SRA Research Project-Final Report

Sugar Research Australia

Research Funding Unit

Project

GGP060 - Developing a robust soybean industry in Central and Northern Queensland

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Contents

Summary

The benefits of using soybeans as a break crop during the traditional sugarcane crop fallow period has been well documented. Trials conducted under the SYDJV highlighted that legumes, such as soybeans, produced the following benefits.

- Improvements in soil health through better balanced biology
- Fewer sugarcane root pathogens
- Biologically fixed nitrogen reducing the need for inorganic nitrogen fertilizer and consequently reducing the use of fossil fuel to produce that fertilizer
- Better cane growth and yield and increased profitability
- The tap root on legumes compared with the adventitious root system of sugarcane can work to improve soil structure.

(Final Report – SRDC Project YDV002 Sugar Yield Decline Joint Venture Phase 2 (July 1999-June 2006)

Outside of these benefits, the opportunity to value add by harvesting and marketing soybean seed has been sporadic and adhoc at best, particularly in the northern sugarcane producing areas. Hampering any possible emergence of a soybean seed industry has been the lack of suitable high value, short season varieties.

Dominating the current Central and northern soybean arena is the variety Leichardt. Leichardt is a high biomass, pest and disease resistant variety well suited to Central and northern climates. Its seed however, while still marketable, is of low value. Another negative is Leichardt's long growing season, which often overlaps with the sugarcane planting season. As a result, soybean crops are traditionally destroyed or removed before full pod fill to conserve soil moisture, maximise soil nitrogen return and allow time for ground to be prepared for the subsequent sugarcane planting window.

Central, Burdekin and the Herbert were identified as regions with the highest potential for establishing a viable soybean industry, which could operate in conjunction with the established sugarcane industry. Establishing a full soybean breeding program within these regions would be cost prohibitive. Instead, replicated field trials utilising current commercial and experimental soybean varieties were identified as the most economically viable alternative to a dedicated breeding program. Trials to assess biomass, nitrogen production, seed yields, general agronomic traits and pest and disease resistance for both short and long season varieties will assist in establishing whether or not the current opportunistic soybean fallow crop could be expanded to become an economically viable industry for each of the regions involved.

The grower group, led by Greg Miller (Burdekin seeds) established links with organisations such as NSW DPI, DEEDI, Soybean Australia, CSIRO, NQ Tropical Seeds, PB Agrifood, Farmacist, HCPSL and BSES Ltd. CSIRO, Soybean Australia, Burdekin Seeds, NQ Tropical Seeds and PB Agrifoods provided both agronomic advice on trial establishment and protocols, as well and supply of seed material. Farmacist, HCSPL and BSES Ltd provided infield resources, technical advice, grower extension and reported on trial results.

In year one, one trial site was selected in each region where the same soybean varieties were planted, established and assessed according to an agreed protocol. Although there were some difficulties, particularly in the wet tropics (Herbert), all trials were harvested and results collated and reported to the grower group and project partners.

The information collected in year one was then used to formulate a second round of trials in each region for year two. The number of trials, varieties and planting methods were all assessed and designed to suit each regions specific requirements and environments. Several new varieties imported from Zambia were also included in the second round of trials.

While similarities in varietal performance across regions was evident, the impact of each regions environmental conditions weighed heavily on the overall outcomes. The Central and Burdekin regions displayed the most potential for developing a viable soybean fallow crop industry. The Herbert's extreme environmental conditions however points to a less conducive environment and will potentially maintain is "opportunistic" nature. The biggest gain obtained by conducting these trials was to the sugarcane industry with several new viable short season green manure varieties highlighted.

1.0 Background:

Two previous projects, GGP047- Maximising Soys in the Central region and GGP045 - Sarina Sustainable Farmers, had helped growers in the Central region gain a better understanding of current soybean crop characteristics. Using the data collected from these two projects as a base line, this project expands the research work done on developing new soybean varieties to meet markets and climate requirements. Both GGP047 and GGP045 have evaluated a number of soybean varieties and as such this project will utilise the information collected to produce the variety standards that will form the basis of the new variety comparisons.

In 2011, a group of growers from Central, Burdekin and the Herbert regions identified the potential for soybeans to provide a second source of income for sugarcane growers during the fallow period. They also identified possible improvements to the traits of a soybean crop that would improve its utilization as a fallow crop for sugarcane growers. The group set out to establish regional soybean variety trials in Central, Burdekin and the Herbert with the aim of investigating several traits that would be beneficial within each region. These traits included,

- seed yield
- season length
- biomass production
- nitrogen production, and
- pest and disease resistance

Soybeans had already been identified as a beneficial fallow legume within the sugarcane crop cycle. The dominant commercial variety Leichardt is a low value, late maturing variety that has been grown for decades in Central and northern Queensland. Finding a higher value, earlier maturing variety with similar environmental and pest and disease traits would be beneficial, particularly for sugarcane growers who often removed immature Leichardt crops to suit regional sugarcane planting windows.

Subsequently, a series of soybean variety trials were established in Central, Burdekin and the Herbert to assess several existing commercial soybean varieties typically grown outside of these regions, along with several promising experimental soybean varieties still in the development phase. The grower group also imported a number of Zambian varieties to assess their suitability within each region.

2.0 Objectives

Harnessing the work delivered by GGP047- Maximising Soys in the Central region and GGP045 - Sarina Sustainable Farmers this project aimed to take it one step further by branching out into the Burdekin and Herbert regions. This, combined with the experience of organisations such as Soybean Australia, CSIRO, Burdekin seeds, NQ Tropical Seeds, HCPSL, Farmicist, BSES Ltd and PB Agrifoods, would also aid in the goal of achieving the projects objectives.

By utilising both infield variety trials and collaborating with project partners the project encompassed the following objectives,

- Evaluate new soybean varieties that will provide benefits and alternative options for Central and North Queensland cane growers.
- Develop a process that will import non GMO soybean varieties from Zambia and other overseas sources for field assessment.
- Select soybean varieties that will cater for various marketing options such as human consumption, oil extraction, and fodder production.
- Evaluate soybean varieties that will handle different climatic conditions (i.e. wet and dry growing conditions and high insect pressures).
- Develop and improve soybean agronomy for the Central and North Queensland cane growing areas.

3.0 Methodology:

After consulting with project partners and technical resources it was established that the best way to capture data to meet project outcomes was to develop a program that would screen soybean varieties new to the Central, Burdekin and Herbert regions. These trials accessed soybean varieties from the CSIRO breeding program, the John Rose breeding program and commercially available varieties from Zambia. The overseas varieties were imported into Australia through AQIS and seed bulked up in the Burdekin and Central areas for trial purposes.

The trial designs and variety selection parameters for each series of trials was chosen with technical assistance from soybean agronomists and local industry researchers. Trial design consisted of RCB designs with four replicates. This was altered in year two on the Herbert site which split its replicates across two environments. These two environments are best catagorised as tropical dryland and tropical wetland sites.

Each region hosted one trial per year for two years. The only exception to this was in the Herbert, which assessed genotype x environment interactions within the region by establishing two variety trials in year two over two distinctly different environments. Varieties in all regions were screened for several key traits on both series of trials that would form the basis of meeting project objectives.

3.1 General adaptability

General adaptably of each variety was assessed through infield observations. Observations included germination and establishment and each varieties ability to grow and develop normally in each region.

3.2 Biomass production

Biomass was assessed on above-ground biomass only. Hand harvesting of above-ground sub-samples within each replicate were taken at or around commencement of pod fill. These sub-samples were weighed and the results used for varietal comparison.

3.3 Seed production

In year one all trials in all three regions were sampled using a small plot harvester. In year two only the Burdekin and Central regions harvested seed using the same small plot harvester due to the loss of trials in the Herbert region. Seed was bagged, weighed and assessed for quality and damage. During harvest each variety was inspected for pre-mature pod shed and seed yield losses estimated.

3.4 Nitrogen production

During biomass sampling sub-samples were taken for assessment of nitrogen content. These samples were shredded, dried and ground before being dispatched to BSES Limited for nitrogen content analysis.

3.5 Crop agronomy

General crop agronomy characteristics were monitored throughout each trial in each region. Water stress, irrigation requirements, crop height, harvestability and stages of maturity were all recorded.

3.6 Pest and disease tolerance

During regular infield inspections throughout the crop phase each region kept notes on pest types, incidence and damage to crop. Field technicians also attended a workshop in the Burdekin that assisted with identification of insect pests and what damage they may cause.

3.7 Marketing potential.

Marketing potential of each variety was assessed through information gathered from seed merchants and agronomists. Infield assessments of seed quality was also used in conjunction with known seed quality parameters of each variety.

4.0 Results:

The results of all trials in all regions have been communicated to both the grower groups and the respective sugarcane industry stakeholders via grower field days, forums and shed meetings. Each region has also utilized newsletters, information sheets (*See Appendix 7 – Herbert Field Tour Infosheet*), trial reports and local media. Feedback has also been given to respective project supporters and key stakeholders within each region.

4.1 Central

Both series of trials conducted in the Central region were taken through to harvest stage with all key traits being assessed. A comprehensive report on the results and outcomes of the first and second year trials in the Central region can be viewed in appendices one and two respectively.

4.2 Burdekin

Both series of trials conducted in the Burdekin region were taken through to harvest stage with all key traits being assessed. A comprehensive report on the results and outcomes of the first and second year trials in the Burdekin region can be viewed in appendices three and four respectively.

4.3 Herbert

Series one of the Herbert of trials was taken through to harvest stage with all key traits being assessed. Due to extreme environmental conditions not all traits were captured in the second series of trials. Industry presentations showing results and outcomes of the first and second year trials in the Herbert region can be viewed in appendices five and six respectively.

5.0 Intellectual Property and Confidentiality:

The results and outcomes of this project are to be used to educate and inform project and industry stakeholders and as such are not bound by confidentiality. However, several soybean varieties including M10317 and M10322 are still in the experimental phase and are not currently available for commercial use. It must also be noted that several varieties are covered by plant breeder's rights.

6.0 Environmental and Social Impacts:

A side benefit of this project has been the promotion of using a legume fallow crop to improve soil health and productivity within the sugarcane industry. Having alternative soybean varieties offering improved nitrogen production with varied season lengths gives growers better choice and the ability to manage their fallow crop in a way that compliments their sugarcane crop.

Having the ability to create an extra revenue stream through the harvest and sale of soybean seeds or biomass material, which does not impact on their sugarcane growing activities, will assist some growers by improving viability and sustainability. This is particularly so for those growers farming the Central and Burdekin regions. While environmental constraints weigh heavily on soybean crops grown in the Herbert region, there is still scope for an opportunistic, low value seed crop. A more viable, sustainable and profitable farming sector will flow on to local businesses and communities.

For all regions, soybeans utilisation as a fallow crop for the sugarcane industry will offer benefits to soil health through increased organic matter, improved soil biology and soil structure. They also offer improved ground cover and reduced threat of erosion, and the choice of a soybean variety with a shorter growing season will in itself improve the way sugarcane growers in all regions manage their fallow periods and subsequent sugarcane planting windows.

7.0 Expected Outcomes:

This project has provided a better picture of the difficulties involved with developing a viable soybean crop during the sugarcane fallow period. It has also provided researchers and grower co-operators a better understanding of its complexities and the issues and constraints involved. It has delivered a new or improved skill set to local agronomic advisors and grower co-operators.

While the current commercial variety Leichardt did outperform many of the new varieties, the identification of two alternatives M10322 (pending commercial release) and A6785 (short-season variety) will give growers the opportunity to better manage their soybean fallow crop.

The major outcomes of this project have been,

- Improved agronomic skills and knowledge of soybeans in the Central, Burdekin and Herbert regions.
- A reduced risk associated with the reliance of a singular soybean variety (Leichardt) in the Central, Burdekin and Herbert regions
- The opportunity for growers to plant alternative soybean varieties
- The opportunity for growers to better manage fallow crops to suit sugarcane planting windows via access to varieties with varying season lengths.
- Increased uptake by growers to introduce soybeans as legume break crop with sugarcane
- Increase market options for growers in the Central and Burdekin regions; and to a lesser extent in the Herbert region

8.0 Future Research Needs:

This project was successful in highlighting several alternatives to the soybean variety Leichardt. In all three regions M10322 showed that it had potential to perform as well if not better than Leichardt as a long season variety, while A6785 displayed promise as a short season variety. This is also true for several others, particularly in the Central and Burdekin regions.

Establishing a variety's potential within the confines of an isolated variety trial does not guarantee its commercial success, nor does it rule out the potential of other varieties tested within this subset of regional trials. Further testing on a commercial scale will need to be carried out before that potential can be converted into commercial value. This testing will require support from local and regional extension agronomist. While dedicated support for further trials and testing cannot be allocated, each group will continue to offer assistance on a reduced capacity. This will be particularly true for grower co-operators who have been involved with this project.

An example of this assistance has already been established with suppliers for the top performing varieties, which are currently commercially available, being identified by project leaders. Each region has and will continue to promote the results of this project and the benefits of those top performing varieties identified from regional trials.

9.0 Recommendations:

9.1 Establishing a Viable Soybean Industry

With the decline of SRDC and the formation of SRA the likelihood of funding for any further grower led soybean project/s is unknown. The grower and extension groups from within each of the Central, Burdekin and Herbert regions will need to independently progress any notions of establishing a viable soybean cropping industry. If this can be achieved it is possible that the Central and Burdekin regions may be able to develop a small commercial soybean crop in conjunction with their sugarcane crop. Due to climatic conditions however it is difficult to see the Herbert develop any similar industry.

9.2 Utilising a Fast Maturing Soybean Variety during Sugarcane Fallow

For many sugarcane growers, soybean and other fallow crops can often deplete soil moisture levels leading into the traditional sugarcane planting season. Planting a faster maturing variety such as A6785 can assist in reducing such risks. Each region should further promote the benefits of planting A6785 for this purpose.

9.3 Alternating Soybean Varieties during the Sugarcane Fallow

Leichardt has proven its worth as a sugarcane fallow green manure crop for the past three decades. Reliance on a singular variety however increases the risk of disease or pest pressures. While varieties such as M10322 or M10317 may display no current benefit in terms of biomass or soil nitrogen accumulation, they do provide an alternative to break the dominant cycle of Leichardt. The promotion of these alternatives, if and when they become commercially available, should be extended to not only these three regions but all sugarcane growing areas.

List of Publications:

Final Report – SRDC Project YDV002 Sugar Yield Decline Joint Venture Phase 2 (July 1999-June 2006) A Garside)

Central GGP105 - Developing a robust soybean industry in Central and Northern Queensland (Regional Report #1(J Muscat, R Sluggett, Natalie Fiocco)

Central GGP105 – Developing a robust soybean industry in Central and Northern Queensland (Regional Report #2(J Muscat, R Sluggett, Natalie Fiocco)

Burdekin GGP105 - Developing a robust soybean industry in Central and Northern Queensland (Regional Report #1(J Dowie)

Burdekin GGP105 - Developing a robust soybean industry in Central and Northern Queensland (Regional Report #2(J Dowie)

Herbert GGP105 - Developing a robust soybean industry in Central and Northern Queensland (Regional Report/presentation #1(A Royle)

Herbert GGP105 - Developing a robust soybean industry in Central and Northern Queensland (Regional Report/presentation #2(A Royle)

Special Acknowledgements:

A special thank you to Jayson Dowie and Robert Sluggett. Without their support and effort this report would not have been possible.

Appendix 1: - Year one trial report from Central region

Mackay Soybean Variety Evaluation 2012

A soybean variety evaluation trial was established at Oakenden as part of the GGIP Project "Developing a robust soybean industry in Central and North Queensland".

Soybean are grown as a break crop in the sugarcane farming system in the Central region. A number of growers are dedicated to producing soybean grain from their fallow crops, while others are opportunity croppers – only taking soybean to grain under favourable conditions. The variability in grain production that results makes it difficult for critical infrastructure to be economically established in this region. Improved reliability of yield and returns will enhance industry development.

More suitable varieties providing improved yields and shorter times to harvest will enhance the viability of the industry.

Ten soybean varieties from different breeding programs, including 3 standards, were planted in a randomised block design. An additional 4 overseas varieties (Zambian) were propagated for future evaluation. Each treatment was planted into plots consisting of 3 rows per bed on 2 beds, ten metres in length. Each treatment was replicated 4 times.

	Replicate							
	1		2		3		4	
	Propagation Planting							
Buffer 6m	Zambia 4	Buffer 6m	A6785	Buffer 6m	Leichhardt	Buffer 6m	Fernside	Buffer 6m
	Stuart		Bunya		M10322		A6785	
	M10322		Fernside		M10317		Leichhardt	
	Bunya		Hayman		Zambia 4		Leichhardt	
	Hayman		A6785		Stuart		Hayman	
	A6785		M10317		Leichhardt		Stuart	
	Leichhardt		Stuart		Fernside		Bunya	
	Leichhardt		Leichhardt		Stuart		M10317	
	Fernside		Zambia 4		A6785		M10322	
	Stuart		Leichhardt		A6785		Stuart	
	A6785		M10322		Hayman		Zambia 4	
	M10317		Stuart		Bunya		A6785	
	Water Furrow							

Commercial Planting

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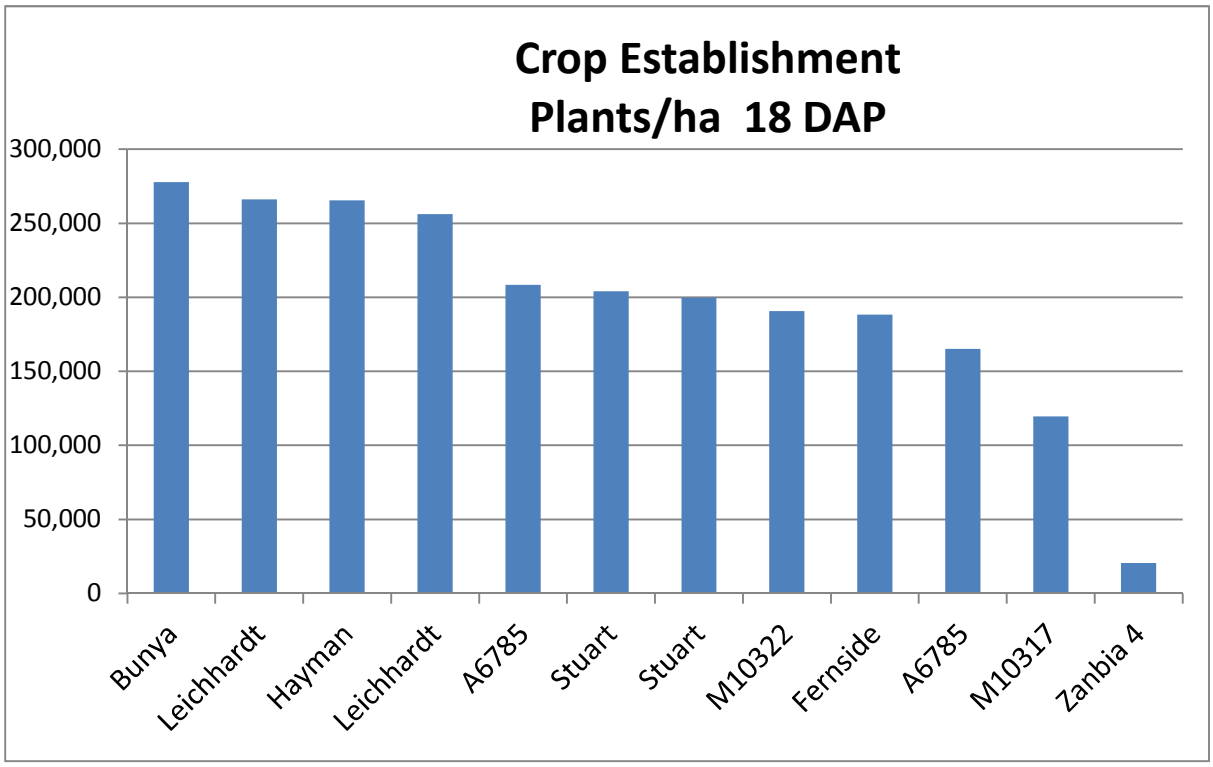
Figure 1: Mackay Site Layout

Crop Establishment

The trial was planted on the 6th of December 2011, targeting 300,000 plants per hectare. Approximately 52mm of rainfall fell that night and 129.5mm of rain on the 10th. The wet conditions had some impact on crop germination and establishment.



Assessments

Insect Pressure

Insect pressure was monitored regularly through the life of the crop. Insecticide sprays were applied as required, lower thresholds were applied than would be used in a commercial crop, due to the nature of the trial.

Table 1: Insect Damage Ratings

Variety	13/01/2012	2/03/2012
M10322	1.25	2
Leichhardt	1.5	2
Leichhardt	1.5	2
M10317	1.5	2

Stuart	1.5	2
A6785	1.75	2
Fernside	1.75	2
Stuart	1.75	2
Zambian 4	1.75	2
Bunya	1.75	2.25
Hayman	1.75	2.25
A6785	2	2

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Insect Damage Ratings

0 No damage to leaves, stalk or fruit
1 Slight leaf or plant damage, no likely impact on crop growth or yield potential
2 Obvious minor damage to plant no likely impact on crop yield
3 Minor damage to plant, potential for crop growth and yield impact if left untreated
4 Moderate crop damage, growth and yield loss likely,
5 Severe plant damage, severe restriction to crop growth and yield potential

Insect damage ratings were recorded for all treatments prior to any insecticide applications (13/01/12) and again after a number of insecticide applications (2/3/12). There was little difference in damage rating or insect counts between varieties.

Biomass Assessments

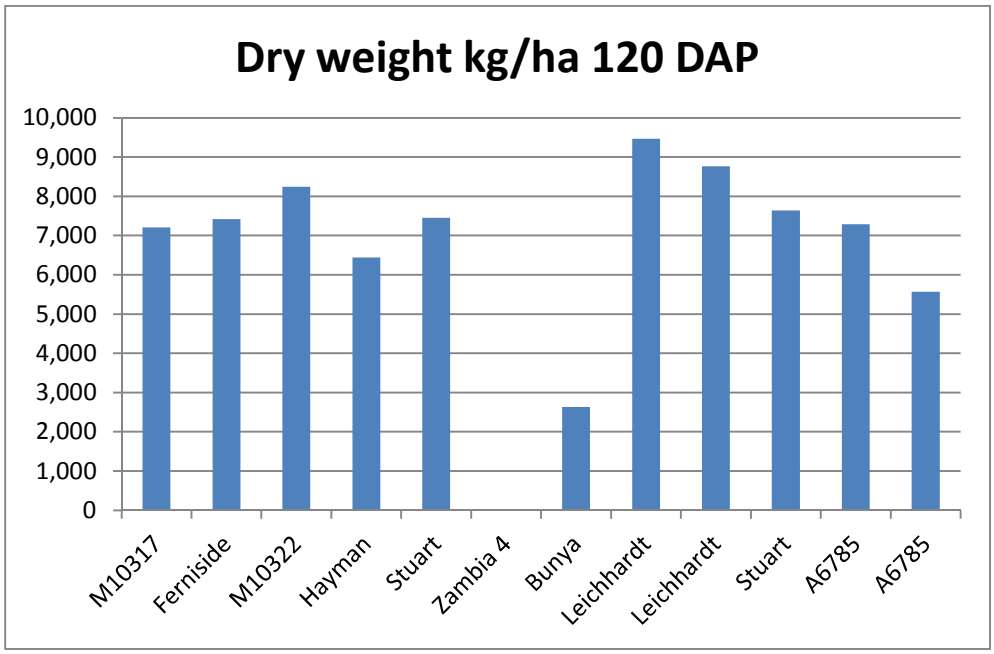

Figure 3: Crop Biomass at 120 days after planting.

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All varieties, except Bunya, exceeded 6 tonnes per hectare of dry matter produced. Zambia 4 was not sampled due to the small number of plants in each plot.

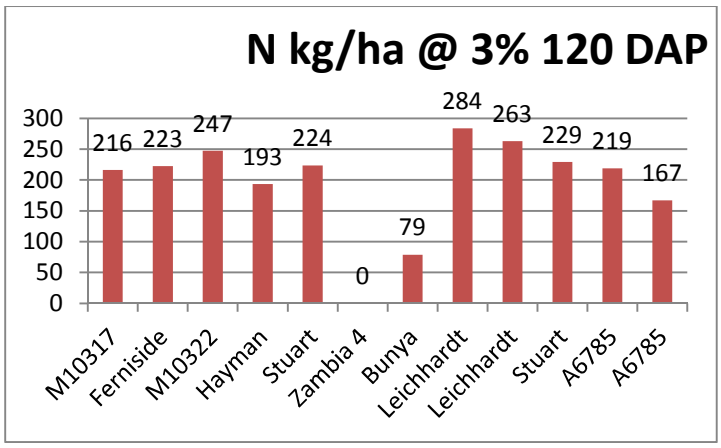


Figure 4: Nitrogen content

Nitrogen produced based on dry matter yield and 3% nitrogen content. Laboratory results not available at time of reporting.

Maturity Stage

At the 38 DAP assessment, early flowering was recorded for Fernside, Bunya and first flower for A6785 (Rep 2). By 87DAP assessment differences in maturity rates were clearly assessable. Maturity ratings were given as 0 for vegetative, 1 flowering, 2 early podfill, 3 mid-podfill, 4 late podfill and 5 mature.

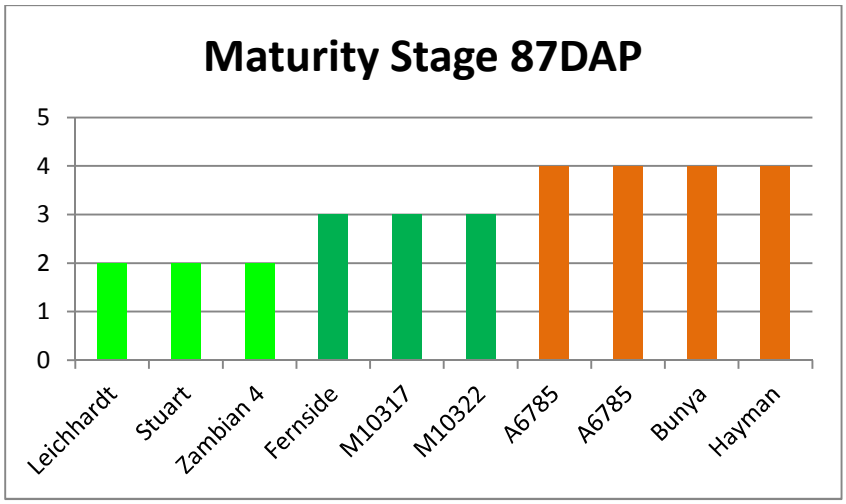
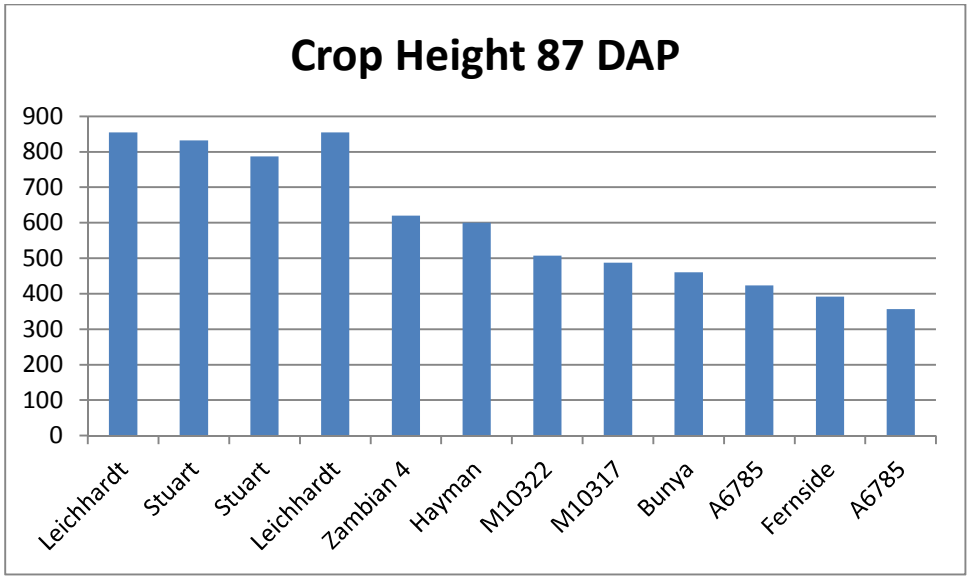


Figure 5: Variety Maturity Rating

Varieties Zambia 1, 2, 3 and 5 undergoing propagation were all rated 2 for early podfill at 87 days after planting.

Crop Height

At 87 DAP an assessment of mean crop height was undertaken to evaluate likely issues with harvest pickup for short varieties and lodging risk for tall varieties. Height was measured in millimetres to growing point.



Lodging

An assessment of lodging was made at harvest for all varieties. No significant lodging occurred, with only Leichhardt and Stuart recording minor sprawling with little impact on harvestability.

Grain Yield

The trial was harvested at two dates – early maturity varieties at 141 DAP (25/04/12) and later maturity varieties at 154 DAP (08/05/12). A portable grain moisture meter was available at the second harvest and grain moisture contents varied from 12.6% - 14.5%.

Harvesting Plots

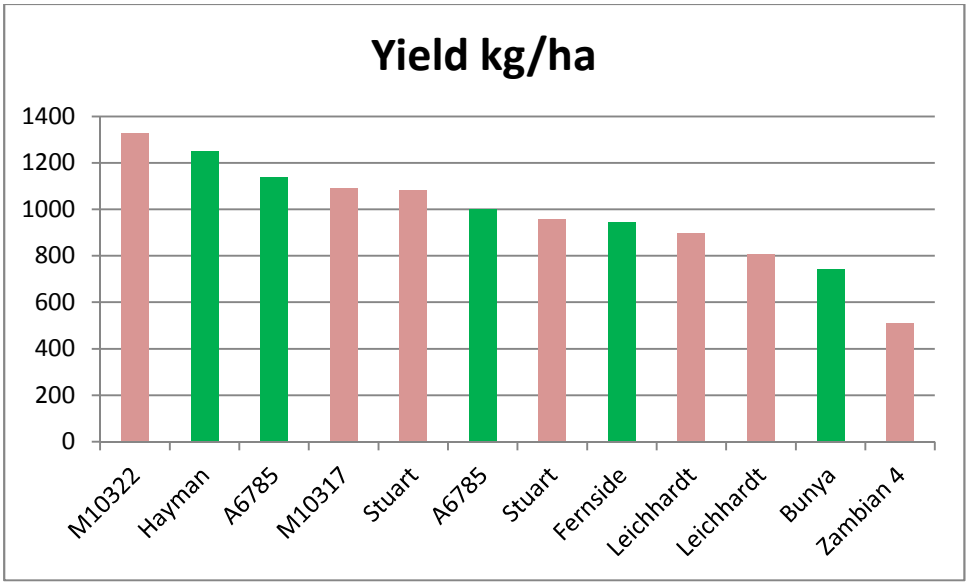


Figure 7: Grain Yield at harvest – Green bars early harvested varieties

Grain yields at harvest were lower than anticipated, based on crop size, pod set and commercial yields achieved in the field beside the trial block. This result is believed to be a results of extremely high grain loss at harvest. Grain was lost from the front before gathering and much was blown out of the rear of the machine during cleaning.

Figure 8: Considerable grain was lost in the harvesting process.

Figure 8: Example of grain left at harvest

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Grain Yields – Non-Replicated Propagation

Four Zambian sourced varieties were propagated outside of the replicated trial in order to bulk up seed for future evaluation. Grain yields are presented here for interest sake only.

Variety	Yield kg/ha
Zambia 1	214
Zambia 2	983
Zambia 3	719
Zambia 5	432

Discussion

Fifty two millimetres of rain the night after planting and another 129.5mm three days after caused some germination issues. Leichhardt, Bunya and Hayman all established over 250,000 plants per hectare, A6785, Stuart, M10322 and Fernside achieved established populations of 150,000 to 200,000 plants per hectare while M10317 and Zambia were most weather affected with 120,000 and 20,000 plants established per hectare respectively.

Other than the initial rainfall post planting, the remainder of the growing season was favourable with a good spread of rainfall, few excessively dry or wet periods.

Despite the impact of weather on establishment, all varieties apart from Zambia 4 were able to exceed 6 tonnes of dry matter production by 120 days after planting. Varieties with lower plant populations were able to compensate with larger plant sizes. There was no relationship between crop establishment and grain yield for all varieties other than Zambia 4.

Crop lodging was assessed, but only sprawling occurred in the taller varieties Leichhardt and Stuart, but insufficient to create harvesting difficulties.

Recommendations

Modifications to the harvester are required to reduce grain loss. High losses in this trial meant that final yields were substantially below commercially harvested crops in the adjoining field.

Extension / Promotion Activities

MAPS bus trip – 60 odd growers – March 2012

10th April 2012 Plane Creek Growers bus trip – 20 odd growers

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Conclusion.

This trial has highlighted some promising new varieties with beneficial characteristics. M10322, Hayman, A6785 and M10317 all matured earlier and had higher mean yields than the standards Leichhardt and Stuart. Grain colour for each of the promising varieties was exceptional. All of the promising new varieties gave biomass yields above 6tonne dry matter per hectare and nitrogen inputs of over 200kg/ha, making them highly suited to green manuring also. The yield of Bunya was disappointing, given its very early maturity and grain quality. Zambia 4 has a purple hilum and would be restricted to the crushing market only.

Acknowledgements

The considerable efforts and expertise of Joe Muscat were essential to the successful conduct of this trial. Kaylea Pauler and Barry Chalmers of Farmacist P/L are also acknowledged for their assistance with trial establishment and data collection.

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Appendix 2: - Year two trial report from Central region

GGP 105

DEVELOPING A ROBUST SOYBEAN INDUSTRY IN CENTRAL AND NOTHERN QUEENSLAND

MACKAY TRIAL 2013 HARVEST

THE UNITED SOYBEAN GROWERS GROUP
Report Prepared by: Joe Muscat, JCS Enterprises
Rob Sluggett, Farmacist
Natalie Fiocco, Farmacist

Introduction

This report presents the results for the second and final soybean variety assessment trial conducted under GGP 105, Developing a Robust Soybean Industry in Central and Northern Queensland. Over the 2 years of the trials a number of promising varieties have been identified with faster maturity, equal or higher yield and better quality than Leichhardt, the current Central Region industry standard.

Trial Site:

The trial site was located on an acidic (pH 5.7) loam soil at JCS Enterprises near Oakenden (148.9942 -21.3156).

Fourteen varieties were planted into pre-formed beds using an austil planter with 2 rows planted 50cm apart on each bed with 1.83m between beds. Each treatment plot was 20m long x 6rows and was replicated four times down the block. See trial plan below.

The target plant population for each variety was 350,000 plants per hectare. Seed was inoculated by liquid injection during planting

The crop received 3 knockdown insecticide applications for heliothis (*Helicoverpa armigera*) and green vegetable bug (*Nezara viridula*).

The crop was desiccated with Reglone (diquat) 10 days prior to planned harvest. Harvesting was delayed due to showery weather and was partially undertaken on 29th & 30th May and completed on 1st June 2013.

Harvesting was undertaken with a small plot harvester, with a 1.8m front, harvesting 1 bed of 2 rows at each pass.

Zambian 2	Zambian 4	Zambian 1	Moonbi	A6785	M10317	Hayman	**REP 4**
Bunya	Zambian 5	Zambian 3	M10322	Leichhardt	Fernside	Ascot	
Bunya	Fernside	Zambian 4	Hayman	Zambian 2	Zambian 3	Moonbi	**REP 3**
A6785	Zambian 1	M10317	Ascot	M10322	Zambian 5	Leichhardt	
M10322	Zambian 3	Leichhardt	Bunya	Zambian 1	Moonbi	Zambian 2	**REP 2**
Fernside	Hayman	A6785	M10317	Ascot	Zambian 5	Zambian 4	
Zambian 1	Moonbi	M10322	Zambian 3	Fernside	Bunya	A6785	**REP 1**
Ascot	Zambian 5	Zambian 2	Leichhardt	Zambian 4	Hayman	M10317	

Figure 1: Variety trial plan layout

Results and Discussion

Crop Establishment

Most varieties established well in the trial. Four of the Zambian varieties established poorly (Zambian1, Zambian2, Zambian3 and Zambian5) due to the quality of seed retained from the previous year's harvest. Some seed damage had occurred from the harvester.

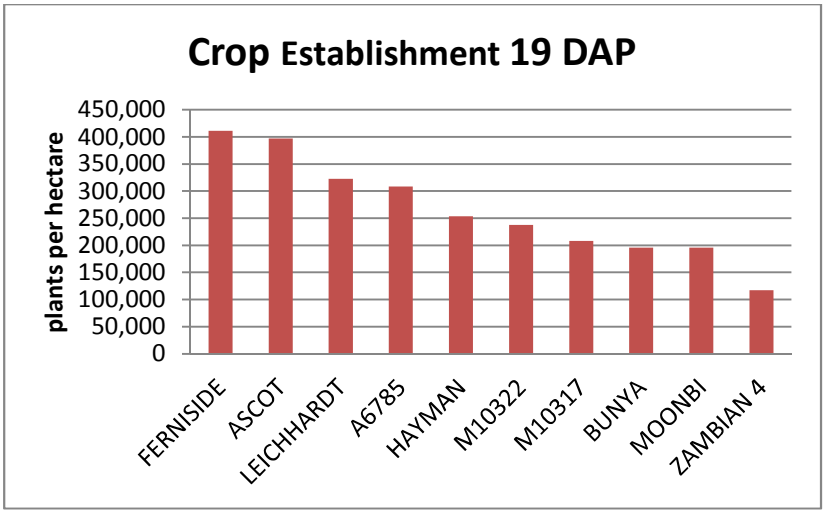

Figure 2: Crop establishment counts at 19 days after planting

Crop Growth and Biomass Assessments

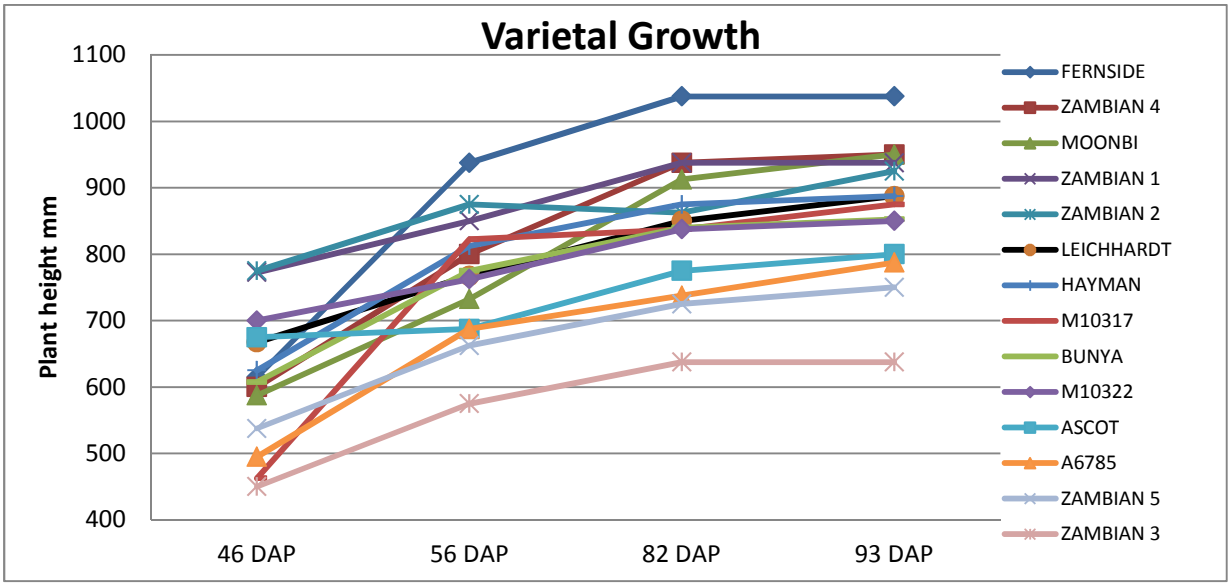

Figure 3: Plant height and development

All varieties grew rapidly between 46 DAP and 82 DAP, by 93 DAP growth in terms of crop height had plateaued for all varieties.

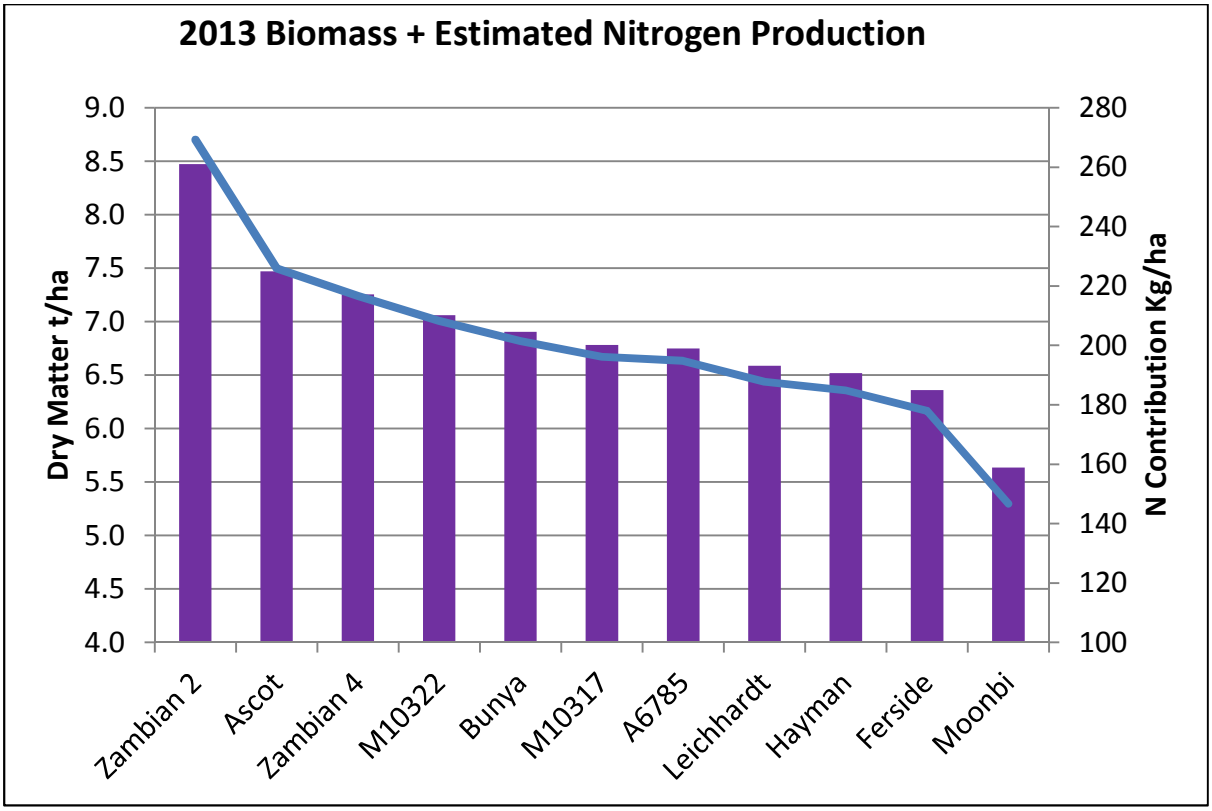

Figure 4: Biomass Produced by Selected Varieties.

Crop biomass assessments were taken at 93 DAP. One metre of bed (2 rows) was harvested at ground level and weighed for fresh weight. A sub-sample of material was taken and dried at 60 oC until constant weight, to determine final dry matter yield per hectare.

The results of the trial demonstrate that there are a number of varieties that are capable of producing similar or better biomass yields than Leichhardt.

Crop Maturity

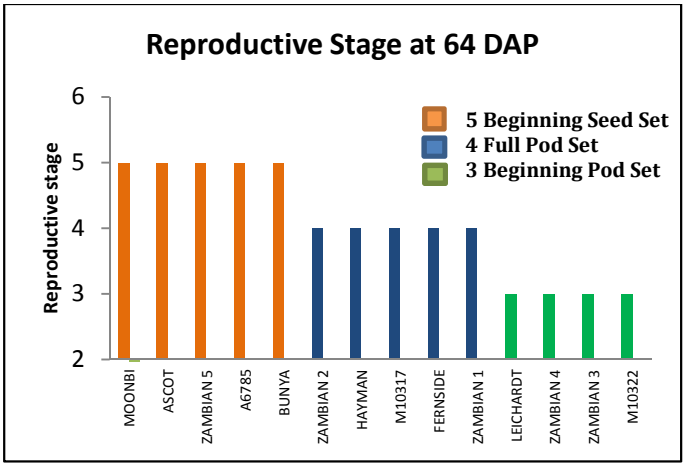

Figure 5: Variety Maturity Groupings

Crop maturity was assessed at 64 days after planting. All varieties could be categorised into three reproductive maturity stages – early maturing varieties were at R5 beginning seed set, mid maturity varieties were at R4 full pod set and the slower maturing varieties were still at R3 beginning pod set.

Lodging

Lodging is an important issue affecting harvesting efficiency. An assessment of crop lodging was undertaken prior to harvest. The nominal rating scale presented in Table 1 was used to score lodging for each variety.

Rating	Description
0	Crop Erect
1	Minor Sprawling
2	Moderate Sprawling
3	Some Plants Lodged
4	Many Plants Lodged
5	Severe Lodging

Table 1: Lodging Assessment Ratings

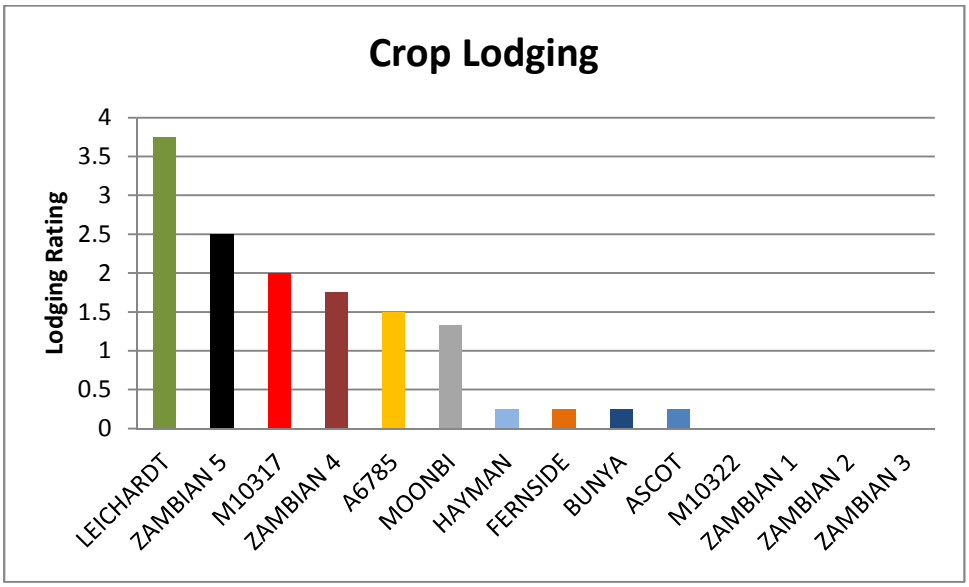

Figure 6: Lodging ratings for each variety at harvest

Leichhardt was again the most heavily lodged variety in the trial. Each of the other varieties displayed only low levels of lodging.

Grain Yield

The crop was again harvested with a small plot harvester. Grain losses out of the rear of the machine were very high, likely to be 50%. The machine was adjusted in a commercial crop before

commencing harvest of this trial.

Zambia 4 produced the highest yield for the trial, with just over 1.2 t/ha produced, followed by Leichhardt and M10322. These three varieties are is the slowest maturity group and suggest the seasonal conditions experienced favoured later maturity varieties.

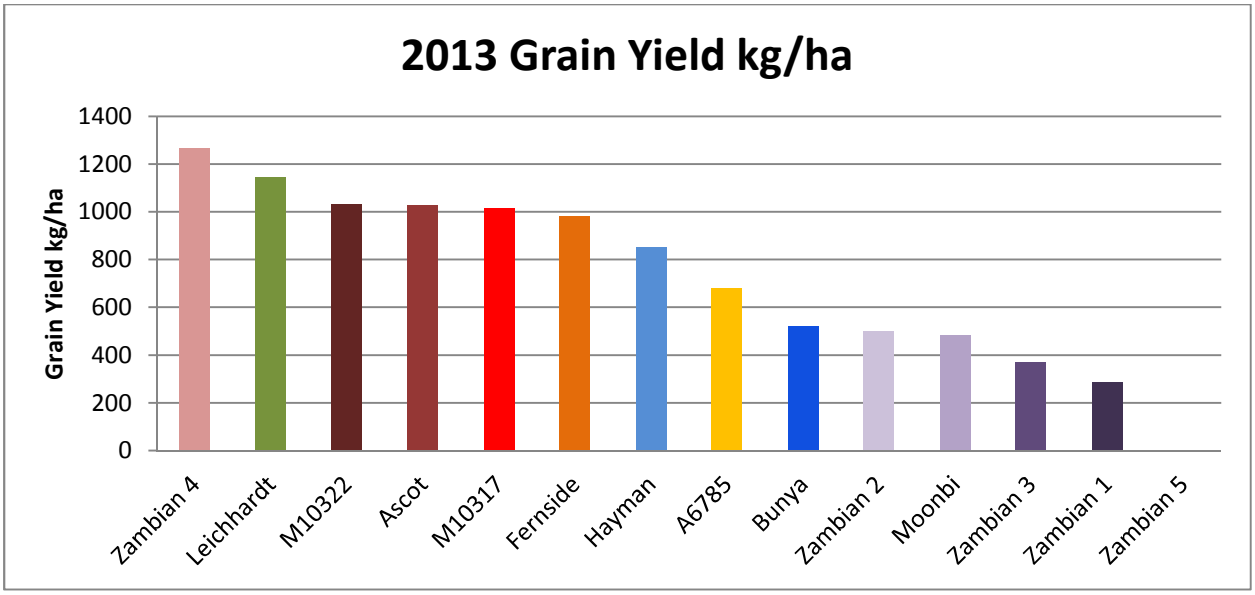

Figure 7: Comparison of Variety Grain Yield for 2013 Harvest

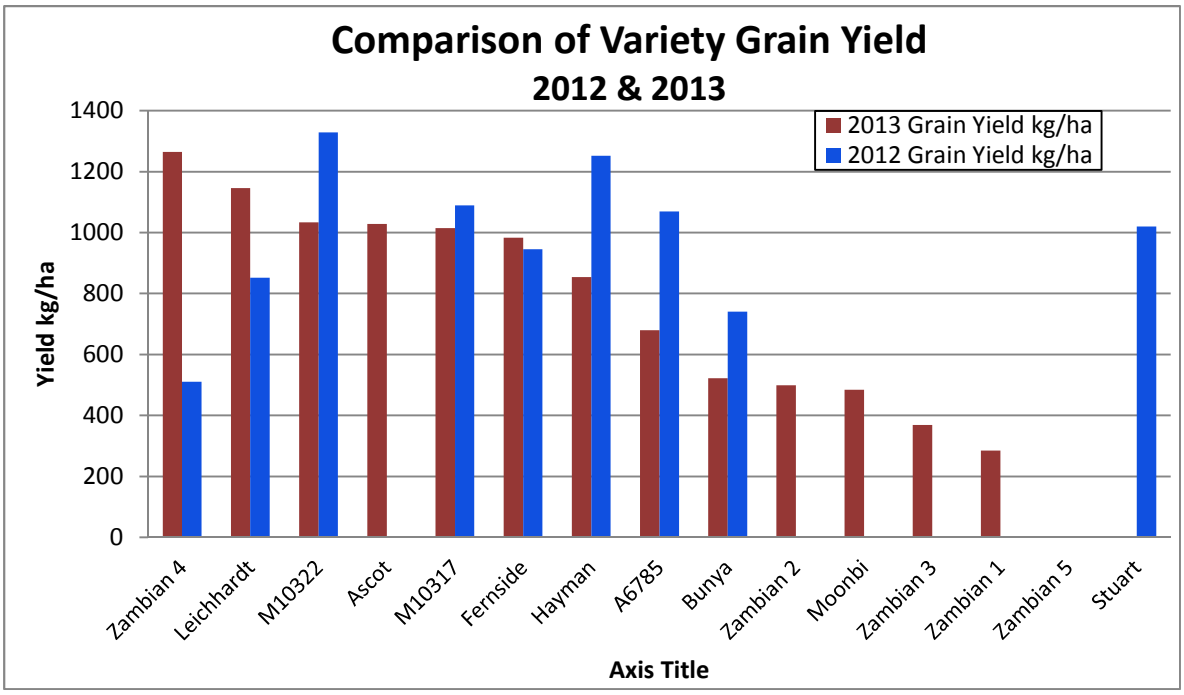

Figure 8: Comparison of 2012 and 2013 Grain Yields

A comparison of the yields achieved for the 2012 and 2013 harvests, highlights the consistent performance of several varieties including M10322, M10317, Leichhardt and Hayman. Zambia 4 gave produced high yields in 2013. It's 2012 yield was hampered by poor establishment due to heavy rain. This variety is very promising for this district and requires further assessment. Bunya's yields have been consistently behind the high yielding varieties and probably only has a role as a super-fast maturity variety allowing an early sugarcane plant following harvest.

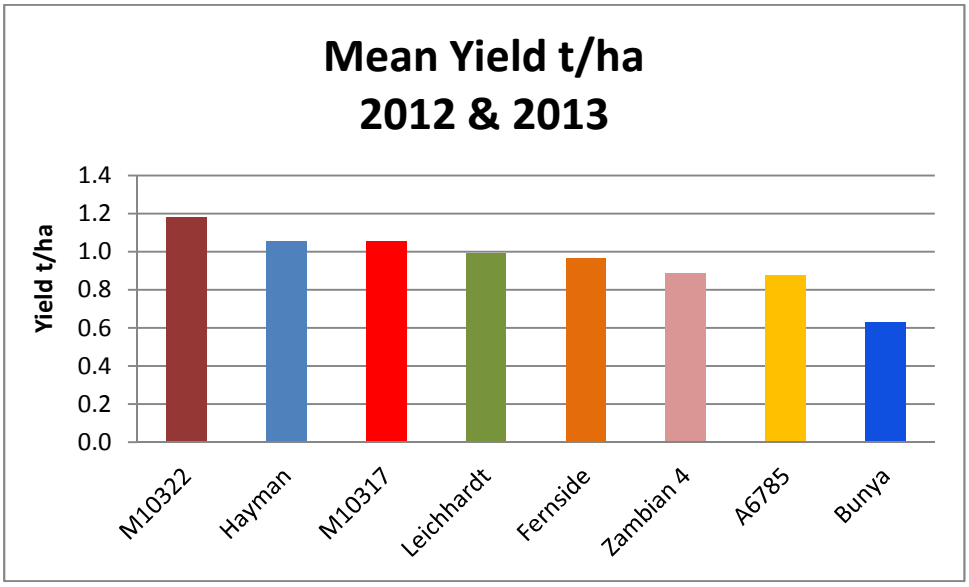

Figure 9: Mean yields of varieties trialled over 2012 and 2013 seasons

Figure 9 clearly highlights a number of varieties have been consistent in out-yielding the standard variety Leichhardt. M10322, Hayman, M10317 and Fernside all have maturity lengths slightly quicker than Leichhardt and produce similar biomass and superior grain quality.

Communication

A poster of the 2012 trial results was presented and discussed at the AgTradeLife field days in Mackay in May.

A field walk was conducted at the trial site on Thursday 30th May 2013. The field walk attracted 53 growers, industry advisers, soybean seed resellers and Productivity Service Staff. Soybean industry expert Judy Plath from Bean Growers Isis was guest speaker while Joe Muscat and Rob Sluggett provided background to the trial, conduct and variety performance. Aaron Sanderson, GRDC Northern panel member was able to attend the day and discussed the role of GRDC and opportunities with a number of growers and industry staff.

Strong support was expressed by the group for continued work on soybean varieties and agronomy to improve yields in the Central District.

Conclusion

This project aimed to identify soybean varieties that would contribute to enhancing and strengthening the soybean industry in the Central and Northern cane growing regions.

The project has been successful and achieved the following key outcomes:

1. Identified a number of varieties with equal or superior yield potential to Leichhardt
2. Identified a number of varieties with equal or superior biomass production to Leichhardt
3. A number of varieties were identified with better grain quality than Leichhardt
4. Several varieties were identified with faster maturity
5. Propagation of the Zambian varieties was successful with several hundred kilograms of Zambian 2 and Zambian 4 now available for further evaluation. Zambian varieties 1, 3 and 5 have smaller quantities of seed available.

Acknowledgements

The considerable efforts and expertise of Joe Muscat were essential to the successful conduct of this trial. Natalie Fiocco, Tina Sant, Kaylea Paulger and Rob Sluggett of Farmacist P/L are also acknowledged for their assistance with trial establishment and data collection.

Appendix 3: - Year one trial report from Burdekin region

Burdekin Soybean Trial 2012 - Results and Review

Soybeans as a rotational crop with cane in the Burdekin can show many benefits regarding the advantages of break-cropping, soil health benefits, weed control and N addition. Currently, the most widely used variety used in the Burdekin is Leichardt. Leichardt is typically planted early- Mid December and is harvested early May (140 days), however, cane planting typically begins around mid-March.

The aim of project is to assess the performance of a number of alternative soybean varieties under Burdekin climatic conditions and farming practices. One of the key outcomes will be to identify earlier maturing varieties that can fit better into our cane rotational system whilst still giving a viable economic return.

Varieties were sourced from both Northern and Southern Australia. Zambian varieties grown under similar climatic conditions to that of the Burdekin were also identified and sourced. To compensate for the lack of germplasm from Zambia, we planted other varieties such as PR443, NF246 and P791 as well as an extra treatment of Leichardt.

Eleven varieties of Soybean were planted on 20/12/2011 at Rob Town's farm near Giru (147.107546, -19.575692). The trial consisted of 12 plots, with each plot being 20m x 4 rows. Rows were spaced at 1 meter. Treatments were replicated 4 times under randomised plot design. Soil was a brown clay loam and was fully irrigated using clean channel water.

Seeds were inoculated and planted with a 12 row maxi-merge planter. NO fertiliser was used. Crop was treated once for insect control. Upon maturity, crop was desiccated with Reglone awaiting harvest. Harvesting was done by a modified small plat harvested with a 1.5 m front. Seed was collected and weighed.

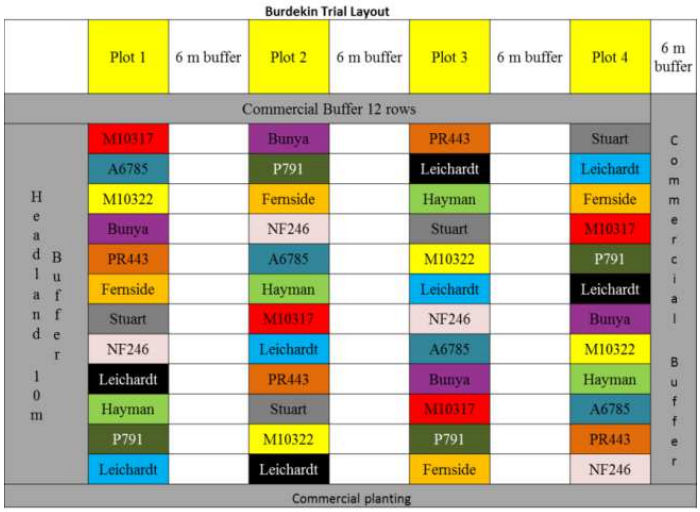

Figure 1 - Burdekin Trial Layout 2012

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Results

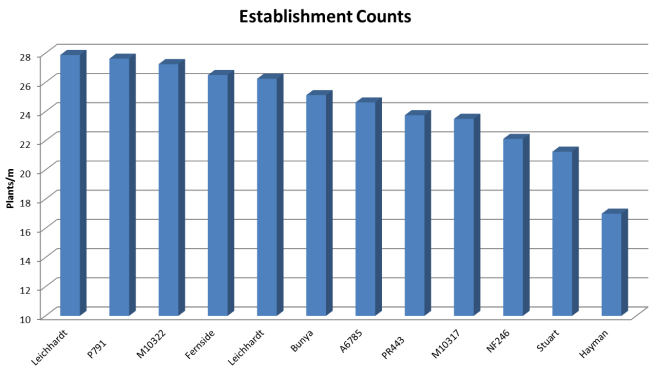


Figure 2 - Establishment Counts x Variety

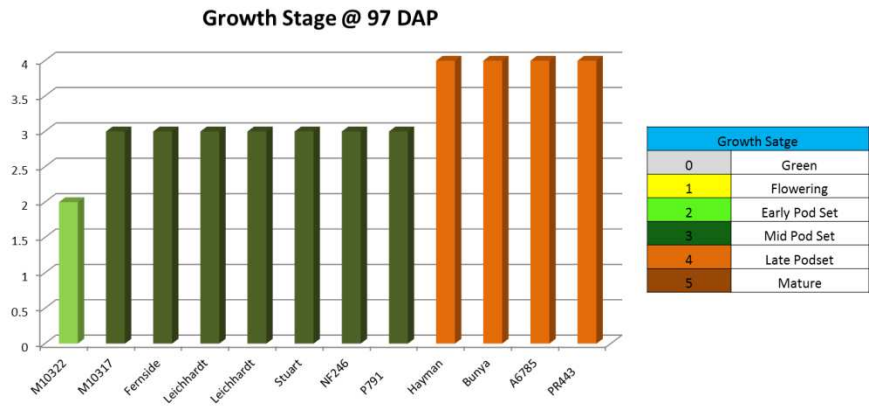


Figure 3 - Varieties x Growth Stage at 97 DAP

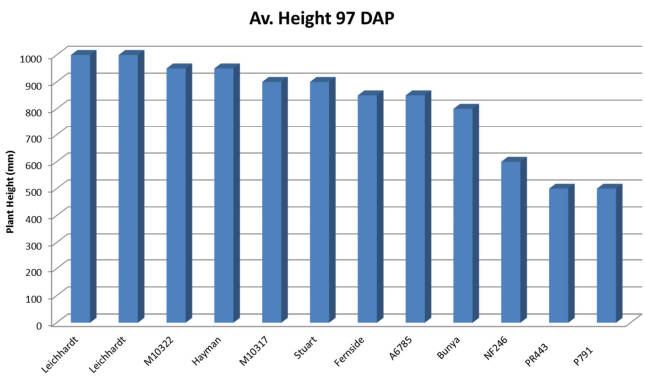


Figure 4 - Average Plant Height at 97 DAP

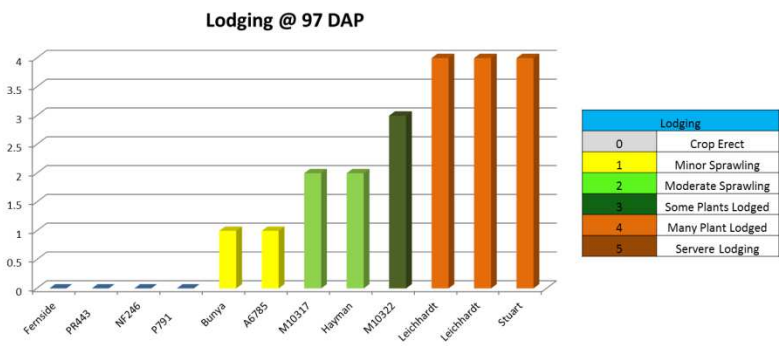


Figure 5 - Lodging Assessment at 97 DAP

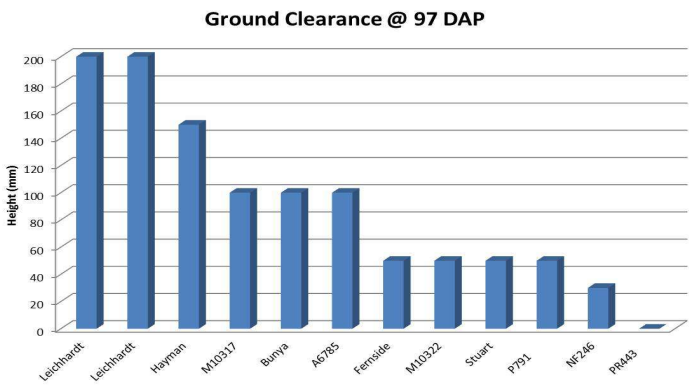


Figure 6 - Distance between ground level and first seed set (mm)

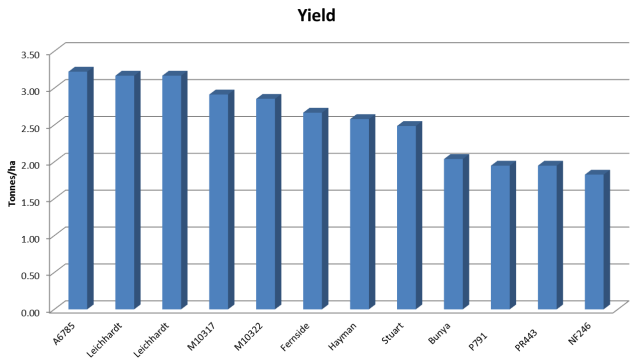


Figure 7 - Final Yield Results

At 23 Days after planting, establishment counts were conducted based on plant population per m2 (See Fig.2) The Hayman variety performed the lowest in counts, however performed above average in yield. There was little relationship between germination and establishment counts (R^2=0.51), between seed size (seeds/kg) and establishment (R^2=0.04), and establishment and yield (R^2=0.11)

At 97 Days after planting, infield assessments were conducted to evaluate growth stages (Fig.3). For the Burdekin, one of the objectives of this trial was to identify any varieties that would mature faster and maintained an economic yield to enable earlier cane planting. At 97 DAP, Hayman, Bunya, A6785 and PR443 were the more advanced in their growth cycle than the other varieties.

Besides A6785 and Hayman, trends suggest that the smaller varieties in height, matured faster than the larger ones. Statistical analysis showed a positive relationship between plant height and final yield (R^2 = 0.85). Because of the smaller plant height, yield was not as great as the larger varieties. Future trials could examine increasing yield with greater plant density by having 2 or 3 rows of these compact varieties across the top of the bed.

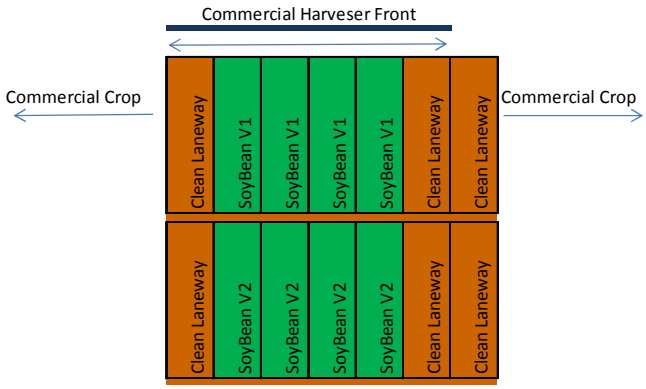
Lodging can cause issues with harvesting efficiency and can lead to unnecessary seed loss. Obviously this was a function of plant height. Lodging was more prevalent in the taller varieties, especially in the 2 common Burdekin varieties, Stuart and Leichardt (Fig.5).

Ground clearance was also assessed as a factor of harvestability. There seems to be less harvesting efficacy when seed pods are situated too close to the ground. By selecting varieties that have a higher ground clearance, we can ensure more seed is captured by the harvester and less seed is left in the paddock. Results showed that Leichardt and Hayman varieties showed the best characteristics regarding seed height (Fig.6). Varieties such as P791, NF246 and PR443 showed the most limiting ground clearance between all varieties and also resulted in the worst yields. The best performing varieties were the A6785 and the Leichardt varieties which yielded 3.22 and 3.17 tonnes/hectare respectively (Fig.7).

Learning's.

Trial design in the Burdekin needs to be modified to accommodate better irrigation control. In 2012, irrigation was not able to be controlled for trial purposes as the trial was positioned at the bottom of the paddock behind commercial crop. Irrigation was scheduled for the commercial crop, not the trial block. This caused problems with harvest scheduling and moisture control.

Trial design for 2013 should arrange plots down the field in the same irrigation set so we can control it more. Also, a laneway should be introduced to accommodate movement of infield harvester to enable better access to plots that may mature faster than others. This design would also allow chemical applications to be applied via commercial spray rig.



Accessibility to small plot harvester proved to be quite difficult due to logistics. Varieties had matured and started shedding well before we could get access to the harvester. The commercial harvester can harvest 6 rows at 40 inches so the proposed trial plan above will allow a commercial harvester to effectively harvest the crop on time as a fall-back mechanism so better quality data can be attained.

Conclusion.

As a result of this trial, one particular variety did show promising results for the Burdekin. A6785 showed better than average establishment, was one of the fastest maturing varieties, showed good plant height, low lodging, and performed the best yield out of all varieties beating the traditional standards.

The Bunya variety also showed promise. Although it yielded 36% less grain than the A6785, it showed good ground clearance allowing better harvestability, good establishment, was not prone to lodging and definitely matured the fastest of all varieties. This variety was ready to come off at least 3-4 weeks before the other varieties and was actually shedding well before harvest which may have had an effect on final yield (See Appendix 2). Due to Bunya being a shorter, more compact variety it could show better yield potential if plant population was increased to 2 or 3 rows per bed.

Appendix

Figure 8 - "Bunya" shedding before harvest

Treatment	Variety	Rate (kg/ha)	Germination	seeds/ha	Establish-ment 97 DAP (plants/m)	Average Height 97 DAP (mm)	Insect Damage	Growth Stage @ 97 DAP	Lodging @ 97 DAP	Ground Clearance @ 97 DAP	Avg Yield/plot @145 DAP	Calculated t/ha
1	M10317	60.22	81%	6818	17	900	Low	3	2	100	10.49	2.91
2	Fernside	69.11	92%	5500	24.625	850	Low	3	0	50	9.6	2.67
3	M10322	49.77	84%	9375	26.25	950	Low	2	3	50	10.28	2.85
4	Hayman	67.77	80%	5555	27.875	950	Low	4	2	150	9.29	2.58
5	Leichhardt	47.99	98%	6940	27.25	1000	Low	3	4	200	11.41	3.17
6	Bunya	100.66	80%	4411	25.125	800	Low	4	1	100	7.34	2.04
7	Leichhardt	47.99	98%	6940	26.5	1000	Low	3	4	200	11.41	3.17
8	Stuart	72.22	96%	4700	22.125	900	Low	3	4	50	8.95	2.49
9	A6785	56.66	97%	6720	27.625	850	Low	4	1	100	11.6	3.22
10	PR443		90%	5600	21.25	500	Low	4	0	0	7.01	1.95
11	NF246		96%	4900	23.75	600	Low	3	0	30	6.58	1.83
12	P791		92%	5450	23.5	500	Low	3	0	50	7.01	1.95

Appendix 4: - Year two trial report from Burdekin region

DEVELOPING A ROBUST SOYBEAN INDUSTRY IN CENTRAL AND NOTHERN QUEENSLAND – RESULTS FROM THE BURDEKIN DISTRICT FOR THE 2013 SEASON

GGP105

THE UNITED SOYBEAN GROWERS GROUP

Prepared by Jayson Dowie on behalf of FARMACIST PTY LTD

Contents

Table of Figures

Introduction

The benefits of cane crop rotations with break-crops such as legumes have been well documented over the years. Results from the SYDJV illustrated that legume breaks produced;

- Improvements in soil health through better balanced biology
- Fewer sugarcane root pathogens
- Biologically fixed nitrogen reducing the need for inorganic nitrogen fertilizer and consequently reducing the use of fossil fuel to produce that fertilizer
- Better cane growth and yield and increased profitability
- The tap root on legumes compared with the adventitious root system of sugarcane can work to improve soil structure.

(Final Report – SRDC Project YDV002 Sugar Yield Decline Joint Venture Phase 2 (July 1999-June 2006)

Trials comparing soybeans, mungbeans, cowpea and peanuts demonstrated that soybeans were the most preferred legume as they produced the most dry matter and accumulated the most nitrogen. (Garside et al, 2001). Soybeans also offer attractive opportunities for diversification of income and improved cash flow. Current prices indicate $520/tonne for soybeans which is around the average price for the last five years. (See Fig.1). Using an average soybean yield in the Burdekin of 3.8 tonnes per hectare, gross incomes of almost $2000/ha could be expected.

Figure 4 - Soybean commodity prices (AUD) from 2008-2013

(http://www.indexmundi.com/commodities/?commodity=soybeans&months=60&currency=aud)

The main variety of soybean planted in the Burdekin is Leichhardt. Leichhardt is very well suited to the climate and soils in the Burdekin and has excellent grain yield, however, it is a particularly slow maturing variety. Planting of soybeans in the Burdekin usually occurs through the December period. Typically, Leichhardt is not ready to be harvested until early May. Immediately after harvest, land

preparation begins for the planting of sugarcane and usually takes about 2-3 weeks after harvest to be ready allowing for a late May plant.

Coupling the attractive gross return of soybeans with the many benefits associated with a legume break crops, one would expect a considerable uptake of this practice, however, uptake in the Burdekin seems to be stifled due to the potential yield loss of the following plant cane crop if the cane is planted too late. BSES trials in the Burdekin compared yields between treatments planted on different dates (See Fig.2).

Treatment	Cane Yield (t/ha)
Early cane plant, soybean crop incorporated	160.5
Late cane plant, soybean crop incorporated	120.3
Late cane plant, soybean crop harvested	125.5

Figure 5 - BSES Burdekin Time of Planting Trial 2010

The early cane plant treatment was planted on the 13 April 2010 and the ensuing late plant treatments were planted on the 31 May 2010. There was no difference in CCS however a 40 t/ha yield difference was observed between the early planted cane compared to the cane planted late May. This highlights the importance of timeliness of planting on plant cane production.

In order to accentuate the uptake of soybean production in the Burdekin district, earlier maturing varieties need to be identified so that growers can take harvest seed as well as having sufficient time to plant cane on a reasonable time. The objective of this trial is to identify potential varieties that provide yields similar to the standard (Leichhardt) and mature faster than the current Northern varieties to maximize productivity for the following cane crop.

Following on from trials completed in 2012 which explored potential varieties for the Burdekin district, seven varieties were deemed suitable to go forward into the 2013 trials. These varieties were A6785, Bunya, Leichhardt, Hayman, Fernside, M10322 and M10317.

A dual row planting of Bunya (Bunya x 2) was also included in this year's trial. In the previous years report, Bunya matured the fastest, however yield was 36% lower than the standard being Leichhardt. Given that the variety was small and compact, we decided to explore the yield potential of a dual row planting at 400,000 plants /ha in comparison to the single row Bunya treatment at 300,000 plants per hectare. This gave us eight treatments. (See Fig.3)

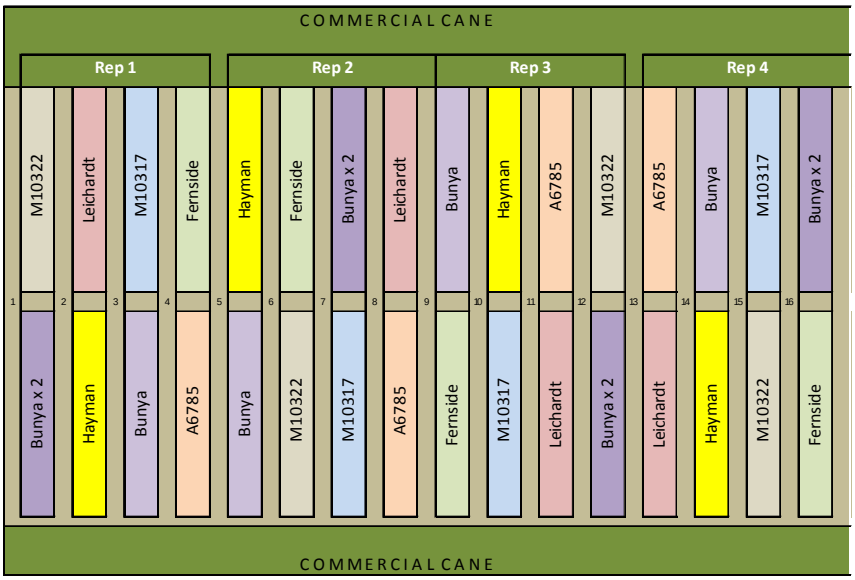


Figure 6 - 2013 Soybean Trial Layout (BKN)

These eight treatments were planted on the 5th December 2012 at Greenock Enterprises near Giru (147.107546, -19.575692). Soil was a brown clay loam furrow irrigated with clean channel water. Each treatment plot was 20m x 6rows and was replicated four times down the block.

Seeds were inoculated and planted with a 12 row maxi-merge planter. Crop was treated once for insect control. Upon maturity, crop was desiccated with Reglone awaiting harvest. Harvesting was done by a modified small plat harvested with a 1.5 m front. Seed was collected and weighed.

Results & Discussion

Establishment

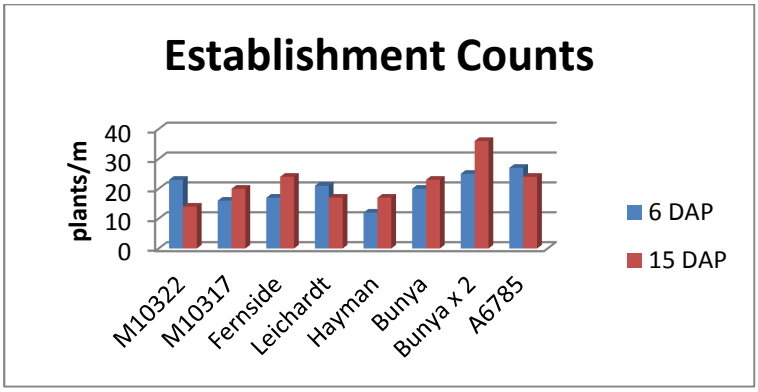
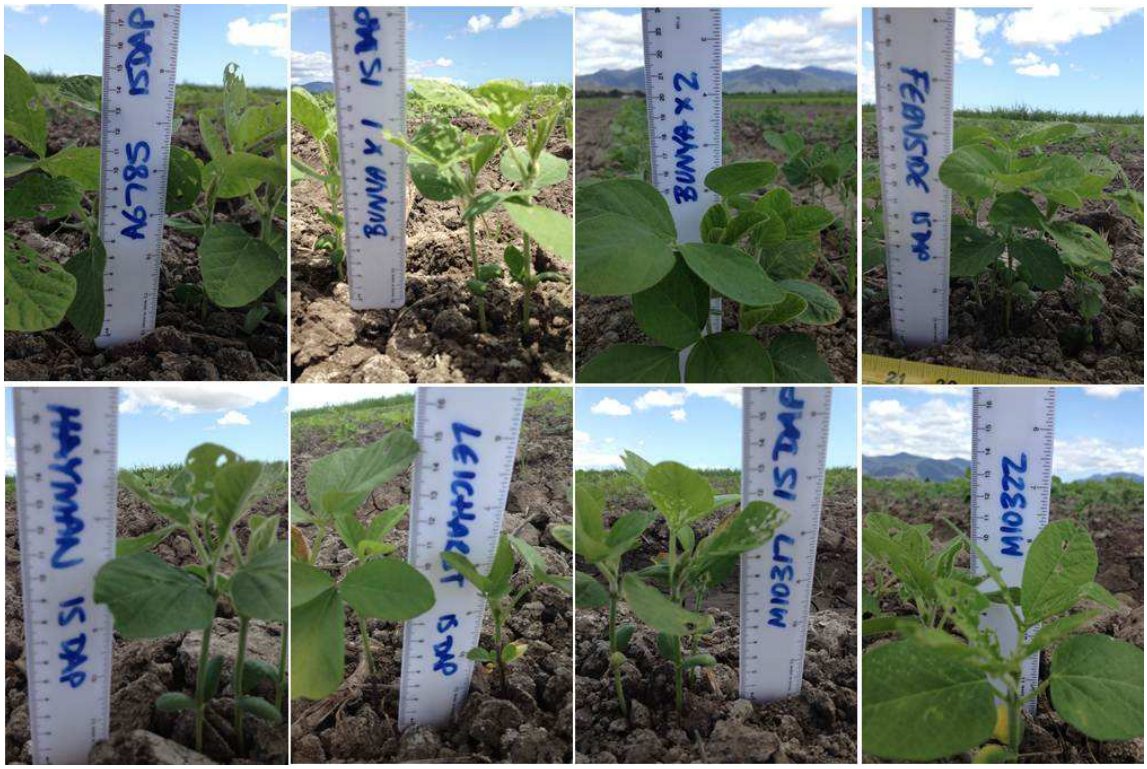


Figure 7 - Plant Establishment Counts

At 6 days after planting (DAP), all varieties had over 80% germination. At this stage, all varieties had their unifoliate leaves fully expanded, however the A6785 was slightly more advanced physiologically as its first trifoliate leaf was fully emerged and opened. At 15 DAP, all varieties had their first trifoliate leaves fully emerged and opened. Nodulation was present at 15 days. Lateral roots were developing well. Bunya germinated the fastest of all varieties. (See Fig.4)



Growth Patterns

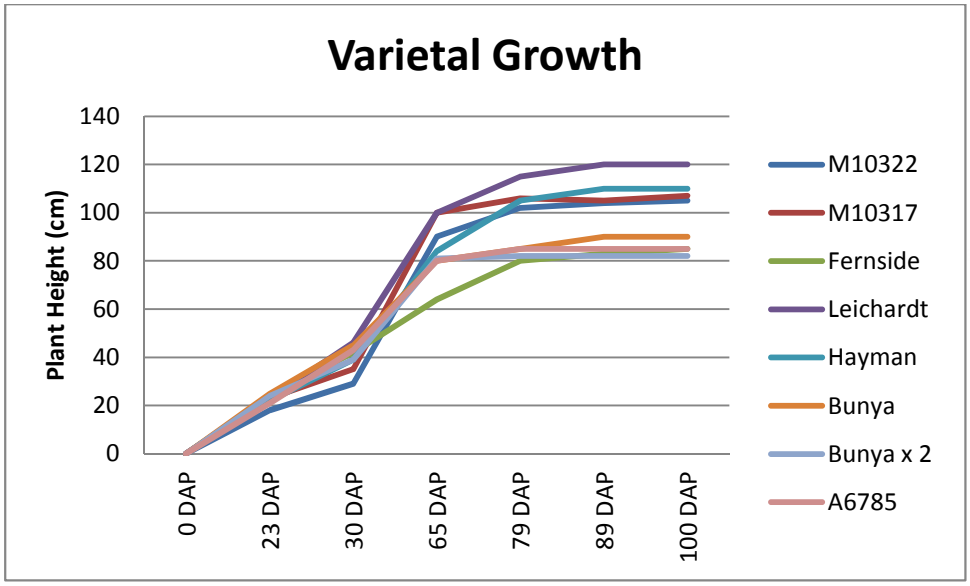


Figure 8- Plant height for all varieties over 100 days

Plant height was monitored and measured over the crop cycle. Bunya and A6785 were smaller and compact in comparison. Maximum growth rate was occurring between 30 and 65 days after planting in all varieties (See Fig 5). Leichhardt produced the most biomass and height of all varieties.

Maturity

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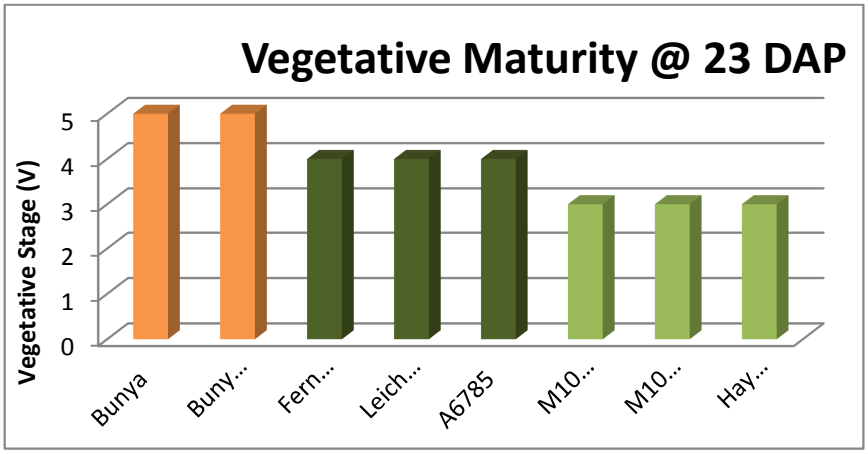


V1- First trifoliate leaf is fully emerged and opened
V2 - 15-20 cm in height and have three nodes with two unfolded leaflets
V3 - 18-25 cm in height with four nodes and four unfolded leaflets
V4 - 22-27 cm in height with five nodes of unfolded leaflets
V5 - 25-30 cm in height with at least six nodes with unfolded leaflets.

Figure 9 - Vegetative Growth scores

At 23 DAP, Bunya was the most advanced (See Fig 6). The Bunya was well developed, did not seem as prone to insect pressure and has broad, large, rounded leaves. Both of the M varieties were smaller

than the other varieties at this stage, were smaller in size and had more compacted internodes. Both the M varieties were darker in colour and had a pointed leaves. The Hayman variety had germinated and established well considering that it only had 65% germ rating. All varieties were throwing buds from the node at this stage

At 65 DAP, both Bunya treatments and the A6785 had dropped their flowers and pods were rapidly developing. Pods were at 40mm in length and were filling with bean (See Fig.7). At this stage, the Leichhardt variety was noticeably behind and still had flowers developing at 100 DAP when every other variety was almost, or at full seed. Both of the M varieties had bloomed and were dropping their flowers and were getting ready for pod initiation. Hayman and Fernside had also dropped their flowers and had started developing pods at about 7mm in length.

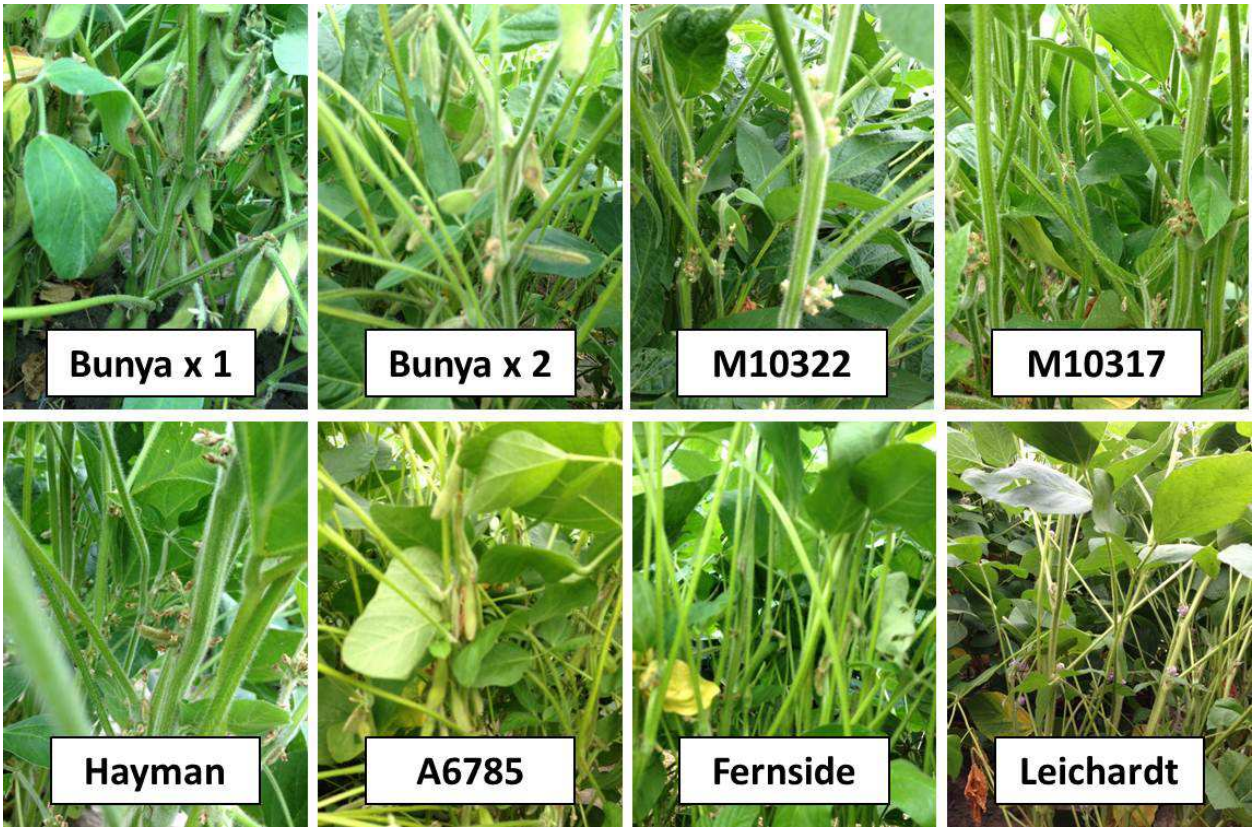


Figure 10 - Varietal Development at 65 DAP

At 75 DAP, the Bunya and A6785 variety was the most advanced in the 'green bean' stage. They remained at this psychological phase for at least another 3 weeks. At 100 DAP, all varieties were developed in accordance to the R6 physiological requirements as described in the "Better Soybeans Training Manual' except for Leichhardt which had not yet begun to make seed.

At 125 DAP, Bunya, A6785, Fernside and Hayman were physiologically mature and was subsequently desiccated with Reglone in preparation for harvest. The M varieties were very close to being mature, so we decided to hold off on desiccation for another 3-4 days to allow them to develop more. It was noted that the M10317 variety did seem to mature slightly faster than the M10322. Both M varieties were desiccated 128 DAP. The Leichhardt took another 18 days to reach physiological maturity (See Fig 8).

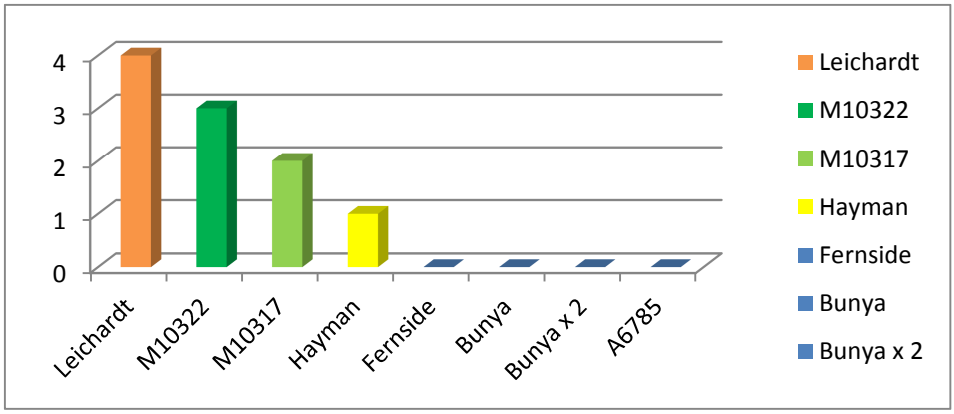
	65 DAP	79 DAP	89 DAP	100 DAP	125 DAP	128 DAP	146 DAP
Bunya	6	6	6	6	8		
Bunya x 2	6	6	6	6	8		
A6785	4	6	6	6	8		
Fernside	4	5	6	6	8		
Hayman	3	5	6	6	8		
M10317	2	5	6	6	7	8	
M10322	2	5	5	6	7	8	
Leichardt	2	3	3	4	5	6	8

Legend	
1	Beginning bloom
2	Full Bloom
3	Beginning Pod
4	Full Pod
5	Beginning Seed
6	Full Seed
7	Beginning Maturity
8	Full Physiological Maturity

Figure 11 - Reproductive stages at specific DAP

Lodging

Lodging can cause significant issues with harvesting efficiency, yield losses and seed quality issues. A6785, Fernside and Bunya did not show any real signs of sprawling or lodging in 2013, however in 2012, Bunya and A6785 did show some minor sprawling. These varieties remained upright and erect in 2013. Hayman and M10317 showed some signs of sprawling however there was no evidence of lodging. The only varieties that lodged were Leichhardt and M10322 with Leichhardt being the worst (See Fig 9).



0	Crop Erect
1	Minor Sprawling
2	Moderate Sprawling
3	Some Plants Lodged
4	Many Plants Lodged
5	Severe Lodging

Figure 12 - Lodging Scores

Ground Clearance

Ground clearance was a measure from ground level to first pod set. If seeds are set too close to the ground potential yield may be lost if the cutter bar is not set low enough. Having a good ground

clearance in a variety is beneficial for harvesting efficiency and yield. The optimum height for the cutter bar in this situation was 100mm. At 100mm, ground clearance, Leichhardt, Hayman, M10317 and A6785 had sufficient height to first seed set. It was observed that even though plant height for Leichhardt was similar to the 2012 season, first pod seed set was significantly reduced in 2013. This however still had no detrimental effect on harvestability. Shorter distances from ground to first seed node were also observed in the Hayman and Bunya. Minor losses could be expected from the Bunya and M10322 varieties. Interestingly enough, the Bunya x 2 treatments proved to be a taller plant with greater ground clearance in comparison to the single row Bunya, driven mainly by associative competition. Fernside performed the worst in both years at 50mm (See Fig 10). Bunya x 2 was not a treatment in 2012 therefore has no 2012 data associated with it.

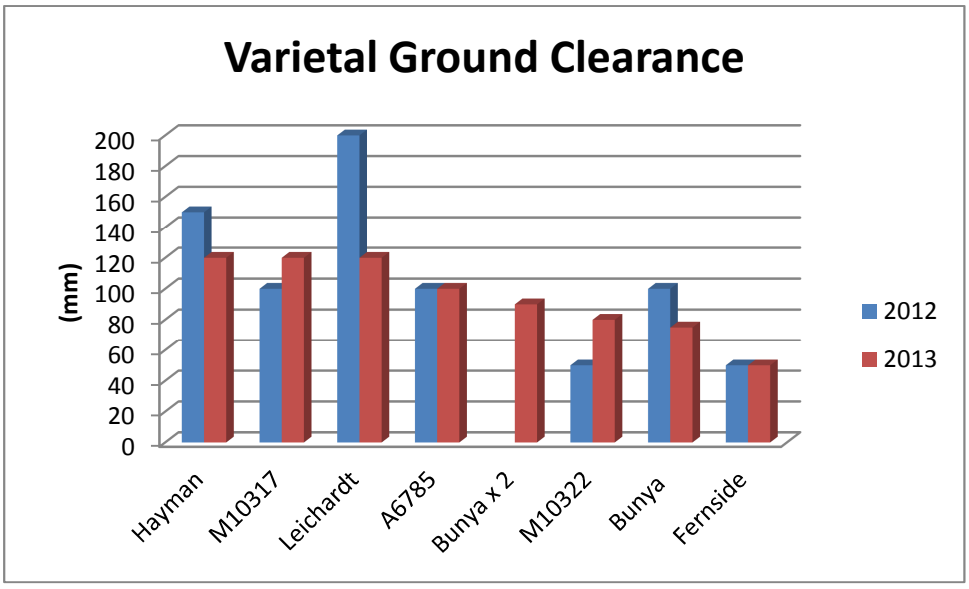


Figure 13 - Ground clearance (mm)

Yield

Yield weights were significantly lower than the 2012 season due to harvesting losses out of the small plot harvester which were estimated to be approximately 25%. Unfortunately this was not ideal however, it was decided to proceed given that all treatments would be harvested with the same machine and no treatment had an advantage over another. It was unfortunate that harvesting inefficiencies were present, however, the yield trends corresponded to those seen in 2012 where A6785 and Leichhardt produced similar yield in both years (See Fig 11 and Fig 12). Fernside, Hayman, M10322 and M10317 were midfield. And the Bunya variety had the lightest yield but was also the shortest variety. An additional treatment of Bunya placed on two rows on the same bed was introduced in 2013 to explore the possibility of increasing yield per hectare, however, results showed

that increasing the plant population had no effect on yield, in fact, there was a yield decrease in comparison to the single row Bunya which could be due to competition for resources.

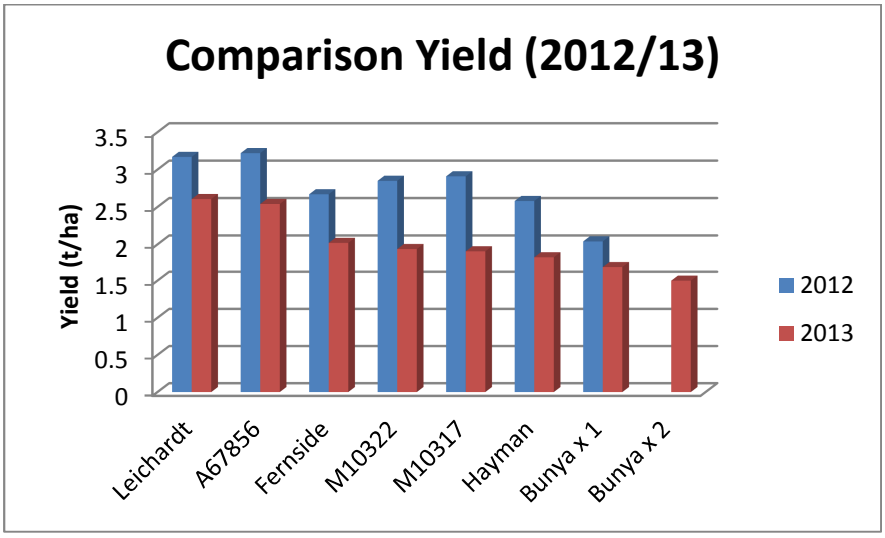


Figure 14 - Comparative yield between 2012 and 2013

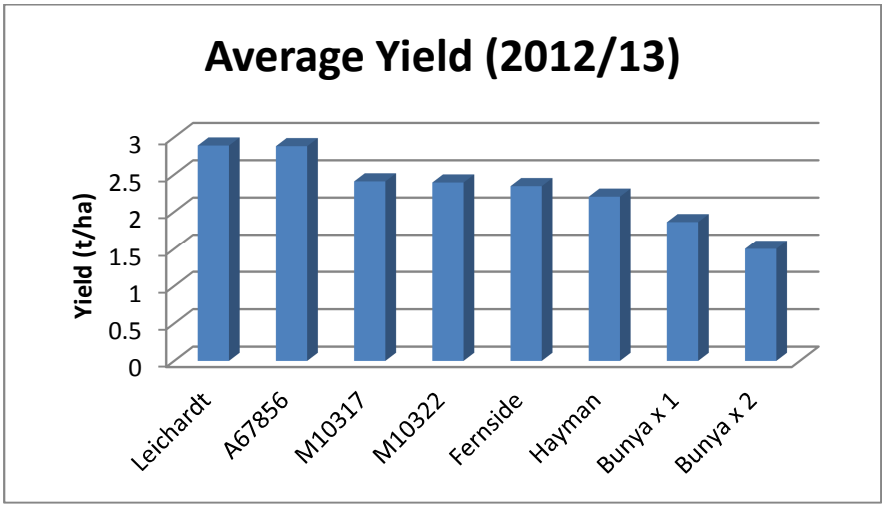


Figure 15 - Averaged yield from both seasons

Conclusion

The aim of the project was to develop a robust soybean industry in Central and Northern Queensland. One of the limitations of uptake, particulars here in the Burdekin, is timing. Ideally, growers need a faster maturing variety to allow successful early planting of cane in order to maximize productivity and profitability. Unfortunately, a large percentage of soybean crops never make it to grain yield as growers opt to pull the crop out to enable early planting of cane. .

A6785, in particular, would be an excellent varietal choice for the Burdekin. Yields are heavy and comparable to Leichhardt. Additionally, the crop has matured approximately 3 weeks earlier allowing time for harvest and ground preparations for the ensuing early can plant. Bunya also matured very early in comparison to other varieties. Although yields were significantly lower, Bunya can attract market premiums due to its clear hilum. It is the preferred variety for tofu markets.

The M varieties performed well. Although initial growth was slower than others, it produced good yield and biomass, however large amounts of biomass in our irrigated farming systems can have disadvantages due to maintaining moisture in the profile. When harvesting the plots, we found that the plots with large biomass were still wet due to surface shading. These wetter soils could not only potentially cause harvesting issues, but can also delay ground preparations for the coming cane crop.

Dual planting of Bunya with a higher plant population showed no advantage in comparison with the single row. The Bunya x 2 treatment grew taller than the single row due to completion however it did not produce any more yield.

This project has been successful in identifying faster maturing varieties to fit into our rotational window. With successful extension, production advantages relating to better soil health, soil nitrogen accumulation, and better cane growth can be delivered to the industry. Coupled with financial rewards of soybean grain production, reduced N application and increased cane yield potential due to earlier planting, the future of the soybean industry in the Burdekin looks very promising.

References

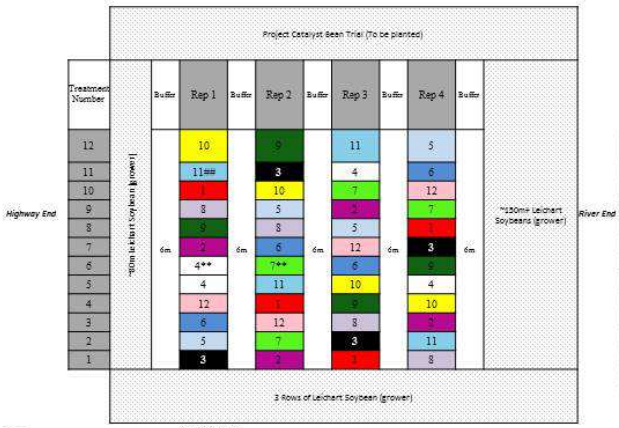
1. Garside, A.L., Bell, M.J., Berthelsen, J.E., and Halpin, N.E. (2001) Species and management of fallow legumes in sugarcane farming systems. *Australian Society of Agronomy 2001*.

Appendix 5: - Year one trial presentation from Herbert region

GGP105 – Developing a robust soybean industry in Central and NQ

HCPSL
Herbert Cane Productivity Services Ltd.

Herbert Soybean Trial - Tom Gilbert Farm (Planted by A. Royle, H Clements)



Herbert Soybean Trial - Tom Gilbert Farm (R. Slugget/A. Royle Design)

Treatment	Variety	% Germ.	Seeds/kg	Viable seeds/kg	Planting Rate (total seeds/ha)
1	M10317	81%	6818	5523	312,000
2	Fernside	92%	5500	5060	312,000
3	M10322	84%	9375	7875	340,000
4	Hayman	96%	5555	4444	312,000
5	Bunya	80%	4411	3529	325,000
6	A6785	97%	6720	6518	356,000
7	PR443	90%	5600	5040	344,000
8	NF246	96%	4900	4704	275,000
9	P781	92%	5450	5014	325,000
10	Stuart	96%	4700	4512	288,000
11	Leichnardt	98%	6940	6801	340,000
12	Leichnardt	98%	6940	6801	340,000

Design

Plot length	20m
Mounds/plot	3
Rows/mound	2
Mound width	1.8m

Planting Notes:

1. Planting Date = 20.12.11
2. Planted with T. Gilbert planter using BayRhiz innoculant injected into each row
3. ** = Planting error (2 x trt 4 in rep 1, 2 x trt 7 in rep 2)
4. ## = Planter/mound profile error (1 row of beans planted in centre plot only)

Post Plant Notes:

1. Pre-emergent = Stomp + Gramoxone

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Planting

Establishment

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Weed control

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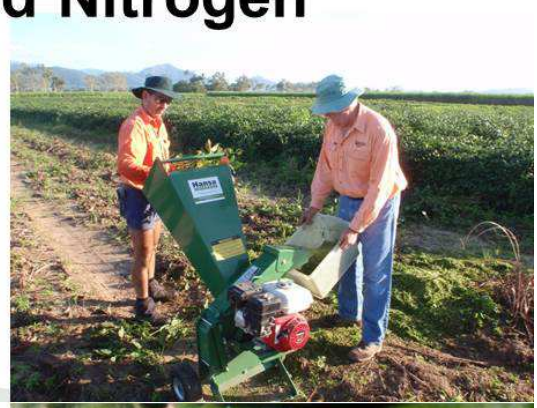
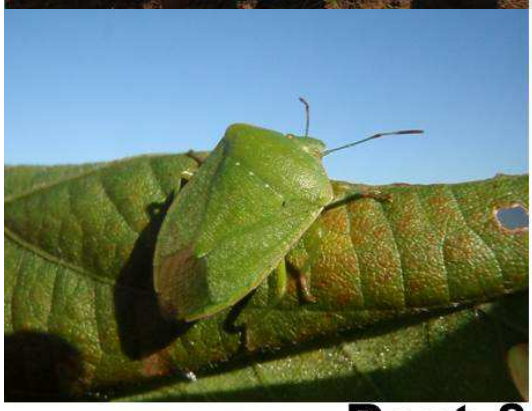
Biomass and Nitrogen


Pest & Disease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Harvesting

Hand Harvesting

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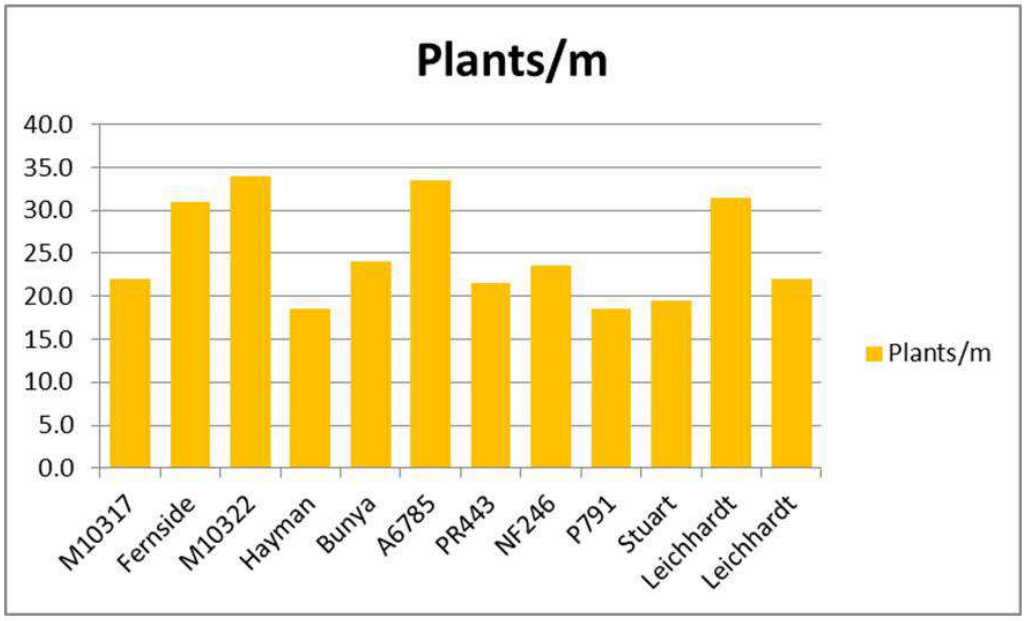
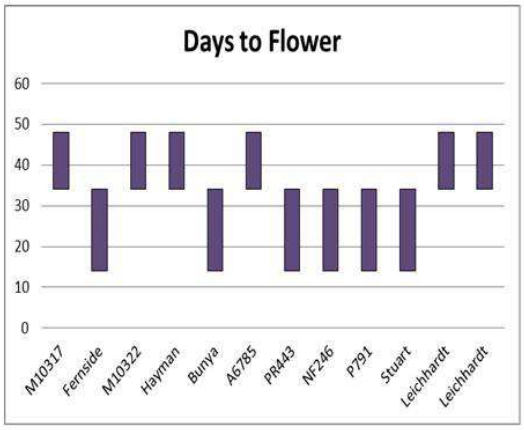
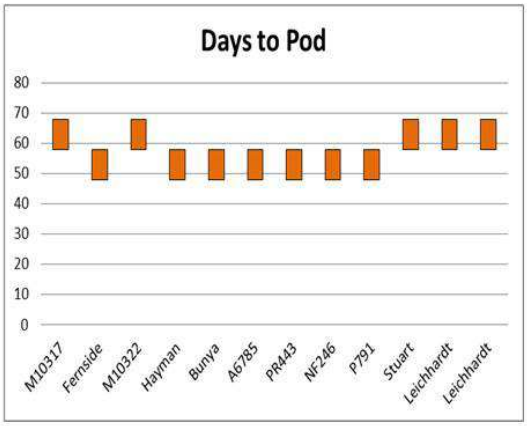
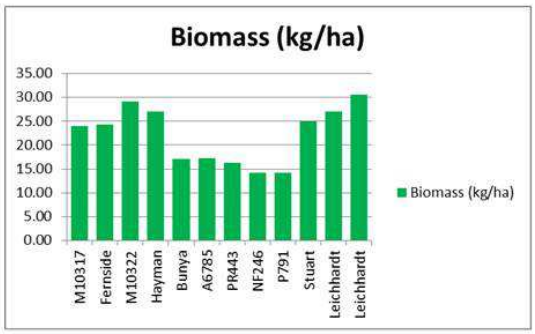


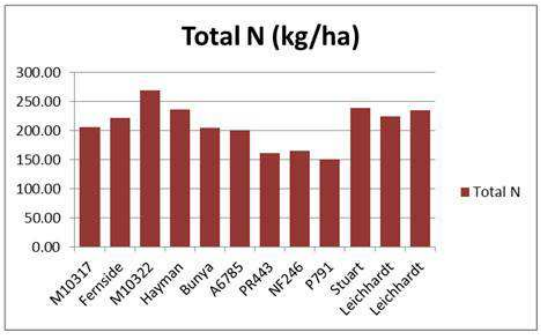
Germination & Establishment

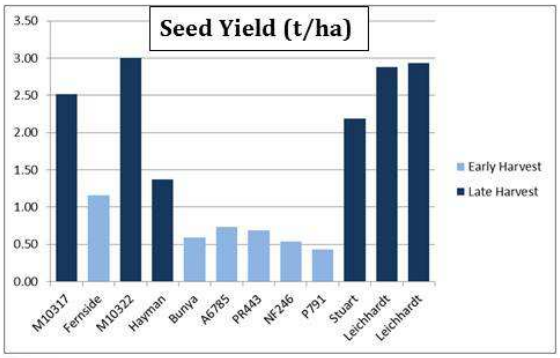
Variety x Season Length











Appendix 6: - Year two trial presentation from Herbert region

GGP105 – Developing a robust soybean industry in Central and NQ

Project Group Presentation - 2013
Adam Royle

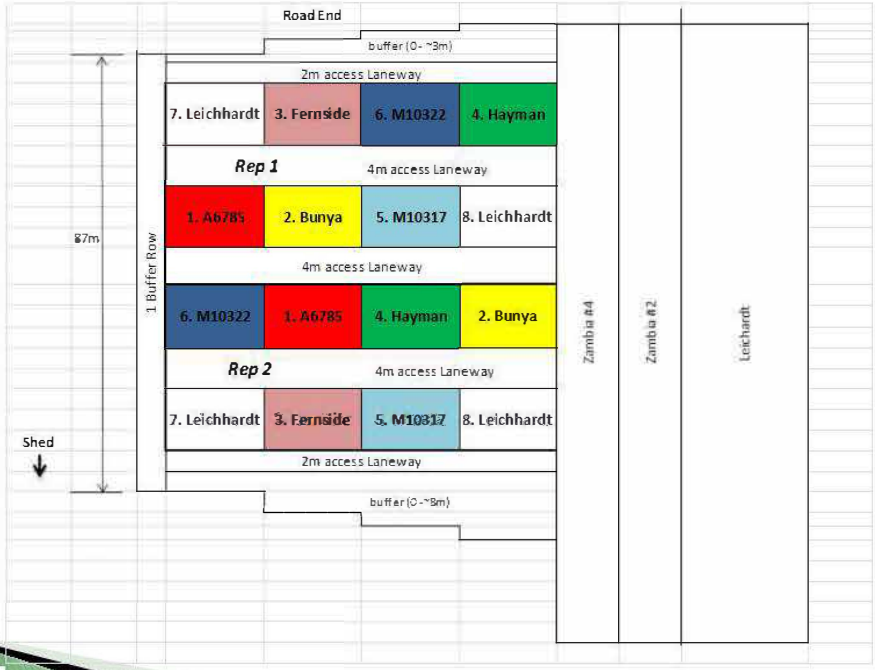
HCPSL
Herbert Cane Productivity Services Ltd.

Planting

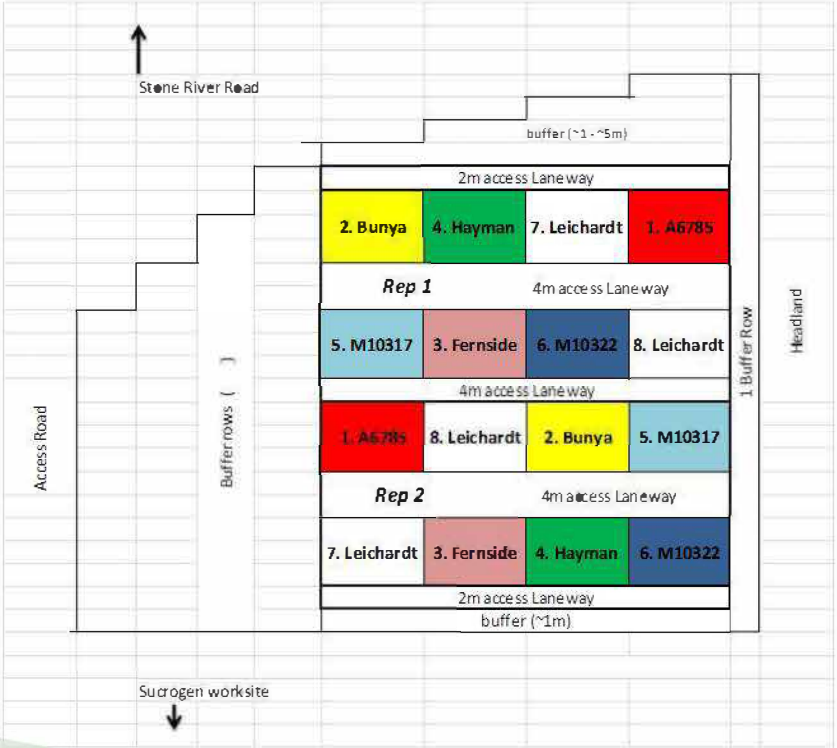
Trials
- 2 trial sites
- 1 observation plot

Sites
- Lower Herbert (D Robino wetland site)
  - Prone to minor flooding
  - Selected to assess waterlogging tolerance
- Stone River (HCSPL dryland site)
  - Prone to prolonged dry periods
  - Selected to assess drought tolerance
- Observation plot (Central site, L Di Bella)
  - Centrally located
  - Planted with remaining seed from trials
  - Selected to promote varieties and project

Lower Herbert Site (D. Robino – Wetland)



Stone River Site (HCPSL – Dryland)



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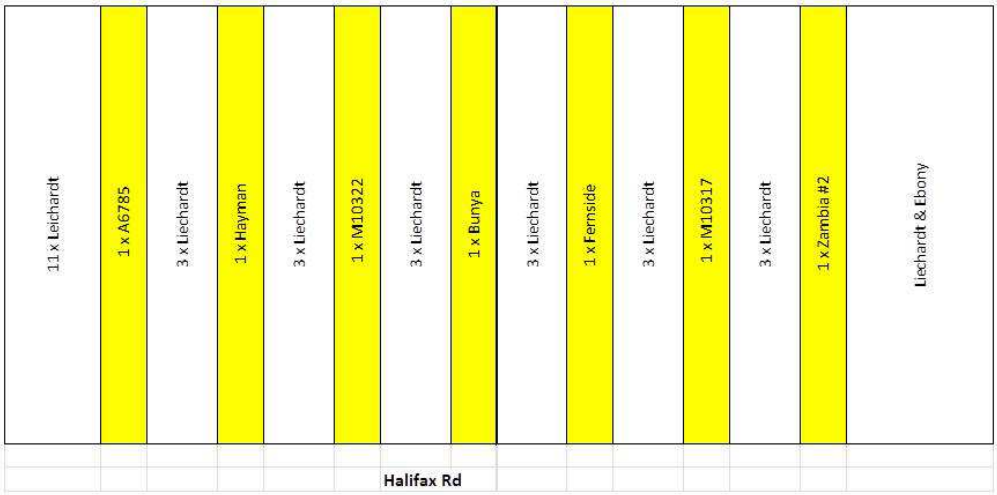
Observation Site (L Di Bella)



- All sites pre-mounded using ripper renovator
- Due to an exceptionally dry end to 2012 planting was delayed.
- Heavy rainfall at Christmas delayed planting even further.

- Prior to planting in mid January trial sites were sprayed with a knockdown herbicide.
- A pre-emergent herbicide mix was applied post plant.

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Germination & Establishment

- Post plant, Herbert region received 573mm of rainfall, 262mm of that rainfall falling over a 24hr period (*B.O.M. rainfall data, 2013*).
- The heavy rainfall was followed by a period of hot, humid conditions.
- Stone River site was heavily waterlogged reducing establishment to approximately 20-30% of expected.
- Lower Herbert site completed submerged under flood waters for three days, which significantly reduced germination and establishment.
- Both sites were monitored for a further six weeks to record germination of each variety post flood.
- Di Bella observation plot, which escaped major flooding, was salvaged and the following attributes monitored,
  - Crop establishment
  - Growth stages
  - Biomass
  - % nitrogen

- Flooding of Lower Herbert Site, Day 4 – trial site starts to emerge from flood waters

- Lower Herbert site 3 days after flood water subside.

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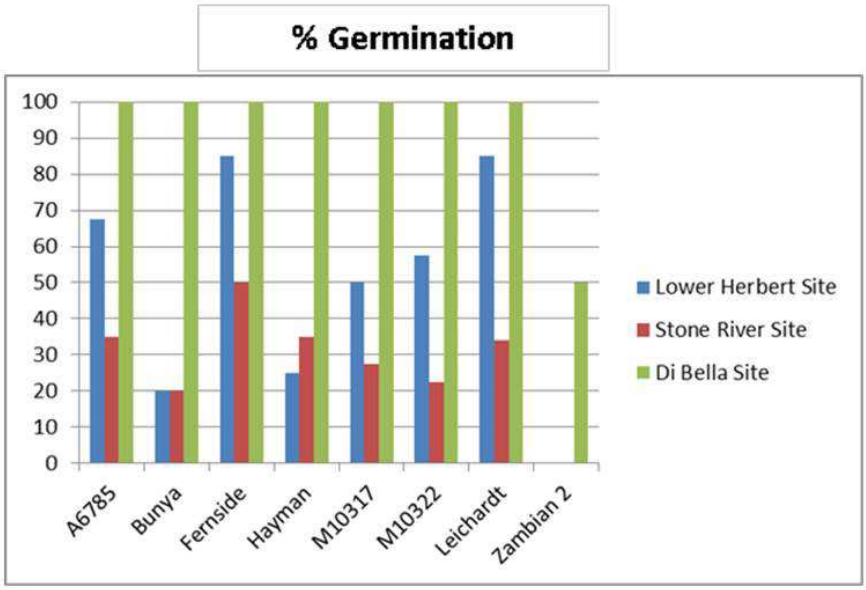
Top Left - Leichardt on lower Herbert site

Bottom Right – Leichardt on Di Bella observation site



Growth Stages

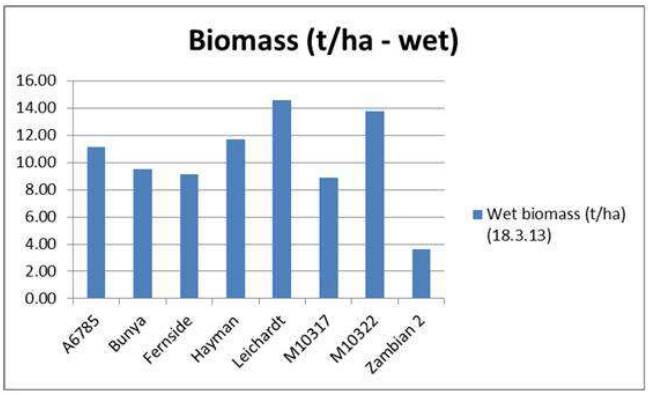
The 12 different stages of growth were monitored and recorded at the Di Bella observation plot. The table below indicates the variability amongst the chosen group of soybean varieties and as expected shows a similar trend to that noted in the 2011-12 trial.

Variety	4.2.13	11.2.13	18.2.13	25.2.13	1.3.13	18.3.13	3.4.13
	Stage	Stage	Stage	Stage	Stage	Stage	Stage
A6785	V1	V2	V5	R1	R3	R4	R6
Bunya	V2	V3	V6	R1	R2	R3	R6
Fernside	V1	V3	V5	R1	R2	R3	R6
Hayman	V1	V2	V5	V6	R2	R3	R6
M10317	V1	V2	V5	V6	R1	R2	R6
M10322	V1	V2	V4	V5	R1	R2	R6
Zambian 2	V1	V2	V4	V6	R1	R2	R6
Leichardt	V1	V2	V4	V5	R1	R2	R6

Vegetative phases: V1-V6
Reproductive phases: R1-R6

Biomass

The 2012-2013 series of trials were planted almost four weeks later than the 2011-2012 series. This, combined with poor early growing conditions, resulted in a reduction of biomass of all varieties. Never-the-less, the results were similar to the previous years trial with Leichardt and M10322 producing the greatest wet and dry total biomass totals. Zambian #2 suffered heavily under the early wet conditions and never recovered.



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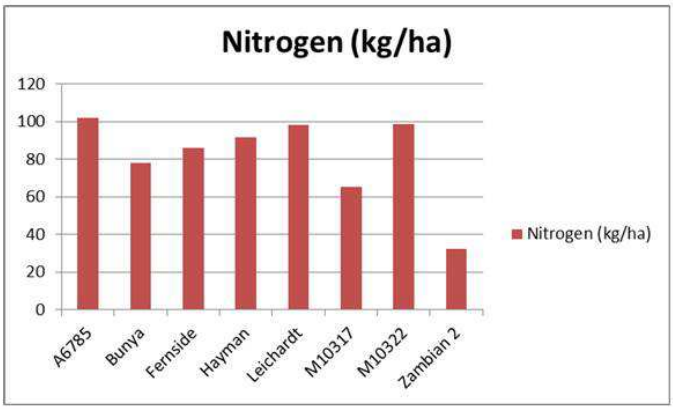
Adam Royle, Sam Sellick and Melissa Royle sampling biomass the 2013 Di Bella observation plot

Nitrogen Production

As with the biomass samples, the total above-ground nitrogen return production was taken from the Di Bella observation plot due to the loss of both official trial sites. With nitrogen production and an early season alternative to Leichardt ranked highly on the Herbert's wish list it was pleasing to see A6785 display high levels of nitrogen production. Leichardt and M10322 once again ranked highly, as they did in 2011-12.



Seed Yield

As both official trial sites were lost to major flood events no harvesting took place in the 2012-13 series of Herbert soybean trials.

Display signage at the Di Bella observation plot

Discussion

This series of trials once again highlighted the difficulties faced by Herbert growers in producing a consistently viable crop. Previously the Herbert stakeholders believed that while a small scale "opportunistic" soybean industry is possible in the Herbert, the biggest value is in the use of soybeans as a fallow cover crop.

The two questions begging to be asked are,

Is this still the groups opinion?

and

Where to from here?

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Appendix 7: - Herbert Grower Field Tour Infosheet

Developing a robust soybean industry in Central and NQ

Overview

To develop a program that will screen new soybean varieties in Ingham, Burdekin and Central regions. This program will access soybean varieties from the CSIRO breeding program, the John Ross breeding program and commercially available varieties from Zambia and elsewhere. Foreign varieties will be imported into Australia through AQIS and seed bulked up in the Burdekin and Mackay for trial purposes. All varieties will be screened for general adaptability, biomass production, seed production, crop agronomy, pest and disease and marketing potential. Trials will be conducted over 2 years to account for seasonal variability and to assess performance on different soil types across each region.

Varieties and Trial Design

Treatment	Variety
1	M10317
2	Fernside
3	M10322
4	Hayman
5	Bunya
6	A6785
7	PR443
8	NF246
9	P791
10	Stuart
11	Leichhardt
12	Leichhardt

Assessing the Trials

- Plant Establishment
- Crop Density
- Time to flower
- Time to Seed
- Time to Harvest
- Total Biomass
- Seed Production
- Nitrogen Production
- Diseases and Pests
- Water use Efficiency

The Big Questions

What have we learnt?

Was it all worthwhile?

Where to from here?