final report

Project code: B.NBP.0791

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Date published: 12 August 2019

PUBLISHED BY
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NORTH SYDNEY NSW 2059

Lifting Leucaena adoption in north Queensland

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

The introduction and successful establishment of leucaena has the potential to double annual live-weight gains and increase carrying capacity for beef enterprises.

The low rate of adoption of leucaena by graziers across north Queensland appears to be linked closely to establishment costs, potential frost impact in some areas, tree clearing regulations, low confidence in plant establishment and the impact of psyllid attack on productivity.

The Producer Demonstration Site (PDS) at Whitewater Station, near Mount Surprise, included both a 40 ha site aimed at improving industry understanding of establishment costs and options, as well as a one hectare replicated experiment to assess the palatability of new leucaena lines bred specifically for psyllid resistance.

The leucaena planting on a 40 ha lightly timbered site was fully established in mid-2016 enabling assessment of management requirements and potential productivity-profitability gains on uncleared land.

The palatability assessment of the four new psyllid tolerant lines was conducted by the Department of Agriculture and Fisheries (DAF) and the University of Queensland (UQ) in December 2014 and May 2016. With the aid of this data, all four lines were confirmed to be palatable with Line 12 (Redlands) selected and released to commercial partners.

Based on these preliminary study results, UQ and Meat and Livestock Australia (MLA) proceeded to commercialise the Redlands variety by contracting two seed producers in Central Queensland. Commercial seed is now available for producers to plant in the 2019 growing season.

Executive summary

The potential role of leucaena in north Queensland

Extensive beef businesses in northern Queensland are under significant financial pressure with rising debt, high cost of production and relatively low annual live-weight gains. A relatively short growing season and the associated rapid decline in feed quality are key constraints to the profitability of northern beef enterprises. These are frequently exacerbated by wild fires and runs of poor or failed wet seasons. Producers need to increase their productivity if they are to stay viable in the current economic climate. Increasing annual live-weight gain and reducing age of turn off through the use of improved pastures are achievable targets on northern properties with suitable soils and rainfall.

Enterprises with well-managed leucaena (*Leucaena* sp.), an introduced tree legume, can be substantially more profitable than those with grass-only pastures. However, leucaena systems are difficult to establish and require a specific agronomic skillset. Although the profitable use of leucaena is well-established in central and southern Queensland, the rate of adoption of leucaena is low in north Queensland (<2500 ha established to date). This low adoption rate is variously attributed to low producer confidence in adopting the technology (technical knowledge), potential establishment issues including costs, psyllid (insect) attack on existing varieties and the low availability of suitable cleared land and soils with good access for production.

The fertile and freely drained basalt soils in northern Queensland are well suited to growing leucaena with the area available between Charters Towers and Mount Garnet including more than two million hectares. Generally, the annual live-weight gain on native pastures is approximately 120 kg per head, but the introduction and successful establishment of leucaena has been shown to double live-weight gains (200-240 kg per head), increase stocking rate potential and open up premium marketing opportunities. However, the establishment of leucaena, usually planted in rows on cleared country, is difficult on this land type due to surface rock which is damaging to conventional mechanised planters. Also, the area of cleared basalt soils in northern dry tropics is limited under the current vegetation policy. These constraints require some novel approaches to effectively grow and adopt leucaena in north Queensland.

The research team

A producer group representing approximately 30 000 cattle on 265 000 hectares was established for the project and worked with researchers from the Department of Agriculture and Fisheries (DAF) and the University of Queensland (UQ). The primary aim of the producer management group was to increase the awareness and adoption of leucaena-based pasture in beef businesses with suitable soils in north-east Queensland. Within the project, high upfront costs, standing vegetation and surface rock were considered the key challenges to successful adoption.

Testing leucaena under trees

A producer demonstration site was established at Whitewater Station, near Mount Surprise, to test the capacity to establish commercially available (Wondergraze) leucaena under trees in lightly timbered country on open basalt woodlands. Beginning in 2014, a 40 ha site was sown to Wondergraze using simple, commercially viable minimum-tillage methods involving the use of glyphosate to reduce weed competition, deep ripping, sowing with locally developed planters and the use of selective herbicides after sowing. At the end of year three, and despite poor establishment in one year due to low post-plant rainfall, ~ 75% of the planted rows were successfully established across the project site and the establishment costs of a woodland leucaena production system calculated. Based on 2014 values the payback period of this leucaena system was approximately 10 years.

Key lessons and recommendations were developed: in a dryland environment rainfall reliability can be variable so it is important to assess seasonal outlooks before committing to the planting operation. Poor seedbed moisture and little follow up rain can often lead to poor establishment as experienced in this trial. Good seedbed preparation is essential and agronomic practices such as ripping need to be completed earlier in the season. Prior to investment in this level of pasture development producers must gain a thorough knowledge of leucaena systems and understand what is achievable on their property. To gain confidence and ensure success, producers should trial a small leucaena plot on their property before committing to plant larger areas.

Psyllid tolerance and palatability of leucaena breeding lines

The impact of psyllid (*Heteropsylla cubana*) attack on the productivity of existing commercial leucaena varieties has been well documented and prompted the development of psyllid tolerant hybrids (*Leucaena leucocephala* x *pallida*) in a long-term program co-funded by MLA and UQ. In a collaborative project between UQ and DAF, a 1 ha replicated palatability experiment was conducted on 'Whitewater' to compare the four new promising psyllid tolerant leucaena lines with the current commercial cultivars 'Cunningham' and 'Wondergraze'.

The experiment provided DAF, UQ and northern graziers the opportunity to observe the new varieties first hand in a commercial environment. Four breeding lines and two commercial cultivars were monitored for psyllid damage and were assessed over two palatability experiments. Results demonstrated that cvv. Cunningham and Wondergraze were preferred to all the psyllid-resistant breeding lines, especially when undamaged by psyllid, but under higher stocking rates all varieties were consumed and were therefore palatable in these short-term experiments. Trial data has endorsed the selection of 'Redlands' to be progressed towards commercialisation. The palatability and psyllid tolerance data collected is important for producers across northern Australia contemplating establishing leucaena production systems in psyllid prone areas. The experimental results clearly demonstrated that the psyllid tolerant lines were less damaged by psyllids than the commercial varieties.

Future research and development

This project has led to the development of a large-scale replicated research experiment at 'Pinnarendi Station' (Mount Garnet), co-funded by MLA and DAF, to compare the live-weight gains of cattle grazing 'Redlands' with that of the current industry cultivar 'Wondergraze'. Animal performance data from 'Pinnarendi' will be combined with the results of this project to produce a 'Tips and Tools' guide for conventional and woodland leucaena production systems in north Queensland.

The methods and practices followed in this PDS adhered to the Leucaena Code of Practice (http://www.leucaena.net/codeofconduct.pdf or admin@leucaena.net).

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1 Background

The Mt Surprise producer group representing approximately 30 000 cattle on 255 000 hectares was formed in 2013 with the aim of better understanding leucaena as an option to use in improved pasture systems. Most graziers are aware of the production benefits associated with leucaena, however there was a distinct lack of knowledge in establishment methodology, particularly on uncleared basalt country in northern Queensland. Previous experience with learning activities was diverse, ranging from those who had actively participated with previous research activities, to producers with minimal contact with research and training organisations. Pasture improvement, productivity gains and better marketing opportunities were the key motivations within the producer group.

Previous trials across Queensland clearly establish the production benefits of leucaena including increased annual live weight gain and reduced age of turnoff for cattle (Harrison et al 2015). Leucaena, if successfully established, will double existing annual live weight gains in north Queensland and improve access to premium markets. With the current economic climate and financial pressures being felt in the northern Queensland beef industry, the PDS has detailed the direct costs and financial benefits associated with establishing woodland leucaena systems.

Prior to setting up the PDS site, the Saunders family at Whitewater Station, Mt Surprise had already begun to trial leucaena on basalt soils. This was done on a small scale to compare varieties and evaluate various agronomic techniques. Varieties Wondergraze, Cunningham and Peru were observed noting the close management leucaena requires to ensure successful establishment and ongoing production. The PDS project has allowed the owners of Whitewater Station, as well as other interested producers, to improve their understanding of the preparation, costs and animal productivity gains associated with leucaena production systems.

The leucaena psyllid (*Heteropsylla cubana*) is a small insect that feeds by sucking sap from developing shoots and young foliage. Large infestations can defoliate the plant and stop growth (Dalzell 2006). In north Queensland, the psyllid has a huge impact on the yield potential of current industry cultivars. Psyllid attack greatly reduces the productivity of northern leucaena systems and is a major reason behind the low industry adoption rates in the region.

To address this, UQ in partnership with MLA began a breeding program to develop leucaena lines which showed specific resistance or tolerance to psyllids in 2002. *Leucaena leucocephala* lines had to be back crossed with *Leucaena pallida*. A maximum of 10% *L. pallida* genes were used to develop psyllid tolerance whilst still maintaining productivity and palatability.

During 2013, four lines from the UQ breeding program at Redlands were identified to progress and the PDS project at Whitewater was identified as an ideal location for initial palatability trials. A fully replicated trial was set up on one hectare to measure the animal preference of the new lines when compared to the current industry cultivars of Cunningham and Wondergraze.

2 Project objectives

By 1 December 2017 the Whitewater Producer Demonstration Site has:

1. Evaluated and demonstrated the dry-land establishment and productivity of leucaena in timbered basalt country of NQ.
2. Assessed the likely profitability to beef production of leucaena-based pasture in this environment, including its sensitivity to reliability of establishment and extent of

productivity benefit above native pasture.

3. Assessed the psyllid tolerance and palatability of elite psyllid-resistant varieties, relative to Cunningham and Wondergraze.
4. Developed a 'NQ leucaena Tips&Tool' including establishment techniques and costs, on-going costs, and variety performance.

3 Methodology

This demonstration project monitored the successful establishment and productivity of leucaena on timbered basalt country in north Queensland. The economics of this task were assesed and collated allowing graziers to make informed decisions about the suitability leucaena has in their current business model.

The project commenced in December 2014 and monitoring was completed in June 2017. The aim of the study was to demonstrate leucaena establishment in lightly timbered country at an affordable cost.

The second component of the trial assessed the psyllid tolerance and palatability of elite varieties bred by UQ, relative to the current industry cultivars of Cunningham and Wondergraze. The aim was to prove that lines were palatable and choose one of the four lines for commercialisation.

3.1 Whitewater Station

Whitewater Station, owned and managed by the Saunders family, covers an area of 25 200 hectares and is located on the north-western edge of the McBride Plateau approximately 26 kilometres from Mount Surprise (S18.1467 E144.3183) (Fig. 1). Elevation across the station ranges from 600-700m and the main soil groups consist of 60% red basalt, 35% granite and 5% black basalt. The red basalt country, derived from recent volcanic activity, is fertile supporting productive native pastures. Average long-term annual rainfall is approximately 796 mm with 70% falling between December and March.

The Droughtmaster and Brahman cross cattle operation generally produces animals for live export in the 280-350 kg range. The 40 hectare site is comprised mostly of native and naturalised grass (Indian Couch) and legume (stylos) species well established on the granite soils. Most paddocks are opportunistically spelled on a rotational basis annually with typical stocking rates at one Adult Equivalent (AE; 450kg steer at maintenance) per seven hectares.

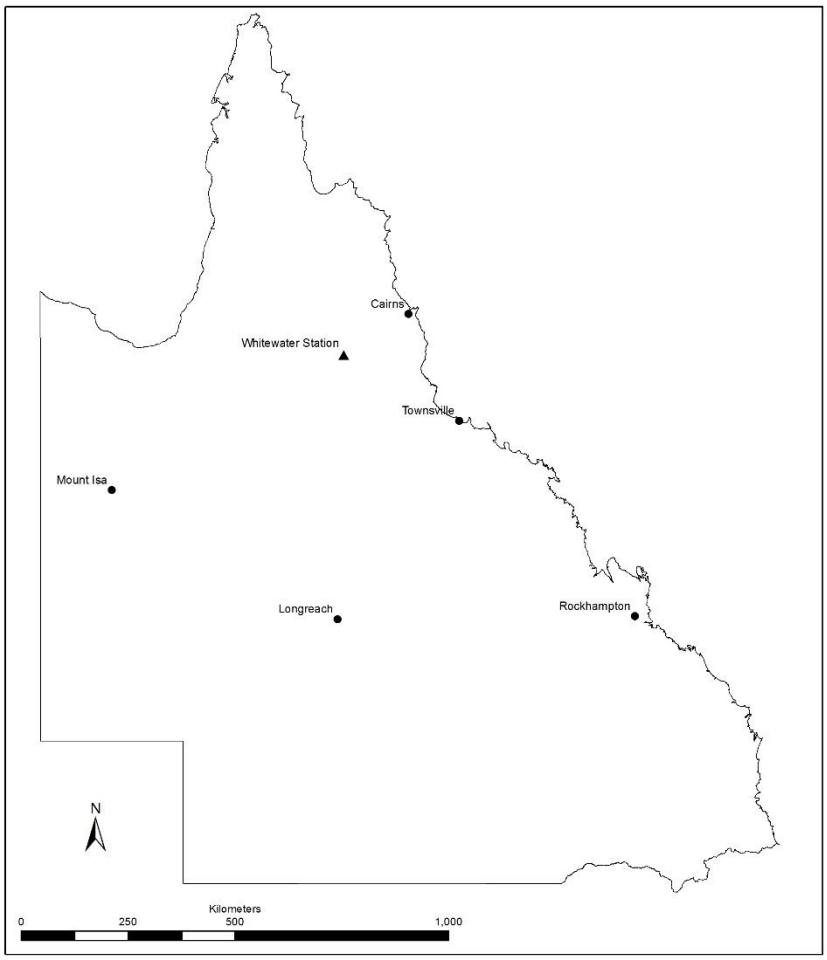

Fig. 1 Location of the Whitewater PDS site.

3.2 Forty hectare establishment site

In close consultation with the Saunders family on Whitewater and project stakeholders, a lightly timbered trial site was selected on well-drained and fertile red basalt soils.

Site preparation and ripping was completed on the 40 hectare site in late November 2013 in preparation for the early break of the wet season. Lines were ripped approximately 10 metres apart and followed a path of least resistance through the timber and rock to allow for an easier planting operation. Large surface rocks and timber were cleared from each row with a blade to improve planting accessibility. Key stakeholders of the project convened mid-February 2014 and a decision was taken to postpone the planting until the following season due to insufficient early season rainfall.

No ripping was necessary because the ripped rows completed late November 2013 were adequate, however a light cultivation with a chisel plough the width of the tractor was completed in early January 2015. Planting started on 21 January 2015, with 12 rows sown following 130 mm of rainfall (Table 1). The planting rate used was 1.5 kilograms per hectare of pure seed and fertiliser (Gran-am®) at 30 kilograms per hectare applied either side of the row. Some planter adjustments were necessary to reduce planting depth. The seedbed was also improved through attaching a heavy piece of railway line in front of the planter as a levelling device. Sixteen rows were planted with these modifications on 30 January 2015.

All rows were sprayed with Roundup® (glyphosate) herbicide using a three metre boom mounted on a quadbike before the planting operation. Post planting, Verdict® (haloxyfop) herbicide was applied at 100 millilitres per hectare with a tractor mounted calibrated boom spray for grass control. Visual assessments were made of plant establishment during the following dry season months from May to October. Replanting of the site was necessary due to the failed wet season and drought conditions. Drip irrigation was installed on the first five rows to mitigate a third wet season failure and enable the successful establishment of these rows in the standing timber. Prior to replanting in the 2015/16 season re-ripping the site was necessary. It is essential that the leucaena seedling taproot gets easy and rapid access to subsoil moisture to enable survival during the drier months. This was completed in early October 2015 (Fig. 2).

Fig. 2 The bulldozer re-ripping single rows in October 2015.

The seed was treated above the recommended rate (1 bag inoculum:40 kg leucaena seed) on a tarp with a slurry of a rhizobium bacteria commercially referred to as NoduleN™ (strain CB3126) before rows one to five were sown under drip irrigation on 30 November 2015. After the same seed inoculation regime the planting of non-irrigated rows (26) was completed on 7-8 January 2016. The planting rate used was 1.5 kilograms per hectare of pure seed. No fertiliser was added at planting because soil tests confirmed all nutrients were adequate from the previous applications. All rows were sprayed with a combination of Roundup® and Spinnaker® (imazethapyr) herbicide in a single pass using a calibrated tractor mounted boom. Granulated sulphur was applied on 26 September 2016 with a fertiliser spreader at a rate of 50 kg/ha.

Visually, the leucaena trees lacked vigour at the end of the 2016/17 wet season, so a small trial was conducted to identify plant deficiencies. Results of the small trial were hoped to determine nutrients needed to be applied over the entire area. Products trialled included Gran-am® and gypsum.

The trial area consisted of 10 rows, 50 metres long with five replications of two treatments side by side. Treatment one was gypsum applied at 300 kg/ha (45kg/ha of sulphur per hectare). Treatment two was Gran-am® applied at 200 kg/ha (48 kg sulphur and 40 kg nitrogen per hectare). Both treatments were applied by hand application on 8 March 2017.

At 18 months old the trees were large enough to allow a grazing event. The project committee met with the Saunders family and it was decided to run a low stocking rate for a set period across the entire site in July 2017 (Fig. 3). Granulated sulphur (90% S) was applied directly on the plant row at

140 kg/ha in August 2017 to top up sulphur stores while tractor access over the row was still possible.

Fig. 3 Eighteen month old leucaena plants pre-and post-graze July-October 2017.

3.3 One hectare palatability trial site

Small amounts of seed of the four new leucaena lines bred specifically by UQ for psyllid tolerance were sent to the DAF team in Mareeba for growing out in September 2013.The seed coat was clipped to overcome dormancy and placed in grow-out trays using a customised seed raising mix. Approximately 500 plants of each breeding line were raised in the shade house facilities at Mareeba along with the industry cultivars Cunningham and Wondergraze. Seedling transplantation was chosen because each breeding line had limited seed and it was deemed to be the most reliable establishment method in the variable Mount Surprise environment.

A suitable one hectare site was selected near the Whitewater homestead and securely fenced to exclude stock, kangaroos and rabbits. The site was cleared of surface rock and single rows were ripped 8–10 metres apart. The ripping operation lifted additional rocks that needed to be removed and then a final pass with a rotary hoe provided a good seedbed for planting.

A basal fertiliser application of granulated sulphur (30 kg/ha – 90% S) was applied over the one hectare area in early January 2014 with a fertiliser spreader. Gran-am® was also applied by hand in early February on the ripped lines at 20 kg/hectare.

Leucaena seedlings were inoculated by hand-watering with a slurry of rhizobium bacteria NoduleN™ (strain CB3126; 1 bag inoculum:40 kg leucaena seed) and sun-hardened to prevent transplant shock prior to planting on 10 February 2014. A replicated site plan (Appendix 11.1) was developed and individual plots were pegged out. The hand planting was very labour intensive, however a large number of interested producers and Northern Gulf Resource Management Group (NGRMG) representatives streamlined the planting operation (Fig. 4).


Fig. 4 Site preparation and the planting operation 10 February 2014.

A dripper line system was set up following planting to supplement rainfall and ensure the survival of the breeding lines. Gran-am® (30 kg/ha) was applied in early March in the planted rows only. Only three plants failed to survive and height assessments in late June 2014 indicated plant heights ranged from 900 – 2700 mm.

When psyllid damage was first noticed at Whitewater Station, the project management team decided to evaluate psyllid damage in both the breeding lines and current commercial varieties Cunningham and Wondergraze.

Five plants in each line across all replications were tagged to allow repeat measurements on the same plant. Plants were assessed using the psyllid damage rating scale (PDR) developed for leucaena (Wheeler 1988. Appendix 11.2). Two hundred and forty individual measurements were recorded every two weeks from July to October incorporating both pre-and post-grazing. Following this establishment phase, the project team decided to reduce plant biomass through grazing in September 2014. This reduced plant height and increased branching prior to the first grazing trial in December 2014. The amount of standing feed was assessed and a set number of weaners grazed the site for several days. Water was installed in the paddock and the gate shut during the day and opened at night. Animal activity was closely monitored to ensure the leucaena plants were not damaged through overgrazing. Trees were then manually pruned evenly to a height of 1.5 metres across the whole plot in preparation for the palatability trial in December 2014.

In the first palatability trial the leucaena lines were monitored for palatability preference without grass in the inter-row. Electric fencing lanes were installed to allow stress free movement of the cattle in and out of each replication at the site.

Dr Max Shelton and his team from UQ conducted the first grazing experiment in December 2014. The experiment involved the grazing of six varieties of leucaena (four breeding lines plus two commercial cultivars) replicated eight times (=48 separate 15 m row-plots of leucaena), using approximately 30 weaners, plus an additional nine cows over the last two days.

Initially, six weaners per replication were used to graze the leucaena to gauge preference at a very low stocking rate, then a larger mob was introduced to measure palatability at higher grazing pressure. A total of 2300 separate observations on cattle behavior (from 6 am in the morning to 6 pm in the evening) were performed. The yield of each leucaena line was measured pre- and post-

grazing on 480 trees totaling 960 measurements. Pre-grazing yield estimation also involved making approximately 2200 non-destructive measurements of branch diameter and length as well as the reproductive status of 240 trees. Leaf samples were also taken for chemical and digestibility analysis. Following the grazing trial all plants were cut back evenly to allow recovery during the wet season.

A light cultivation of the inter-row area in January 2015 created the soil disturbance necessary to successfully sow improved pastures. A mix of coated Gatton Panic and Buffel grass seed was sown at high rates (approximately 20 kilograms per hectare) and a heavy steel roller was used to ensure good seed soil contact to encourage establishment. Adequate follow up rain did not eventuate after planting and most of the seed died on or just below the surface before germination.

Grazing was again used to reduce biomass across all replications in September 2015. A second palatability trial required a good body of inter-row grass to increase diet selection. The site was prepared for an improved pasture grass species to be sown between the rows in early December 2015 when a wet weather event was forecast. The soil surface was disturbed with diamond harrows and Gatton Panic seed was sown through a calibrated hand spreader at 15 kilograms per hectare. The seed was then lightly covered and rolled. Establishment of the Gatton Panic was poor, however, there was a good emergence of annual grass species.

Eight weeks prior to running the palatability trial the entire site was heavily grazed with cattle removed before overgrazing of the inter-row pastures. Following grazing, the leucaena plants were hand pruned to a height of 1-1.5 metres allowing adequate regrowth and an ideal grazing height of two metres for the palatability trial.

The second palatability trial on the one hectare plot took place in mid-May 2016. The area was divided into four small paddocks each containing two replications with electric fencing. Lanes were also re-installed to allow stress free movement of the cattle in and out of each replication at the site. The amount of standing feed was assessed and each small paddock was grazed for 24 hours by 15-24 steers and cows weighing 400-500 kg (~ 20 AE). Plant leaf yield before and after grazing was measured (Fig. 5).

Fig. 5 Second palatability trial pre (left) and post grazing (right) in May 2016.

Water was installed in the paddock and the gate shut and animal activity was closely monitored with a Go-Pro day-night camera to observe grazing preference. Animal behavior was observed using a 180^{o} day/night time-lapse camera mounted on a pole.

With all palatability trial assessments completed the project team removed all breeding lines other than Redlands. The commercial lines of Cunningham and Wondergraze were retained and Redlands seedlings were transplanted into these areas of the trial in late January 2017 at a spacing of 50

centimetres. Once the planting was completed the trickle irrigation tape was reinstalled and plants were watered as necessary depending on rainfall. Verdict® herbicide was applied 8 March 2017 across all of the newly transplanted areas. Gran-am® was also applied by hand at 20 kg/hectare.

3.4 Extension activities

PDS group meetings were held on-property prior to each planting season in the 40 hectare site. Discussions were also held prior to the running of each palatability trial. Producers were encouraged to visit and participate in activities at both sites wherever possible. Other field days were also held at both sites in conjunction with industry events such as the Leucaena Network Annual Conference in May 2016 and the BeefUp Forum at Mt Surprise in June 2016.

4 Results

4.1 Forty hectare site establishment

Planting of the demonstration site (2013/2014) was delayed due to insufficient rainfall. Good rain fell in the first two weeks of January 2015 allowing planting to take place. Planting started on 21 January, with 12 rows sown. The planting rate used was 1.5 kilograms per hectare of pure seed and fertiliser (Gran-am®) at 30 kilograms applied either side of the row.

Planting was delayed for several days because of a broken chain on the planter box and not able to recommence due to insufficient moisture in the planting zone. During the delay assessments were made of both planting depth and population. Some adjustments were made to the planter to reduce planting depth. The seedbed was also improved by using a heavy piece of railway line in front of the planter as a levelling device. Sixteen rows were planted with these modifications on 30 January 2015.

Comparisons of the differing plant seedbeds could be made if soil moisture was adequate. The Whitewater site received substantially less than half of the average monthly rainfall (Table 1).

Table 1: Whitewater and Mount Surprise monthly rainfall from November 2014 to April 2015.

Month	Whitewater site monthly rainfall (mm)	Mt Surprise average monthly rainfall (mm)
November 2014	5	54
December 2014	31	115
January 2015	180	210
February 2015	103	205
March 2015	5	112
April 2015	4	28

Smaller plants died as the season became drier, with most dead by September 2015. Some areas of the site showed promise with small sections of rows making it through the dry season. This result shows that planting needs to take place early in the wet season so the leucaena can develop a good root system to withstand the drier months of the year. The growth rates of the plants were recorded

(Table 2). Some plants performed better because of the time of planting and more ideal soil conditions.

The 16 rows planted following the planter modifications received a total of 123 mm of rain including pre-plant moisture. Plant populations were assessed after the dry season and a re-plant was necessary.

Anecdotal observations indicated leucaena plant growth under trees was superior, with shading possibly cooling the plant zone and reducing soil moisture loss. This changed over the subsequent drier months when the trees started to draw on available subsoil moisture.

Table 2: Plant height data from first half of the planting.

Days from Planting	Range of plant height
51	50 mm to 800 mm
70	50 mm to 1325 mm
100	50 mm to 1500 mm

Following germination tests (> 95%) the seed was treated with specific rhizobia before rows one to five were sown under drip irrigation on 30 November 2015. Some rows were sown dry whilst others were irrigated prior to sowing. This allowed for some modifications to the planter to reduce issues when planting directly into soil moisture following rainfall. A single row without drip irrigation was also sown. Ideally the drip irrigation (although expensive) allows an earlier planting with moisture supplemented until rainfall occurs. Planting occurred on 7-8 January 2016 with 26 rows sown.

Soil moisture was excellent with rain having fallen the previous week. Follow up rain was good with consistent falls through until the end of March. The Whitewater site received good average monthly rainfall compared to long-term trends (Table 3).

Table 3: Whitewater rainfall 2015/2016

Month	Whitewater site monthly rainfall (mm)	Mt Surprise average monthly rainfall (mm)
November 2015	21	54
December 2015	319	115
January 2016	242	210
February 2016	87	205
March 2016	152	112
April 2016	4	28

All rows were sprayed with Roundup® and Spinnaker® herbicide mixed together, using a calibrated tractor boom. Mixed results were achieved, most notably because of the heavy rainfall event post planting, boom maintenance issues and blocked nozzles. Plant population was adequate across the

entire site after germination with an average spacing of around 10 centimetres between plants (Fig. 6). Observations across all rows show the established leucaena plant population was approximately 75% with most plants large enough to survive the dry season.

Fig. 6 Adequate plant population after germination.

Surviving plants from the previous growing season yellowed at the end of the first wet season. The problem proved difficult to diagnose however sulphur and/or nitrogen deficiencies were considered a likely cause. Plants in this environment often take time to start fixing their own nitrogen and slow-release granulated sulphur applied previously may not have been available to the plants. To address this issue a small trial was designed to help decide which nutrient needed to be applied over the entire area. The two products used were Gran-am® and Gypsum®. Although not a replicated trial visual assessments were made. Plants responded quickly to the Gran-am with nitrogen being immediately available suggesting that plants were struggling to fix their own nitrogen. There was little or no observed colour change in the rows that had Gypsum® applied.

4.2 One hectare palatability trial

4.2.1 Psyllid damage measurements

Up until late June 2014 observations indicated the defoliation rate from damage caused by psyllids was low. With the weather cooling and vigorous growth present, conditions were optimal for psyllid attack. When psyllids were first observed at Whitewater the property owners wanted to gain a better understanding of leaf damage on the new breeding lines compared to that in the current commercial leucaena varieties Cunningham and Wondergraze.

A methodology was decided upon through a consultation process with researchers from university and government agencies. The aim was to make measurements user friendly, so landholders could complete assessments and data collection.

Five plants in each line across all replications were tagged to allow repeat measurements on the same plant and assessed for psyllid damage as described by Wheeler 1988 (Appendix 11.2). Under the scale, one represents no damage observed ranging through to nine with blackened stems and

total leaf loss. A rating of five as seen in Table 4 for the variety Cunningham represents a loss of up to 25% of young leaves.

Two hundred and forty individual Psyllid Damage Ratings (PDR) measurements were recorded every two weeks from the end of July to the end of October 2014, incorporating both pre-and post-grazing strategies. The psyllid damage data was collated and averaged for each line across the eight replications (Table 4).

Table 4: Mean pre-and post-grazing psyllid damage using the 1-9 PDR scale (1=no damage observed; 9=blackened stem with total leaf loss).

Line	Pre-grazing			Post-grazing			
	31/07/2014	14/08/2014	28/08/2014	11/09/2014	25/09/2014	9/10/2014	24/10/2014
12	1.125	1	1.3	1	1	1	1
24	1.1	1.125	1.5	1	1	1	1
34	1.175	1.1	1.325	1	1	1	1
39	1.125	1.1	2	1	1	1	1
Cunningham	5.25	2.525	5.525	1	1	1	1
Wondergraze	3.85	2.625	4.525	1	1	1	1

When psyllid pressure was high in July and August 2014 the commercial lines suffered greater foliar damage when compared to the new hybrids. Although not measured, these lines appeared to recover faster and produce more biomass both pre-and post-grazing. There was no visible difference across all lines in September and October, most likely because plants had been grazed and the psyllids had moved on. This result clearly showed the new lines suffered minimal damage, compared to the existing commercial cultivars, which experienced up to 25% damage to young leaves.

4.2.2 Palatability trial 1

The purpose of the palatability trial was to gain information on grazing preference enabling a recommendation of which psyllid resistant breeding line to release for seed increase and distribution. The experiment included six varieties of leucaena including four breeding lines (12=Redlands, 24, 34 and 39) plus two commercial cultivars (Cunningham and Wondergraze) replicated eight times (=48 separate 15 m row-plots of leucaena). There was poor establishment of improved pasture grasses in the trial area for the first palatability trial (15-19 December 2014) meaning cattle were given nocturnal access to native and naturalised pastures outside the trial.

Before grazing commenced, there was more leaf dry matter on the breeding lines than on the commercial lines owing to previous psyllid attack on the commercial lines (Fig. 7). However, there were also edible green pods on the commercial cultivars and almost no pods on the breeding lines.

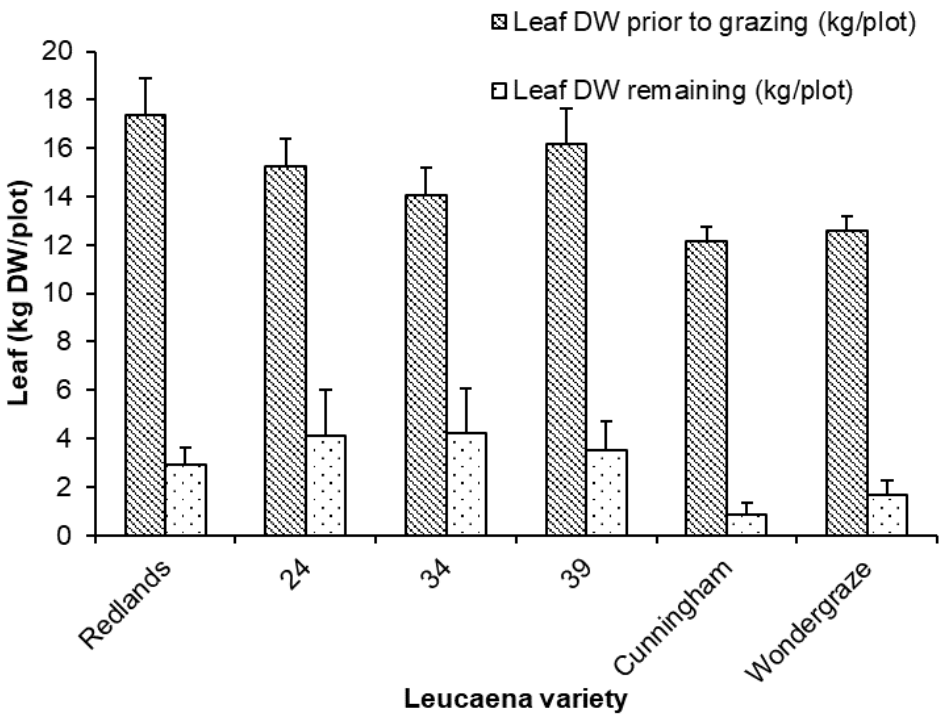

Fig. 7 Mean dry weight of leucaena leaf (kg/plot) prior to grazing and remaining after grazing for Trial 1 (Redlands = Breeding Line #12)

Initial grazing by six weaners indicated that cv. Cunningham and Wondergraze were preferred to the breeding lines, when offered at very low stocking rates and weaners were able to freely select according to preference. This difference in preference was of importance given that the breeding lines are >90% genetically similar to *L. leucocephala*. The two caveats to the observation of grazing preference for Cunningham and Wondergraze were that both commercial cultivars had abundant green pods, which were preferred by the cattle, and the commercial cultivars were also shorter in stature and therefore more accessible (owing to previous damage by psyllids) than the breeding lines (Table 5).

The breeding lines, unaffected by psyllids, were taller with some edible material initially out of reach of the weaners. The additional weaners and larger cows introduced into the plots for the second grazing overcame this height issue. However, the smaller weaners ultimately learned to bend trees over to access all available feed. When the larger group of weaners (21 head), and later nine cows, were introduced, edible forage in all treatments was almost completely eaten, indicating that all lines were palatable (Fig. 7). An average of 80% of all leaf of cv. Redlands and the breeding lines was removed with little difference among them, while 85–90% of the leaf of cv. Cunningham and Wondergraze was removed.

Table 5. Percentage of total grazing time spent by 6 weaners browsing four leucaena breeding lines and commercial cultivars Cunningham and Wondergraze (17 December 2014) and the reproductive status of all leucaena lines (Trial 1). Legend for reproductive status: 1 = vegetative; 2 = budding stage; 3 = flowering stage; 4 = green pod stage; 5 = brown pod stage.

Line	Proportion of grazing time (%)	Reproductive status
12 (Redlands)	7	2.1
24	10	2.7
34	7	2.0
39	12	1.7
Cunningham	34	3.7
Wondergraze	31	3.6
Total / Mean	**100**	**2.1**

4.2.3 Palatability trial 2

In 2013, cv. Redlands (Breeding line 12) was selected for release to industry based on high level of psyllid resistance, in-vitro digestibility, yield, branchiness and fertility. A second palatability trial was completed at Whitewater Station to confirm the results of the first palatability trial. Grazing behaviors were observed using a 180 degree day and night time-lapse camera mounted on a pole (Figures 10 and 11).

Fig. 10 Time lapse day photography was used to capture grazing time of each leucaena plot (length=15 m)

Fig. 11 Time lapse night photography recorded nocturnal grazing time of each leucaena line.

The trial was grazed in mid-May 2016 by 15-24 steers and cows (400-500 kg; ~20 AE). The yield of leaf before and after grazing was measured. Cunningham and Wondergraze suffered psyllid damage but there were no major differences in grazing time among the six different leucaena lines (Table 6).

Table 6. Percentage of total grazing time spent browsing the leucaena breeding lines and commercial cultivars for Trial 2.

Leucaena line	Proportion of grazing time (%)
Redlands	18
24	18
34	17
39	19
Cunningham	14
Wondergraze	14
Total	**100**

All leucaena lines were well eaten with approximately 10–15% of leaf remaining at the end of each grazing period, indicating that all lines were palatable. Given that there was significantly more leaf on cv. Redlands and the breeding lines at the beginning of the trial (due to psyllid damage to the commercial lines), it is inferred that the cattle again preferred the commercial lines. Overall, there were no major differences in preference among the varieties. All were well eaten with approximately 10% of leaf remaining at the end of grazing period (Fig.12). Given that there was more leaf on the breeding lines at the beginning of the trial, the cattle spent more time grazing these lines.

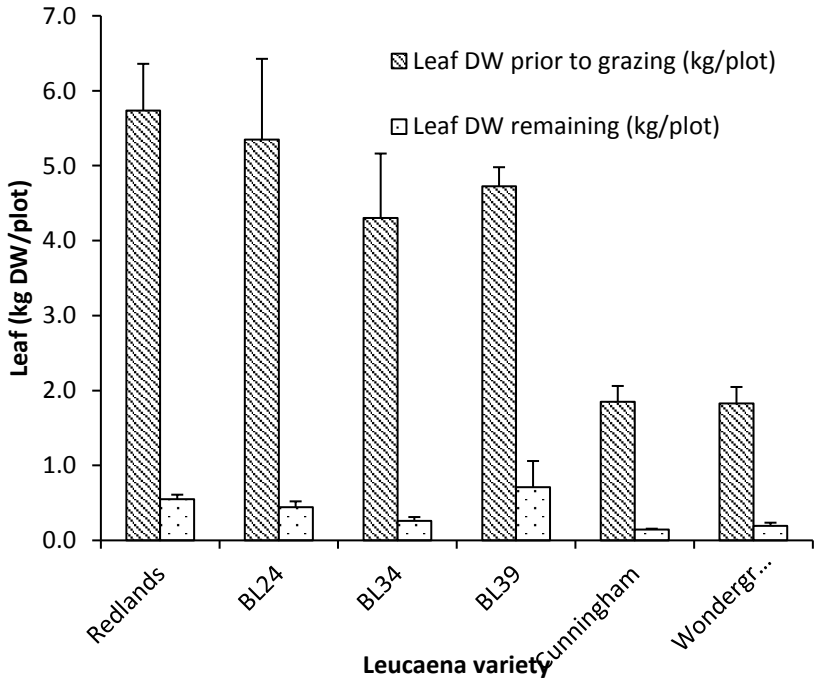

Fig. 12 Mean dry weight of leucaena leaf (kg/plot) prior to grazing and remaining after grazing for Trial 2 (Redlands = Breeding line #12)

4.3 Monitoring and evaluation

Seven producers on properties with fertile soils suited to leucaena undertook a survey in 2013 to determine their level of skill and knowledge in relation to leucaena production systems. The results are detailed below.

4.4 Pre-skills Audit Questionnaire results (property details)

Property	Size (ha)	No. of Head	Operation
A	24 000	3000	Breeding and finishing
B	50 000	3500	Breeding
C	45 000	2500	Breeding
D	60 000	7000	Breeding
E	30 000	35 000	Breeding and steers to coastal block
F	41 000	5000	Breeding
G	24 900	3000	Breeding and agistment

4.5 Pre-skills Audit Questionnaire results (comments)

Q1.	**Have you previously been involved with leucaena production systems?**
A	Yes, have established 3,000 acres of Leucaena since mid-1990s.
B	No
C	Yes, keen observer of what Tom Saunders is doing on Whitewater.
D	No
E	Yes, trialled small areas several years ago—varying success.
F	No
G	Yes, several small trial plots around house over last four–five years.
Q2.	**Do you think leucaena could benefit your operation?**
A	Yes, enormous benefit- double annual LWG. Can now fatten steers to good slaughter weights.
B	Yes, weaners and to finish steers - value add.
C	Yes, increase LWG and if big enough area established we could finish steers.
D	Yes, increase LWG and finish steers/cull heifers.
E	Yes, from Meadowbank it is obvious you can get annual LWG of 200–250 kg. This would allow me to fatten steers.
F	Yes, benefit weaner performance and to finish steers.
G	Yes, leucaena could double my LWG annually - huge weight for age benefit for steers and cull heifers.
Q3.	**Would you feel confident to successfully establish leucaena without assistance?**
A	Yes
B	No
C	No, keen to get some assistance. Already investigating options on old orchard area with Beef team.
D	No
E	No, have several ideas I would like to trial but would appreciate some tips. From my experience I know establishment can be difficult.

F	No
G	No, feel I need some assistance to establish larger areas cost effectively.

4.6 Pre-skills Audit Questionnaire results (ratings)

Question	1 nothing	2 very limited	3 limited	4 very general	5 general	6 moderate	7 good	8 confident	9 very confident	10 excellent
1. How would you rate your understanding of the cost of establishing leucaena?			BC DF	E	G			A		
2. How would you rate your knowledge of different leucaena techniques/methods in north Queensland?			BC DF		E	G			A	
3. How would you rate your understanding of leucaena and its production benefits in north Queensland?			B	CD F		E			AG	
4. How would you rate your understanding of leucaena grazing management systems?			BD F	C		E		G	A	
5. How would you rate your understanding of leucaena and its financial benefits in north Queensland?			BF	CD	EG				A	
6. How would you rate your understanding of the impact of psyllids on leucaena growth and productivity?		B	CD F	E				G	A	

4.7 Extension activities

4.7.1 Palatability trial planting (producer forum)

A small producer forum was held during the planting of the one hectare trial site in February 2014. Properties present included Whitewater, Meadowbank, Burlington, Rocky Springs, Blanncourt and Springfield. On the planting day in February 2014 the Management Committee met at Whitewater to discuss the one hectare trial site as well as the merits of postponing the planting of the 40 hectare demonstration site on Whitewater. The Management Committee re-convened for a follow up meeting on 4 March 2014 when the MLA pasture trial was planted. The timbered leucaena demonstration site was inspected leading to discussions regarding site preparation, sulphur application and establishment costs.

4.7.2 Karma Waters Forum.

A project update was presented at the Karma Waters "Tackling the tuff times" Beef Industry Forum in May 2014 (Appendix 11.3). Forty-five people including producers, agribusiness, rural lenders and Department of Natural Resources and Mines (DNRM) representatives attended. Participant's feedback is shown in the graph below (Fig. 13) including participant numbers on the vertical axis and participant responses on the horizontal axis.

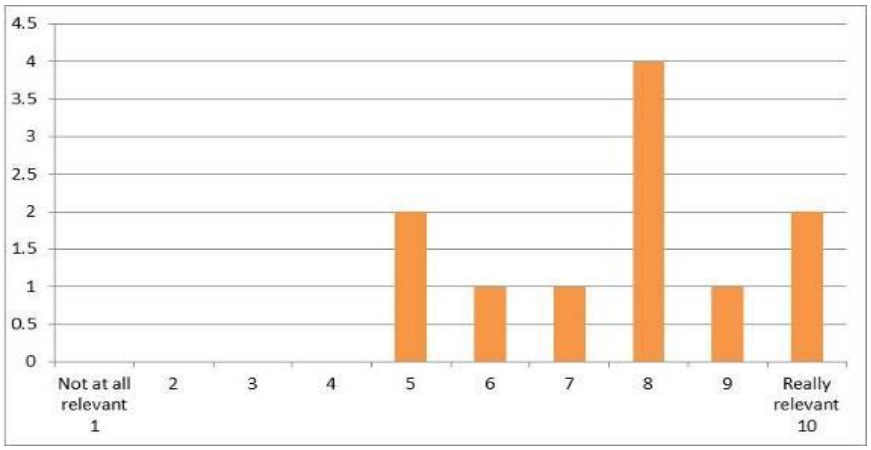

Fig. 13 Producer feedback regarding the pasture and leucaena research update session at the Karma Waters industry forum in May 2014.

4.7.3 Bull$, Beef and Pastures field day Whitewater

A Bull$ Beef and Pasture field day was held at Whitewater on 19 August 2014 with seven grazing properties represented. Producers were briefed on bull selection, paddock presentations on leucaena and other improved pasture systems (Appendix 11.4).

4.7.4 Leucaena network annual conference.

The Leucaena Network held their annual conference on the Atherton Tablelands 11-14 May 2016. The conference included presentations, a practical training day and a field trip to Whitewater Station to inspect the research sites (Appendix 11.5). The leucaena training day was designed to reduce the risk establishment failure and maximise returns from leucaena production systems in northern Queensland. Twenty-five people attended the day with six to eight local properties represented along with producers from central and southern Queensland. The field trip provided producers with an insight into establishment techniques used in timbered basalt country and showcased the new leucaena variety Redlands in the palatability trial (Fig. 14).

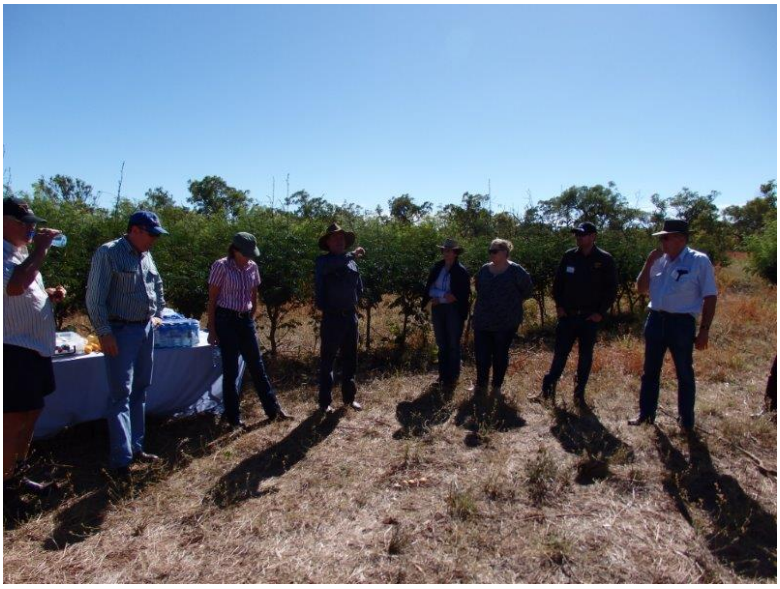

Fig. 14 Tom Saunders discussing the palatability trial to attendees of the Leucaena Network Conference (May 2016).

4.7.5 Mount Surprise Beefup Forum

Over 100 people attended the Mount Surprise Beefup Forum (June 2016) with an optional field trip to Whitewater to gain an insight into the improved pasture research activities including both leucaena trials (Appendix 11.6). Representatives from seven grazing businesses participated in this field trip.

4.7.6 Leucaena field day Whitewater and Pinnarendi

A field day "Leucaena Evaluation in North Queensland" was held at Whitewater and Pinnarendi Stations on 24 May 2017 (Appendix 11.7). Twenty-four graziers from 18 properties, representing an area of 588 000 hectares carrying 53 650 cattle, were in attendance. Information was presented on the palatability trial and the establishment of the 40 hectare leucaena site in timbered country. The costs for establishing leucaena on uncleared red basalt country were also discussed. (Appendix 11.8).

4.7.7 Media releases

"Graziers gather for profitable practices field day." North Queensland Register, 30 October 2014 (Appendix 11.9).

"Mt Surprise trial varieties demonstrate psyllid-resistance." Northern Muster, August 2014 (Appendix 11.10).

"Leucaena varieties show promise at field days." Northern Muster, December 2014 (Appendix 11.11).

"Leucaena leading productivity in the north." North Queensland Register, 17 August 2017 (Appendix 11.12).

4.7.8 Northern Beef Research Update (NBRUC) conference paper

Max Shelton and the UQ team presented a poster-paper at the NBRUC conference in Rockhampton September 2016 (Appendix 11.13).

4.8 Leucaena adoption

As a result of the demonstration site a number of beef producers have gained considerable knowledge and confidence in establishing leucaena production systems. Several north Queensland producers are currently establishing leucaena on their properties (Table 7; Fig. 15).

Table 7: North Queensland beef producers currently establishing leucaena on their properties.

Name	Property/location	Area of leucaena
Ron Plath	Atherton Tablelands	10 ha established
Darcy O'Brien	The Brook	400 ha (17/18 season).
Doug Buchanan	Rocky Springs	40 ha
Craig McDougall	Julatten	Small trial area
Ronnie and Colleen Henry	Riverview	160 ha (17/18 season)
Glen and Cheryl Connolly	Blanncourt	54 ha (15/16 season)

Fig. 15 Ron Plath of Rocky Creek (left) and Darcy O'Brien on The Brook (right) trialling leucaena.

In late 2017 the "Redlands for Regions" project was established in partnership with The Leucaena Network, Meat and Livestock Australia and DAF. By matching producer and MLA Donor Company funds the project focused on establishing six north Queensland sites to raise industry awareness of the new psyllid resistant leucaena variety (Redlands). Only two sites near Mount Garnet-Malanda (Goshen and Quincan Springs) were successfully established with Redlands during the 2017/18 growing season. There were two establishment failures near Townsville due to unsuitable soils and hot-dry weather conditions. Poor seasonal conditions delayed the planting of two demonstration sites near Mackay until the 2018/19 growing season.

4.9 Leucaena economics

Leucaena in native pasture systems in north Queensland enhances the feed-base with annual weight gain potentially increasing from 120 to 240 kilograms per head. On basaltic country stocking rates can also be increased from one AE: 5 ha to one AE: 3.2 ha (Appendix 11.14). Faster growth rates also allow producers to target and meet high end market specifications.

The establishment of leucaena on lightly timbered country in northern Queensland is expensive. The major costs include ripping, fertiliser, chemicals and seed. Costs can range from $300-350 (Fig. 16) per hectare when overheads and other hidden costs such as failed plantings and depreciation are taken into account. This cost is based on the use of contractors to perform necessary cultural operations. The cost per hectare would be reduced (Fig. 17) if equipment is owned by the producer. There is an opportunity cost involved with this, however this is offset by flexibility to access the equipment when required (D*AF northern beef team pers. comm., 2017)*.

If basing calculations on operational cost and returns from 2009-2014 the payback period is approximately 10 years (Appendix 11.15). The high cost of establishment of a viable area of leucaena on a typical breeding enterprise in north Queensland appears to be a major constraint for most producers. Crop agronomy and plant management skills are essential for successful leucaena establishment. However, with the new psyllid tolerant cultivar Redlands set to be commercially available and establishment techniques in lightly timber country being refined, leucaena is likely to become a more widely adopted improved pasture option for graziers in north Queensland.

Legume establishment and development costs
10M strip

Leucaena on Red Basalt with 10m row spacing timbered country					100 hectares		
Forage development cost calculator		**Machinery Contract rate**					
Treatment No	**Pre planting costs**	Rate of application	cost / unit	number of applications	% of area treated	**per hectare**	**total**
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
363	Ripper and blade	1.00	$148.32	0.7	100%	$103.83	$10,383
359	Linkage spray rig	1.00	$8.35	1	50%	$4.18	$418
162	Roundup CT	1.50	$8.50	1	50%	$6.38	$638
72	Granam	100.00	$0.59	1	20%	$11.70	$1,170
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
Treatment No	**Planting Costs**	Rate of application	cost / unit	number of applications	% of area treated		
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
364	Leucaena planter	3.00	$21.23	1	100%	$63.70	$6,370
307	Leucaena seed wondergraze	2.00	$50.00	1	100%	$100.00	$10,000
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
98	Granulated sulphur	70.00	$0.95	1	20%	$13.23	$1,323
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
359	Linkage spray rig	1.00	$8.35	1	50%	$4.18	$418
171	Spinnaker	0.14	$107.50	1	50%	$7.53	$753
162	Roundup CT	1.50	$8.50	1	50%	$6.38	$638
359	Linkage spray rig	1.00	$8.35	1	50%	$4.18	$418
184	Verdict 520	0.20	$48.00	1	50%	$4.80	$480
332	Uptake Oil	0.10	$6.32	1	50%	$0.32	$32
Treatment No	**Post Planting Costs**	Rate of application	cost / unit	number of applications	% of area treated		
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
0	No treatment	0.00	$0.00	0	0%	$0.00	$0
		Total direct development costs at contract rates				$330.37	$33,037

Fig. 16 Leucaena establishment costs with contractor rates.

Legume establishment and development costs

10M strip

Leucaena on Red Basalt with 10m row spacing timbered country				Area of forage	100 hectares		
Forage development cost calculator		**Machinery FORM + Labour**					
Treatment No	**Pre planting costs**	Rate of application	cost / unit	number of applications	% of area treated	**per hectare**	**total**
	No treatment		$0.00			$0.00	$0
348	Ripper and blade	1.00	$79.95	0.7	100%	$55.96	$5,596
344	Linkage spray rig	1.00	$3.66	1	50%	$1.83	$183
162	Roundup CT	1.50	$8.50	1	50%	$6.38	$638
72	Granam	100.00	$0.59	1	20%	$11.70	$1,170
	No treatment		$0.00			$0.00	$0
Treatment No	**Planting Costs**	Rate of application	cost / unit	number of applications	% of area treated		
	No treatment		$0.00			$0.00	$0
349	Leucaena planter	3.00	$10.53	1	100%	$31.58	$3,158
307	Leucaena seed wondergraze	2.00	$50.00	1	100%	$100.00	$10,000
	No treatment		$0.00			$0.00	$0
98	Granulated sulphur	70.00	$0.95	1	20%	$13.23	$1,323
	No treatment		$0.00			$0.00	$0
344	Linkage spray rig	1.00	$3.66	1	50%	$1.83	$183
171	Spinnaker	0.14	$107.50	1	50%	$7.53	$753
162	Roundup CT	1.50	$8.50	1	50%	$6.38	$638
344	Linkage spray rig	1.00	$3.66	1	50%	$1.83	$183
184	Verdict 520	0.20	$48.00	1	50%	$4.80	$480
332	Uptake Oil	0.10	$6.32	1	50%	$0.32	$32
Treatment No	**Post Planting Costs**	Rate of application	cost / unit	number of applications	% of area treated		
	No treatment		$0.00			$0.00	$0
	No treatment		$0.00			$0.00	$0
	No treatment		$0.00			$0.00	$0
	No treatment		$0.00			$0.00	$0
	No treatment		$0.00			$0.00	$0
	No treatment		$0.00			$0.00	$0
		Total direct development costs				$243.35	$24,335

variable costs of the basis of the machinery being owned

Fig. 17 Leucaena establishment costs with machinery owned outright.

5 Discussion

5.1 Summary

The adoption of leucaena in north Queensland has been low with an estimated area of 2800 ha (Rolfe and English *pers. comm* 2019) established to date. Low adoption can be attributed to low producer confidence related to establishment and costs, psyllid attack on existing varieties and vegetation management laws. The 40 ha demonstation site has allowed upfront costs and establisment technologies to be assessed on fertile lightly timbered basalt country.

The impact and damage a psyllid attack can have on existing leucaena crop varieties is well documented and has resulted in the development of Redlands. While Redlands will address producers' concern over psyllid damage, there was still a need to assess the palatability of this new variety. The one hectare PDS site at Whitewater Station provided the ideal opportunity to perform a replicated trial whilst also making regional producers familiar with these new lines of leucaena and their role in northern production systems. The primary aim of the PDS project was to increase the awareness and adoption of leucaena-based pasture in beef businesses with suitable soils in north-east Queensland.

5.1.1 Evaluated and demonstrated the dry-land establishment and productivity of leucaena in timbered basalt country of north Queensland

Seasonal conditions made the establishment of the 40 hectare site difficult in the first year with planting being delayed and then subsequently failing the following season. However, when a typical wet season eventuated successful establishment of leucaena in an open woodland area was achieved. Although not ideal, these setbacks showed that the establishment of leucaena is challenging and requires specific expertise

The evidence collected over the three year period of this project clearly demonstrates that successful dryland establishment of leucaena in timbered basalt country is possible. The productivity of leucaena in this system can only be observed as there is no official grazing trial design or replication. Visual estimates show that 75% of the entire paddock has established successfully. The site has been grazed after being locked up for 18 months.

Issues that need to be investigated further include: the competition effects of the existing tree population; the rocky nature of the landscape preventing traditional land preparation; and the identification of best row spacing to determine the right grass balance in the pasture system.

The low sulphur status of the soils also needs to be addressed as it can greatly influence leucaena production. Further investigation is required around plant uptake, deficiencies in the system and application frequency to maximise production.

5.1.2 Assess the likely profitability to beef production of leucaena-based pasture in this environment, including its sensitivity to reliability of establishment and extent of productivity benefit above native pasture.

Leucaena combined with improved grass species is the most productive, sustainable and profitable grass-fed beef grazing system in northern Australia (Dalzell *et al.,* 2006). It can potentially double annual live-weight gain compared to productivity from native pasture systems. Environmental factors such as rainfall can have a big impact on successful establishment. The soil profile needs to be recharged before committing to planting. Deep ripping prior to the wet season is essential in the preparation of a good plant seedbed. It also aids in leucaena taproot development meaning plants can readily access subsoil moisture which aids establishment and survival over the dry season. Good soil moisture at planting is essential and follow up rain within seven days is critical. An early wet season planting is ideal as the plants have more time to grow and develop before being exposed to the dry season.

It is difficult to quantify the competitive impact of native trees on leucaena production and subsequent cattle live-weight gain. A simple trial where animals are left to graze at a set stocking rate with and without leucaena for a specific period and weights recorded could help quantify the effect the trees have both on leucaena productivity.

5.1.3 Assessed the psyllid tolerance and palatability of elite psyllid-resistant varieties, relative to Cunningham and Wondergraze.

The PDS provided the opportunity to compare the psyllid tolerance and palatability of four unreleased leucaena hybrids bred for tolerance to psyllid with two current commercial lines of Cunningham and Wondergraze. All lines were affected by psyllids in July 2014 and results clearly show that all of the breed lines were less damaged than the current commercial cultivars.

The first grazing trial was conducted in December 2014 without grass and results show that, when undamaged, cvv. Cunningham and Wondergraze were preferred but all were ultimately consumed. Following this trial cv. Redlands (Line 12) was selected for release to industry based on high levels of psyllid resistance, in-vitro digestibility, yield and the capacity to branch.

The second palatability trial (May 2016) had the objective of comparing the grazing preference of Redlands and three similar breeding lines, with existing commercial cultivars following a period of high psyllid pressure. Overall, there were no major differences in preference among the breeding lines. The Redlands line was also established in a replicated grazing experiment (MLA Project B.NBP.1618 at Pinnarendi) measuring live weight gain in comparison to the commercial cultivar Wondergraze.

5.1.4 Develop a 'NQ Leucaena Tips and Tools' including establishment techniques and costs, on-going costs and variety performance.

Establishment techniques have been refined and documented for a number of soil types including basalt, red earths and alluvial frontage country. Costings from 2014 are included in the Results section of this report. Since completing these, cattle prices have increased and some input costs have also changed. The production of the Tips and Tools document has been delayed until revised economic analyses and live-weight gain data from the Pinnarendi trial is available. In 2019 the DAF Beef and Feedbase Team is contributing to the production of the revised leucaena booklet, including a north Queensland section.

5.2 Redlands for regions (P.PSH.0920)

MLA, in conjunction with the Leucaena Network and DAF, is supporting northern graziers to develop a small area of the new variety Redlands on their properties. A cautious approach needs to be undertaken until Phase 2 (MLA Project B.GBP.0040) of the Pinnarendi grazing trial proves weight gains are similar or better than current cultivars in the north.

6 Conclusions & recommendations

The project's primary goal was to gain an insight into leucaena establishment and promote adoption in north Queensland. Many landholders have suitable soils but don't have land which is cleared. Other legumes such as stylos have been successfully established under trees, so why not leucaena? This PDS has demonstrated that establishment is possible but two key research areas require attention.

1. Better understanding of the competition effects from the trees on leucaena production, annual liveweight performance and stocking rates.
2. Investigate sulphur requirements of leucaena and subsequent fertiliser requirements on northern basalts

There is a need for better understanding of plant nutrition in this environment. Sulphur is vital in protein synthesis, and leucaena has a high sulphur requirement. The basaltic soils of north Queensland are acutely deficient in sulphur. More research into the system as a whole needs to be undertaken to better understand where sulphur is being utilised or stored. Row spacing within the trees may need further investigation to ensure there is sufficient inter-row grass.

Many producers have visited the established site and engaged with the landholder and DAF staff. This consultation has improved producer understanding and confidence to trial areas on their own properties as discussed in the Results section.

7 Key messages

Leucaena is a proven legume that can improve live weight gain substantially over native or grass-only pasture. Successful establishment of leucaena in lightly timbered basalt country in north Queensland is achievable although expensive and can be difficult to establish.

Substantial areas of leucena need to be established for beef enterprises to improve economies of scale and access better marketing opportunities.

The new Redlands line is tolerant to psyllid attack and is palatable; however animal live-weight gain data over extended periods is yet to be generated. Preliminary live-weight gain data from the now completed first phase of the Pinnarendi grazing trial will be available from May 2018 and reported separately.

8 Bibliography

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9 Acknowledgements

I wish to acknowledge the significant efforts of the landholders of Whitewater Station, Tom and Christine Saunders, in providing the trial sites, accommodating project staff and providing valuable know how in delivering a worthwhile demonstration for the northern beef industry.

Thanks also to Management Committee Producers, staff of the University of Queensland and the Department of Agriculture and Fisheries research and extension team for their significant contributions to the project, and to MLA for co-funding.

10 The code of practice

Although highly palatable to cattle, leucaena can be potentially invasive in un-grazed areas if not managed correctly.

The leucaena Code of Practice (http://www.leucaena.net/codeofconduct.pdf or admin@leucaena.net) describes the productive and responsible management of leucaena.

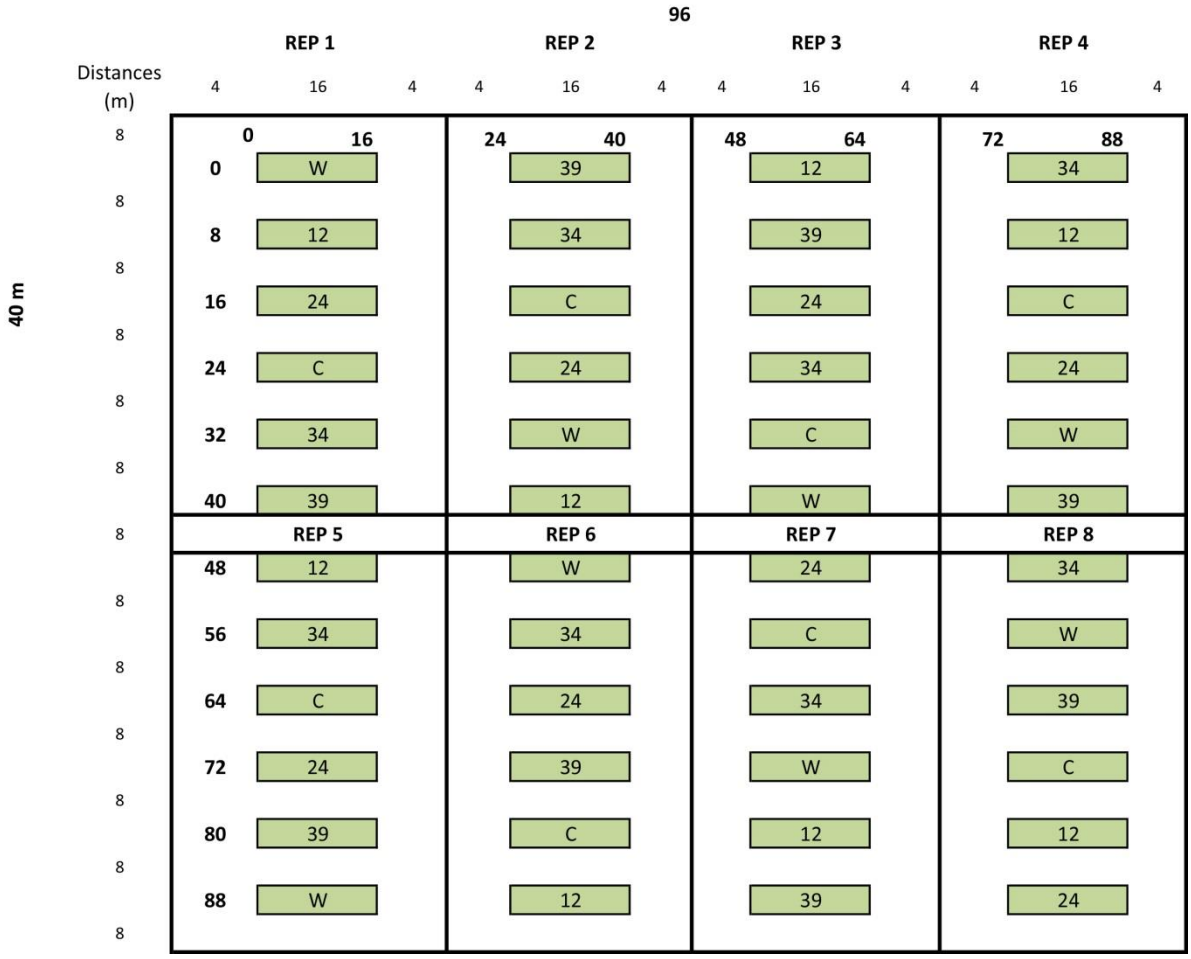
The Code of Practice is endorsed by DAF and the use of these protocols will assist landholders meet their obligations under the *Biosecurity Act 2014*, whereupon landholders are responsible to take practicable steps towards preventing the spread of potentially invasive plants.

11 Appendices

11.1 One hectare trial design

Treatments and Dimensions of trial area

Length of area =	96 m	
Width of area =	104 m	
Area =	9984 m^2	
No of breeding lines =	4	(BL#12, BL#24, BL#34, BL#39)
No of commercial cultivars =	2	(Cunningham and Wondergraze)
Length of plots =	16	
No rows/plot =	1	
No plants / m =	2	
No plants / plot =	32	
No reps =	8	
Total number plants each entry =	256	
Total number of seedlings to be transplanted =	1536	



11.2 Psyllid damage rating scale

Psyllid damage rating (PDR) scale developed for *leucaena spp.*

Scale of damage observed (Wheeler 1988).

1 No damage observed.

2 Slight curling of leaves.

3 Tips and leaves curling and yellow.

4 Tips and leaves badly curled, yellowish and covered in sap.

5 Loss of up to 25% of young leaves.

6 Loss of up to 50% of young leaves.

7 Loss of up to 75% of young leaves.

8 One hundred percent loss of leaves and blackening of lower leaves.

9 Blackened stem with total leaf loss.

11.3 Karma Waters Forum

Beef Industry Forum
Tackling the tuff times

FutureBeef

Where: Karma Waters Station
When: Tuesday, May 13 2014
8:15am – 4pm

Featuring guest speaker – Richard Rains (Sanger Australia)

Richard convinced McDonalds North America that they should use Aussie beef in their burgers and was instrumental in establishing that trade for Australia, not only in USA but also Japan, Korea, Taiwan, China, and much of South East Asia as well as domestically in Australia.

Other topics include:

- Carbon and Cattle - *Finding the Win:Win*
- Breeders productivity & cost effective supplementation
- Understanding your beef business – Current debt, cash flow & profitability challenges
- Q&A session with our local Bankers
- Stylos and boosting live weight gains
- New grass & legume research in north QLD
- Have your SAY – The Gulf Graziers' Group wants your feedback

RSVP by 8th of May 2014

Please contact

Olivia Pisani
Olivia.pisani@daff.qld.gov.au

or

Joe Rolfe
0427 378 412

Smoko and BBQ lunch provided

The $avannaPlan-Beef$ense and Climate Clever Beef projects integrate production, business and greenhouse gas outcomes.

Australian Government
Department of Agriculture, Fisheries and Forestry
Carbon Farming Futures - Action on the Ground program

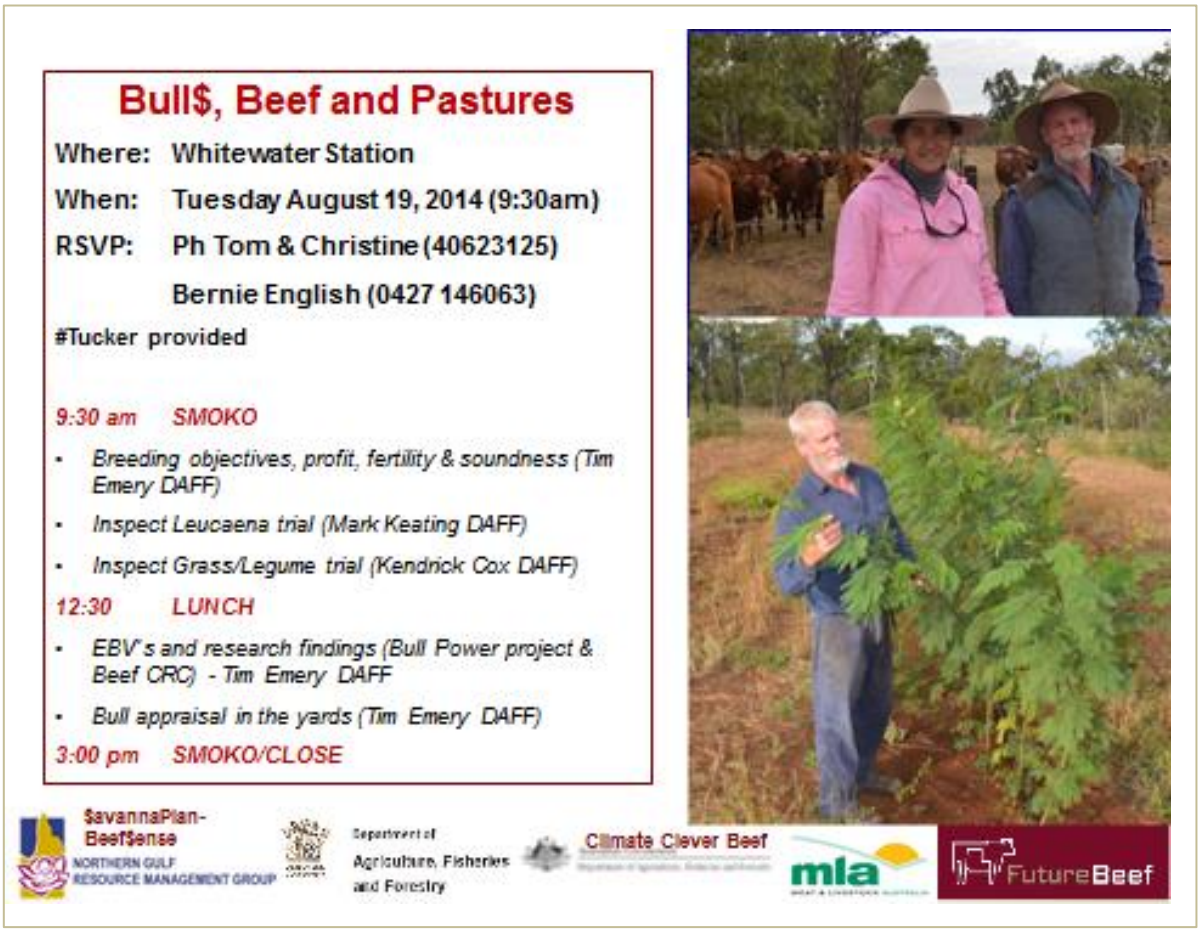
FutureBeef
www.futurebeef.com.au

$avannaPlan-Beef$ense
NORTHERN GULF RESOURCE MANAGEMENT GROUP

mla
MEAT & LIVESTOCK AUSTRALIA

Queensland Government
Department of Agriculture, Fisheries and Forestry

11.4 Bull$, Beef and Pastures field day



11.5 Leucaena network conference and field day

11.6 Mount Surprise BeefUp Forum

Photograph: Mel Bethel

Day 1
Wednesday 1 June
9.30am – 5.30pm
BBQ from 6.30pm

Welcome
Michael Lyons (NQBRC)
John Brisbin (NGRMG)
Barry Hughes (GCA)

MLA RD&E Update
Nick Sangster (MLA)

Beef Market Update
Ben Thomas MLA

Beef Business Management
Ian McLean (Bush Agribusiness)
Peter Whip (Climate Champion)

Beef Business Management – Multi-Generational Businesses
Barbara Bishop (BB & Associates)

Balancing Grass, Cattle and Finances
Barry Hughes (North Head)
Roger Landsberg (Trafalgar)

NRM Spatial Hub Innovations
Mike Digby
(Australian Rangeland NRM Alliance)

Tools, Products, Technology Presentations & Demonstrations
(Trade Exhibitors)

Day 2
Thursday 2 June
8.00am – 1.00pm
Tour or NGRMG Meeting post 1pm

Production Techniques Reproduction
Gehan Jayawardhana (NT)

MLA R&D Priorities
Barbara Bishop & Mary Goodacre (MLA)

Live Export Markets
Justin Slaughter (Austrex)

Gulf Graziers' BeefUp Panel
Barbara Bishop (Chair)

Option A: Field Trip
Leucaena & Grass/Legume Trials
Tom & Christine Saunders
Whitewater Station

Option B: Northern Gulf General Meeting for Members & Guests

Venue & Accommodation

Venue
Mt Surprise Sport & Recreation Facility
Gulf Development Road (3km East Mt Surprise)

BBQ Dinner
Bedrock Village Caravan Park
Garnet Street, MT SURPRISE

Accommodation Options
Bedrock Village Caravan Park
T: 07 4062 3193
Mt Surprise Tourist Van Park
T: 1800 447 982
Mt Surprise Hotel
T: 4062 3118
Undara Volcanic Park (55km)
T: 07 4097 1900

Great Family Entertainment
Wednesday 1 June

Carter & Carter
Australia's independent country music artists of the decade will:
* Perform a FREE evening concert at Bedrock Village (bring your guitar)
*Offer a FREE Singing & Songwriting Workshop for children at the Mt Surprise school

REGISTRATION FOR TWO-DAY PROGRAM

Registrations Online: Click Here to Register
Cost: $20 RSVP: Friday 27 May 2016
Includes: morning and afternoon teas, lunch, BBQ dinner, all transfers, Day 2 tour.

11.7 Leucaena field day: Whitewater and Pinnarendi Stations

Leucaena Evaluation in North Queensland

WEDNESDAY 24 MAY 8AM-2PM

WHITEWATER & PINNARENDI STATIONS, MT SURPRISE

Discussion topics at this field day:

- Introduce the psyllid resistant leucaena variety– ***Redlands***
- Detail results from psyllid & palatability studies
- Application of Redlands in north QLD
- View the demonstration site of establishing leucaena in timbered country
- See a pasture trial site of promising grasses and legumes for north QLD
- Visit the liveweight grazing study site at Pinnarendi where the newly released psyllid resistant leucaena variety ***'Redlands'*** is to be compared to the existing commercial variety Wondergraze in a grazing performance comparison study
- Discuss the economics and practices of establishment (LWG performance, establishment cost/ha, etc)

Successful leucaena planting in January 2016. Sulphur & Gran Am fertiliser is applied to overcome sulphur deficiency issues across the red basalt soils in north Queensland.

Grazing behaviour was closely studied during the palatability trials on Whitewater Station (2014 & 2016).

Itinerary:

Meet at Whitewater Station at 8AM
Visit Pinnarendi Station at 12noon
Lunch at Pinnarendi Station at 1pm
Finish at 2pm

Liveweight gain study to be conducted on the 60ha fully replicated trial site at Pinnarendi Station. Trial site planted and established over 2016-17 wet season.

Palatability trial conducted by UQ and DAF in May 2016.

Registration Essential: **RSVP by 17 May 2017** ***Catering to be Provided***

Contact: **CRAIG LEMIN** M: **0467804870** E: **craig.lemin@daf.qld.gov.au**

FutureBeef
www.futurebeef.com.au
Queensland Government
mla MEAT & LIVESTOCK AUSTRALIA
The University Of Queensland AUSTRALIA

11.8 Leucaena establishment costs on red basalts

Leucaena on Red Basalts

***10m row spacing in lightly timbered country.**
***Inter-row - native pastures**
***Fencing or shooting costs not included**
***Soils are well structured and fertile but acutely deficient in S**

Pre planting costs	Per hectare	Total for 100ha
Blade and rip (contract rate for D6)	$ 100	$ 10,000
Roundup	$ 7	$ 713
Planting Costs		
Leucaena seed - scarified and including inoculant/freight (2 kg/ha) allow for some replanting	$ 100	$ 10,000
Granulated Sulphur on row (applied every 2 years)	$ 48	$ 4,750
Gran Am - row	$ 30	$ 2,950
Spinnaker	$ 5	$ 521
Labour and fuel (planting, fertiliser/herbicide application)	$ 50	$ 5,000
Post Planting Costs		
Post Emergent grass (Verdict)	$ 6	$ 582
Total direct development costs	**$ 345**	**$ 34,516**

Equipment requirements

- 70 hp tractor
- Fertiliser spreader
- Boom spray (boomless in timber?)
- Leucaena planter

11.9 Media article October 2014

SUSTAINABLE FARMING

SPECIAL FEATURE

Gulf producers aim to improve their beef businesses

THE current seasonal, debt and cost/price pressures across the northern beef industry are overwhelming for many families.

However, the resilience of beef producers is shining through in their enthusiasm to identify and overcome key financial, herd and grazing management constraints.

The Northern Gulf Resource Management Group (NGRMG) staff, DAFF Beef Team and Alison Larard offer a range of services to help beef producers address their sustainability and viability issues.

Property infrastructure mapping

The demand to map paddocks, water points, land types and infrastructure is increasing, with Ricky Archer (NGRMG) receiving several calls on a weekly basis. Ricky can be contacted on 0498 814 105.

Once the mapping is complete, Ricky is also busy updating property maps so new waters and fencing can be included.

These property maps greatly assist with decision making when it comes to land management, carrying capacity, stocking rates, property layout and infrastructure development.

Producer feedback in relation to the value of property mapping is very encouraging and details:

- How measuring paddock areas and detailing land types improve both understanding and management of stocking rates.
- How grazing circles from water points clearly identifies un-grazed areas and assists in planning the placement of additional waters.
- How various formats of the property map can be used, including wall maps for planning, A4 glove-box versions to help new staff on the property and as inserts in funding or bank applications.

$avannaPlan-Beef$ense

$avannaPlan-Beef$ense is delivered on-property by a team which understands all aspects of running a profitable beef business, from breeder productivity and stocking rates through to cash-flow budgeting, debt management and marketing.

We work with producers to help them better understand the financial and economic aspects to their business, gauge the implications of making significant changes to their production systems and move towards securing a better future.

Attuned to the sensitivities of people's lives and businesses, a service agreement is used to outline the program and cover confidentiality issues.

More than 20 beef businesses, including 35 gulf properties, are participating in $avannaPlan-Beef$ense to better understand their business position and identify ways to move forward sustainably and financially.

Successful beef producers concentrate on managing grass through wet-season spelling, wise stocking rate decisions and maintaining good break-of-season ground cover.

These management practices maintain the health of our northern gulf landscapes and the productivity of our native pasture systems.

Several producers participating in $avannaPlan-Beef$ense have managed to unload cattle in response to the challenging seasonal pressures.

Through on-property contact, the $avannaPlan-Beef$ense team have noticed the following financial constraints continuing to emerge:

- Business equity remains critical for some producers, with the fall in property prices (30 per cent since 2008) and regular transferral or 'rolling over' of operating facilities (overdrafts) into term loan facilities.
- Poor communication with lenders which results in high interest rates and in extreme cases, 'frozen accounts' and referral to asset-management sections within the banking sector.
- Profits are rarely seen when analysing the past five years of financials.
- Few businesses can afford to pay a base-line wage to the owner(s) and principal repayments are very rare.

However, in light of these pressures, there are several positives emerging from $avannaPlan-Beef$ense, including:

- The top producers clearly model 'what' and 'how' to communicate effectively with their lenders.
- The team offers support and acts as a sounding board for families facing the hard decisions such as selling assets (land and/or cattle) or staying on in tough circumstances to see out a specific business strategy.
- Four businesses are refinancing with a new lender or are negotiating improved interest rates and terms with existing lenders.

Producers are using detailed business analysis including financial and herd productivity benchmarks over the past five years to identify and implement options to improve the production and financial performance of the business.

Alison Larard and Tom Saunders inspect the leucaena trial on Whitewater. Alison delivers $avannaPlan-Beef$ense with the local DAFF Beef Team.

Ricky Archer (NGRMG) helping Luke Kingsley map paddocks and water points on Mount Mulgrave near the Mitchell River.

Families are improving their understanding of the 'people' issues in their business (roles and responsibilities, succession and asset transfer) and taking positive steps to meet these challenges (family meetings, employing communication and succession experts).

Methodical cost/benefit analysis of pasture improvement, infrastructure development and cattle-marketing strategies are working.

Producers find getting a better grip on their finances empowers them and supports decision making. There is some peace of mind in acknowledging what is likely to lie ahead and making plans accordingly.

Putting numbers to likely business activities reduces uncertainty, and keeps you on top of things.

One producer said: "I now have a sense of control and better understand what I think is going to happen."

Graziers gather for profitable practices field day

GRAZIERS from across the Gulf Savannah attended the Profitable Practices for Northern Grazing Businesses field day at Lanes Creek Station, Georgetown, on October 8.

The field day was jointly facilitated by QDAFF Beef Team and Northern Gulf Resource Management Group under the Regional Landcare Facilitator Program.

Dr Ian Braithwaite is a leading cattle-production vet who works with grazing businesses and corporations throughout northern Australia.

Ian has identified innovative herd-management strategies to improve profitability for extensive northern grazing operations.

Ian's concepts were met with great enthusiasm at the Northern Gulf Grazing Forum last June, and his presence at Lanes Creek reinforced his support for northern producers.

Using local reproduction records and trials at Bulimba, Haydon and Greenhills, Ian covered practical breeder-management systems relevant to the region with practical demonstrations at the yards.

The Lanes Creek Station field day also included presentations from Alison Larard, and the QDAFF Beef and Seed Team.

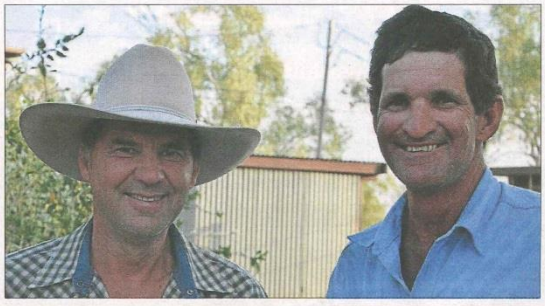
Alison has been providing financial management support to grazing businesses throughout the northern gulf as part of the Beef$ense project with the Beef Team. Alison provided simple business management and marketing tips to the attendees at Lanes Creek.

The QDAFF Beef and Seed Team have been implementing new pasture and hay trials throughout the region as part of the Tropical Savannah Plan Project, and used the field day as an opportunity to present the results of the trial.

Often, fences are required to adopt improved grazing and herd-management strategies. Electric fences have the significant advantage of being considerably cheaper and quicker to install.

The Beef Team and the regional landcare facilitator have been preparing a case study of two effective electric fence systems installed in the region. Findings from the case study were also presented on the day.

LEFT: Craig Lemin, DAFF, providing an overview at the Lanes Creek forum of leucaena trials on Whitewater and Walkamin, featuring new psyllid-resistant varieties.



RIGHT: Greg Ryan, Greenhills Station, and field day host Brian Hughes, Lanes Creek.

11.10 Media article August 2014

Mr Surprise trial varieties demonstrate psyllid-resistance

Leucaena

Northern beef producers need to increase their productivity if they are to stay viable in the current economic climate.

Increasing annual live weight gain and reducing age of turn off through the use of improved pastures, such as leucaena, are achievable targets on properties with suitable soils and rainfall.

The introduction and successful establishment of leucaena can potentially double annual live weight gains, giving the producer more options with herd management and marketing.

Currently, the adoption of leucaena production systems is very low because of the impact that psyllid insect attacks have on the productivity of the pasture.

Establishment costs, the potential impact of frost and low confidence levels in plant establishment are also factors that have contributed to the low adoption of leucaena.

Meat and Livestock Australia in partnership with DAFF and the Northern Gulf Resource Management Group have established a producer demonstration site at Whitewater Station, Mt Surprise.

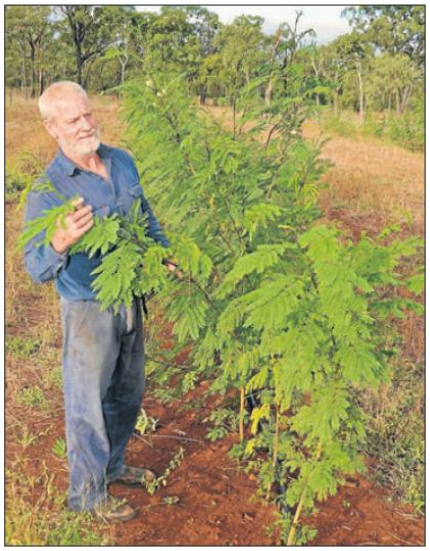
The demonstration consists of a 40-hectare leucaena establishment site.

The aim of the demonstration site is to improve industry understanding of the establishment methods, costs, management requirements and potential productivity and profitability gains associated with leucaena production systems.

In conjunction with the 40-hectare demonstration site, a one-hectare plot was also established on Whitewater Station with four new promising leucaena breeding lines.

These four lines were identified by the University of Queensland as showing good psyllid tolerance.

The one-hectare plot also has commercial leucaena varieties, Wondergraze and Cunningham, established to assess each varieties psyllid tolerance and palatability in the field.



MLA in partnership with DAFF and NGRMG has established a producer demonstration site at Whitewater Station to improve industry understanding of leucaena production systems.

Four new promising leucaena breeding lines identified as being psyllid resistant are being tested at the demonstration site.

The development of psyllid tolerant hybrids is based on a back-cross between the palatable leucaena leucocepha and the unpalatable but psyllid resistant leucaena pallida.

The demonstration so far has shown promising results in terms of psyllid damage. Grazing trials are due to commence at the demonstration site on replicated plots.

The four new breeding lines have also been established for seed production at the DAFF Walkamin Research Facility on the Atherton Tablelands.

Mark Keating
Senior technical officer
DAFF Mareeba
0408 751 187

11.11 Media article December 2014

Leucaena varieties show promise at field days

PRODUCERS at two recent field days (Whitewater and Lanes Creek Stations) were presented with information on the value of improving current feed base systems with improved pastures such as leucaena.

Successful establishment of leucaena can potentially double annual liveweight gains, giving the producer increased herd management and marketing options.

The Producer Demonstration Site (PDS) at Whitewater Station, Mount Surprise, is aimed at improving industry understanding of establishment methods, costs and management requirements of leucaena.

The PDS will also showcase the potential productivity and profitability gains associated with improving the feed base with leucaena.

Refer back to Northern muster issue 35 for further information on the establishment of the Whitewater Station Leucaena PDS.

A 40- hectare site will be planted this coming wet season to Wondergraze, a current industry cultivar.

The aim is to establish leucaena into an area with minimal disturbance of the existing woody vegetation.

During this process a 'Tips and Tools' guide will be developed for local graziers.

The project will also include a detailed economic analysis of leucaena production systems and will include experiences from both northern and central Queensland.

During the grazing trial no apparent difference in palatability was evident, with all lines being freely grazed and little preference shown to a particular variety.

The economic analysis will enable producers to make informed decisions about leucaena establishment through using sensitivity analysis and various cattle price scenarios.

The 1-hectare grazing trial established on Whitewater – with four promising lines showing good psyllid tolerance – has been progressing well.

Psyllid tolerance has been measured using current industry cultivars of Wondergraze and Cunningham as comparators.

The PDS will also showcase the potential productivity and profitability gains associated with improving the feed base with leucaena.

Results to date indicate that the four new breeding lines suffered only a minor setback in growth, with minimal damage.

In comparison, both Cunningham and Wondergraze suffered extensive damage with leaf production almost completely stopping.

Given the success of the new lines, seed production blocks have been set up to enable a cultivar release in the future once grazing trials have been completed.

A preliminary grazing trial was completed in September on Whitewater. The graze trial incorporated weaners freely grazing the 1ha site for four days.

No apparent difference in palatability was evident, with all lines being freely grazed and little preference shown to a particular variety.

A replicated grazing trial is about to commence, measuring and comparing the palatability preference of the new Psyllid tolerant lines with the two commercial cultivars – Wondergraze and Cunningham.

A pre-wet season measurement took place in November, with no grass yet established in between the rows. Grasses will be established between the rows and post-wet season palatability trials will begin in April 2015.

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11.12 Media article August 2017

20 NORTH QUEENSLAND REGISTER Thursday August 17, 2017 northqueenslandregister.com.au

FutureBeef NORTHERN MUSTER Information for rural business in North Queensland Queensland Government

Leucaena leading productivity in the north

Leucaena, a proven performer in Central Queensland, can also transform beef production systems further north. The Cunningham leucaena variety established across 1200 hectares near Mount Garnet in the 1990s doubled annual live weight gains and improved carrying capacity from one adult equivalent to 5–6 hectares on native pastures to one adult equivalent to 2.5–3 hectares on leucaena with native pastures.

With more than two million hectares of soils suited to leucaena in the north, it has significant potential to increase productivity of beef and breeder operations. Adoption has been low with less than 2500 hectares established in North Queensland. This is due to a lack of producer experience and capability, the perceived high establishment costs and risks, tree clearing restrictions and ongoing production losses from damage caused by psyllid insects.

In North Queensland, the Cunningham and Wondergraze varieties, while productive, are very susceptible to the leaf sucking psyllid. Psyllid attacks occur annually in the autumn–winter period and in some years can defoliate a leucaena stand in three weeks. Leucaena palatability is often compromised even during moderate psyllid attacks due to an accompanying black exudate on the plant.

A University of Queensland (UQ) and Meat and Livestock Australia (MLA) plant breeding program was initiated in 2002 to develop a psyllid-resistant leucaena variety derived from crossing the susceptible species Wondergraze with the resistant species *Leucaena pallida*.

An MLA and Department of Agriculture and Fisheries (DAF) led producer demonstration site on Whitewater Station, Mount Surprise, includes a 33 hectare trial aimed at improving industry understanding of establishment costs and options in timbered country. The trial also includes a one hectare plot to assess the palatability of new leucaena lines bred specifically for psyllid resistance.

Viewing new Redlands psyllid resistant leucaena at the Pinnarendi trial are Dean Jonsson of Wombanoo Station, Rob Pagano an Atherton Tablelands producer, Rob Caird of DAF, Bruce Carzany an Atherton Tablelands producer, Greg Brown formerly of Mouldiwhunk and Warren Jonsson of Wombanoo Station.

Establishing leucaena in timbered country

The 33 hectare timbered red basalt trial site was planted in January 2016 and Wondergraze was successfully established across 75 per cent of the paddock. The basalt soils on Whitewater, while freely drained and generally very fertile, are extremely low in sulphur. Adequate sulphur levels (> 10mg per kg) are essential to maximise the productivity of legume production systems like leucaena. The producer demonstration site paddock will be fertilised in July to address the current sulphur deficiency and steers will graze the area from July to September 2017. Competition from the native timber and the subsequent impact on leucaena productivity will be assessed after the 2017–2018 wet season.

Palatability trial

In 2014 a palatability trail on Whitewater compared four psyllid resistant breeding lines with two commercial varieties, Wondergraze and Cunningham. Psyllids had damaged the commercial varieties in early April 2016 and the trial was grazed in mid-May 2016 by 15-24 steers and cows. The yield of leaf before and after grazing was measured. Psyllid pressure reduced the palatability and the available leaf by 60 per cent on existing cultivars. Overall, there were no major differences in preference among the varieties. All were well eaten with approximately 10 per cent of leaf remaining at the end of grazing period. Given that there was more leaf on the breeding lines at the beginning of the trial, the cattle spent more time grazing these lines.

A previous preference trial in December 2014 had also shown that, when undamaged, Cunningham and Wondergraze were preferred but all were ultimately consumed. The Redlands variety was selected for release to industry based on high levels of psyllid resistance, in vitro digestibility, yield and seeding ability. The productivity of Redlands is being compared to Wondergraze on the recently established grazing trial at Pinnarendi Station, about 50km south-west of Mount Garnet.

Pinnarendi Station demonstration site

To confirm the potential productivity and profitability gains from using the Redlands variety in psyllid prone areas, a large-scale live weight gain trial site has been established at Pinnarendi. This project is also funded by MLA and DAF and includes the establishment phase (phase one) as a pre-requisite for the phase two live weight gain trial.

The Pinnarendi site comprises 61 hectares divided into eight replicated paddocks. Of these eight paddocks, four paddocks are established with Redlands and four paddocks with Wondergraze. The red earth soils on the trial site are well drained and rock free but deficient in phosphorus and sulphur.

Site preparation took place from August to December 2016 and the trial perimeter was completely fenced with netting to prevent damage by rabbits or wallabies. Plant rows were laid out, cultivated and fertilised. Planting occurred in mid-January and mid-February 2017 with reasonable rainfall ensuring good germination and ongoing growth. Pre-planting and post-planting herbicide applications as well as regular cultivation either side of the plant line has controlled weeds.

Establishment across all eight paddocks ranges from excellent to acceptable and it is likely the leucaena plants will survive until break of season storms. Wondergraze has had a more consistent germination and is generally more vigorous than the Redlands paddocks. However, psyllids are now active at the site and are beginning to cause significant damage to the Wondergraze, whilst the Redlands remains untouched.

Grazing trials will commence in March 2018 with eight uniform cohorts of Brahman-cross steers will graze in each of the paddocks. Grazing will occur for periods of eight or ten months with live weight gains monitored regularly.

A recent field day was held at both Whitewater and Pinnarendi on 24 May 2017. The day was well attended with 22 beef producers and nine agency and agribusiness representatives keen to learn about the potential of leucaena to significantly lift beef productivity in North Queensland. While establishment issues and costs were acknowledged, feedback from the day indicated at least four producers will establish leucaena trial sites during the 2017–2018 wet season.

For more information contact:

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11.13 NABRUC paper Rockhampton September 2016

Grazing preference of the psyllid resistant *Leucaena* inbred cv. 'Redlands' compared to the commercial *L. Leucocephala* cvv Cunningham and Wondergraze

H.M. Shelton[A,E], H.E. Giles[A], M.J. Halliday[A], J. Rolfe[B], M. Keating[B] and T. and C. Saunders[C]

[A]School of Agriculture and Food Science, The University of Queensland, Qld, 4072
[B]Animal Science, Department of Agriculture and Fisheries Mareeba, Qld 4880
[C]Whitewater Station, Mt Pleasant, Qld 4521

Introduction
An MLA-supported breeding program was initiated in 2002 to develop an interspecific psyllid-resistant *Leucaena* variety derived from crossing the susceptible species *L. leucocephala* with the resistant species *L. pallida* (Dalzell *et al*. 2013). In 2013, cv. Redlands was selected for release to industry based on high levels of psyllid resistance, in-vitro digestibility, yield, branchiness and fertility. A previous preference trial had shown that, when undamaged, Cvv Cunningham and Wondergraze were preferred' but all were ultimately consumed. The objective of this program was to compare the grazing preference of Redlands, and three similar breeding lines, with existing commercial cultivars following a period of high psyllid pressure.

Methods
The experiment was located on Whitewater Station (18^{o}S, 144^{o}E, 628 m asl) owned by Tom and Christine Saunders. Treatments were six leucaena genotypes planted in two independent 15 m rows, 10 m apart, with four replications. Seedlings were planted in February 2014 and the entire area fertilized with Sulphur at 30 kg/ha and Gran-Am at 50 kg/ha; while gypsum at 150 kg/ha was applied at the base of the trees. Some dripper irrigation was used as needed, especially in the dry season and weeds were controlled. Psyllids had damaged the commercial varieties in early April 2016. The trial was grazed in mid-May 2016 by 15-24 steers and cows (4-500 kg); yield of leaf before and after grazing was measured. Grazing behaviors were observed using an 180^{o} day and night time-lapse camera mounted on a pole attached to a forklift.

Results and Discussion
Overall, there were no major differences in preference among the varieties. All were well eaten with approximately 10% of leaf remaining at the end of grazing period (Fig. 1). Given that there was more leaf on the breeding lines at the beginning of the trial, the cattle spent more time grazing these lines (data not presented). A video of grazing behaviour over the period of the trial can be viewed by accessing the QR code below (Fig. 2).

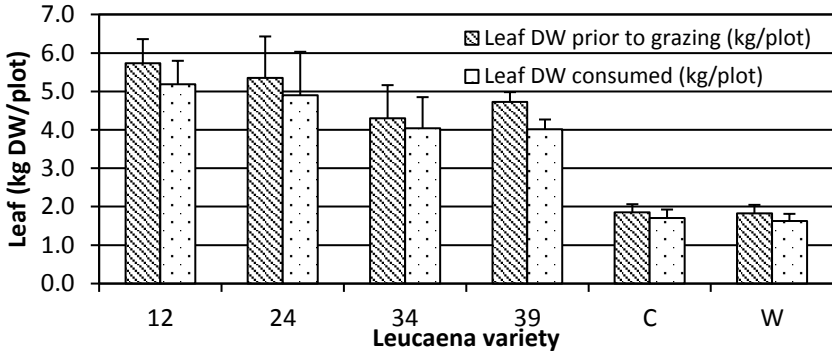

Fig. 1. Dry weight of leaf/plot before and after grazing

Fig. 2. QR code-grazing video

References

Dalzell SA, Robertson LM, Lambrides CJ, Brewbaker JL, Greenway D, Dieters M, Shelton HM (2013) Tropical Grasslands – Forrajes Tropicales 1, 66−68

[E]Corresponding author: m.shelton@uq.edu.au

11.14 Herd performance Leucaena and native pastures

Potential herd performance with improved pastures—Leucaena and native pastures—on fertile soils in north Queensland

Assumptions:

- LWG to rise from 120 kg to 240 kg.
- Stocking rate from 1–5 ha to 1–3.2 ha.
- The most profitable turnoff from this country is meatworks ox.
- Typical family block of 100 sq. mile = 25 000 ha.
- Develop 2000 ha.
- $279/ha development costs = $558,000
- No overhead costs included in calculations below.
- Improved pasture cattle turnoff prices do not allow for MSA grading premiums.

Total gross margins (Leucaena vs. no Leucaena) Based on 2014 estimates.

	No clearing/no improved pastures	Improved pastures on 5,000 acres
Total cattle	4418	4399
Cows mated	2115	2135
Cull cows and heifers sold	451	455
Av. sale price–females	$542	$580
Steers and bullocks sold	502	519
Av. male sale price	$815	$1,017
Total cattle sale	$653,816	$792,508
Direct costs – dips, drenches, vaccines, bull replacement and supplements	$177,666	$151,532
Total Gross Margin	$476,150	$640,976

11.15 Leucaena payback period

Cumulative cash flow budget showing a 10 year payback period based on 2014 estimates.

Year	Leucaena	No Leucaena
1	$24,260	$451,662
2	$304,911	$903,324
3	$841,953	$1,354,986
4	$1,378,994	$1,806,648
5	$1,916,035	$2,258,310
6	$2,453,077	$2,709,972
7	$2,990,118	$3,161,634
8	$3,527,159	$3,613,296
9	$4,064,200	$4,064,957
10	$4,601,242	$4,516,619
11	$5,217,730	$4,968,281
12	$5,834,218	$5,419,943
13	$6,450,706	$5,871,605
14	$7,067,194	$6,323,267
15	$7,683,681	$6,774,929