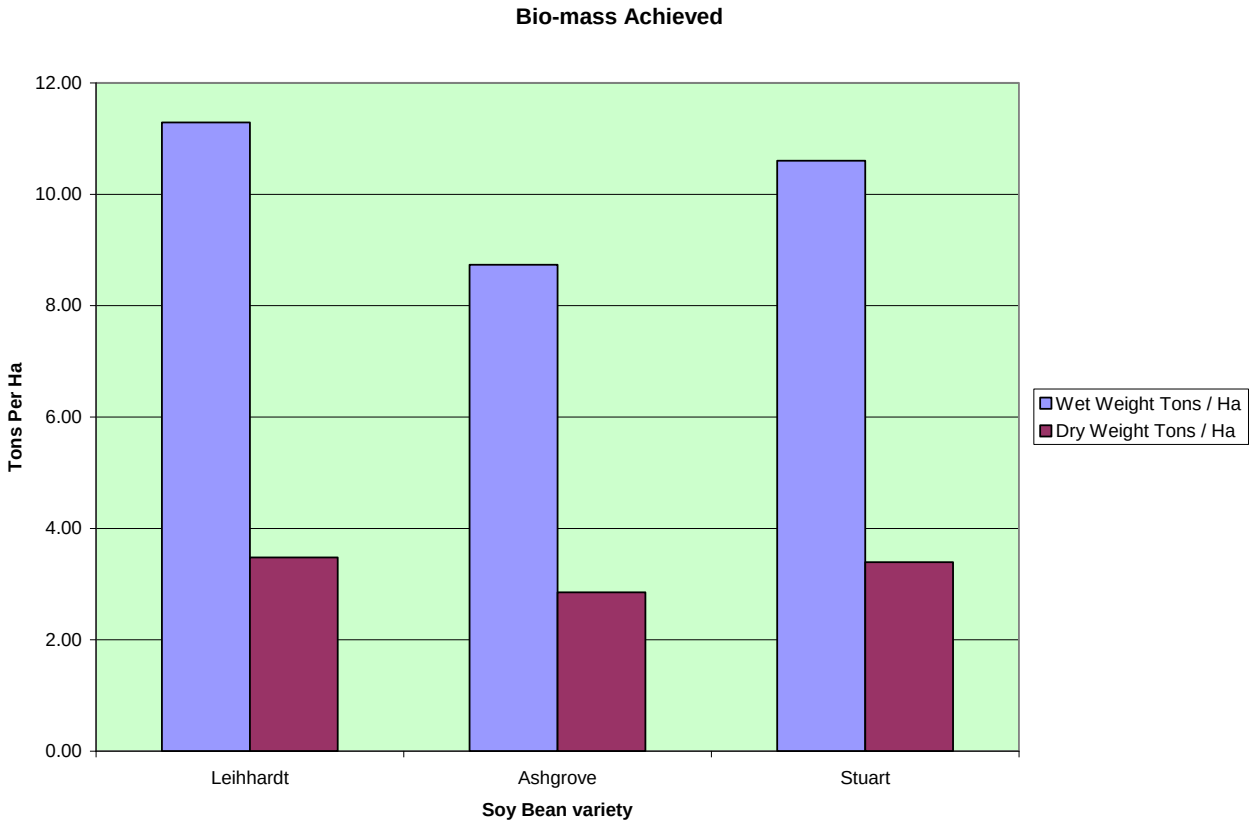
Results and Outputs:

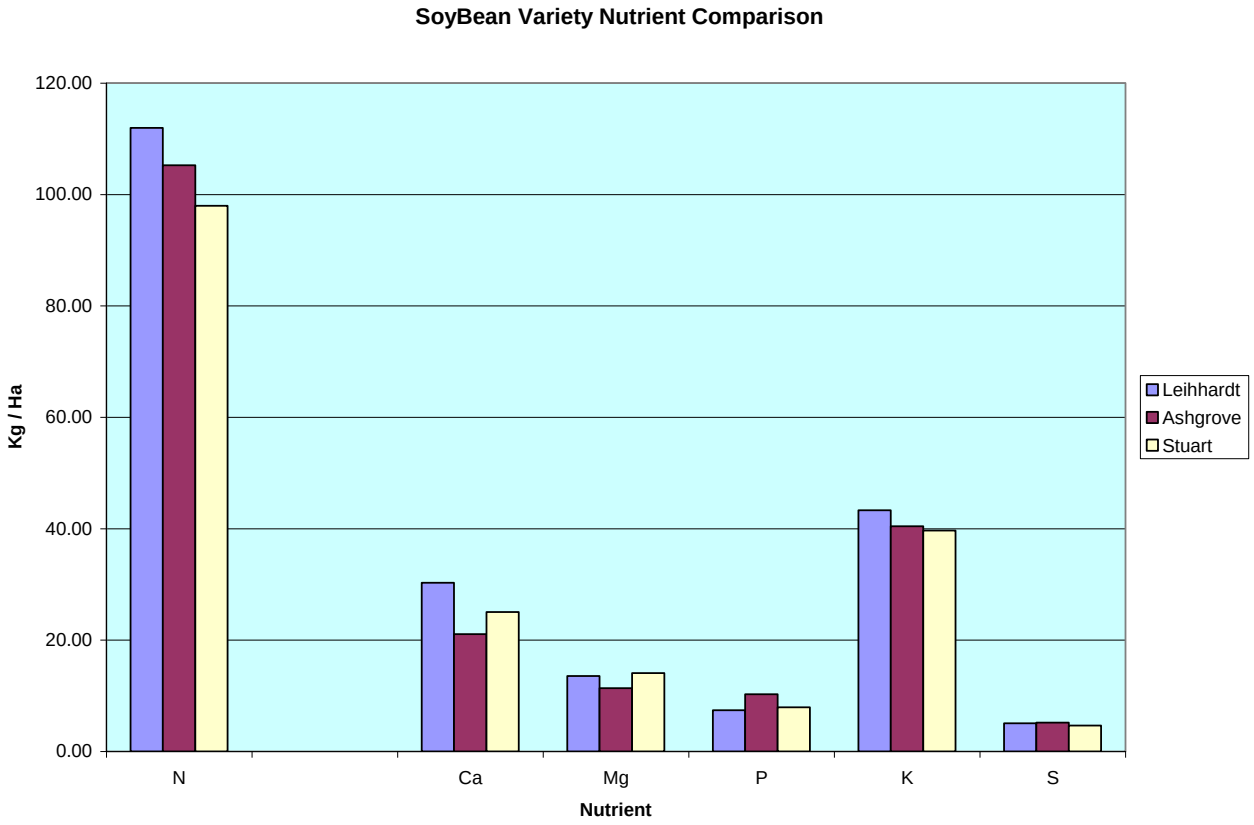
Trial 1, Butch Portelli trial site – Legume Variety Trial

Comparison of three different legumes (replicated)

- Liechhardt Soy bean
- Ashgrove Soy bean
- Stuart Soy bean




Bio-mass Achieved
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Tons Per Ha
Leihhardt
Ashgrove
Stuart
Soy Bean variety
Wet Weight Tons / Ha
Dry Weight Tons / Ha

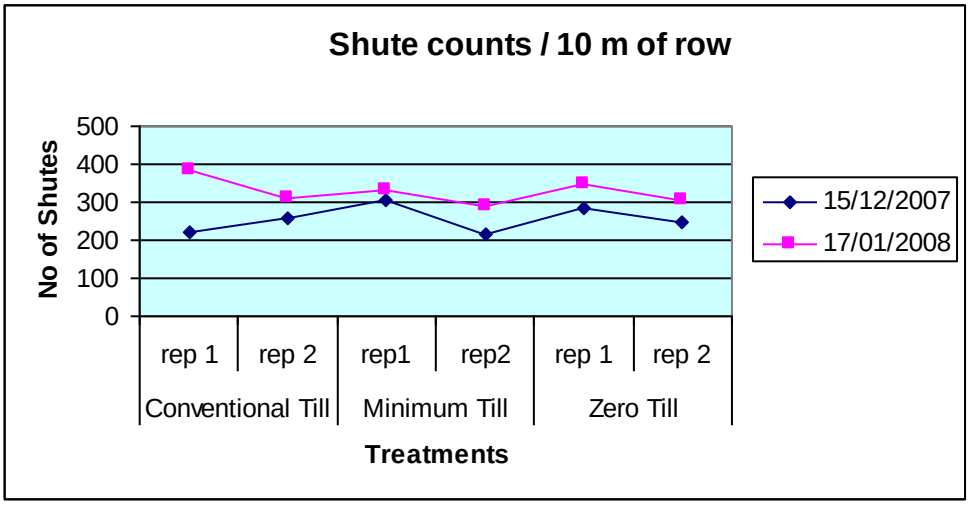

SoyBean Variety Nutrient Comparison
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Kg / Ha
N
Ca
Mg
P
K
S
Nutrient
Leihhardt
Ashgrove
Stuart

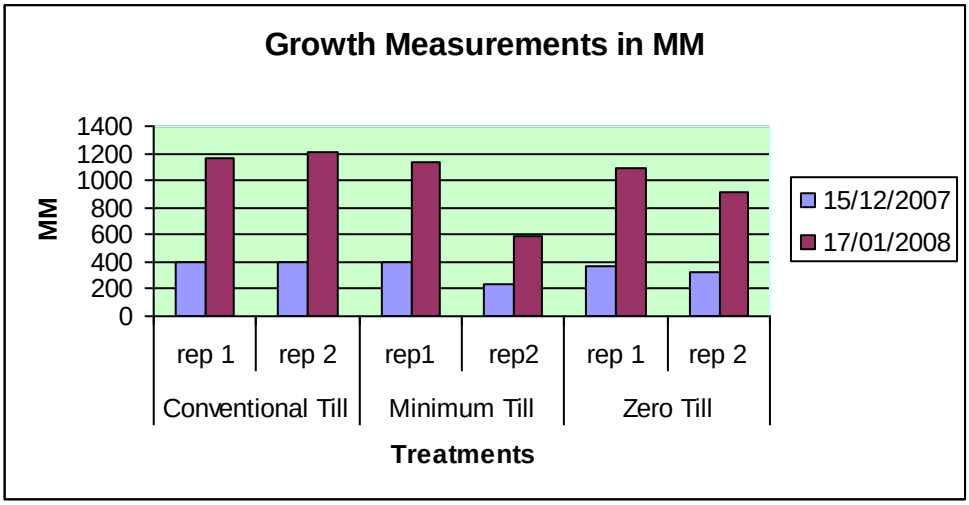
Trial 2, Rino De Boni trial site – Tillage Trial

Costs for weed control and fertiliser were recorded, with input costs detailed in the table below.

Rino DeBoni Comparison trial input summary	
Treatment	**Cost / Ha**
Zero Till	**$1010.36**
Min Till	**$1052.94**
Full Cultivation	**$1193.76**

As is evident the cost difference is marginal between the treatments is marginal.
Shoot counts, growth rates, harvest results and gross margin were also measured and detailed in the below tables.





Zero till treatment rep rep1		Min till treatment rep rep1		Cultivation treatment rep1	
Harvest date	24/09/08	Harvest date	24/09/08	Harvest date	24/09/08

Paddock conditions	Dry	Paddock conditions	dry	Paddock conditions	dry
Crop conditions	erect	Crop conditions	erect	Crop conditions	erect
Tons cane / Ha	56.78	Tons cane / Ha	45.5	Tons cane / Ha	54.46
PRS	16.78	PRS	17.69	PRS	17.46
Tons of sugar / Ha	9.5	Tons of sugar / Ha	8.0	Tons of sugar / Ha	9.5
NIR	Pol 16.2 Fibre 17.6 Impurity 2.3 Dirt 2	NIR	Pol 16.5 Fibre 17.2 Impurity 2.2 Dirt 1.2	NIR	Pol 16.9 Fibre 16.7 Impurity 2.1 Dirt 1.1
Zero till treatment rep rep 2		**Min till treatment rep rep 2**		**Cultivation treatment rep 2**	
Harvest date	23/09/08	Harvest date	23/09/08	Harvest date	23/09/08
Paddock conditions	Dry	Paddock conditions	dry	Paddock conditions	dry
Crop conditions	erect	Crop conditions	erect	Crop conditions	erect
Tons cane / Ha	57.22	Tons cane / Ha	51.08	Tons cane / Ha	53.05
PRS	16.24	PRS	17.29	PRS	16.49
Tons of sugar / Ha	9.3	Tons of sugar / Ha	8.8	Tons of sugar / Ha	8.7
NIR	Pol 15.7 Fibre 16.9 Impurity 2.3 Dirt 1.4	NIR	Pol 16.3 Fibre 16.9 Impurity 2.2 Dirt 1.2	NIR	Pol 16.8 Fibre 16.9 Impurity 2.1 Dirt 1.0

	Zero Till	Min Till	Full Cultivation
Gross Return/ha	$1363.03	$1246.70	$1335.25
Input Costs/ha	$1010.36	$1052.94	$1193.76
Profit/ha	$352.67	$193.76	$141.49

Results for Zero Till indicate the most profit per hectare compared to Min Till and Full Cultivation. With regards to the type of season, in January 2008 we received 400mm and in February we received 1100mm of rain, 700mm of this falling in seven hours on February 15. Possibly due to this heavy rainfall the nutrients in the less compacted ground of the Conventional and Min Till may have been washed away or leached through to the sub-soil compared to the Zero Till, which is firmer ground so having less water saturation. This could explain why the zero till produced more tonnes per hectare.
A couple of issues showed up with Zero Till, the first one being the depth of planter in the untilled soil resulting in shallow planting of billets, which will dry them out if not followed closely with rainfall or irrigation. Secondly, lack of depth in the courser soil there was little to no coverage of the billets resulting in dead billets.
So until we can correct these problems we will keep practicing the Min Till method.

The preparation for planting the trial with the disc opener planter was as follows:

- Zero till (planting directly into a sprayed out legume crop)
- Min till (para plough grow zone)
- Cultivation (full cultivation of the grow zone)

After planting of soybean block, this block had large amount of rain it was evident that the block sustained a minimum amount of soil erosion when traditionally with this amount of rain the block would have suffered severe soil erosion.

Another observation in this block was that a very heavy infestation of rats was identified, this was because of the seed available which the rats were feeding on, this was exceptional because this has not been a characteristic of this farm in the past.

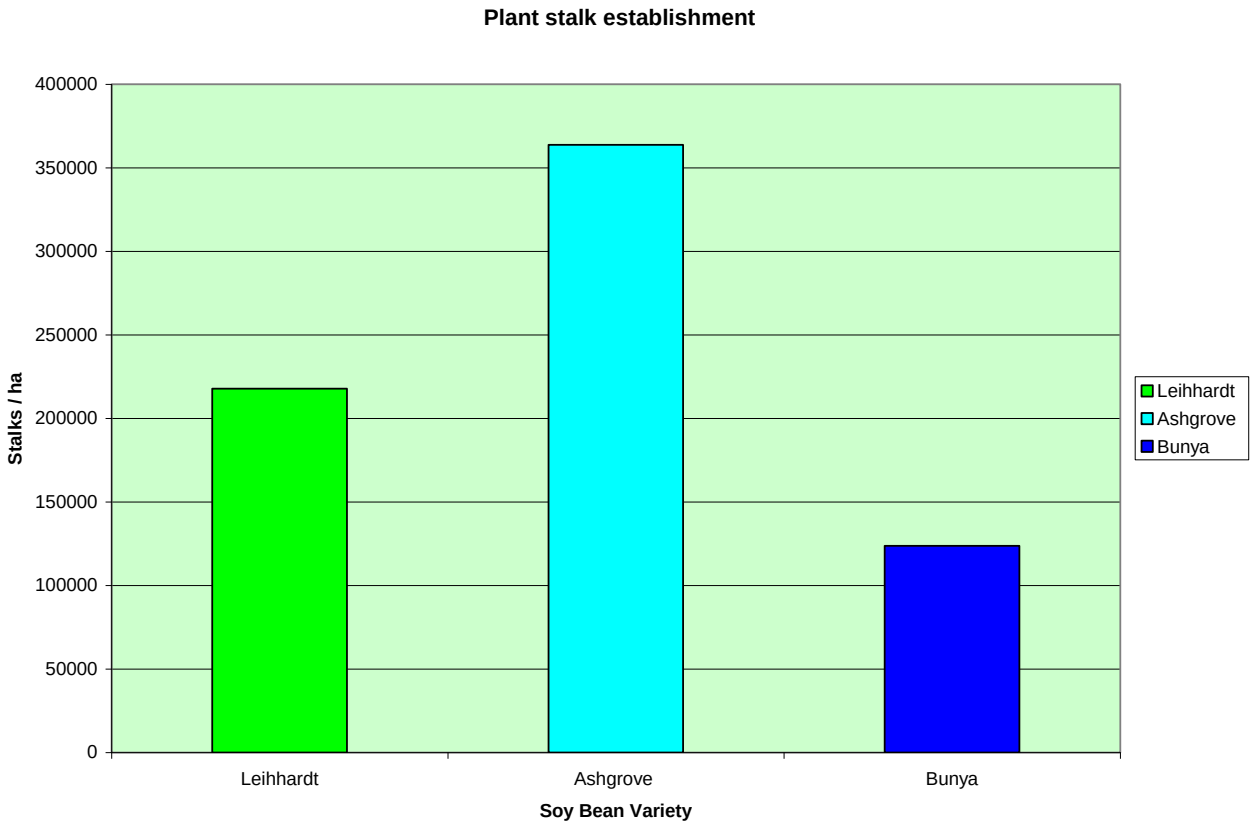
Following the soybean crop on this block, and prior to planting the tillage trial, two methods were utilised to identify the nitrogen available to the following cane crop. The first method was to take representative sample across the block weigh the samples, dry the samples to achieve the dry matter per ha. Sub samples (bio-mass sample) were taken to identify the nutrient value. This method determined that 130kg/ha of N was produced by the soybean.

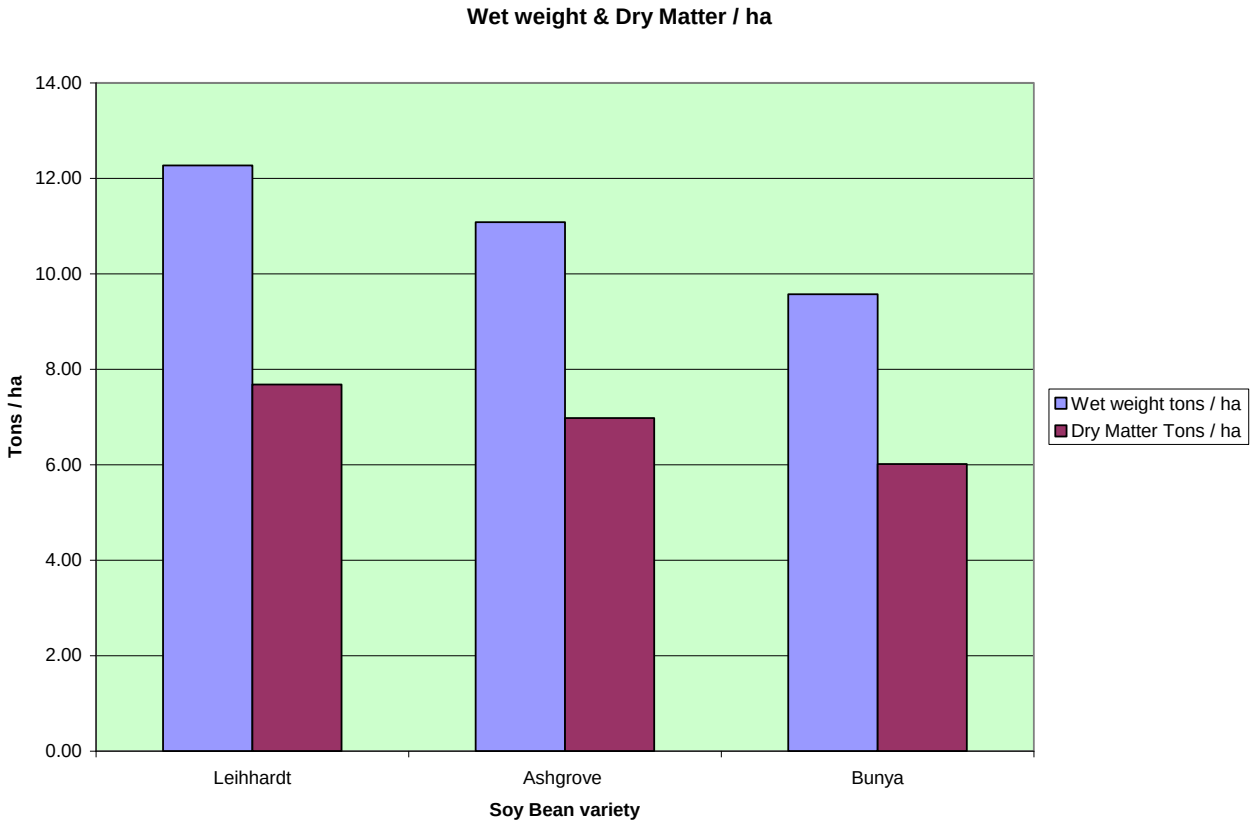
The second method that was utilised was to apply Garside's formula. This method determined that 177kg/ha of N was produced by the crop.
The trial was planted with the smut resistant variety Q208 across the whole trial.

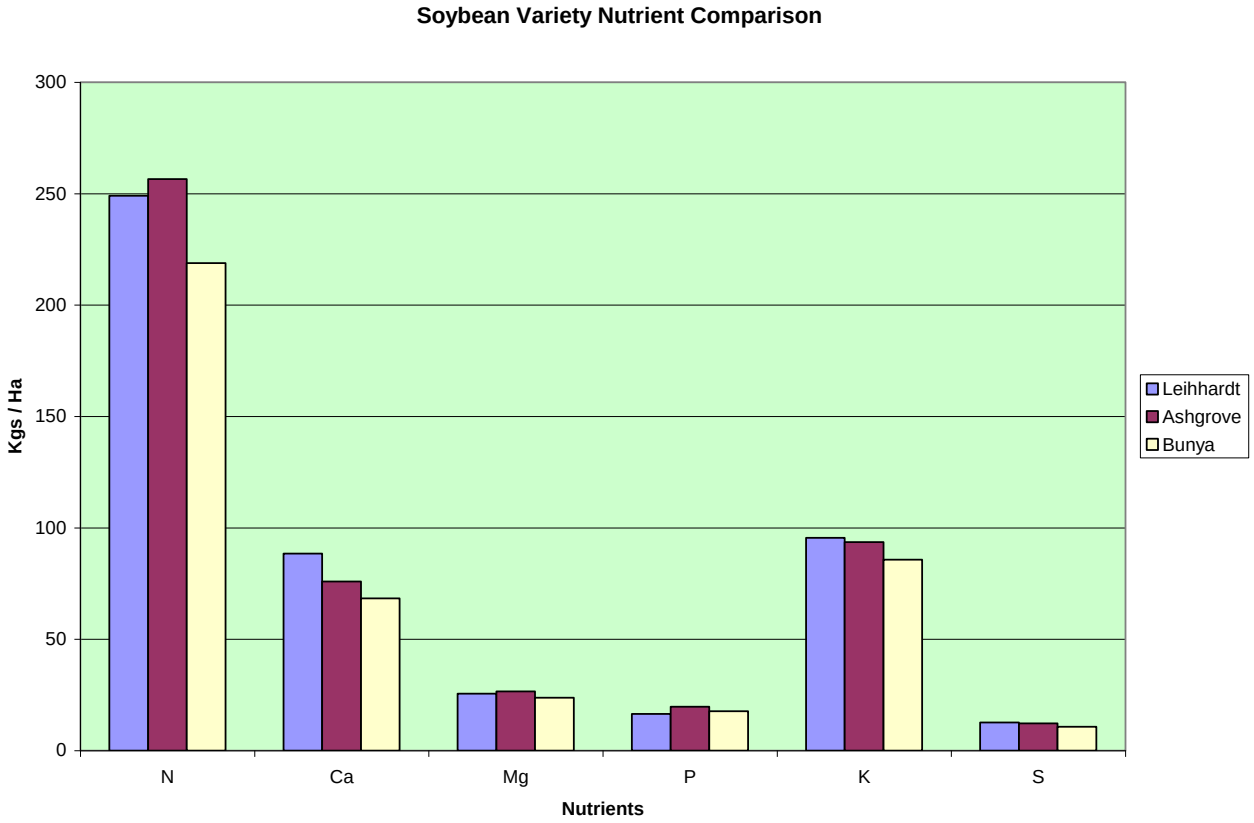
Trial 3, Rino DeBoni trial site – Soybean Variety Trial

Comparison of three different legumes (replicated)

- Liechhardt Soy bean
- Ashgrove Soy bean
- Bunya Soy bean




Wet weight & Dry Matter / ha
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Tons / ha
Leihhardt
Ashgrove
Bunya
Soy Bean variety
Wet weight tons / ha
Dry Matter Tons / ha


Soybean Variety Nutrient Comparison
300
250
200
150
100
50
0
Kgs / Ha
N
Ca
Mg
P
K
S
Nutrients
Leihhardt
Ashgrove
Bunya

With the soybean trials that were planted on January 9, 2008 the results of the Leichhardt variety produced the most tons of biomass per hectare, however the Ashgrove produced more nitrogen per hectare. This could have been largely due to poor quality seed of Leichhardt as it did not reach our plant establishment target of 275 000 per hectare. If Leichhardt had of reached target plant establishment it most probably would have fixed more nitrogen than Ashgrove. Both Ashgrove and Leichhardt performed well in our local climate where Bunya suffered under the wet conditions of the 400mm of rain we received in January and 1100mm in February 2008. After doing these trials we feel we have a better understanding of these soy varieties, Leichhardt being the most tolerant of being submerged in water and also performs well in higher poorer quality ground. Ashgrove will not tolerate as much water when planted in low country but performs well in higher poorer quality soils, a characteristic which suits our particular undulating country. Ashgrove is also suited better to take to grain for the reason that when ground it produces a better quality flour.

Machinery modifications

Modify the double disc planter to be transferred between billet and whole stick

I approached Hodge Industries, a local implement factory to manufacture a double disc assembly to be attached easily to the front of the grubber shute of my planter to be able to minimum till plant. The double disc assembly was attached to the shute by two twenty millimetre bolts. On the rear end of the shute I fitted a pair of 360 MM discs to cover the billets with dirt. Once fitted I tested it in all the different types of soils I have on my farm ranging from a heavy glue pot, red clay to a white gravely soil. In each of these soils the results were much the same as in there was inconsistent depth that the planter would penetrate and leaving the soil too coarse to cover the billets properly. It wasn't until the soil was ripped a couple of times and rotary hoed once before the planter would plant at a consistent depth and cover the billets properly. My aim in this part of the project was to plant the heavy glue pot with out working the soil before planting, as it requires several passes with the ripper and rotary hoe to bring it to a fine tilth to plant into and also requires irrigation or rain immediately after planting otherwise the soil will dry out before plant germination. In our view, we still do not have the equipment to successfully minimum tillage plant in some soil types.

Investigate/purchase zero till Break Crop Planter

On BSES' recommendation, we organised for Austil to come up to Mackay came up with a demo planter in July. The ground under the cane trash was still a bit wet from recent rain, the coulters on the planter that were to cut the trash before planting the seed were not doing so but instead was pushing the trash into the moist soil creating air pockets around the seed resulting in a poor strike. Conversing with other group members that were there we agreed on a modification to the planter to rectify this. The idea was to mount a set of wheel rakes in front of the coulters to leave a trash free path for the coulters. The photo below displays the rake unit for removal of trash when zero till planting soy bean.

Intellectual Property and Confidentiality:
Nil

Capacity Building:
We have learnt to be able to manage soys in dry land situations by planting seeds soon after rain, therefore germination occurs at peak soil moisture content and to have plant emergence through dirt before follow up rain. The rain creates crusting of the surface, which makes it difficult for the seedlings to break through whether it is Full Cultivation or Zero Till in cane trash blanket. Also weed management is best done chemically so as not to lose soil moisture like you would if done mechanically and then there is less likely to be soil erosion.
By doing these soy variety trials the results have showed us which ones perform better and produce more nitrogen in the different types of soil. By attending SRDC conferences we learnt correct procedures in trial design, collecting results correctly so to be able to determine cost and compare our findings. At the conferences we met growers from other regions and were able to discuss outcomes from their group trials.

Environmental Impact:
With Zero Till cane planting we achieved less erosion, because the soil had not been worked up and loosened, that even when it rained heavy there was noticeably less soil movement.
Introducing soys into rotation with sugar

- increases organic matter in the soil and improves fertility
- breaks sugar cane monoculture
- improves soil structure and water infiltration
- supplies fixed nitrogen

Communication and Adoption of Outputs:

- Bus trip 17th April 2007
- BSES Field day 17th 7 18th May 2007
- Trial information day Jan 22 2008
- GIVE conference 2008
- Attended Rise and Shine and High Noon
- Dissemination of trial information (soy bean variety performance) at alternative crop field day hosted by BSES Mackay.

In late April a field day bus trip was organised by BSES to attend my trial site but at the time my farm was too wet for the bus to access. In May the BSES held their annual field days at their Te Kowai station where we shared a site with fellow SRDC group members. We transported our soybean planter to the field day site to be put on display. Over the two days our fellow farmers at the SRDC site showed a great deal of interest. On the 22nd of January the Dryland farmers group results to date were presented to 48 industry people and will be taken to the broader growing community through the next round of shed meetings.
Our data was presented at a BSES Alternate Crop Field Day to 124 growers and industry people that attended the field day at WESTS league club November 7 2008.

The project has been a great help to us as a group in the way of getting to see the results for yourself not on paper and learn first hand the right and wrong way to do things in a small controlled environment. Once problems have or can be rectified for Zero Till cane planting we will continue with this method.
By using soybeans as a break crop the soil is loaded with nitrogen and tills up better ready to plant cane into, saving in fertilizer and fuel bills. Also the information we have gained enables us to continue with our own trials and better our farming practices and profit.

Recommendations:
Further research and development in zero till farming practices.

Publications:
(List and attach copies (electronically if possible) of all articles, newsletters and other publications from the project.)
All milestone reports 1-4 and final report will be found on the SRDC web site as well as trial results of similar trials from the Grower Group Services website.