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Grains Research and Development Corporation

RAISING THE BAR WITH BETTER SOYBEAN AGRONOMY

Soybean case studies and demonstration site activities

SUMMER 2010

AOF

better OILSEEDS

GRDC

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Front cover: Ian Morgan, Philp Brodie Grains, front right, inspecting a Darling Downs soybean crop with visiting north coast NSW growers as part of a Better Oilseeds activity. Photo: Sue Knights.

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INTRODUCTION

Soybeans are a summer legume that are playing an increasingly important role in cropping rotations on the eastern coast of Australia, in a variety of cropping systems stretching from Victoria to Queensland. The last decade has seen many advances for the Australian soybean industry.

Traditionally, the main market for Australian grown soybeans has been the crushing sector. Up until the late 1990's almost 50% of the crop was crushed for meal and oil and a further 25% went into full fat meal for intensive livestock. The human consumption market only accounted for around 25-30% and the remaining 5% was retained for planting seed. There were little or no exports. This has changed significantly in recent years with the crush and full fat sectors declining, increasing domestic consumption of edible beans and an expansion of the edible soybean export market. This shift has been driven by higher returns from the edible market facilitated by the availability of new varieties targeted at the higher quality these markets require. Demand from Asian countries, including Japan, Taiwan, Thailand, Singapore and Indonesia, for Australian edible soybeans has grown. Japan alone imports almost half a million tonnes of tofu grade soybeans each year. At present the US and Canada are the major suppliers to these markets. However, Australian soybeans have been well positioned as a premium product at the top end of the market. This export opportunity is based on Australia's reputation for high quality, identity preserved, non-GM and an outstanding food safety record. In particular the expansion of GM elsewhere in the world has opened a niche human consumption market for Australian soybeans.

The 2008/09 season saw the first operational year for Soy Australia, the peak industry body. This company represents the interests of soybean growers across Australia, with its main purpose being to commercialise new varieties of soybeans developed with the support of the Grains Research and Development Corporation (GRDC) funded National Soybean breeding project. This project is a joint venture between CSIRO and Industry & Investment NSW.

This booklet has been compiled by a team of agronomists and researchers who support the Australian soybean industry. It is one of the outputs from the Better Oilseeds project funded by the GRDC and Australian Oilseeds Federation (AOF). It showcases the management practices of leading soybean growers together with reports from demonstration sites of topical agronomic practices within the different soybean production regions to improve grower knowledge and soybean production. ***Readers should be aware that the demonstration data is from unreplicated sites and should be interpreted appropriately.***

THE BETTER OILSEEDS PROJECT

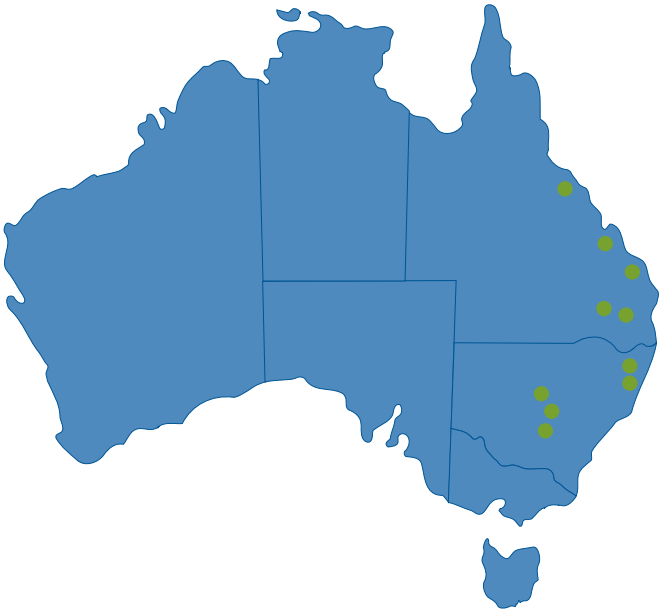
The Better Oilseeds project was jointly funded by the GRDC and AOF and commenced in 2006. The project provided much needed support for oilseed growers, aiming to lift the productivity of oilseed crops ensuring critical mass and consistency of production, and to improve the quality of grain produced.

Australian oilseed production peaked in 1999, but the peak was less than what many analysts believed was the potential Australian oilseed production. In recent years poor seasonal conditions and/or lower prices have resulted in the crop area declining from the 1999 peak and resulted in oilseeds disappearing from some traditional production areas.

This project aimed to put aside the weather and price factors and to look at ways the industry could be supported. The project outcome was for the industry to improve the skill level of advisers and growers so that they could more reliably produce oilseeds under our current climatic conditions.

Specific project aims were:

- *To capture all existing knowledge and place relevant information onto an easily accessed website.*
- *To utilise existing successful growers and share their knowledge with other growers within their region.*
- *To address common problems/issues through demonstration field sites. Issues were determined through a review but could include: cost of production; rotational benefits/farming system approach; decision support on when to grow an oilseed given a range of grain prices and dates of the opening rains; disease management etc.*
- *To conduct regular forum and field days to engage advisers/ growers and get them thinking about what the possibilities were for their clients/farms.*
- *To identify and highlight ways that growers could improve grain quality to make the industry more competitive.*



Better Soybean demonstration site and case study locations

SUMMARY

This book is one of the outputs from the Better Oilseeds project and brings together a collection of the activities undertaken for soybeans over two seasons of the project, specifically:

Case studies to showcase the diversity of soybean production systems

Twelve soybean case studies are included spanning the production regions from the Riverina in the south to Mackay in the north of Australia. Compiled during the growing seasons 2006/07 and 2007/08 the case studies illustrate the diverse cropping systems that soybeans are grown in within Australia and the complex reasons why growers choose to grow soybeans including:

- suitability for double cropping systems
- lower water use than other summer crops and ability to handle periods of moisture and temperature stress
- adding nitrogen to the cropping system reducing fertiliser costs
- perform well on low pH soils
- a good disease break crop particularly in sugarcane systems
- a good soil conditioner
- being quite profitable in their own right
- filling the winter feed gap in beef businesses

Each grower shares their keys for success with soybeans in their cropping system and region, including:

- choosing an appropriately adapted variety for your region and sowing at the optimum planting date
- controlling weeds
- using minimum tillage
- controlling insects, especially through integrated approaches
- managing irrigation to ensure plants are not stressed
- monitoring crops regularly, using good husbandry and ensuring timely operations
- ensuring good harvesting techniques

Demonstration sites to showcase key production issues in the soybean regions

Five demonstration site reports are included, undertaken in the 2006/07 and 2007/08 seasons in key soybean production regions of Australia. The nature of these sites were determined by the Soybean Advisory Group and considered highly relevant to the production region where they were demonstrated. Field days were held each season to communicate the production issues to growers and advisers.

A double cropped soybean water usage demonstration undertaken at Coleambally in 2007/08 showed that a double cropped soybean crop of Djakal yielded approximately 3.4t/ha using 7.5ML/ha of water. Of this 7.5ML, 2.3ML was drainage water and was recycled. Soil moisture probes indicated less water was used when only targeting to refill the root zone of the soybean plants when planted on the outer edge of the raised bed. It takes more water and time to refill the entire soil profile under the bed.

A soybean fertiliser demonstration undertaken on Chatsworth Island in the North Coast region of NSW in 2006/07 used a soil test and a soybean nutrient budget to determine the correct type and amount of fertiliser required. Yield data was collected from the fertilised and unfertilised areas in the same paddock. The fertilised areas yielded 1t/ha higher than the unfertilised areas.

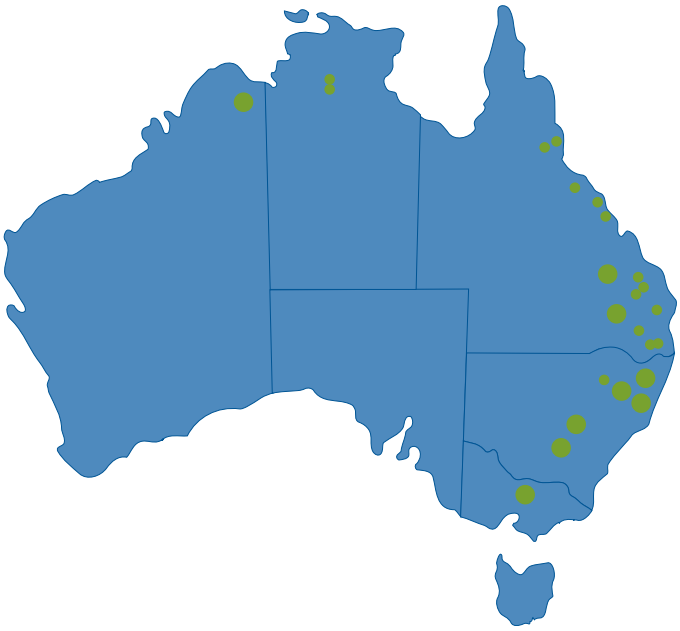
A soybean plant density demonstration also undertaken on Chatsworth Island in 2006/07 showed that a crop sown at the recommended rate for that region and sowing time yielded 0.5t/ha more than the crop that was planted at too high a planting density.

A cane trash management demonstration undertaken in Wide Bay in 2006/07 showed that farmers in the Bundaberg area can improve profits from soybeans by adopting minimum tillage practices. It also indicated that thick cane mulch in the plant line can reduce final yields through planting and establishment difficulties, or through the release of growth inhibiting chemicals.

Another demonstration in the Wide Bay region in 2007/08 investigated pre- and post-emergence weed management options.

SOYBEAN PRODUCTION REGIONS IN AUSTRALIA

Australian soybean production regions extend from 37° South in the temperate zone to 16° South in the tropic zone.



Victoria

In northern Victoria, soybeans have been produced since the 1980s as a summer crop in the irrigation areas. In these areas summer temperatures are warm and day length is long. Most crops are grown on border check irrigation. However with the decline in irrigation water allocation soybean production has declined proportionately. The main varieties grown are culinary types and soybean is sometimes grown in a double cropping rotation with winter cereals.

New South Wales

In southern NSW soybeans traditionally have been produced under irrigation in the Murrumbidgee, Murray and Lachlan Valleys. Soybeans can be a profitable crop for irrigated farming systems in this region, particularly where the crop addresses the quality standards for human consumption markets. Significant premiums are paid for soybeans suitable for these markets, making the crop more attractive where high yields are achieved. New short-season varieties allow for double cropping with winter cereals. Reduced water allocations have impacted significantly on the production in southern NSW.

In northern New South Wales the crop has been successfully grown over a long period in all of the irrigation areas from the Macquarie valley north to the Queensland border. While the areas grown reflect strong competition for scarce water from other crops, many producers have retained soybeans in their crop rotations. Long-term success has also been achieved in many seasons growing dryland soybeans in the milder areas of the North-West Slopes and Northern Tablelands. Dryland soybeans have been shown to have a beneficial role in mixed livestock and crop-farming systems.

The North Coast of NSW has become the largest soybean producing area in Australia as a result of expanding soybean production in the region, coupled with extensive inland drought, particularly in Queensland. In this region, soybeans are grown mainly in the Clarence and Richmond valleys and as far south as the Manning Valley. The crop is grown on better class alluvial soils, on mixed soil types in rotation with sugarcane, on lighter textured hill soils in pasture development programs and in rotation with winter and summer cereal crops.

Queensland

Traditional soybean growing areas in Queensland include the Darling Downs, central Burnett and Atherton Tablelands. In more recent years production has expanded to coastal areas where the crop is produced in rotation with sugar cane. This includes the Wide Bay region, Mackay and Burdekin.

In the inland subtropical region of the Darling Downs soybeans are grown under irrigation in rotations with winter crops where they compete for a place with other summer crops, in particular cotton and sorghum, the choice of which is driven basically by the profitability of the crop.

In the cane cropping systems on the coast, soybean is largely grown as a rainfed break crop. These crops may be grown as green manure or managed appropriately and harvested for grain. The use of soybeans as a break crop in sugar systems has significantly increased subsequent sugarcane yields due to the reduction in pest and disease pressures and provision of nitrogen from the soybean crops.

Dr Natalie Moore (Grafton) and Dr Ian Rose (ex Narrabri) Industry & Investment, NSW

BETTER SOYBEANS DEMONSTRATION

Double cropped soybean water usage demonstration

COLEAMBALLY, SOUTHERN NSW, 2007/2008

Luke Gaynor, Research Agronomist, Industry & Investment NSW, Wagga Wagga

What happened?

A double cropped soybean crop of Djakal yielded approximately 3.5t/ha using 7.5ML/ha of water. Of this 7.5ML, 2.3ML/ha was drainage water and was recycled. Soil moisture probes indicated less water is used when only targeting to refill the root zone of the soybean when planted on the outer edge of the raised bed. It takes more water and time to refill the profile under the entire bed, which is not really necessary on wide row spacings.

Luke Gaynor, Industry & Investment, NSW, Wagga Wagga

Background

Faster growing, shorter season soybean varieties have been bred for the irrigation areas of southern NSW and northern Victoria. These new higher-yielding varieties, coupled with good crop agronomy and management mean that growers in these regions now have much greater flexibility with soybeans. Due to their short growing season, they can be sown in back-to-back summer-winter continuous cropping rotations until landforming/bed renovation or a change in irrigation system is required. Such systems can maximise water use efficiency within the irrigated cropping system and provides the option of growing high quality soybeans for human consumption markets with an attached premium. Monitoring, however, is paramount, by using key checks during the season to ensure crops yield to their maximum potential.

Demonstration site aims

The aim was to demonstrate what is happening in terms of water use on a commercial scale in a soybean crop for double cropping irrigators in southern NSW.

Site details

The site was a double cropped field of permanent raised beds (1.83m wide), with the soybeans following a winter soft wheat crop which yielded 6.25t/ha. The wheat stubble was removed (baled & burnt) prior to planting. The variety Djakal was sown early December 2007 into a pre-watered field with a targeted population of 35plants/m^2. No fertiliser was used in the soybean crop as soil phosphorus levels were high from previous fertiliser applications. Another soft wheat crop followed the soybean crop.

- Location - Bellato's property just outside Coleambally (southern NSW)
- Soil type: Grey vertosol
- Beds: 1.83m raised beds with 2 plant rows per bed. Runs were 380m long
- Irrigation:
  - Type: siphon into furrows
  - Frequency: when required as per plant water use and pan evaporation (approximately every 7-14 days)
- In-crop rainfall: approximately 100mm

Method

Soil moisture probes were installed to monitor water use in the raised beds. Two soil probes were placed on the plant row and two placed in the middle of the bed. The probes were one metre capacitance probes with sensors at 10cm, 30cm, 50cm and 80cm depth. All probes were connected via cable to a solar powered data logger, which was downloaded to a computer on a monthly basis. These probes monitor soil moisture movement, plant water usage and moisture refilling during irrigation.

Water flow meters were placed in the irrigation furrows and siphons to record flow rates onto the field and also off the field in the tail drain. Water use monitoring in the soybean crop included irrigations and all rainfall. A weather station was also located at the site to correlate water use with climatic conditions.

Irrigation details were:

- Quantity:
  - Inflow through siphon: 73mm
  - Tail drainage: 23mm
  - Infiltration: 50mm
- Irrigations: 10 (including pre-water)
- Water use:
  - On to field = 7.5ML/ha
  - Drainage = 2.3ML/ha
  - Infiltration = 5.2ML/ha

Results.

One of the main issues that became obvious from the demonstration was the effect of letting the middle of the bed dry out. This happened prior to the irrigation on 5 March. Normally when the irrigations are applied only the top 40-50cm has run out of readily available water. On the 5 March, all levels down past 80cm had been depleted, making the irrigation event use more water, take longer, and be less effective than the earlier irrigation events. This is illustrated in Figure 1.

Table 1. Summary of Irrimate flow meter and field observations

Irrigation options			
	Actual measured irragation event	Maintain maximum flow of 1.8L/sec (same inflow volume)	Maintain maximum flow of 1.8L/sec (shut off at end)
Flow rate (L/sec)	1.34	1.80	1.80
Time - water applied	10hr 31min	7hr 30min	0hr 34min
Time - advance to end of field	6hr 31min	5hr 44min	5hr 44min
Target application (mm)	63	63	63
Inflow (mm)	73	72	55
Tailwater (mm)	23	26	9
Water infiltrated (mm)	50	46	46
Application efficiency (30% of tailwater recycled)	95%	95%	95%
Potential water (ML/ha)	-	0.03	0.05
Water use (ML/ha)	7.5		
Drainage water recycled (ML/ha)	2.3		
Infiltration and crop water use (ML/ha)	5.2		

On this occasion, the water did not reach the middle of the bed at all and if plants had been there they would have been under stress conditions. This drying of the soil coincides with the crops peak water use period. Rainfall events during 2008 summer (January and February) would have helped keep the profile full in the mid bed area.

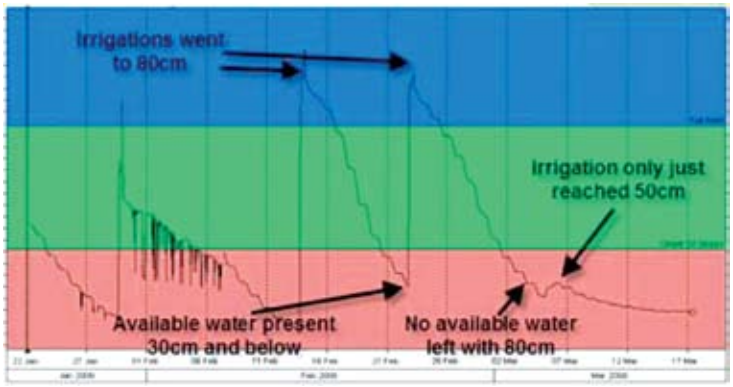


Figure 1. Irrigation events and soil water movements

In summary, it takes more water and time to fill the profile to the middle of the bed and is inefficient for summer crops in the hot, dry environment of southern NSW. Further examination of individual plant yields across the beds would be necessary to ascertain where the highest yield is located. It is hypothesised that the vast majority of yield and high protein beans would come from the plants on the shoulder of the bed (closer to water source in the furrow) and a higher proportion of beans would experience insect damage in the middle of the bed (as they become stressed sooner and therefore are more likely to be subject to insect attack).

Greater Water Use Efficiency (WUE) is achieved by only having 2 rows per bed and crop water use could be reduced if only aiming to refill the root zone not the entire bed. In a rain-fed environment this is not particularly relevant. Keeping the soil moist reduces the amount of time it takes to refill the profile mainly due to the nature of vertosol soils and the self cracking properties ie once cracks form, irrigation water infiltrates deeper and it takes longer to fill up. More frequent shorter periods of irrigation will help maximise WUE and reduce stress periods on the plant and help maintain or even boost protein levels and yield potential.

Commercial relevance

At 2007/08 soybean prices of $750/t and higher, growers can use these WUE's to calculate gross margins from their own costing. Combined with the income from the wheat crops this results in a very healthy profit per hectare and per megalitre.

Table 2. Water use efficiency (WUE) and tonnes/ML

Yield (t/ha)	Maximum water use (no recycling) (ML)	Minimum water use (full recycling) (ML)	Maximum WUE (t/ML)	Minimum WUE (t/ML)
3.5	7.5	5.2	0.47	0.67

Acknowledgements

Paul Hudson and technical staff from CropSol for irrigation measurements and calculations and Coleambally Irrigation Cooperative Ltd.

FARMER CASE STUDY

Better water use for soybeans

COLEAMBALLY, SOUTHERN NSW

Paul Bellato, brother David and father Vic

Location: 5km from the Riverina town of Coleambally, NSW.

Enterprises: The family produce a range of summer and winter crops. Rice has been the 'mainstay', but they also grow soybeans, maize, soft wheat, faba beans, oats, malting barley, wool (400 merino wethers) and prime lambs (about 800 first-cross ewes with lambs at foot).

Property size: Around 1200ha.

Average annual rainfall: 380mm.

Soil type: Mostly brown-grey self-mulching cracking clays.

Soil pH_{ca}: Neutral 6.0-7.0.

Keys to success with soybeans

As Paul and his family produce edible soybeans, quality is critical. To ensure high quality they:

- Retain the structure of the raised bed (i.e. keep the tops of the bed flat) to prevent soil discolouring the grain.
- Control weeds which can result in contamination (e.g. Bathurst burr) or staining (e.g. blackberry nightshade).
- Control insects, particularly pod-sucking insects during podding which can adversely affect seed size, shape and flavour of the bean.
- Carefully manage irrigation, in particular timing the final irrigation before maturity which ensures large grain size, which is strongly desired by the end-user for tofu manufacture.
- Grading of grain to meet end-user's specifications.

History of property

The Bellato family has grown soybeans for more than 20 years and in recent years has moved to the high yielding human consumption varieties.

Area of farm under irrigation layout (ha)

All of the property; 1200ha.

Types of irrigation on farm %

50% landformed contour (rice bays), 50% raised beds.

Farm water allocation (ML)

In the 2007 season the Bellatos had a 450 megalitre allocation per farm for six farms, plus 650ML of bore water on one farm. With the low allocations in recent years, three farms were dry in 2006 and the other three had water, which was recycled.

Raised bed size and slopes

Beds are 1.83m wide (centre to centre). Most slopes are 1:1200 to 1:1800, although some are 1:200 (1:500 is considered ideal). Paddock length ranges from 400m to 1km (700m is considered ideal for water application and drainage).

Why grow soybeans?

- The main benefit of soybeans to the Bellato family, in the double cropping system, is the added cash flow it generates. Although yields of soybeans following a cereal are slightly lower than following fallow, the income from two crops more than compensates for this. When it all comes together, the returns are high.

Paul Bellato and Luke Gaynor, I & I, NSW, Wagga Wagga

- Soybean is the only summer grain crop that can be sown late enough to allow growers in the region to immediately follow a winter crop. They are the only summer crop which allows for double cropping year in year out.
- Soybeans are the most flexible and simple of all the summer double cropping options for the region.
- The family has the equipment set up for double cropping with soybeans, allowing for one person to harvest while another is sowing. Also, in some years the seeder has immediately followed the harvester to sow a winter cereal.
- Newer varieties such as Djakal have the ideal growing season length. Unlike rice and maize, which are sown in the first half of October, soybeans are sown from mid November and harvested in late March to mid April. The different sowing window from rice and maize is a bonus, spreading the workload at sowing time. The same applies at harvest.
- Greater water use efficiency use across the farm is another major benefit. The Bellato's soybean crops receive their final watering just before maturity, to ensure high yields and large seed size, which is strongly desired by end-users.
- The following winter crop can be sown on-time directly into moisture and gets away to a great start, and utilises the winter rain.
- The soybean stubble is spread evenly across the beds by the header's straw spreaders and there has never been an issue of planting wheat through it.
- Soybeans are a low water user compared with other summer crops, and the combined gross margin both on a per hectare basis and a per megalitre basis can be better than a single summer crop of rice or maize (see Table 1).
- Soybeans are a legume, and require no nitrogen fertiliser, a major cost for other summer crops.
- For the Bellatos, soybeans are a lower financial risk as they have much lower up-front costs, compared with maize.
- It doesn't take a lot of expensive preparation to double crop.
- Soybeans provide a disease break to cereal crops.

Negative aspects of growing soybeans

Paul says the only limitation to growing soybeans in a double cropping system is the risk of a wet harvest for both the winter and summer crops. This can delay harvest and the planting of the next crop. But that's not just a problem for soybeans, it's for all summer crops.

Sowing system

Once beds are formed, soybeans are direct drilled and sprayed with a knockdown herbicide. The Bellatos pre-water, then sow the soybean directly into a moist seedbed, they may give the paddock a quick irrigation to ensure maximum germination.

Harvesting equipment

Soybeans are normally harvested in April, but sometimes in May.

Paddock preparation

Cereal stubble is burnt or baled, the paddock is normally pre-watered, sprayed with a knockdown herbicide and sown. If the soybeans are sown following a fallow, single super is banded and they shape the beds earlier in the year using power harrows and furrowers. After about three and a half years (seven crops), the beds can become flat and need to be knocked out, trimmed with a laser bucket and rice banks put in. The paddock is then sown to clover and oats, flushed in February and ready for rice again. Rice is sown for a maximum of three consecutive years. The paddock is then lasered and a winter crop sown.

Varieties

The Bellato family prefer shorter maturing varieties, which permit double cropping. They are currently growing the culinary variety Djakal and have grown the culinary variety Snowy$^{\phi}$ for seed increase in the recent past.

Crop nutrition

When following a winter crop, no fertiliser is used, and the crop uses residual phosphorus fertiliser from the previous crop. 200kg/ha DAP is applied to wheat either banded or spread with a spreader. Poultry manure is incorporated at the start of the rotation before beds are put up, but not applied before the soybeans.

Single superphosphate is applied at the rate of 250-350kg/ha if soybeans are sown after fallow.

Weed control

Grasses are sprayed with Asset® or Verdict® for barnyard grass at the 3-4 leaf stage. A shielded sprayer is used for Bathurst burrs. Spinnaker® is now being used two weeks later for Bathurst burr and blackberry nightshade.

Pest management

The Bellato family time their sprays for insects based on resistance management strategies to ensure rotation of chemical groups and minimise the detrimental effects on beneficial insects. They use a shielded sprayer when spraying post-emergent herbicides with an insecticide. They have moved to using Decis® during pod set for *Helicoverpa* spp. The family have also hosted an integrated pest management workshop at their farm.

Disease management

Diseases are managed through crop rotation, selection of varieties with disease resistance and taking care not to waterlog paddocks to prevent phytophthora root rot.

Dr Hugh Brier, DEEDI, QPI&F

Cost of production

Table 1. Typical gross margins of rice and maize as a single crop, compared with soybeans-barley in a double cropping system in the Coleambally Irrigation Area. Figures applicable December 2007.

		High yielding soybeans	Soybeans in double cropping	Barley in double cropping	Combined soybeans-barley	Med. grain rice	High yielding medium grain rice	Maize	High yielding maize
Yield	t/ha	4.6	3.2	5.5		10	12.5	10.5	13
Price	per t	$650	$650	$360		$404	$404	$400	$400
Income	per ha	$2990	$2080	$1980	$4060	$4040	$5050	$4200	$5200
Variable Costs:									
Operations	per ha	$156	$156	$123		$263	$263	$199	$199
Seed	per ha	$115	$115	$40		$34	$34	$318	$318
Fertiliser	per ha	$87	$87	$185		$186	$186	$491	$491
Chemicals	per ha	$100	$100	$4		$177	$177	$66	$66
Irrigation ($28/ML)	per ha	$238	$210	$42		$392	$448	$280	$280
Insurance	per ha	$26	$20	$9		$22	$22	$40	$40
Water Use	ML/ha	8.5	7.5	1.5	9	14	16	10	10
Total variable costs	per ha	$722	$688	$403	$1091	$1074	$1130	$1394	$1394
Gross margin	per ha	$2268	$1392	$1577	$2969	$2966	$3920	$2806	$3806
Gross margin	per ML	$267	$186	$1051	$330	$212	$245	$281	$381

*Note. assumes for all crops cost of $28ML for irrigation water. Yields of soybeans, maize and barley as single crops are usually higher than when double cropping.

The typical soybean-barley rotation provides a gross margin of $1704 per hectare, compared with only $1326 per hectare for rice – a difference of $378 per hectare. And for every megalitre of water used, the double cropping system is higher value, with a gross margin of $162 per megalitre, compared with $95 per megalitre for rice.

Crop compared to other crops

- Later sowing date of soybeans compared with all other summer crop options (like rice and maize) allows it to follow a winter crop.
- Soybeans are easier to manage than maize and are more flexible for double cropping.
- The different sowing and harvest window spreads the workload at sowing time and harvest.
- Soybeans require less water per hectare than rice and maize.
- Soybeans require no nitrogen fertiliser, a major cost for other summer crops.
- Soybeans carry a lower financial risk as they have much lower up-front costs than maize.
- Soybeans provide a disease break when grown in rotation with winter cereal crops.

Crop intensity

Normally 50% of the area sown to winter crops is wheat, 30% barley and 20% either faba beans or oats. For the summer crop, the ideal percentages are 60% rice and 20% each of maize and soybeans. But with the recent dry years with low water allocations, it has been more like 40% rice, 40% maize and 20% soybeans.

Crop yield

The Bellatos achieve a minimum yield for the soybeans of 3.5-3.7t/ha on fallow and a minimum of 3.0t/ha when double cropping. In 2007/08 the crops yielded 3.75t/ha

FARMER CASE STUDY

Better monitoring of soybeans

WHITTON, SOUTHERN NSW

Rob Houghton

Location: 8km east of Whitton, near Leeton, southern NSW

Enterprises: Rob grows soybeans and rice in summer and prior to 2004, grew maize. Winter crops include barley, canola and wheat and sometimes faba beans.

Property size: Around 500ha.

Average annual rainfall: 400mm.

Soil type: The farm includes sandy clay loam, transitional red brown earths and self-mulching grey clay.

Soil pH_{ca}: Neutral and ranges from 6.0 to 7.0 on heavier soils. On lighter soils, the pH was previously 4.9, but is now 6.0 to 6.5, due to three applications of 2.5t/ha lime every five years.

Keys to success with soybeans

- To ensure high quality soybeans, Rob adheres to 'key checks' throughout the cropping season. This includes ensuring optimal plant densities are achieved for good weed competition. He aims for the crop to avoid moisture stress, but has now found that irrigation schedules can be stretched out during the less critical crop stages, allowing for a saving of water. Canopy cover needs to be complete by the end of January.
- The final watering of the soybeans is done quite late to ensure large and consistent seed size, a requirement of the end user. March 15 is the usual cut off date for the last irrigation, but crop yellowing and pod monitoring is a more accurate measure.
- Insects are monitored carefully to ensure that they are not doing damage to the crop in terms of quality (and yield) and economic thresholds for control are adhered to. An integrated approach is essential with synthetic insecticides only being used after February if necessary.
- Rob is considering becoming a certified organic producer to take advantage of price premiums. He has a strong belief in minimising the use of synthetic chemicals on his farm and has successfully grown soybeans without the use of any pesticides or synthetic fertilisers.

History of property

Rob has grown soybeans for more than 15 years. To begin with he grew 'black-eyed' varieties which yielded well (once exceeding 5t/ha), but these varieties were used for poultry feed, were late maturing and needed desiccation. In recent years Rob has moved to the high yielding human consumption varieties for soy milk. Rob first tried double cropping in the early 1990s, initially with canola-soybeans, but ran into problems with Rutherglen bug. He has now found a good combination of crops in the double cropping system, which works well due to the new shorter season soybean varieties.

Area of farm under irrigation layout (ha)

475ha, 25 hectares is native vegetation.

Types of irrigation on farm %

90% beds, 10% landformed contour (bankless channels for rice).

Farm water allocation (ML)

3191ML.

Raised bed size and slopes

Beds are 1.83m wide with 1:1200 slopes.

Rob Houghton & Luke Gaynor, I&I NSW, Wagga Wagga

Why grow soybeans?

- Soybeans have provided some very profitable opportunities for Rob.
- The high yielding short season variety Djakal has allowed Rob to double crop with winter cereals like barley.
- Double cropping with soybeans gives better use of residual moisture for subsequent winter crops, which has been critical during the drought.
- Rob is able to produce high yielding, high quality edible soybeans with minimal or no use of synthetic chemicals.
- He is very happy with the supply contract he has with his end-user.
- No additional nitrogen is required to grow soybeans.
- Soybeans don't have a lot of disease problems.
- Soybeans rotate well with cereals.
- The crop residue is easy to handle and is easily retained (i.e. left on soil surface).
- Soybeans can handle periods of moisture stress.
- They are more robust under slight temperature stress than other summer crops.

Negative aspects of growing soybeans

Issues with growing soybeans have included marketability (not a problem for Rob at present), the requirement for a rotary harvester, and sometimes the need to dry down beans post-harvest. Storage and grain cleaning can be costly and sometimes tedious (sometimes a breeze).

Sowing system

Rob's soybeans are usually sown between 20 November and 7 December, when double cropping. A John Deere MaxEmerge™ planter is used planting two rows per bed.

Harvesting equipment

Soybeans are normally harvested in April, but sometimes in May. A Case IH rotary header is used.

Paddock preparation

Virtually no paddock preparation is required with double cropping, which is a major advantage. Simply, the cereal stubbles are burnt or ploughed and the soybeans are sown. Rob is now trialling wider row spacings with the barley and planting the soybeans in between standing stubble.

After lasering a paddock, Rob sows a cereal - usually malting barley. The stubble is incorporated and sown to soybeans. This may be sown back to barley, then faba beans or a green manure crop, followed by soybeans and barley again. The barley-soybean rotation can follow for a few years, provided water is available.

Pre-irrigation is essential to germinate weeds for a kill with glyphosate. Plus, the soil temperature is higher at sowing time with pre-irrigation compared with watering up.

After the third soybean crop, barley is sown and the stubbles are incorporated back, rather than burnt to maintain organic matter and beds are busted. Rice is the perfect crop to rotate with this system at this point or if the soil is unsuitable for rice the beds are reformed and the rotation starts again.

Varieties

Rob has grown the newer, human consumption varieties Djakal and Snowy(1) in recent years. Djakal was developed by NSW DPI and Snowy(1) by CSIRO.

He has found that the short length of the growing season of Djakal is perfect in the double cropping system, providing 'an extra week to play with'. He has rarely produced a crop of Djakal under 4t/ha.

Crop nutrition

Paddocks receive a combination of 'chicken litter' at 5t/ha (manure mixed with rice hulls), compost and lime (2.5t/ha). In the 'cut' areas, gypsum is also used and the soil texture clearly shows the benefits of the applied organic matter.

300kg/ha Sulfos (15% P) is banded under the barley crop, so there is no soil disturbance needed prior to sowing the soybeans.

A full analysis soil test is undertaken about every two years after lasering paddocks.

Weed control

Weeds are sprayed with glyphosate after emerging with the aid of pre-irrigation. Grasses are sprayed with the herbicides Select® and Verdict®, applied with a shielded sprayer as a broad spectrum spray between the plant rows.

Pest management

Green vegetable bug and *Helicoverpa spp*. are the main pests. Rob has found that a healthy plant growing in healthy soil without moisture stress is less likely to need spraying. Beneficial bugs do a great job in this environment. However if thresholds are reached, a chemical application will be used after February.

Disease management

Rob has little trouble with disease in his soybeans. Sound soil preparation is important to him for keeping plants healthy and less susceptible to diseases like phytophthora root rot.

Cost of production

Rob aims for at least $120/ML gross margin. Variable costs have been $900-$1000/ha, including costs such as water, fertiliser, weed control and contract harvesting. Although he cannot divulge prices received, in years past, a typical gross margin budget includes a 3.75 t/ha crop at $550/t and variable costs at $990/ha, leaving a gross margin of $1073/ha. However, he has not produced a crop of Djakal yielding under 4t/ha. This is only for the soybean component of the double cropping rotation, and the opportunity to grow a winter crop in the same year means that the combined gross margin per hectare and per megalitre is much higher.

Crop compared to other crops

Soybeans are the preferred summer crop as they are the most profitable and use the least amount of water.

Crop intensity

The summer cropping mix is 50% soybeans and 50% rice. Winter crop intensity fluctuates with water availability. Summer cropping is where the good returns are - winter cropping keeps you in business in between.

Crop yield

Although Rob budgets on a 3.75t/ha yield, he has consistently grown Djakal crops with yields of at least 4t/ha. He has produced a 5t/ha soybean crop in the past with a longer maturing variety.

FARMER CASE STUDY

Better organic soybeans

COLEAMBALLY, SOUTHERN NSW

Neill and Gina Wiseman

Location: Coleambally, southern NSW.

Enterprises: Onions, soybeans, pumpkins, about 200 prime lambs - all certified organic.

Property size: 400ha.

Average annual rainfall: 300mm.

Soil type: Very variable, red to heavy grey cracking clay.

Soil pH: Neutral, following 10-12 years liming.

Keys to success with soybeans

- Using good crop husbandry, ensuring the nutrition is right and keeping the insect pressure down.
- Monitoring water usage as good irrigation management can increase yields through larger grain size.

Neill Wiseman

History of property

Neill's father began farming the property around 1960. Neill began farming in 1975. Neill and Gina started to convert to organic agriculture in 1998, and over a five year period converted the entire farm to organic to meet the demands of niche markets. They are now keen to remain organic growers for a range of reasons.

Why grow soybeans?

Neill has been growing soybeans since the 1980s, originally conventionally. He decided he could grow them organically very basically, after they worked out what they had to do to make it happen. They started with organic onions as a winter crop.

Negative aspects of growing soybeans

Neill does not consider there is anything negative about them. With the newer varieties, they can get them off (harvested) fairly timely, usually before the break of the season. The soybeans work quite well in the Wiseman's organic situation.

Sowing system

Sowing is the same as everyone else. Neill has a John Deere MaxEmerge™ planter. It is a disc opening precision planter with decent closing wheels (press wheels). If it's too wet, they don't put too much pressure on the wheel. They sow into pre-irrigated moisture and don't water up.

Neill aims to pre-irrigate about two weeks before sowing so they don't lose moisture. Beds are 1.83m wide with three rows of soybeans per bed (45cm spacing on the bed). They aim to sow soybeans mid November, and aim at an establishment rate of 35 to 40plants/m^2 (350-400,000 plants/ha).

Harvesting equipment

The Wisemans use an International header with a front fitted with a floating cutter bar. In the past they used a contractor, but with the cleandown requirements before harvesting, it made it very difficult. It could take eight hours to clean down a harvester beforehand.

Paddock preparation

Before the drought, a green manure crop was sown the previous autumn, including a mix of vetch, oats, faba beans and other crops as green manure material. The crop would be ploughed in during August, usually with a rotary hoe. The beds are then prepared and the seedbed is ready to pre-irrigate in late October or early November.

Varieties

Neill predominantly grows Djakal. In the past he has grown Snowy(i), Bowyer and Curringa, which are suited to an earlier planting time.

Crop nutrition

The Wisemans do a soil test before sowing. They use rock phosphate and other nutrient sprays, such as 'Seed and Soil' which provides food for the biology (microbes) they add. They also use a product called 'Balance and Grow' which contains the living organisms as well as food for them. The rates and products they use depend on the year and crop. The green manure also helps fire the soil up. Seed is treated with a legume inoculant and organic starter nutrients.

Weed control

Pre-irrigation allows for germination of weeds which are harrowed before planting. After sowing weeds are controlled by inter-row cultivation.

Pest management

Pests are managed with good husbandry, good watering and keeping the cultivation right and trying not to stress the plants. They have concentrated on looking after the health of the plant, and find that when they do that they have very few pest problems.

Disease management

With soybeans, the Wisemans haven't had any major issues. They've found them pretty good regarding diseases. They try to always use clean, fresh seed. Their country has been lasered so they don't get waterlogging (which leads to disease like phytophthora).

Cost of production

The organic soybeans cost more than a conventional crop to grow, because they include half of the costs of the green manure crop into the costs for soybeans. This can add about $150/ha (half of the full cost) to the variable costs. Water is $300/ML at the moment. In the 2008/2009 season the soil was so dry it needed 2 to 2.5ML/ha to wet it up to field capacity.

A fully irrigated crop takes 7-8ML/ha, so you need to look at the opportunity costs. If you can buy water at $100/ML, it's feasible.

Economic benefit from growing soybeans

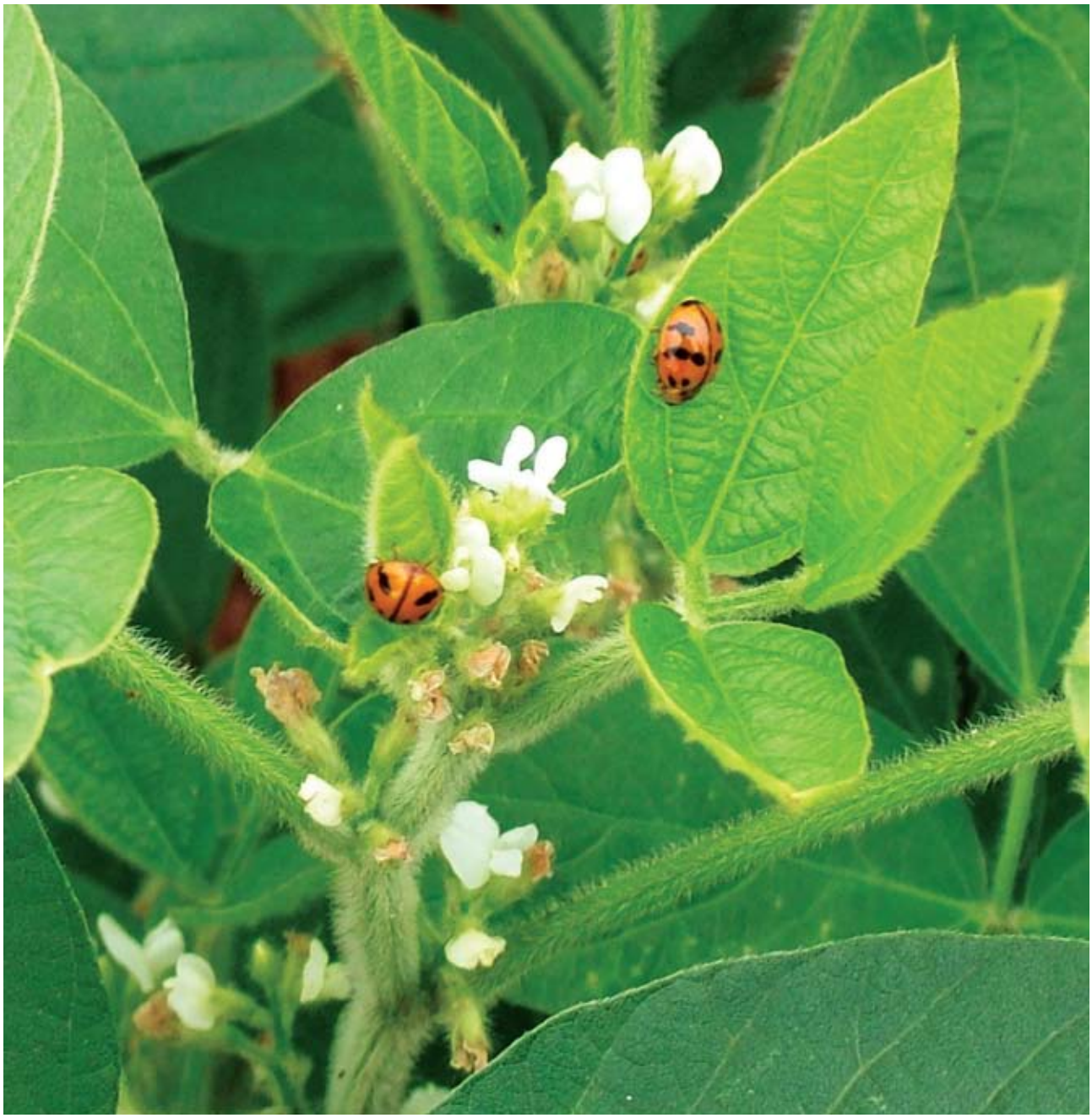
In past years, the price of conventional soybeans has ranged from $500-$600 per tonne, while organic soybeans were in the vicinity of $800 - $900 per tonne. The benefits also include high quality sheep feed following a soybean crop, due to some beans being left behind after harvest. Some nitrogen is also added for the following crop. Although the amount is not massive, it can add up to be quite reasonable. Two soybean crops leave enough nitrogen for an organic crop of linseed, for example.

Soybeans compared to other crops

Neill sees organic soybeans as an advantage as they produce their own nitrogen.

Crop yield

The last crop the Wisemans grew yielded more than 3.5t/ha, which was more than the district average. Most of the grain is sold to Vitasoy® and some may go to smaller niche markets.



BETTER SOYBEANS DEMONSTRATION

Soybean fertiliser demonstration

CHATSWORTH ISLAND, NORTH COAST, NSW, 2006/2007

Natalie Moore, Industry & Investment NSW, Grafton, and Robert Aitken, BSES Limited, Harwood.

What happened?

A soil test and soybean nutrient budget were used to determine the correct type and amount of fertiliser required. Yield data was taken for fertilised and unfertilised areas in the same paddock. The fertilised areas yielded 1t/ha higher than the unfertilised areas.

Background

Soybean crops have a high requirement for phosphorus, potassium and sulfur. Sulfur can be lacking in some coastal NSW soils and is an important element for high protein crops like soybean. Soybean also has a high requirement for nitrogen but if inoculated properly to ensure good nodulation, the soybean plant will fix more than enough nitrogen for its own needs. Application of too much nitrogen at planting (i.e. more than 15-20kg/ha) can risk interfering with nodule formation on the roots, which in turn limits nitrogen fixation and growth later in the crop cycle. A small amount of starter nitrogen is acceptable for soybean in certain situations e.g. when a variety is being sown late in its planting window or where there is substantial cane crop residue.

Demonstration site aims

To demonstrate benefits of fertilisation for soybeans and highlight using a soil test for determining which nutrients are required.

Site details

Andrew Fischer's property, Fischer's Lane, Chatsworth Island, NSW. This sugar cane farm on the Clarence River produces soybean and several other grain crops. The soil is a river bank alluvial (alluvium overlying Holocene marine sediments).

Method

Planting date: 18 Dec 2006 (after 18mm rain on 16 Dec)

Variety and planting rate: A6785 at 74kg seed/ha with inoculant

Table 1. Soil analysis information (standard NATA endorsed soil analysis)

Nutrient	Level in soil test	Level required for soybean	Interpretation
Phosphorus (P)	110	Over 40	Just adequate
Potassium (K)	0.17	Over 0.4	Low
Sulfur (S)	5.6	Over 10	Low

The fertiliser CK66S (N 13%, P 10.6%, K 15%, S 5%) was chosen because it provided adequate sulfur and potassium and low levels of phosphorus and nitrogen as required in this particular situation.

The rate chosen (135kg/ha) was determined by the soil test results, the predicted nutrient needs for a soybean crop to achieve 2.5t/ha grain yield and the cane stubble present.

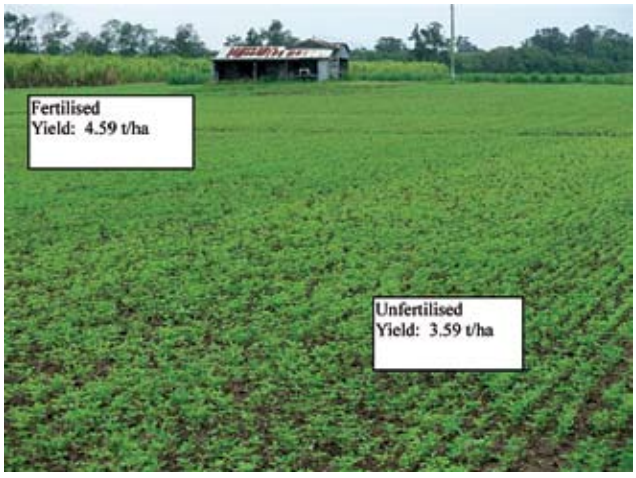


Figure 1. A demonstration of soybean fertiliser conducted at Andrew Fischer's property at Chatsworth Island. The fertilised area (left) produced 1t/ha more grain than the unfertilised area (right). Photo R. Aitken, BSES Limited.

Figure 2. Seedlings from the fertilised area (left) show a distinct difference in vigour and root growth compared to those from the unfertilised area (right). Photo R. Aitken, BSES Limited.

Results

Table 2. Yield results from demonstration

	Demonstration 1 (Un-fertilised)	Demonstration 2 (Fertilised)
Fertiliser added	NIL	CK66S at 135kg/ha
Yield	3.59t/ha	4.59t/ha

Why the difference in yield?

As the soil test indicated, this soil was lacking in some of the critical nutrients for soybean production, particularly K and S.

There was a visible difference between the fertilised and unfertilised areas early in the crop, but this was not as obvious later in the crop.

Phosphorus (P) is very important early in the soybean plant's growth and potassium is critical later in the crop cycle. Sulfur is a critical element in protein production.

Commercial relevance

The cost of the soil test and fertiliser was more than offset by the extra 1t/ha grain yield. Excess nitrogen fertiliser for soybeans at planting can be uneconomic as it can reduce nodulation of the roots, which leads to less nitrogen fixation later in the crop cycle and less nitrogen residues for following crops.

Acknowledgements

Additional funding for this demonstration was provided by BSES Limited and I&I NSW.

Thanks to the Fischer family and Warregah Harvesting Group for their generous assistance in conducting this demonstration.

BETTER SOYBEANS DEMONSTRATION

Soybean plant density demonstration

CHATSWORTH ISLAND, NORTH COAST NSW, 2006/2007

Natalie Moore, Industry & Investment NSW, Grafton, and Robert Aitken, BSES Limited, Harwood.

What happened?

The soybean crop sown at the recommended planting rate for a north coast NSW enviroment for a December planting yielded 0.5t/ha more that the soybean crop that was planted at too high a planting density.

Background

Soybean plant population directly influences crop yield. Optimum plant populations for soybean in the North Coast NSW environment are 300,000– 400,000 plants per hectare (30-40plants/m^2) for narrow rows (e.g. row spacing of 75cm or less) and 280,000–320,000 plants per hectare (28-32plants/m^2) for wide row spacing (e.g. greater than 75cm). Lower plant populations are acceptable when sowing a variety early in its recommended planting window, whilst higher densities are acceptable when sowing a variety later than its recommended planting time.

Figure 1. A demonstration of soybean crop density conducted at Andrew Fischer's property at Chatsworth Island (left) showed that sowing the crop at the recommended rate produced 0.51t/ha more grain yield than the area planted at too high a rate. Photo: N. Moore, I&I NSW, Grafton.

Some growers in the North Coast of NSW have been planting soybean crops too densely for this environment and have missed out on potential grain yield. It is a common misconception that planting densely will prevent the need for weed control early in the crop.

Demonstration site aims

To demonstrate optimum soybean plant density for the North Coast NSW environment by comparing the optimum with a crop planted at too high a density.

Site details

Andrew Fischer's property, Fischer's Lane, Chatsworth Island, NSW. This sugar cane farm on the Clarence River produces soybean and other grain crops. The soil is a river bank alluvial (alluvium overlying Holocene marine sediments).

Method

Planting date: 18 Dec 2006 (after 18mm rain on 16 Dec)

Variety and seed size: A6785, 7,000seeds/kg

Fertiliser used: CK66S at 135kg/ha. This rate was determined using a soil test and the nutrient budget for a soybean crop.

Results

Table 1. Results for planting rate demonstration

	Demonstration 1 (not recommended)	Demonstration 2 (Recommended)
Planting rate	111kg seed of A6785/ha	74kg seed A6785/ha
Plant density achieved in the crop	484,500 plants/ha (=48 plants/m^2)	323,000 plants/ha (=32 plants/m^2)
Yield	3.71t/ha	4.22t/ha

Commercial relevance

Higher than recommended sowing rates can be costly due to the extra seed cost, lost returns from lower yields, harvesting difficulties and reduced grain quality.

Why the difference in yield?

When the planting rate is higher than recommended for the planting conditions, individual plants become too crowded. Over-crowding of soybean can result in:

- Less branches produced per plant
- Less pods produced per branch and less pods set at lower nodes
- Individual plants growing tall and thin and producing weaker stems
- Lodging (due to weaker plant stems, tall plants and wind or storms)
- Greater risk of disease development especially in humid coastal environments (e.g. the Sclerotinia or white mould fungus favours humid, dense or lodged soybean crops). White mould disease can lead to further lodging and unfilled pods as the infection rots the stem.
- Difficulties in harvesting a lodged crop and a higher risk of picking up soil that can reduce the quality of the grain and reduced access to higher value markets.

Remember: Calculate the planting rate based on the size and weight of the seed each season not on a fixed number of bags/hectare!

Seed size is different for each variety and can vary between seasons. Check each bag for number of seeds PER kg.

For example: A6785 usually has around 6400 to 7000 seeds per kg
Manta and Zeus usually have around 5000 seeds per kg
Cowrie usually has around 4400 seeds per kg

Growers will recall the planting seed of most varieties for the 2008/09 season being much smaller than normal due to unfavourable conditions experienced during the previous season.

Recommendations for coastal NSW

- For narrow rows (e.g. less than 75cm) aim to establish a crop that has between 300,000-400,000 plants/ha or 30-40plants/m^2 (Fig 2).
- For wide rows (greater than 75cm) aim to establish a crop that has between 280,000-320,000 plants/ha or 28-32 plants/m^2
- Lower plant populations are acceptable if the variety is being sown early in its recommended plating window
- Higher plant populations are acceptable when the variety is being sown late in its recommended planting period

Figure 2. Planting at the correct rate achieved a plant population of 30-40plants/m^2 for this variety that was sown in narrow rows (30cm spacing). The variety shown was planted in its optimum planting window. Photo N. Moore I&I NSW.

Useful formulae for calculating planting rates

Note a seed germination test result (%) should come with planting seed
assume an establishment rate of germinative seed of 85%

1 ha = 10,000 m^2 = 2.47 acres

Seeds to drop per linear m of row =

$$\frac{\textbf{row spacing (m) X targeted plant population (plants/ha)}}{\textbf{(seed germination \%) X (establishment rate \% of germinative seed)}}$$

Sowing rate (kg/ha) =

$$\frac{\textbf{targeted plant population (plants/ha)}}{\textbf{(seed germination \%) X (establishment rate \%)}} \times \frac{\textbf{100}}{\textbf{seeds/kg}} \times \textbf{100}$$

Acknowledgements

Additional funding for this demonstration was provided by BSES Limited and I&I NSW.
Thanks to the Fischer family and Warregah Harvesting Group for their generous assistance in conducting this demonstration.

FARMER CASE STUDY

Better timing of operations for soybeans

TWEED RIVER, NORTH COAST NSW

Mark North

Location: On a flood plain, Tweed River near Murwillumbah, North Coast NSW.

Enterprises: Cane with 15-20% soybean rotation.

Property size: 162ha.

Average annual rainfall: 1800mm, predominantly summer storms between November and January and a monsoon-like wet season.

Soil type: Alluvial grey/brown peat to grey clay loam.

Soil pH_{ca} : 4.0-6.5.

Keys to success with soybeans

- Mark says the most challenging element of producing a quality soybean crop in his region is the prevailing weather.
- Mark says timing of operations is the essence of producing the best soybean crop.
- He uses good crop husbandry and ensures healthy plants through the use of raised beds and suitable plant population matched with good integrated pest management and good weed control.
- Finally he ensures good harvesting techniques by matching the header to the bed width, maintaining the cutter bar height above the soil to reduce soil and other contamination of the soybeans and maximises the yield by cutting as close to the soil surface as possible.

History of property

Mark and his wife purchased the property about 18 years ago. It probably had a history as a beef and dairy property and then cane. Mark first introduced soybeans into the system in 2003 to address the ongoing yield decline in the monoculture cane system.

Why grow soybeans?

Mark is part of a 10-grower cane harvesting group who have developed soybean rotations with the implementation of raised bed, controlled traffic, minimum till farming systems. They have successfully turned around a two-decade situation in the cane industry where no yield increases had been recorded since mechanical harvesting was introduced as it created soil compaction problems.

The group has achieved average yield increases of around 7%, topping at 19%, on trials on their 660 hectare shared farm. But they say even with no cane yield increases, the savings in production and harvesting costs are more than enough to justify going down the new path.

While it is still relatively early days and quantifying savings due to improved soils is difficult, they say there has been an immediate 25% decrease in fertilising costs for the first cane ratoon crop thanks mostly to the residual nitrogen benefits of soybean.

Negative aspects of growing soybeans

Mark does not see any negative aspects to growing soybeans, in fact he enjoys growing soybeans!

Growing season

Sown in December harvested in April or May.

Mark North

Sowing system

The beans are sown using controlled traffic on a 1.9m bed system (bed itself is 1.4m wide at the top) raised 100 to 125 millimetres, which is retained for cane planting, greatly reducing soil compaction. Three rows of soybeans are grown on each bed, and then cane is direct drilled between the soybean stubble in two rows. A soybean sowing rate to achieve 320,000-360,000 established plants per hectare is the target.

Mark moved from a non controlled traffic system 10 years ago to the use of controlled traffic 5 years ago. He estimates that the area that is trafficked now with the bed system and using GPS has been reduced from 95% to 36% of the land during the crop growth cycle.

In country which can receive nearly 1800mm of rainfall annually, the 2007/08 season was flooded twice, the raised bed system provides an invaluable tool to plant, manage and harvest soybeans successfully.

Harvesting equipment

Much of the group's production system is designed around the shared use of a 30 year old John Deere 95 harvester which with slight modification fits the bed system of 1.9m dictated by cane harvesting equipment.

Paddock preparation

Paddocks to be sown to soybeans are cultivated, laser levelled and raised beds are formed and these beds are retained for the cane. Beds may require some renovation prior to cane planting. Lime is also applied on an 'as-needs' basis but it is the fact that the soy preparation carries over to the following sugar cane crop, with cultivation and liming costs spread over five to seven years, that allows cane growers the greater economies of scale.

Varieties

Manta - dark hilum for crushing, Soy 791, A6785, Warrigal(l) (latter 3 for food markets).

Weed control

It is difficult to keep the property clean of weeds as it is located on a flood plain and fairly frequently flooded. Glyphosate is applied prior to planting, with spraying then conducted on an as-needs basis throughout the growing cycle. Mark also uses Verdict® and Spinnaker®.

Mark says one of the concerns is to maintain the soybean crops clean of sugar cane volunteers to reduce the risk of ratoon stunting disease caused by a virus that lives in the xylem of the cane plant.

Herbicide resistance

Mark is well aware of this issue and although he does not have herbicide resistant weeds on his property he is vigilant in rotating herbicides.

Pest management

Helicoverpa spp. and looper caterpillars are the major pests to be managed using Vivus® and Dipel®. Mark practices integrated pest management techniques with regular monitoring and sprays when necessary.

Disease management

Sclerotinia fungal root rot is managed with a suitable plant population and row spacing to ensure air circulation through the traffic zone. Phytophthora root rot is managed with laser levelling and raised beds to reduce the incidence of waterlogging within the soybean crops.

Cost of production

Mark gives his average cost break down per hectare for soybeans as: land preparation $60, lime if needed $74, seed $87, weed control $86, grub control $83, harvesting $185 to $250 depending on yield - a total of $575 to $640.

Economic benefit from growing soybeans

With his crop yields at between 3.7 and 5t/ha, and a price range of between $300 and $500 per tonne landed at depot, he says his soy gross return varies from $1100 to $2500 per hectare - plus a nitrogen saving on the following cane crop of $200 per hectare.

Soybeans compared to other crops

Mark has not grown any other break crops or legumes and is very happy with the performance and added benefit of soybeans in his cropping system. He finds that soybeans are a good soil conditioner making the soil more friable.

Crop intensity

20% of Mark's land is sown to soybeans each year.

Crop yield

Soybean yields range from 3.7-5.0t/ha.

FARMER CASE STUDY

Better farming systems with soybeans

CASINO, NORTH COAST, NSW

Roger Bailey

Location: Rappville, 40 kilometres south of Casino, North Coast NSW.

Enterprises: cattle core business.

Property size: 1165ha.

Average annual rainfall: 1100mm.

Soil type: alluvial clay flats which run back to sandy loam ridges.

Soil pH_{water} : 5.0-5.5.

Keys to success with soybeans:

- Choose an appropriately adapted variety for the environment.
- Use good agronomic practices.
- Use good nutrition.
- Use good weed control .
- Use good harvesting techniques.

History of property

The property has been in the Bailey family for 4 generations; Roger started growing soybeans 17 years ago.

Why grow soybeans?

For more than a decade, the best margins for Roger's beef business have been in reaching the 250 kilogram live weight mark for cattle at six to nine months but the only way to do that has been to bridge the winter feed gap.

Roger says that in a sub-tropical pasture system growing winter forage was clearly the best option but the economics of doing that on its own was just not a proposition due to the amount of cultivation required and ongoing fertilisation costs.

On the back of a soybean crop, it is viable.

Nitrogen reducing input costs of soybean is a big benefit and it is a good cash crop in its own right. Without the residual nitrogen benefits of the soybeans, Roger would have to fertilise throughout the winter growing period. He has reduced his fertiliser input by around 25%.

Negative aspects of growing soybeans

The window for planting winter crops is a little tight, and the land has to be cultivated twice. Roger has to cultivate due to the compaction caused by the cattle. A shorter maturing soybean variety that maintains the same weather-hardiness as Manta would be of benefit.

Growing season

Planted early December, harvested late April.

Sowing system

Soybean sowing rate 90 kg/ha.

Paddock preparation

Paddocks are established with earthworks carried out to drain the edge, and the resulting material used to level low areas.

Varieties

Manta, chosen for its adaptability to extremely variable weather events.

Roger Bailey

Crop nutrition

Limed at 2.5t/ha when first brought into rotation.

Weed control

Aerial spray twice a year, in the 2008 season.

Pest management

Soybean looper, tobacco looper and heliothis caterpillars. Roger used a biological insecticide due to its low impact on beneficial species.

Disease management

Sclerotinia now and then.

Cost of production

For the 2008 season harvest and cartage were Roger's largest expense, at $182; machinery $140, seed and fertiliser costs $64, spraying, weed and pest control making up the remaining costs.

Economic benefit from growing soybeans

With variable expenses at $553 and a contract price of $629 a tonne, the budgeted gross margin per hectare for 2008 was $705.

Market for soybeans

Roger's soybeans are sold to the crushing market.

Crop intensity

Typical rotation – soybean – winter cereals (oats, ryegrass) - improved perennial pasture for grazing, 11% of land to summer crops, 13% of land to winter crops, 70-100ha of soybeans planted each year.

Crop yield

On average around 3.5t/ha.

FARMER CASE STUDY

Better livestock production with soybeans

NORTH COAST, NSW

Brett and Leanne Warne

Location: The 240 hectare home farm Ten Mile at Leeville, 15 kilometres south of Casino on the Far North Coast of NSW, is the home of Jembrae Droughtmaster stud. The Warnes also own another 89 hectare grain and forage crop property, Kerrs, at nearby Ellangowan and share farm a total of 124 hectares for grain production in the same location.

Enterprises: Winter and summer cropping, stud and commercial cattle.

Property size: 453ha in total.

Average annual rainfall: Extremely variable rainfall, ranging from 900mm to 1650mm, dominant summer rainfall, storm events are getting more frequent.

Soil type: Home farm is podsolic sand over clay while the Ellangowan properties have red and chocolate loam soils and deep river loam.

Soil pH_{ca} : 5.6 - 7.9.

Brett Warne

Keys to success with soybeans

- Good weed control.
- Use minimum tillage to conserve soil.
- Good nutrition.
- Ensure good harvesting practices are utilised to maximise grain quality, harvest at a reasonable moisture content.

History of property

Almost a decade-and-a-half ago, the Warne's started growing soybeans under the *"Beef and Beans"* program to reduce costs on winter feed. At the time they were part of a larger family-owned operation and soybeans provided an excellent option for both a cash return and residual nitrogen for winter feed. When the larger enterprise was split up, Leanne and Brett had to find a way to finish large numbers of cattle on less hectares. Expanding was not an option given the $4000-$6000/ha price tag of coastal land - where it is even available for farming - so the Warnes turned to the concept of a feedlot. Their current silage-based feedlot has 95 percent of its input home grown, with only protein meal and feedlot concentrates bought in. At any one time, around 300 head are being fed on silage.

Why grow soybeans?

The Warne's property is essentially landlocked, so they need to look for options to maximise their return per unit of land. Soybeans perform well on the low pH soils and are extremely hardy in extreme weather events. Soybeans for the grain market provide the best return on a small area of land and they are also used in the feedlot. Agronomically they see advantages with the use of soybeans in terms of improved soils and reduction in the need for nitrogen fertilisers and they are also a good break crop for their maize. The soybeans are used in the Warne's feedlot program and they see huge advantages in utilising them on farm. The soybeans are utilised in their feeding rations for their feedlot enterprise and appear to aid digestibility and may even provide a phytoestrogenic effect in their artificial insemination program. Utilising soybeans in the feedlot program ensures that a minimal amount of feed is bought onto the farm.

Negative aspects of growing soybeans

There is an additional workload in cleaning and storing of soybeans.

Growing season

Soybeans are sown at the end of November and harvested up to the second week of April.

Sowing system

The Warnes aerate country for soybeans with an AerWay® aerater then direct drill or minimum till, sowing on 75cm or 37cm rows. Sowing rate is 360,000seeds/ha, this lower rate is used when producing grain crops.

Harvesting equipment

John Deere header, own chaser bins, seed cleaner and silos equipped with aeration so the Warnes are set up for wet harvests.

Paddock preparation

Paddocks are laser levelled to aid drainage of water. This is especially necessary after any flood events as the flood water moves the soil around.

Varieties

A6785 and Soya 791.

Crop nutrition

Soils are tested twice a year; a full in-crop test and a pre-summer shorter version is carried out mainly to determine phosphorus levels. Chicken manure is spread on the paddocks and a legume complete type fertiliser is used (a blend of phosphorus and potash).

Weed control

Problem weeds are those that commonly appear in direct drill systems; summer grass and barnyard grass; broadleaf weeds are not too much of an issue. Roundup® at planting and some areas get in-crop herbicide treatments but in the past few years there has been a shift to inter-row cultivation and no herbicides have been used. They can inter-row cultivate up to 3 times within the crop lifecycle.

Pest management

Tobacco looper and heliothis are the major pest problems. The Warnes use an IPM approach and an agronomist assists with monitoring. Their approach is to keep things simple and promote beneficial bugs, they have found that soybeans are quite resilient to pests especially pod sucking bugs. They do their own spraying with a 24m boom spray.

Disease management

Rust can be a seasonal issue, possibly due to changing climate.

Cost of production

$675/ha, including planting, sprays and harvesting.

Economic benefit from growing soybeans

$511 per hectare. However the Warnes stress that in their particular case, additionally using soybeans in their feedlot enterprise, the system benefit is huge.

Market for soybeans

All soybeans are sold to the crushing or human consumption market.

Crop compared to other summer crops

Nitrogen benefits, good returns and opportunity to value add using existing infrastructure (storage).

Crop intensity

25% on owned land, 7% on leased land. Their typical rotation is soybean - winter cereals - maize - winter cereals.
The Warnes fly the forage crop seed into the maturing soybean crop and essentially gain one month's growing season by doing this.

Crop yield

Average yield achieved is 2.9t/ha.

Leanne Warne

FARMER CASE STUDY

Better cash returns with soybeans

BREMMER VALLEY, SOUTHERN QUEENSLAND

Geoff Freinberg share farms two properties owned by Warwick Abrahams

Location: Bremmer Valley, 1 hour west of Brisbane

Enterprises: mixed enterprise; cattle – 130 breeders; charolais and charbray, onions, oats, lucerne and soybeans (50% cattle, 50% cropping)

Property size: 342ha in total; 128ha Fairview and 214ha Springhurst.

Average annual rainfall: 711mm predominantly summer rainfall.

Soil type: clay loam.

Soil pH_{water} : 8.1.

Geoff Freinberg

Keys to success with soybeans

- Ensure the crop is weed-free.
- Monitor insects; in particular green vegetable bug which can affect the quality of soybeans.
- Ensure a careful harvest, gentle on the crop and moisture of the seed around 11%.

History of property

The property was an old dairy. Geoff has managed the property since 1981 running the same mixed farming enterprise. He has been growing soybeans also since 1981. In 1996 the property was drought proofed with the construction of several dams with a capacity for natural catchment of up to 480ML over the two properties.

Why grow soybeans?

Geoff grows soybeans for a cash income. They fit well in his cropping rotations and are a good break for diseases and to fix nitrogen. He usually grows oats following soybeans in winter.

Negative aspects of growing soybeans

None.

Growing season

Soybeans are sown at the end of November and harvested in April.

Sowing system

Covvington boxes on head stock; the selected soybean variety is sown at the recommended sowing time and rate for the region.

Type of irrigation

An overhead jet irrigation rig is used.

Irrigation regime

Soybean crops usually receive 3 irrigations in-crop at 12mm/ha/irrigation but it depends upon the rainfall and the assessment of plant stress. Watering is critical from flowering onwards.

Harvesting equipment

Geoff uses a contractor who has a New Holland header with a 7.5m floating cutter-bar.

Paddock preparation

Compacted onion ground is deep ripped and ground is opened twice with offset discs and then Geoff waits for rain.
The soybean crop is then direct sown into flat ground.

Varieties

Soya 791 and Bunya(ϕ).

Crop nutrition

Geoff periodically soil tests before onions, onions are fertilised with a N:P:K mix and the soybeans make the most of any excess fertiliser.

Weed control

Roundup® 1 L/ha pre-emergence, post emergence a mix of Fusilade® (750ml/ha), and Verdict® (150ml/ha) to control grass weeds and Basagran® (1.8L/ha) to control broadleaf weeds. Major weeds in the area are bell vine and jute.

Herbicide resistance

Possibly beginning to show ryegrass resistance in the onion crops which needs to be carefully monitored and managed.

Pest management

Geoff does his own pest monitoring. When necessary he sprays via a plane for green vegetable bugs with Decis® (450 mL/ha-$18/ha) and heliothis with Lannate-Marlin® (1.8L/ha-$21/ha).

Disease management

No disease problems at the moment. The use of good agronomic management and reducing plant stress is very important in minimising or eliminating disease problems.

Cost of production

Seed $85/ha, pre-planting and planning $69/ha, harvesting $150/ha. The major cost of production is chemicals for weed and pest control; Roundup® $15-20/ha, Basagran® $69/ha, Verdict® $20/ha, Decis D-sect EC® $18/ha, Marlin® $21/ha giving a total $447/ha.

Economic benefit from growing soybeans

$700/t on farm for culinary beans. Geoff has also achieved very good returns for soybean hay and considers this a good fallback option if the crop fails to go through to grain. He also sees system benefits with crops following soybean crops performing well.

Crop compared to other crops

Geoff's grain production is limited by the amount of storage he has on the property, only 55 tonnes. Other summer crops such as sorghum or maize produce large tonnages which he is unable to store on farm.

Crop intensity

Soybeans are sown after well fertilised onion crops and then oats follow soybeans. Geoff finds that oats respond well to the soil conditioning abilities of the soybean crops.

Crop yield

After onions Geoff has achieved soybean yields of up to 5.0t/ha on his better country which has better nutrition.

FARMER CASE STUDY

Better summer cropping flexibility with soybeans

SOUTHERN QUEENSLAND

Sharefarmer David Scott and his employee, Nathan Tappendum. Two properties owned by Bertram and Graham Beherendorff


Nathan Tappendum

Location: Lease Block and Mywybilla 65km west of Toowoomba, near the Condamine River, Queensland.

Enterprises: Cropping - cotton, maize, wheat, canary seed, chickpeas and soybeans.

Property size: Lease Block-186ha and Mywybilla- 320ha

Average annual rainfall: 650mm predominantly summer rainfall.

Soil type: Mywybilla clay; a heavy black self-mulching clay soil.

Soil pH_{water} : 7.3-8.8.

Keys to success with soybeans

- David and Nathan are vigilant with their pest monitoring and management, particularly with green vegetable bug which can downgrade the quality of the soybeans.
- They ensure that the plants are not stressed by carefully monitoring their irrigation regime.
- Harvesting also is a key issue to ensure a high quality crop and they ensure they have a good contractor with appropriate equipment which is gentle on the crop to reduce cracked grain and ensure a clean harvest.

History of property

David has sharefarmed the two properties for 14 years; Nathan joined him 11 years ago. The properties have always been cropped, the choice of crops depending upon the return per megalitre of water; historically usually a mix of cotton, maize, sunflower and soybeans more recently added canary seed, chickpeas and wheat. They usually manipulate each crop area to reduce their exposure to financial and crop risk. They consider themselves conservative growers and prefer to better manage smaller areas of crop for the water they may have available.

Why grow soybeans?

David and Nathan are long term soybean growers, as the beans have a handy planting time and are less demanding of water. They budget on one megalitre more per hectare for maize or cotton and we had water on hand at the start of the season. Normally expect summer rain in November, lets you skip a watering for maize and cotton, they can plant up to the first week of January. They say soybeans are beautiful for the soil, soften the ground and leave a bit of nitrogen behind; the beans are easy to produce with little nutrient input.

Negative aspects of growing soybeans

Soybeans can leave some soil-borne diseases for following crops.

Growing season

Soybeans are sown from December to January and harvested in April.

Sowing system

Planted on one metre rows, 275,000 seeds per ha. They use a John Deere disc opener.

Type of irrigation

Flood irrigation; 300ML dam on Mywybilla, 250ML dam on the Lease Block that collects water from runoff. They also have access to bore water.

Irrigation regime

Pre-water ground and then normally 3 'in–crop' irrigations 1.2ML/ha each time, with one at flowering and one at pod fill. In particular they try to avoid moisture stress at the flat pod stage.

Harvesting equipment

David and Nathan use a contractor with a CASE IH header with a floating cutter bar. They find this a real asset to reduce the damage on the soybeans and ensure a quality harvest but it also requires flat, even ground.

Paddock preparation

The hills and contours are levelled with a chisel plough and they use a furrowing bar to re-form the hills one month or so before pre-irrigating.

Varieties

They have tried Fraser$^{\Phi}$ for two seasons when it was still a trial variety, plus another DN2/11 and Bunya$^{\Phi}$. Under the same conditions, Fraser$^{\Phi}$ out-performs Bunya$^{\Phi}$ by up to 0.6t/ha.

Crop nutrition

Generally they have very fertile soil and they do not regularly do soil tests.

Weed control

Weeds are controlled by the use of Roundup® prior to planting and also by cultivation. They use inter-row cultivation in-crop and the soybeans seem to benefit from the aeration of the soil which stimulates plant growth.

Herbicide resistance

Not a problem.

Pest management:

An agronomist does regular bug checks up to twice weekly. At least two sprays are needed each season, either by plane or ground rig, generally for green vegetable bugs and heliothis grubs. They try to use softer options for bug control and Gemstar® for heliothis.

Disease management

They plant disease resistant varieties and try to minimise disease by avoiding plant stress particularly by making sure fields do not waterlog. They also carefully consider the crop rotations.

Cost of production

$1000/t for seed, 50kg/ha. $50 per ha for planting costs plus herbicide, irrigation, cultivation, insecticide, agronomy and harvest costs.

Economic benefit from growing soybeans

Minimal to zero fertiliser inputs. High commodity prices for the 2007/08 season averaged $600/tonne. They were able to achieve a $50/t bonus for seed grade grain to local seed merchants. Soybeans generally leave the soil in a softer condition.

Crop compared to other crops

Soybeans require marginally less water than maize or cotton. Soybeans are a softer crop on the soil.

Crop intensity

Normally summer crop-fallow for 12 months-summer crop. They use the fallow to store moisture in the soil profile and tend not to double crop.

Crop yield

On average 3.75t/ha.

BETTER SOYBEANS DEMONSTRATION

Through trash to cash - increasing cane farmer's profit from soybean rotations

WIDE BAY, 2006/2007

Andrew Dougall – Maryborough Cane Productivity Services

What happened?

This demonstration showed that farmers in the Bundaberg district can improve profits from soybeans by adopting minimum till. It also suggests that thick cane mulch in the plant line may reduce final yields through planting and establishment difficulties, or through the release of growth inhibiting chemicals. This does not rule out direct drill as a viable planting method. Improved yields could be achieved by using more appropriate machinery and planting through mulch that has had time to decompose.

Background

Research has shown that a soybean rotation crop can increase sugarcane yields by 10-20% in comparison to just replanting cane (no fallow). This has been confirmed commercially, and as a result there has been a rapid increase in soybean production in the Australian canelands. Even if the soybean grain is not harvested, the effect on the following cane crop is enough to make the rotation profitable. However, in districts such as Bundaberg, that are close to markets and have a favourable autumn climate, the grain can be harvested profitably.

Demonstration site aims

Most cane in the Bundaberg district is harvested green, the dry leaves create very thick mulch (10-12t/ha) that assists in retaining soil moisture. Conventional land preparation methods bury this mulch, thereby eliminating this advantage. Consequently, local farmers are interested in establishing soybeans with minimum till methods, to retain mulch, save time and reduce machinery costs. The main aim of this demonstration, therefore, was to develop a low cost minimum tillage practice for planting soybeans that retains trash in the system, can be readily adopted by most growers with minor modifications to existing equipment and that actually works.

Site details

Owner	Tony Chapman
Location	Alloway (South Bundaberg)
Soil type	Grey clay
Block history	Q138 3rd ratoon planted at 1.5m; harvested November 2006; sprayed out with Roundup December 2006
Planting date	19 December 2006
Planting details	• Soybean variety - A6785 @ ~6kg/ha • Hi Fert Soybean Mix fertiliser @ ~ 130kg/ha • Double disc opener grain/legume planter equipped with water injection for inoculant • A soil test indicated a pH at an appropriate level and not requiring addition of lime • Each treatment is 6 'cane' rows wide (ie 12 soybean rows wide); roughly one header width • Rows are 400m long • Planter set-up = 5' 4" rows; soybean rows 600mm apart • Buffer zones were left on each side of the trial

Methods

Local agronomists established a demonstrationl to assess some minimum till land preparation methods. A large demonstration block was planted on 19 December 2006 with the following treatments.

- Conventional tillage – One pass with an off-set disc plough, two passes with a rotary hoe.
- Zonal rotary hoe - A rotary hoe with the edge blades removed so only the cane row is hoed, leaving the inter-row un-touched.
- Trash incorporator – A coulter ripper with discs attached to turn the cane mulch into the inter-row. Two zonal rotary hoe passes in the ripped area were required to create a seed bed.
- Light stool rake – A hay rake was used to move the cane mulch into the inter-row.
- Heavy duty stool rake – A rake specially built by a local farmer to move cane mulch to the inter-row more effectively.
- Direct drill (cane cut in August) – Double disc opener planter.
- Direct drill (cane cut in November) – Double disc opener planter.

The old cane rows were spaced at 1500mm, two soybean rows (variety A6785) spaced at 600mm, were planted on them.
A high potassium fertiliser mix was applied at planting, broadleaf and grass weeds were controlled with in-crop selective herbicides.
The season was dry and only supplementary irrigation was available, therefore the crop experienced some moisture stress.
The demonstration strips were un-replicated with five random sections harvested from each block on 19 April 2007.

Results

Yields were similar across the zonal rotary, light stool rake, and heavy stool rake treatments (Figure 1), but were higher than the other treatments. This suggests that some removal or incorporation of mulch in the plant line was required for adequate growth. When there was excessive tillage (conventional and trash incorporator) the depletion of stored soil moisture may have outweighed the effects of incorporation or removal of mulch. The direct drill treatment (cane cut in November) had the lowest yield and a low plant stand, highlighting the difficulties in planting and establishing soybeans in thick cane mulch. Chemicals that inhibit the growth of soybeans may also have been leached into the plant line as the cane mulch decomposed. In all treatments except the conventional till there was a thick layer of mulch in the inter-row. It was noted that the soybean roots explored the inter-row, making use of the extra moisture.

Commercial relevance

The gross margins (Figure 2) assume a 150HP tractor with a fuel price of $1/litre, and soybean price was $540/tonne. The treatments that had the highest machinery use had the lowest gross margins.The highest gross margin of $944/ha was from the light stool rake.

Acknowledgements

The author would like to acknowledge the assistance of a number of people who made the demonstration a success; Neil Halpin (QPI&F, DEEDI), Judy Plath (Formerly ISIS Target 100 now Bean Growers Australia), Matthew Leighton (CANEGROWERS), Jay Hubert, Peter Russo and Jeffrey Plath (local farmers), the Chapman family (trial farm owners) and Pat Halpin for constructing the heavy duty stool rake.

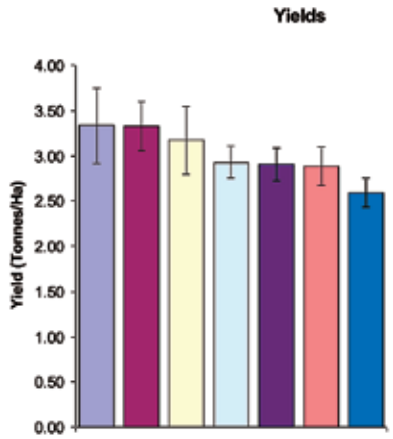


Figure 1: Yields of various treatments

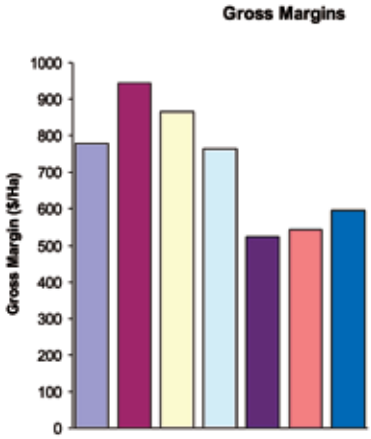
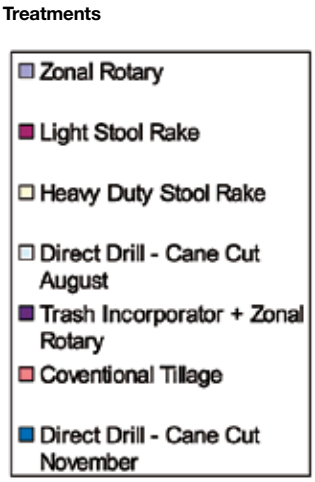


Figure 2: Gross Margins of various treatments



Growers inspecting modified heavy duty stool rake **Photo: G. Mills**

BETTER SOYBEANS DEMONSTRATION

Weed management

WIDE BAY, 2007/2008

Matthew Leighton, Bundaberg Canegrowers

Issue

This demonstration was a pre- and post-emergent herbicide strip evaluation to assist growers in making herbicide decisions. Generally in the Wide Bay region growers rely on knockdown herbicides to control their weeds, with varying levels of success. There are several issues with this strategy including rainfall affecting access to the paddock during key weed control windows, lack of understanding of appropriate target weed size, differing levels of experience with the herbicides and, in some situations, varying condition of the herbicide application equipment.

Location

This demonstration project was split into two sites in the Bundaberg/Childers district in order to access sites with common soil types in the region. Pre-emergent Herbicide Demonstration

Pre-emergent Herbicide Demonstration

Background

The pre-emergent site was in the North Isis district, 11km north of Childers. The soil type in the block changes from what is known locally to growers as a red volcanic soil (Childers/ Red Ferrosol/ Kraznozem) to a brown volcanic (Doolbi/ Brown Dermosol/ Xanthozem) on rolling slopes of moderate to high fertility for coastal soils. The block has access to irrigation from an overhead high pressure winch that applies approximately 50-60mm/ha per application.

Demonstration site aims

To compare several broadleaf and grass pre-emergent herbicides and demonstrate their effectiveness in controlling troublesome weeds on the coast.

Site details /treatments

The cane was cut early and the trash incorporated to minimise the impact of the cane trash on the pre-emergent herbicides. Due to the nature of the soil there were several practices that have been adopted locally that would vary in other regions and other soil types. These soils are very sticky when wet (the baby blanket analogy is often used to describe these soils when wet) however the top 5-10cm dries out quickly after rain or irrigation. With this soil it is hard to plant soybeans into moisture at the recommended depth of 5cm and the seed often requires irrigation to encourage germination and nodulation. With this knowledge it was decided to apply the pre-emergent herbicides post sow pre-emergent (while acknowledging that this is not on the label for all the products it has been a method that has been successfully used locally). The key to this method is to have the herbicide applied prior to emergence which, generally occur 3-4 days after planting).

The unreplicated treatments applied in this demonstration strip were as follows:

Untreated section	Treatment 1
Spinnaker® 700 WDG (Imazethapyr) @ 140g/ha	Treatment 2
Spinnaker® 700 WDG (Imazethapyr) @ 140g/ha + Stomp® Xtra (Pendimethalin 445gai) @ 2.2L/ha	Treatment 3
Spinnaker® 700 WDG (Imazethapyr) @ 140g/ha + Clincher® Plus (Metolachlor 960gai) @ 3L/ha	Treatment 4
Clincher® Plus (Metolachlor 960gai) @ 3L/ha + Sencor® 750 WG (Metribuzin 750gai) @ 470g/ha	Treatment 5
Clincher® Plus (Metolachlor 960gai) @ 3L/ha	Treatment 6

These treatments are a combination of broadleaf and grass control options that either have been used locally in soybeans and/ or sugarcane with the exception of Sencor® 750 WG, which has only recently been registered in sugarcane as Soccer® 750 WG Herbicide.

Method

The soybeans (variety Bunya(ι)) were planted on 15 December 2007 with all the treatments applied on 17 December and incorporated by irrigation on 17 and 18 December. The width of each demonstration strip was 12.6m (7 x 1.8m sugarcane row with 2 soybean rows for each cane row) except for the bottom of the Spinnaker® treatment which had double the rate of herbicide (280g/ha instead of 140g/ ha) due to the paddock narrowing and the applicator not spraying the headland. This did not show any significant herbicide control or yellowing on the soybeans. Previous anecdotal experience of applying rates higher than 140g/ha has however shown that some varieties of the subsequent cane crop do not grow as vigorously as they should when compared to the recommended rate of 140g/ha.

Weeds

The weeds present varied slightly across the treatments in both density and species; however this was not large enough to say there were any differences across the treatments.

Weeds that were common across all treatments were:

- *Ipomea plebeia* (bellvine, known locally as convolvulus)
- *Brachiaria subquadriparia* (green summer grass)
- *Saccharum spp.* (sugarcane volunteers)

Occasional weeds in the block include:

- *Sonchus oleraceus* (milk thistle, sow thistle)
- *Amaranthus viridis* (green amaranth)
- *Cucumis metuliferus* (African horned cucumber, locally known as cucumber or spiny cucumber).

Other weeds that were not observed at the demonstration site but are common in the district are *Echinochloa colona* (Awnless barnyard grass), *Panicum maximum* var. trichoglume (green panic), *Ipomea* spp. (includes morning glory, Star of Bethlehem), *Crotalaria spp*. (gambia pea, grey rattlepod)

Results

The demonstration block was inspected on 7 January 2007 (23 days after planting) to determine effectiveness of the treatments. The photos from this site were taken on this date.

Treatment 1 - Untreated section
The weeds in this section suffered no herbicide effects and helped determine the success or otherwise of the treatments. The green summer grass was approximately 10cm high with six tillers. The bellvine had 6-8 fully expanded leaves and was about to run.

Treatment 2 - Spinnaker® treatment
The effect of this treatment has been two-fold with a reduction in both the size of the weeds and the number of plants emerged when compared to the untreated section. The weeds in this treatment had their development delayed by the herbicide with the majority of the bellvine still in the cotyledon leaf stage and the cucumber was just past the cotyledon leaf stage with the first true leaf not yet fully expanded. In both cases the weeds showed severe yellowing.

Treatment 3 - Spinnaker® + Stomp® Xtra treatment
The effect of this treatment has been two-fold with a reduction in both the size of the weeds and the number of plants emerged when compared to the untreated section. The weeds in this treatment had their development delayed by the herbicide with the majority of the bellvine still in the cotyledon leaf stage, the cucumber was just past the cotyledon leaf stage with the first true leaf not yet fully expanded and the green summer grass approximately 5cm high, with 5 leaves and only one tiller. Observations indicated the presence of other tillers though these appeared deformed and possibly had some yellowing. In the case of the broadleaf weeds they both showed severe yellowing.

Treatment 4 - Spinnaker® + Clincher® Plus treatment
In this treatment there were no grass escapes. This may be from the action of both of the herbicides for grass control, however it is expected that there may be some escapes across the treatment. The bellvine in this treatment were still in cotyledon leaf stage with severe yellowing.

Treatment 1 - An overview of the untreated section of the site showing that the grass and weeds are large compared to many of the treatments

Treatment 2 - Spinnaker Trial Ipomoea. This shows the delayed growth development of the vines to the untreated sections

Treatment 3 - A close up of Ipomoea vine seedlings that are showing signs of phyto-toxicity due to the treatment

Treatment 4 - Overview of relatively clean treatment with mainly cane volunteers present

Treatment 5 - Provides overview of demonstration site.

Treatment 6 - Overview of treatment with cane volunteers and Ipomoea vines present.

Treatment 5 - Clincher® Plus + Sencor® treatment
This treatment had mixed results in terms of broadleaf weed control. There were a large number of bellvine escapes in this treatment with the majority having 3-4 true leaves with some showing signs of yellowing of the leaves.

The label mentions control of cowvine *(Ipomea lonchophylla)* at the rate of 470g/ha which is a close relative of bellvine *(Ipomea plebeia)* although further inspection of the Sencor® /Soccer® label shows that in sugarcane the registered rate for control of bellvine and other Ipomea species is 0.8-2kg/ha. To determine an appropriate rate for bellvine for coastal soybeans further work is required.

There were cucumber seedlings in this treatment that ranged from yellow with one true leaf, to normal colour with 3-4 true leaves. This result is expected as cucumber control is not on the label for control however cucurbits are mentioned as having a 12 month plant-back period after application of Sencor®.

Treatment 6 - Clincher® Plus treatment
There was little metolachlor control of bellvine, though this is expected as there is little broadleaf weed control without the addition of other herbicides. The grass weed control was adequate with the occasional green summer grass plant that survived, having three tillers but only a total height of approximately 5 cm.

Commercial relevance

This site demonstrated that pre-emergent herbicides can be applied post-plant pre-emergence and incorporated by water with a high degree of success. With both the Stomp® Xtra and the Clincher® Plus providing similar results the choice of the products may come down to either the ability to rotate herbicide groups or the plant-back period for following crops. However as Clincher® Plus allows 10 days for incorporation by rainfall or irrigation it is the more flexible product.

Sencor® at the soybean rate provided little control of the bellvine at this site. While the soil is not the heavy clay soil stated on the label for soybeans there were no visible symptoms of yellowing. Similar soils around Bundaberg and on the Atherton Tableland are sprayed with Sencor® in potato crops without any known yellowing. For Sencor® to be used regularly on coastal soybeans further work should be undertaken regarding the appropriate rate for the various soil types, which vary from sands to clay, often in the same paddock.

Summary

Each of the treatments performed as expected with the exception of the Clincher® Plus + Sencor® treatment due to the issue of the Sencor® not controlling the bellvine. There were the occasional weeds that germinated in the treatments however they were less frequent in number and smaller in size than the untreated section. This is expected especially when the soil surface has herbicide shadows due to clods or part of cane stools on the soil surface.

It should be noted that the owner of the paddock with the pre-emergent demonstration decided to spray the demonstration site with knockdown herbicides approximately 28 days after planting to control those weeds that had escaped the pre-emergent herbicides. Whether this would be necessary in all situations would depend on a range of factors including crop vigour (and thus ability to close over quickly), soil type, paddock history and weed pressure.

Conclusion

For those growers with access to irrigation who have potential weed issues in cultivated situations they are able to use pre-emergent herbicides secure in the knowledge that they will control the majority of the weeds in the paddock. For optimum weed control, knockdown herbicides can be used to control the occasional escapee provided Spinnaker® is not used above 140g/ha in one season as this can create herbicide carryover issues for cane and other following crops.

Post-Emergent Herbicide Demonstration

Background

The post-emergent demonstration site was in the Alloway district, 15km south of Bundaberg. The soil type in the block is known locally as a grey forest soil (grey duplex soil over a heavy clay B horizon) however soil mapping by DNR&W describe the soil as a Quart (Yellow Kandosol/ yellow earth) to an Oakwood (Red Kandosol/ red earth) that is relatively flat. The block was irrigated with an overhead high pressure winch system supplying 40-50mm per irrigation.

Demonstration site aims

To demonstrate the effectiveness of various post-emergent broadleaf herbicides in controlling coastal weeds.

Site details /treatments

The soybeans were planted on 14 December 2007 and irrigated after planting with approximately 50mm on the 16 and 17 December. This is normally not the recommended practice for this soil type as it can result in crusting and reduce the emergence of the soybeans. The trash from cane harvested in mid-November was incorporated.

The treatments that were used:

Basagran® @ 2L/ha – Sprayed 21 December 2007	Treatment 1
Spinnaker® @ 140g/ha + Hasten™ Spray Adjuvant @ 500ml/100L of water – 30 December 2007	Treatment 2
Blazer® @ 1L/ha + Hasten™ Spray Adjuvant @ 1L/100L of water – 7 January 2008	Treatment 3
Blazer® @ 2L/ha + non ionic wetter – 8 January 2008	Treatment 4

From planting to 3 January 2008 there was approximately 150mm of rainfall plus irrigation and by the time the field walk was held on 17 January the site had received a total of 250mm of rainfall plus irrigation. This demonstration site suffered from significant waterlogging which markedly affected both the soybean and weed growth and impacted the timeliness of weed control.

Method

The broadleaf herbicide treatments were applied to each area of the paddock when the weed sizes were appropriate and when weather permitted. All treatments were sprayed with a boom spray applying ~ 300L/ha @ 3 bar (300 kpa) pressure. The rig was travelling at 7km/hr with the herbicide being applied through an 02 and an 03 nozzle in a twin cap system (which is recommended in peanuts to ensure good coverage for fungicides). To assist the grower in determining the correct conditions to spray the herbicides he used a hand held unit that measures temperature, humidity, wind speed which determines a Delta T value.

Weeds

The weeds present varied slightly across the treatments in both density and species; however this was not large enough to say there were any differences across the treatments.

Weeds that were common across all treatments were:

- *Mollugo verticillata*
- *Brachiaria subquadriparia* (green summer grass)
- *Eleusine indica* (crowsfoot grass)
- *Saccharum spp.* (sugarcane volunteers)

Occasional weeds in the block include:

- *Amaranthus viridis* (green amaranth)
- *Crotalaria spp.* (gambia pea, grey rattlepod).

Mollugo verticillata is a weed of the United States that has a prostrate growth habit with its leaves are in whorls with small white flowers on a short stalk. It can form a thick mat of plants on the ground and if established can smother or choke out young seedlings. This plant is not a weed of sugarcane however is found in many paddocks, and in thick mats may cause an issue with soybean emergence.

Results

The results of the demonstration were as follows:

Control – There was no designated untreated section as weed control after the field day would have been very difficult and created management complications for the grower. Weed sizes and species identification were determined by regular inspections prior to all the treatments being conducted.

Treatment 1 - Basagran® treatment
This treatment was highly variable in its effect on the weeds with the bellvine partially controlled and the *M. verticillata* barely affected. From discussion with Jim Barnes (former weed agronomist with DPI&F) this treatment should be very successful in the control of bellvine.

Advice and information was sought from CropCare as there was no reasonable explanation as to this variable result. It should be noted that the Basagran® label does indicate that control of bellvine may be inconsistent if the soil is dry. However, at time of application regular rainfall had been received and soil moisture appeared to be sufficient.

Treatment 2 - Spinnaker® treatment
This site demonstrated the potential of Spinnaker® under ideal weather conditions. It was applied as a post-emergent herbicide with Hasten™ spray adjuvant (this has been shown anecdotally to provide superior control over non ionic surfactants) with reasonable success in the suppression of bellvine (up to 6 leaves) and control of *M. verticillata*, and the green summer grass (plants up to three tillers ~ 10-15cm long were affected by the treatment).

With additional rainfall within two days of application it is believed that the Spinnaker® may have been incorporated and began acting as a pre emergent herbicide, providing additional control.

In a year of continual rain and showery weather (which occurred until 17 February) the Spinnaker® kept the paddock cleaner than other options, most likely due to its pre emergent activity.

Treatment 3 - Blazer® @ 1L/ha (+ Hasten™ Spray Adjuvant @ 1L/100L of water)
This treatment was successful in determining the effectiveness of this novel treatment in controlling broadleaf weeds while reducing the cost to the grower. The bellvine controlled were up to 8 true leaves and about to run. The other major broadleaf weed, *M. verticillata*, was successfully controlled by this treatment. Previous experience has shown that Blazer® can control small pre tillering grasses. No comment about this activity can be drawn as the whole site was treated with Verdict* on 7 January 2008 to control the cane volunteers as well as the green summer grass. One comment about this treatment is that it is particularly harsh (harsher than Blazer® at 2L/ha) on the soybean leaves and it is recommended to use this option after 5pm and before 9am (depending on daily temperatures) to minimise the amount of leaf burn.

Treatment 4 - Blazer® @ 2L/ha (+ non-ionic wetter)
This treatment was successful in controlling bellvine in excess of 8 true leaves. The larger bellvine plants did have some lower leaves still green after the treatment however there was no evidence of a growing tip for the plants to recover from the treatment. The other major broadleaf weed, *M. verticillata*, was successfully controlled by this treatment. Previous experience has shown that Blazer® can control small pre tillering grasses. No comment about this activity can be drawn as the whole site was treated with Verdict® on 7 January 2008 to control the cane volunteers as well as the green summer grass.

Commercial relevance

The economic analysis of the Basagran® treatment showed was that it was not effective on the weeds in the treatment area. This is based on the Basagran® not working as per label expectations which is a concern as this reduces the post emergence herbicide control options for bellvine, which is commonly found in the paddocks of the Bundaberg and Isis districts.

The Blazer® 2L/ha treatment demonstrated the value of this product to control weeds slightly larger than listed on the label. While it is not recommended to deliberately target weeds that are larger than listed on the label it is beneficial to know the upper limits in case poor spraying conditions affect the timing of application.

The Blazer® treatment @ 1L/ha with Hasten™ spray adjuvant is taken from the mungbean recommendation and was first applied in the Bundaberg district as a way of spreading the minimal volumes of Blazer® in 2004/05 and 2005/06 across the district and a way of making this herbicide cost competitive with other options. There has been another variation of the Blazer® @ 1L/ha + Hasten @ 1L/100L which is Blazer® @ 1L/ha + Hasten @ 1L/ha as the spray volumes regularly applied in Bundaberg regularly exceed 250-300L/ha of water and the crop damage (leaf burn) can be significant (see photos). Based on this it is not likely to be suitable to dryland farming conditions or shorter duration soybean varieties that require a high degree of management, such as Bunya$^{\phi}$.

Treatment 1 - Shows the weed pressure that was present in the block

Treatment 2 - This close up shows the classic phyto-toxicity symptoms of summer grass to Imazethapyr (Spinnaker®)

Treatment 3 - This close up shows the severe bronzing / leaf burn that can occur when using Blazer® + Hasten™ Spray Adjuvant mix. The young growth is unaffected and in irrigated coastal situations seems to have little effect on yield

Treatment 3 - This long view shows the summer grass burnt from the Blazer® + Hasten™ Spray Adjuvant mix. Grass was also sprayed with Verdict* before the Blazer® mix was applied which stopped growth. The large vines can no longer be seen.

Treatment 3 - This photo shows the effective weed control of Blazer® + Hasten™ Spray Adjuvant mix 7 days after application.

Treatment 4 - This close up shows the dead growing tips and green older leaves of the Ipomoea vines after Blazer® 2L treatment.

The Blazer® treatment @ 1L/ha with Hasten™ spray adjuvant has potential for use in coastal soybean situations and possibly irrigated soybeans in inland situations, especially where there are issues with the plant back period for Spinnaker, the cost-effectiveness of Blazer® @ 2L/ha or where the availability of Blazer® limits its use at the full rate. Further work with this treatment in conjunction with the manufacturer/ distributer to progress a label change.

Summary

Each of the products worked to or exceeded expectations except the Basagran® which had patchy results. The other products did have issues where the weeds were growing in the soybean row which was shielded from the herbicide. This was unavoidable given the prevailing wet weather during the herbicide application period as the soybeans were of reasonable size. Other work by growers and agronomists has shown that this shading effect can be reduced by directing the spray to the base of the plant using droppers.

Conclusion

Post emergent herbicides have a place for broadleaf weed control in soybeans although timing is critical to achieving satisfactory results. Caution is required with Spinnaker® due to the long plant back period for the majority of crops used in rotation with soybeans.

Acknowledgements

The Better Oilseeds project wishes to acknowledge the assistance of the farmers who enabled the demonstration strips on their farms and sprayed each of the treatments as required. Without this assistance it would not have been possible to conduct these demonstrations. The owner/ co-operator of the pre-emergent site was the whole family(s) JJ, Mrs JE, JA, Mrs DG, PF, Mrs NJ, AM and Mrs SM Russo with Peter Russo the primary contact person regarding this site. The owner of the post emergent site was NA and Mrs SM Johnson with Noel Johnson the primary co-operator.

Chemical at Russo's was provided by Peter Russo, Unifact Pty Ltd, and Jeffrey Plath. The chemical at Johnson's was provided by Noel Johnson.

Thanks must go to Judy Plath (formerly ISIS Target 100 officer and now Bean Growers Australia Area Manager), Andrew Dougall (formerly DPI&F FutureCane and now Maryborough Cane Productivity Services Senior Extension Officer) for coordinating the demonstration sites, recording what happened at each site, organising the field day and assisting in preparing this report.

Judy Plath, Bean Growers Australia. Photo S. Knights.

FARMER CASE STUDY

Better cane systems with soybeans

WIDE BAY, QUEENSLAND

Des and Rayna Morris

Location: Granville, Wide Bay region approximately 10km from Maryborough.

Enterprises:

- In 2007/08:- Mix of summer and winter crops: sugar cane 60%, soybeans 40%, chickpeas, have grown peanuts in the past.
- Earthmoving equipment hire business.
- Off-farm income – Des works away in the mines while Rayna is a school teacher.

Property size: 80ha.

Average annual rainfall: Approximately 1100mm.

Soil type: Sandy loam.

Soil pH_{ca}: It varies but the Morris family aim for 6.5 Ca (with the use of lime).

Keys to success with soybeans

- Des Morris sums it up pretty simply…. 'good nutrition, good weed control and timely insect management'.

Des Morris

History of property

The Morrises started growing soybeans 5 years ago and now double crop with chickpeas.

Why grow soybeans?

Soybeans are easy to grow, offer good opportunities to control weeds and Des sees benefits in soil health, especially ease of ground preparation after growing soybeans. In addition, the Morris family appreciate the nitrogen input from soybeans, so when combined with the good returns they've enjoyed, they see soybeans as 'money in your pocket and the soil'. In the past, the Morris family have double-cropped their soybean paddocks with chickpeas which gave them the opportunity to improve cash flow as they aim to maximise their returns per hectare, especially on their small farm.

Negative aspects of growing soybeans

Management of insect pests is an issue especially with both Des and Rayna's off-farm work commitments.

Growing season

Soybeans are sown in November/December and harvested in April/May.

Sowing system

Soybeans are sown at a rate of approximately 60kg/ha, depending on variety and seed size (count).

Type of irrigation

The property is 100% flood irrigated with a 145ML farm allocation and a 100ML temporary transfer (in 2007/08). Moisture levels are monitored using a BSES Epan and visual inspection.

Irrigation regime

Water is applied when the weather dries out; on average the soybeans receive 2-2.5ML/ha if it is a drier season. Typically the final irrigation is around 4 weeks before harvest.

Harvesting equipment

A local harvesting contractor is used. The contractor employs experienced grain harvesting operators from the inland Burnett region who supply the harvesting equipment.

Paddock preparation

Every 4-5 years the fallow blocks are laser levelled after the cane trash has been burnt. Soil fertility is assessed before every crop, particularly the pH, and lime is applied according to the soil test recommendation using a 'ripper and hiller' implement which puts lime into the 2m beds. A controlled traffic system is used on 2m rows (for cane) with 2 rows of soybeans planted on a 2m bed 1m apart using a double disc opener vacuum grain planter.

Varieties

A6785 has been used in the past, now Fraser(ϕ) and Warrigal(ϕ).

Crop nutrition

Fertiliser is applied before planting with a cane fertiliser box at 600mm spacing's. 120kg/ha of a custom blend developed by a local reseller is applied at 120kg/ha which supplies phosphorus, potassium and a small amount of starter nitrogen to the crop. Foliar application of zinc, nitrogen and molybdenum occurs 3–4 weeks after emergence.

Weed control

A grass pre-emergent (Clincher Plus®) is applied prior to planting and then glyphosate is applied through a shielded hooded sprayer at approximately 6 weeks of age. His crop is usually defoliated with Reglone®.

Pest management

Insect pressure varies from season to season. ome years the Morris family have sprayed once for *Helicoverpa spp*. and once for green vegetable bug, but in other years they have sprayed twice for *Helicoverpa spp*. Controlling the insects is fairly straight forward but being able to spray for them in a timely manner is a challenge with Des working away for much of the growing season.

Disease management

Usually the Morris family do not have to manage diseases but in 2007/08 the district experienced soybean rust for the first time which caused approximately 10% yield loss as the rust came in too late to spray. Anecdotally, Fraser(ϕ) was less affected by rust than Warrigal(ϕ).

Crop yield

Yields vary from season to season and variety to variety but typically they expect yields of around 2.5 to 3t/ha.

FARMER CASE STUDY

Better agronomy for soybeans

CHILDERS, QUEENSLAND

Russo Family - Joe, Peter, Anthony and John

Location: Right in the centre of the Isis Central Sugar Mill supply area (which is located near the township of Childers, south of Bundaberg).

Enterprises: The Russos farming endeavours include not only sugarcane but grain and legume crops such as barley, soybeans and peanuts. In addition, the Russos run a contract cane harvesting business, a contract grain planting business and have over 80 hectares of grazing country.

Property size: 800ha.

Average annual rainfall: Approximately 1100mm.

Soil type: The Russo land holdings include A diverse mix of soil types ranging from heavy red volcanic through to light sandy loams.

Soil pH_{water} : Most paddocks have soil pH above 5.5.

Soil pH Note: Soil pH results are quoted in either calcium chloride (expressed as pH_{ca}) or in water (expressed as pH_{water}). Typically the calcium measurement is 0.5-1.0 unit less than the water measurement. The difference between the two values is influenced by soil texture and some other soil properties. As a guide the higher the clay content the less is the difference between Calcium and water. The more sand in the soil the larger the difference.

Keys to success with soybeans

- **Get the basics right -** good planter set-up, good quality seed, sound inoculation, appropriate paddock preparation. Know your crop - While the Russos acknowledge soybeans are a pretty straightforward crop to grow, they firmly believe in having a sound knowledge of the basic agronomy of growing soybeans well…..
- **Apply your knowledge well -** The Russo family has learnt firsthand the value of good agronomy. Doing things at the right time and in the right way is crucial for growing high quality, high yielding soybeans.

History of Property

The original Russo farm was owned by Guiseppe Russo who first began growing sugarcane in the Isis region three generations ago. Today the family owns 800ha of farming land. The Russos first began growing soybeans in December 2003 as a rotation crop for their sugarcane.

Since including soybeans into their farming system the Russo family has gone on to try another popular grain-legume crop in the Wide Bay region, peanuts. Over summer the Russos typically grow soybeans on 10% of their farm each year, peanuts on 10% and sugarcane on the remainder. In addition, a small area of specialty seed crops is grown under contract.

Why grow soybeans?

The Russos noticed an improvement in soil health immediately after their first crop and from then on soybeans have become a key part of their farming rotation. The nitrogen input, improvement in soil tilth and ability to control problem weeds are all reasons the Russos feel soybeans benefit their farming system. Importantly, the family enjoys a financial return from their soybean crop.

The Russo Family

Negative aspects of growing soybeans

Like most cane farmers who grow soybeans, the Russos have grappled with the issue of getting a late cut block of sugarcane ready for soybeans by November or early December. They have found the most efficient way to deal with the cane trash from the last ratoon is to get the trash baled before starting any ground preparation.

Growing season

Soybeans are planted late November early December and harvested mid April to mid May.

Sowing system

Soybeans are sown at rate of 65-75kg/ha, depending on variety and seed count.

Type of irrigation

Irrigation is commonplace on Russo farms, with three pivots installed. A further pivot is in the pipeline and the remainder of the paddocks are irrigated with travelling irrigators. Approximately 2500ML of irrigation water is sourced from the Bundaberg/Isis Irrigation Scheme plus on-farm dams and bores.

Irrigation regime

The Russos believe irrigation is crucial for growing quality, high yielding soybeans. Irrigation starts when the weather and soil moisture dictate, which varies from season to season, but is generally before Christmas. The irrigation strategy for the soybeans usually follows the cane irrigation cycle and is focused on avoiding crop stress. Generally, the Russos will cease irrigating their soybeans approximately three weeks prior to harvest. In a dry season they expect to use roughly 3ML/ha to grow a 4t/ha (or better) crop of soybeans.

Harvesting equipment

A harvesting service is delivered by the local sugar mill which employs the services of a professional grain harvesting contractor from the Nanango region. The Russos believe having access to an experienced grain harvesting contractor with the latest equipment has helped ensure their soybeans are harvested efficiently and professionally.

Paddock preparation

The trash from the previous cane crop is baled, leaving approximately 30% of the trash on the soil surface. After baling the block is usually disced three times and then mill mud is applied at the standard rate of about 112t/ha. Mill mud is a nutrient rich by-product of the sugar milling process. It consists of soil and impurities from the harvest mixed with ash from the boilers. It is sold back to sugar growers to spread on newly harvested paddocks as an alternative form of fertiliser.

If required, the paddock will be laser levelled during paddock preparation and then a final pass with a minimum tillage implement will be completed prior to planting.

Varieties

Over the past five years the Russos have trialled numerous varieties including A6785, Warrigal(ф), Soya 791, Fraser(ф) and Bunya(ф). The 2007/08 crop included A6785, Fraser(ф) and Bunya(ф).

Crop nutrition

The Russos have developed a strong focus on soil nutrition in recent years. During the fallow period most paddocks will be soil tested, treated with lime and gypsum as necessary and often soil tested again before the next sugarcane crop. The family prefers to apply mill mud a month or more before planting soybeans, thus if a block of cane is cut too late to apply mill mud they apply GF402 (or the equivalent fertiliser) pre-plant at roughly 130kg/ha.

There is no doubt in Peter Russos mind that mill mud grows better soybeans and offers more flow-on benefits to the next cane crop however, he is keen to try lower rates of mud in future in an effort to reduce costs.

Weed control

One of the other great benefits this farming family has found is that soybeans offer the opportunity to control problem weeds during the cane fallow period which allows them to really focus on reducing weed banks.

Verdict® is used for grass control and Blazer® for broadleaf control. Peter Russo has found them to be excellent products. Between the two products they can usually target most of our problem weeds and keep their paddocks nice and clean.

Insect management

Integrated Pest Management (IPM) strategies are used wherever possible with paddocks routinely bug-checked after flowering and softer insecticides that preserve beneficial insects preferred.

The most common insects that are sprayed for are green vegetable bugs, red-banded shield bug, loopers and Helicoverpa spp. The Russos use insect monitoring to ensure they only spray the soybeans once insect numbers have reached the economic threshold.

Peter Russo commented that the district has been very fortunate to have access to the insect knowledge of Hugh Brier from the Queensland Primary Industries and Fisheries. The region has learnt a lot about IPM and how to use beneficial insects to their advantage while saving on insecticide costs.

Economic benefit from growing soybeans

Peter Russo is quick to comment that the other great benefit of soybeans is that they are profitable. His closing comment was 'It's fantastic to be able to grow a crop that suits our cane system, improves soil health, provides free nitrogen for our cane, gives us a chance to tackle problem weeds, works the soil and makes us money!!'.

The Russos have applied good agronomic practices to allow them to grow edible or flour grade soybeans consistently. For the past couple of seasons beans have been forward sold or the family has contract grown some varieties for seed at a premium price.

Crop intensity

For the Russo family the introduction of a winter rotation has enabled them to maximise their returns from every hectare of farming country.

The winter crop of choice for the Russos is barley for grain or hay. The Russos feel barley suits their system well as it can be planted after peanuts or soybeans and harvested by early October, enabling sugar cane to be planted in spring straight behind the header. Barley is not a host to cane nematodes and keeps beneficial soil organisms 'ticking over' in the soil during the fallow period. The Russos have also found barley to compete well with winter weeds and offer erosion protection from winter rainfall.

With careful planning in the cane and legume crops the Russos avoid herbicide residue issues limiting their cropping options. They tend to avoid any products that hang around in the soil too long as they want to keep their options open with other crops.

If all goes well they will harvest the barley in early October, run their minimum tillage implement over the paddock using GPS and be planting cane within a few days. Alternatively, if there is a delay in planting cane because the crop is taken through to grain, the Russos can bale the barley earlier and ensure they still plant cane on time.

Crop yield

Five years on and the Russos have become known for growing high yielding, high quality soybeans on a consistent basis. Good agronomy, in conjunction with an excellent season, resulted in their 2006/07 soybean crop averaging 4.5t/ha with the majority of the crop of edible quality.

Peter Russo acknowledges the seasons aren't always as favourable as 2006/07, but their aim is to grow 4.5-5.0t/ha crops year in, year out. He feels that when the soybean price is good it really rewards growers who put in the effort to grow for yield and quality.

FARMER CASE STUDY

Better cane system with soybeans

HERVEY BAY, QUEENSLAND

Darryl Doyle and family; Nathan, Rachelle, Adam, Cassandra, Cheryl and father Colin

Adam, Darryl and Nathan Doyle

Location: Walker's Point and Nikenbah nearest town Hervey Bay/Maryborough approximately 10kms.

Enterprises: While Darryl and his sons, Nathan and Adam, work full time farming their home farm at Walker's Point on the outskirts of Maryborough, they are also kept busy "helping Dad out" with his farm at nearby Nikenbah on the outskirts of coastal Hervey Bay. The Doyles also run a contract cane harvesting and laser levelling business and give Colin a hand with his 800 hectare cattle property 80-odd kilometres away at Biggenden. If that is not enough to keep this enterprising family occupied, 23 year old Nathan runs a cane mulch baling business while 18 year old Adam has recently turned his hand to growing pineapples. Younger sister, Cassandra, who is still at high school, helps out hauling cane in the cane harvesting season over school holidays and weekends.

Property size: 160ha Walker's Point, 160ha Nikenbah.

Average annual rainfall:

Soil type: Walker's Point river alluvial and sandy loam, Nikenbah red soil and grey forest.

Soil pH_{water} : 5.0-5.5

Keys to success with soybeans

- Soil tests are crucial. The Doyle family firmly believe in the importance of measuring soil pH and fertility to improve crop production.
- Optimum planting date. The Doyles believe planting date is an important factor to maximise yields.

History of property

For the Doyle family, soybeans have become an important part of their farming business over the past four years.

Why grow soybeans?

Like many cane farmers the Doyles have incorporated soybeans into their farming system to break the cane monoculture and to generate extra income. Each year 15-20% of their sugarcane is ploughed out and planted to soybeans as part of their fallow management program. They see a benefit in terms of managing weeds especially green panic, and wild sorghum, and a soil benefit in returning fixed nitrogen. Soybeans make the soil more friable and also provide erosion control. They can also return good money.

Negative aspects of growing soybeans

The Doyles do not see any negatives. Darryl considers even if the weather prevented harvest the soybeans have still done the ground good and controlled weeds.

Growing season

Soybeans are sown in early December and harvested in late May.

Sowing system

The Doyles use a 4 row vacuum planter and plant at around 70kg/ha.

Type of irrigation

Hard-hose travelling irrigators on both properties, Walker's Point allocation 450ML, Nikenbah uses recycled water which has no real limit.

Irrigation regime

Consistent rainfall in the Maryborough-Hervey Bay region during the 2007/08 season combined with the high diesel price meant the Doyle family did not dip into their surface water allocation to grow their soybean crop.

Harvesting equipment

The Doyles have used a local contractor with on older model John Deere harvester.

Paddock preparation

The Doyles are keen to develop a reduced tillage method that will allow them to plant cane after soybeans with a minimum of fuss. Currently cane is ploughed out and each block is ripped and sometimes rotary hoed, prior to laser levelling.

After mill mud is applied it is worked in with a rotary hoe and soybeans are planted. The only cultivation after the soybeans are harvested is one pass over the paddock with an old cane trash incorporator that only cultivates the row area they wish to plant with sugarcane.

Varieties

A6785 and Fraser[◊].

Crop nutrition

With soil types on their two farms ranging from sandy loams to river alluvial to heavier red soils. The importance of soil pH really came to the fore in the 2006/07 season when low soil pH (below 5.0) caused significant yield loss on one block.

Darryl admits that they have been a bit casual about soil testing in the past. He admits that after the 2007 season's experience they will be testing all their soybean blocks in future so they can invest in lime if the pH is a bit low.

Soil tests will help them fine-tune their fertiliser program too. For the 2006/07 season they used a fertiliser blend at planting that the local reseller recommended at about 125kg/ha and applied mill mud at 150-200t/ha to meet the crop's needs and improve the soil.

Darryl says foliar fertilisers have become an important part of their soybean management now and there is no doubt in Darryl's mind that their foliar application of zinc, molybdenum and urea when the soybeans were about five weeks old was very effective.

Weed control

Regular rainfall allowed the Doyles to apply grass pre-emergent Stomp® after planting with the confidence that it would be watered in soon after application. The post-emergent grass herbicide Verdict® was used to control any grass escapes or sugarcane volunteers while the post-emergent herbicide Blazer® controlled broadleaf weeds.

Pest management

Regular insect monitoring by a local agronomist gave the Doyles confidence not to spray their soybean. Darryl said the blocks were checked regularly but they did not spray for insects in the end because by the time the insect numbers increased they were basically due to begin harvesting.

Disease management

Disease management is rarely an issue for the Doyles.

Crop intensity

The Doyles crop both summer and winter crops, summer 80-85% sugar cane, 15-20% soybeans, winter specialty sunflower seed approx 10%.

Crop yield

Crop yields vary across the farms and are influenced by water availability but are typically in the range 2.5-3t/ha.

Nathan Doyle

FARMER CASE STUDY

Better cane systems with soybeans

MACKAY, QUEENSLAND

Simon and Sue Mattsson and children Luke and Sophie

Location: Newmans Road, Marian - 25mins drive west of Mackay in the Pioneer Valley.

Enterprises: Sugar cane with soybeans on fallow. Simon also has a full time (four on four off rotating day and night shift) off-farm job as a operator maintainer at the Coppabella washplant which is about one and a half hours drive west of Mackay.

Property size: 105 hectares of cane land with approx. 20 hectares per year out fallow for soybeans. Plus another 35 hectares of cane land on my father's farm with roughly 5 hectares fallow each year.

Average annual rainfall: 1400mm primarily from the end of December to the end of March.

Soil type: Sandy clay loam ranging from light brown to dark brown and an organic carbon between 0.5% and 1%.

Soil pH_{water} : from 5.5 to 4.5.

Keys to success with soybeans

- Good planning and crop monitoring, particularly once the crop has started flowering.

History of property

Originally established as a sugar cane farm by Benjamin Langford in 1890. The Newman family was the second family to own the farm since its original settlement and we are the third. We purchased the farm from John Newman in 1987 and continue to develop the property to this day.

Why grow soybeans?

The benefits of soybeans as a legume soil conditioning plant has been promoted to the sugar cane industry by the BSES for about 10 years now and we have been growing them on fallow ground for the last 10 years. In the heavy soil not only do the beans give you a disease break, add nitrogen and organic matter, but they make the soil so much more friable that we are able to reduce the number of workings before the following cane crop and Simon thinks if they had a disc opener type planter they could no till plant the cane. They have been taking soybeans through to grain for the last 5 years to get the added benefit of the extra income.

Negative aspects of growing soybeans

It takes careful planning to get them in the ground and to have the best chance of growing a good crop. The weather at harvest time is quite often showery, so losses through weather-damaged beans or untimely harvests due to the inability to access wet paddocks are common.

For example in 2008 they planted their beans on 19 Decmber then got 130mm on 20-21 December and were not able to get back on the ground until 3 March because of continuous rain.

Growing season

If growing for a green manure crop, planting can be done early at the beginning of November, or growing for a grain crop, between early December and late January. Harvesting is done between mid April through to June.

Simon Mattsson

Sowing system

A Napier Mason disc opener planter with 8 rows 500mm apart (1100mm wide over wheel tracks) on 1.8m wheel centres. They aim to get 300,000 plants per hectare. After planting and prior to emergence, they spray with Spinnaker® (and Roundup®) if young weeds are already present.

Type of irrigation

Depending on which field is fallow, it could be a centre pivot or a hard hose travelling irrigator. Water comes from the Pioneer River or an on-farm dam.

Irrigation regime

Soil moisture is monitored with tensiometers. Being a wet season crop, they rarely irrigate but if required, we usually apply approximately 25mm per irrigation.

Harvesting equipment

Simon was disappointed to leave a cash crop in the field as there was no local harvester. So they bought their own New Holland TR85 harvester 5 years ago. Initially, they only harvested their own crop, but now they also contract harvest around 162 hectares per year.

Paddock preparation

Cane harvesting season runs from June to December so they try to harvest those blocks of cane they intend to use for soybeans as early as possible. The cane trash is left until it rains or they irrigate, and then they offset disc twice and leave the ground for another 2-3 weeks before rotary hoeing. Trash is ideally left at least 2 months if possible before planting soybeans. The aim is to give the cane trash more time to break down so we get a good seed-soil contact when planting. Soil sampling is done straight after cane harvesting so that they can work out a nutrition strategy for both soybean and the following cane crop.

Varieties

Stuart$^{\phi}$ and Leichhardt are the two most common varieties planted, however Simon has had an SRDC funded variety trial on the property in the 2008 season including Stuart$^{\phi}$, Leichhardt and A6785 and Warrigal$^{\phi}$.

Crop nutrition

This depends on a soil test, but normally includes an application of lime at about 2.5 tonne per hectare and an application of Biodunder™ is the end product from molasses fermentation for ethanol production. It comprises of vegetable matter containing potassium, sodium, calcium, magnesium and phosphorus. Some blocks get mill mud instead of the Biodunder™.

Weed control

One application of Spinnaker® and (Roundup® if necessary) pre-emergence with in crop weed control confined to shielded spraying with Roundup® Spinnaker® at label rates and Roundup® at about 2 litres per hectare.

Herbicide resistance

No herbicide resistance problems have appeared to date.

Pest management

Initially, once a week monitoring, then twice weekly once pod set commences using a beat sheet. When bug thresholds are reached, (green vegetable bug being the biggest problem) they spray with Decis® Options at label rates and have never had to spray more than twice in one season.

Disease management

So far this has not been an issue except for one small crop of Bunya(ϕ) soybeans which was severely affected by a suspected virus disease.

Cost of production

- Ground preparation about $105 per hectare
- Seed and planting about $105 per hectare
- Weed control about $112 per hectare
- Fertiliser about $140 per hectare
- Insect control about $30 per hectare
- Desiccation about $25 per hectare
- Harvesting and drying about $135
- Total costs per hectare are around $652 and that is only if they don't have to irrigate at all.

Economic benefit from growing soybeans

This mainly results from reduced fertiliser requirement in the following cane crop. For example nitrogen requirements can be reduced by 50-75%.They need to get a price for their beans of $400 or more per tonne to make any money from them mainly because of the cost of transport from Mackay to Dalby where most of them have gone over the years.

Crop compared to other crops

Very hard to compare it to sugar cane and they have not grown anything else here.

Crop intensity

Soybeans for the Mattssons are only grown on land that would otherwise be bare fallow so they are not really in competition with any other crop. There are other crops that we could grow in the same time frame however soybeans offer the most benefit for the least risk by far.

Crop yield

So far yields have been in the 2-3.5t/ha range, but yields of 4t/ha or more should be achievable in a good season.

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