FINAL REPORT

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

DAQ00174

Cropping solutions for the sugarcane farming systems of the Burdekin

PROJECT DETAILS

PROJECT CODE:	DAQ00174
PROJECT TITLE:	CROPPING SOLUTIONS FOR THE SUGARCANE FARMING SYSTEMS OF THE BURDEKIN
START DATE:	01.07.2011
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SUPERVISOR:	MIKE HANKS
ORGANISATION:	DEPARTMENT OF AGRICULTURE AND FISHERIES
CONTACT NAME:	MIKE HANKS

Summary

This project studied the cropping opportunities within the sugar dominant farming systems of the Burdekin district in Queensland (QLD). Approx. 15,000ha of fallow land annually provides opportunities for growers to adopt more sustainable farming systems and grow complementary crops such as pulses in the sugarcane system. Rotations with pulses have been proven beneficial to the sugarcane system from the Sugar Yield Decline Joint Venture (SYDJV) research project.

Through a rigorous agronomy trial program, this project developed locally relevant agronomic packages for soybeans and mungbeans in tropical sugarcane systems and investigated the profitability and productivity implications of longer fallows within this system.

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Conclusions

The major conclusions to emerge during the course of the project are:
1. Pulses provide an ideal fit within the sugar crop cycle of the Burdekin and the local climate offers numerous options for planting a range of grain crops including pulses (such as soybeans and mungbeans) and maize. The tropical, frost free climate allows wide planting windows and the ability to grow two crops per year of mungbeans, soybeans, maize and rice. This has significant agronomic and economic advantages.

2. The large rotation trial demonstrated that returns to growers are superior from the long fallow system where three grain crops have been planted and harvested compared with the more typical sugarcane dominated system.

3. Furthermore, the rotations with both single and multiple pulse crops have had positive impacts on following sugarcane yields. Whilst the crop cycle is not complete, the substantial responses in sugar yield from these rotations suggest that this may be an ideal system for grower sustainability and profitability. There remain some unanswered questions whether sugarcane yield over a crop cycle will be equivalent to that from a short fallow conventional system.

4. Existing soil testing parameters for potassium (K) may not be a true reflection of block K levels, possibly underestimating plant available K. Leaf or sap tests may be a more useful tool. This may be possible to explore in the second iteration of the coastal grower solutions program.

5. Optimum time of planting for mungbeans is late August-early September for spring plantings and late January for summer plantings.

6.. Optimum time for planting soybeans is late December-mid January for summer plantings and late April-late June for autumn winter plantings

Recommendations

Recommendations that emerged during the course of this project:

1. Growers in the Burdekin district need to establish a farming system which works best for them. They need to realise the potential of their land and financial return on their water resources and the numerous rotational fallow options that are available to them. There is now a critical mass supporting grain cropping within the district. Growers can enjoy the economic, agronomic and environmental benefits by breaking the sugarcane monoculture with properly managed fallows of different durations and understand the details and components of a farming system that is the most profitable for them.

2. Plant population investigations conducted on mungbean varieties Crystal$^{\Phi}$, Satin II$^{\Phi}$, Berken and Jade$^{\Phi}$ demonstrated that

increasing the planting rate of mungbeans to 500,000 plants/ha did not increase productivity. Current populations of 250,000 to 300,000 plants/ha maximised productivity and profitability.

3. Experiments conducted on soybean varieties Leichhardt, Stuart(Φ), A6785, Bunya(Φ), Fernside(Φ) and Hayman(Φ) suggest that plant populations of 200-300,000 plants/ha are suitable for summer plantings to maximise the yield potential of these current soybean varieties. For winter plantings (not Fernside or A6785), increase plant populations to 400-500,000 plants/ha.

4. This GRDC project for the Burdekin has proved a very valuable resource and point of contact for growers, agribusiness and other agencies. It is important that growers have access to independent and unbiased information. The Department of Agriculture and Fisheries (DAF) is in a unique position to be able to work with growers and GRDC to deliver a benefit to industry.

Outcomes

Economic
The major economic outcome results from the increased area planted to mungbeans and soybeans. Mungbean area increased from 500ha in 2011 to approx. 5,000ha planted in 2015/2016, 300ha of sunflowers and 1,500ha of soybeans. This expansion of crop area brings significant economic benefits such as additional income from grain sales, marketing, seed cleaning and grading, transport, crop checking, sale of crop protection products, machinery purchases and contracting.

To date, the large rotation experiment shows that well managed pulse rotations in the sugarcane system result in increased sugar yields. While the trial has not concluded, sugar yields following the long rotations (soybeans, maize, mungbeans) have surpassed those from traditionally managed fallow periods. In addition, the grower has had the income from the three grain crops to supplement income from sugar. Input costs in this system, particularly herbicides, have also been reduced. Adopting permanent beds and controlling weeds at the start of the crop cycle, and then rotating between grass and broadleaf crops allows cheap selective herbicides to be effectively used. The excellent weed control from using these strategies has also contributed to the high sugar yields.

Environmental
Growing pulses over the summer wet season and providing ground cover is an important tool to reduce sediment loss and prevent leaching and runoff of nitrate nitrogen in the soil profile. The pulses also prevent denitrification, an important greenhouse gas (GHG). Planting pulses into the sugar cropping system has significant soil health benefits, allowing growers to reduce nitrogen (N) applications with sugarcane. Starting the crop cycle prior to planting pulses, preparatory weed management sprays with cheap knockdown herbicides such as glyphosate(#) and then using selective herbicides (where required) like haloxyfop(#) have reduced the overall herbicide use across a crop cycle.

The project demonstrated that a finishing irrigation in mungbeans following the second irrigation produced no yield or quality downgrades. The significant reduction in applied irrigation has both environmental benefits from reduced runoff, leaching and also economic benefits from actual water and pumping costs.

Social
Expansion of areas sown to grain crops has resulted in employment of additional staff by agribusiness, as has the emergence of grains processing facilities (Blue Ribbon Seeds and Sunrice). These complementary crops have also offered growers opportunities to improve their cash flow, diversify their income streams and the multiplier effect of employment through increased transport, machinery, crop checking, and sales of crop protection products.

An Integrated Pest Management (IPM) workshop and Certified Mungbean Agronomy course educated growers and advisers about the need to spray strategically with soft chemistry, also a significant health issue for growers who have been using older, far more toxic chemicals.

Achievements/Benefits

Background
This project worked solely in the Burdekin district of north QLD. As the largest sugar producing area in QLD, this region provides unique opportunities for complementary grain cropping. There is approx. 90,000ha of flat, fully irrigated land almost

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exclusively planted to sugarcane, of which 15,000ha is fallowed annually. The Burdekin is also unique as the frost free winters allow counter-seasonal opportunities for grain cropping - summer crops from traditional southern grain growing areas (Darling Downs) can be grown in the winter period. The ability to grow two crops of mungbeans, soybeans, maize, sunflowers or rice in any year provides great opportunities for rotational cropping within the sugarcane system. This has significant marketing advantages as does the location of the Townsville Port which provides an eight day ocean transit to China (as opposed to 26 days from Brisbane).

A local management committee made up of project staff, local growers and GRDC identified and prioritised local grain productivity issues.

Major achievements
- An increase in area planted to mungbeans from 500ha (pre-project) in 2011 to approx. 5,000ha at March 2016.
- An increase in area planted to soybeans from 400ha to approx. 1,500ha over the same time period.
- Growers who have adopted these grain rotations into their farming systems have seen significant financial benefits to their incomes, with typical gross margins of approx. $1,000/ha+ for each grain crop grown.
- For those who undertake longer breaks within the sugarcane crop cycle, the possibility of cropping instead of an 18 month fallow and earning more than $2,500/ha, is an opportunity too good to pass up. Sugarcane yields following these long fallow breaks have been significantly higher than those from conventional systems and furthermore, their growing costs have been reduced because weeds have been controlled through the cropping rotation.

Increased knowledge and capacity of local agribusiness

At the start of the project, existing local agribusinesses had few specialist grains agronomists, relying on existing (sugarcane) staff to assist the few growers who grew grain crops in sugarcane fallows. As a result of negative experiences, growers lost interest in growing these rotational crops.

By late 2015 at project completion, four local agronomists became successfully accredited mungbean agronomists through Pulse Australia, with a new course scheduled for 2016. Hugh Brier (DAF Pulse entomologist) ran a successful IPM course on February 22 in Ayr. To service the grains industry, there are now six local agronomists with high level grain agronomy skills and associated accreditations. It is now unusual for DAF Townsville to be contacted with grain agronomy questions, whereas in the early project days, it was common to field three to four enquiries per week with agronomy questions.

Mungbean trials
On-farm research was conducted in mungbeans investigating: Varieties, time of planting, plant density, K nutrition, timing of final irrigation, insecticide product and timing in mungbeans.

Project outputs from the mungbean experimental program:
- Burdekin mungbean crops did not respond to planting densities, with plant populations approx. 300,000 plants/ha optimal for yield and quality.
- Burdekin mungbean crops should be sprayed for maruca with a soft, selective insecticide (Altacor®# or Steward®#) immediately upon sighting the first flower in the crop.
- Crystal(ϕ), Satin II(ϕ), Jade(ϕ) are all highly productive varieties with possible yields of more than 2.5t/ha. They are well suited to the Burdekin climate and farming systems, however grower varietal choice will depend on intended market, buyer preference and contracted price offered.
- Establishing that many local mungbean crops are being over irrigated, causing difficulties with crop maturity. The recommendation for alluvial soils is to apply the final irrigation approx. three weeks before harvest.
- Burdekin mungbeans do not require inoculation with Group I rhizobia as these are endemic in Burdekin soils.
- Mungbeans have wide planting windows and perform well in both late summer and spring plantings with a preference for spring planting from mid to late August-mid September to minimise adverse weather damage at both planting and harvesting.
- Detailed historical climatic analysis used, in combination with day degree data for mungbeans, has allowed accurate prediction of ideal planting dates and key crop management milestones. This project output has been widely used by growers in the Burdekin.

Soybean trials
On-farm research was conducted in soybeans investigating: Varieties, time of planting, and plant density.

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Areas planted to soybeans in the Burdekin have increased over the course of the project with approx. 1,500ha of grain soybeans planted in 2015. Grower preference has currently moved towards mungbeans in view of their very short growing season, water use efficiency (WUE) and (current) high prices on offer.

Project outputs from the soybean experimental program:
- Soybeans did not respond to planting density increases in summer plantings with plant populations of 200-250,000 plants/ha ideal for yield and quality
- Leichhardt, Stuart(Þ), M103-17, M103-22, Fernside(Þ), Bunya(Þ), and A6785 are all productive varieties with yields of more than 3.5t/ha possible. These varieties are well suited to the Burdekin climate and farming system, however grower varietal choice will depend on intended market, buyer preference and contracted price offered.
- It is hoped that M103-17and M103-22 varieties are commercialised as soon as possible as they performed well in both summer and winter plantings, have a very high lodging tolerance and produce very high quality grain that should be appealing to both domestic and export markets.
- Summer soybean crops (except A6785) are best planted after the summer solstice (December 21) to mid to late January. Consult agronomy guides for information.

Industry Benefit
This project has provided a substantial benefit to the grains industry and to GRDC. There is now a critical mass of growers to support a small but growing grains industry. There has been an almost 8-fold increase in the area planted to mungbeans, with a corresponding increase in the GRDC levy contribution. An increasing number of growers are achieving good results from even first time mungbean crops. From these successes, more new growers are trialling small areas (10-20ha) of mungbeans to gain experience and gauge their results with this crop. Increased confidence with these crops creates a positive feedback loop and further leads to increased areas planted. At the time of completing this report (late March 2016), there are between 40-50 growers with mungbean crops covering almost 6,000ha.

Crop areas of soybeans have also increased from approx. 500ha in 2011 to 1,500ha at the project conclusion. There have also been small areas of less commonly seen grain crops like sunflowers, with approx. 300ha planted for the birdseed market.

Other research

Other research and development (R&D) opportunities emerged during the course of the project:

1. Investigate timing of final irrigation of mungbeans on different soil types, particularly heavy clays to establish impacts on grain yield and quality, in view of the large area planted to mungbeans across a range of Burdekin soil types. This is particularly pressing research that needs to be undertaken as soon as possible.

2. Investigate pest management parameters for growers using grain on grain rotations in minimum and zero tillage (ZT) situations. Possible issues are emerging with bean fly incursion in mungbeans and lucerne crown borer in soybeans.

3. Quantify economic, agronomic and environmental effects from rotational cropping on a commercial scale within the sugarcane system. Several growers in the Burdekin have moved to this system as a result of this project, but no economic analysis has been undertaken at this commercial scale.

4. Further agronomic experiments are conducted to fill in knowledge gaps that emerge with the expansion of the grains industry in the Burdekin. Areas requiring additional investigation include:
a) Investigate responses in soybeans, mungbeans, and maize to determine non-limited yield potential and use this information to establish limiting parameters for best possible crop yields.
b) Row spacing and density parameters in mungbeans and soybeans - does row spacing and configuration impact on grain yield and quality?

5. Investigate markets and options for other levy paying grain crops that can be utilised within existing Burdekin farming systems

Additional information

Attachments

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1. Agribusiness and adoption of rotational grain cropping.

2. Field walk handout 2012 - Agronomic trials on grain break crops.

3. Case study.

4. Cropping solutions for Burdekin farming systems.

5. Field walk handout 2012 - Time of planting experiment.

6. Addendum to Burdekin Soybean Growing Manual.

7. Review of project experiments.

8. Project update.

9. Survey results.

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