1. Why plant leucaena?

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1.1 What is leucaena?

Leucaena (*Leucaena leucocephala*) is a small-medium perennial leguminous tree with foliage of high nutritive value for ruminant production. It is palatable, nutritious, long-lived and drought-tolerant.

Leaves, flowers and pods of leucaena

In northern Australia, leucaena is planted in hedgerows with grass sown in the inter-row to form a highly productive and sustainable grass–legume pasture for cattle grazing. While it can be found growing in a wide range of soil environments, it performs best on deep, fertile soils in sub-humid environments where annual rainfall averages over 600mm.

Being deep-rooted, leucaena is able to exploit soil moisture beyond the reach of grass roots and so remain productive well into the dry season. Once established, leucaena-grass pastures can remain productive for over 30 years.

Leucaena stand planted in 1975 and grazed every year

A brief history of leucaena

The native distribution of the genus *Leucaena* stretches from southern Texas in North America through Mexico and Central America and into northern South America. Species in the genus have been used as human food for several thousand years.

It is thought that around the 1600s Spanish colonists transported leucaena westwards to the Philippines and South-East Asia for use as a shade plant in tea and coffee plantations. It is now a multipurpose plant in the region and is used for timber, fuel wood, green manure as well as forage for feeding ruminant livestock. In India, it used for paper pulp.

The history of leucaena in Australia is more recent. 'Wild' leucaena arrived on the coast of northern Queensland in the late 1800s, but it was not until the 1960s that the first forage variety was released by the CSIRO. Another decade passed before the first commercial stands were planted in the 1970s.

In the mid-1980s, the leucaena psyllid insect devastated productive stands in humid coastal districts, and commercial planting slowed. But as producers in the drier inland areas realised that the psyllid was only an intermittent problem, major plantings recommenced in the 1990s. A psyllid-tolerant variety, Redlands, is now available and has expanded the area of northern Australia suitable for leucaena development.

Some 500–1000 producers now grow an estimated 200,000 to 300,000ha of leucaena pastures – with the area increasing by some 4,000ha every year.

1.2 Why plant leucaena?

Leucaena and grass pastures are the most productive, sustainable and profitable system for producing grassfed beef in northern Australia.

High growth rates from leucaena pastures enable cattle to grow quickly throughout their lives despite a highly variable climate and severe dry seasons. This ensures flexibility in meeting market specifications for young cattle for feedlot entry, live export or slaughter.

Access to major export markets such as Japan, Korea, Europe and China requires animals to reach a target weight at a young age. Typical market specifications for grassfed animals in Australia are shown in Table 1.1.

Table 1.1: Market specifications for grassfed cattle

Market	Live weight (kg)	Dressed weight (kg)	Fat depth (mm)	Teeth
Grassfed Ox	550–760	300–420	5–22	0–8
European Union	440–550	240–420	5–22	0–4
Domestic	330–550	180–300	5–22	0–2
MSA	330–620	180–340	5–22	0–4
PCAS	330–620	180–340	6–22	0–4

Steers need to gain about 250–300kg per year to grade top quality in EU, domestic, Meat Standards Australia (MSA) or Pasture-fed Cattle Assurance Scheme (PCAS) markets. This can be reliably achieved from leucaena-grass but not from tropical grass-only pasture.

What's wrong with our grass pasture?

Steers on brigalow pastures of buffel grass, Rhodes grass and green panic typically gain 140–190kg live weight a year without supplementation.

Cattle need more than 13% crude protein (CP) in their diet to grow to their potential. Even on fertile soils, the CP content of the grass is generally too low (below 8% for most of year) for maximal beef production. Tropical grasses are also fibrous and with low in digestibility, low metabolisable energy content for much of the year.

In grass pastures, the nitrogen (N) needed for vigorous growth and quality becomes tied up in soil organic matter, especially after the pasture has been growing for a number of years. This 'nitrogen rundown' in grass pastures results in low cattle weight gains because it compromises feed quality.

Higher pasture production can be achieved when tied-up nitrogen is released by disturbing the soil, as seen when brigalow pastures are blade ploughed, but this is a short-term boost.

Grass – more fibre and less protein as it matures

Growing a vigorous legume such as leucaena with the grass is the best long-term option for a sustainable pasture.

What are the special benefits from leucaena?

Leucaena is one of the few tropical or subtropical legumes that will remain permanently productive on fertile alluvial or heavy clay soils. It not only improves the growth rates of cattle at critical times of the year but will keep on doing so for decades. On poorer soils, nutrient deficiencies of phosphorus (P) and sulphur (S) need to be corrected. Cattle on leucaena-grass pastures will gain 250–300kg per year, and at a higher stocking rate; production per hectare can be double that from rundown buffel grass, or up to four times that from native grass pasture (Table 1.2).

Table 1.2: Average productivity and gross margin of forage options on commercial properties in the Fitzroy catchment of central and southern Queensland

Forage system	Grazing days	Stocking rate (ha/AE)	LWG/ year (kg/ha)	Gross margin ($/ha/yr)
Perennial native grass pasture	224	2.7	76	98
Oats	116	1.0	93	31
Forage sorghum	107	0.6	108	54
Lablab	107	1.0	99	44
Butterfly pea-grass	181	1.7	125	143
Leucaena-grass	284	1.3	198	184

Source: Bowen et al. 2018. See Appendix for reference.

Leucaena-fed steers can reach 600kg live weight at 24–30 months of age (2 or 4-tooth). This is 6–12 months earlier than those on straight buffel grass, significantly increasing the carcase value and rate of steer turnover. Table 1.3 and Fig. 1 demonstrate the high carcase quality of cattle finished on leucaena-grass pasture.

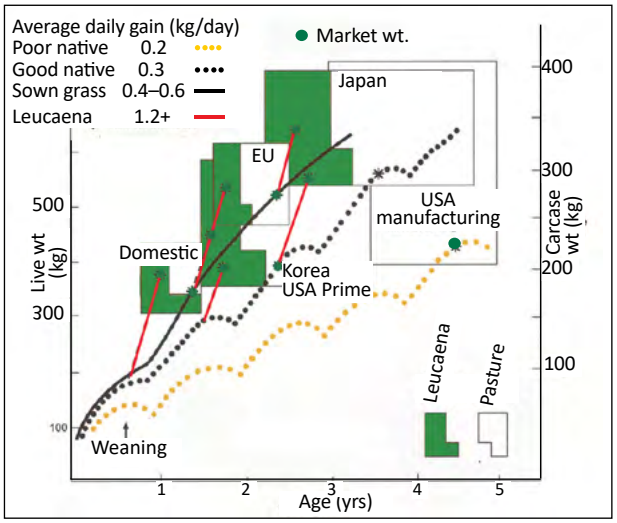
Table 1.3: Carcase grading from assorted drafts of cattle fattened on leucaena (from kill sheets)

Property location	No. of cattle	Average dentition	Average fat depth (mm)	Average carcase weight (kg)
Monto	33	1.9	15.0	322
Wandoan	10	1.6	14.9	330
Banana	62	2.0	13.0	326
Wandoan	42	2.3	16.0	367

1.3 Choose your market

A significant benefit of the rapid live weight gain of cattle grazing leucaena–grass pasture is increased flexibility in targeting domestic and export markets according to the best prices (Figure 1).

Figure 1: Major beef markets and pathways to meet these markets



Source: Adapted from Gramshaw D. and Lloyd D. See Appendix for reference.

The criteria to access both export and domestic beef markets are becoming increasingly stringent. The adoption of product quality standards such as MSA and PCAS set objective criteria with associated price incentives for producers.

High quality pasture systems such as leucaena make it easier to meet the high standards for some domestic and export markets without resorting to grain finishing.

Leucaena pasture can also be used for improving breeder condition, conception and branding rates in breeding herds, for growing out stud bulls and for backgrounding weaners before entry into feedlots.

1.4 Benefits and limitations from growing leucaena

Leucaena has nutritional, agronomic, economic and environmental benefits over other tropical pasture legumes.

Nutritional and agronomic benefits

- **Better weight gains for longer.** Leucaena is the most productive and most sustainable tropical forage legume available when grown under suitable conditions. No other forage legume can put the same weight on ruminant livestock over extended periods of the year. It also recovers quickly after drought following good rain.
- **Top nutritional value.** Leucaena leaf is high in protein and is easily digested by ruminants; it rivals lucerne in feed value. Part of the protein is protected by tannins and passes through the rumen and is more efficiently digested in the small intestine.
- **High palatability.** Cattle relish leucaena and eat it in preference to most other forages, ensuring high intake and weight gains. But it may need special grazing management to prevent over-grazing or wasteful utilisation.
- **Improved animal health.** Leucaena has anthelmintic properties and its consumption provides some control of gastro-intestinal parasites. Unlike lucerne, clover or medics, leucaena does not cause bloat.

Economic benefits

- **Costs and returns.** Commercial data from producers show that leucaena-grass pastures produce almost 2.5 times more beef than grass-only pasture, and gross margins are two-fold higher. Economic modelling shows that fattening cattle on leucaena is more profitable than other forage options in central Queensland because of its long life and low maintenance costs once established.
- **Flexible marketing.** Excellent weight gains over long periods allow producers to target either domestic or export markets, and to market finished animals when prices are highest.
- **Long life, lower cost.** Once leucaena is established, it can remain productive for more than 40 years provided soil mineral deficiencies are corrected with fertiliser, and regularly frosted paddocks are allowed to fully recover before grazing. It is a more profitable option than other short-term legumes or expensive annual forage crops.

Environmental benefits

- **Drought tolerance and animal welfare.** Leucaena's deep root system allows it to use water deeper in the soil profile than grasses. It keeps producing high quality green leaf through dry periods during summer, autumn and early winter – or until hit by frost. Producers with access to leucaena report improved animal welfare outcomes during dry times.
- **Reduced greenhouse gas emissions.** Carbon is locked up in the woody stems and roots of leucaena and in the increased growth of grass. Ruminants grazing high-quality leaf of leucaena may reduce methane production by 20–30%.
- **Improved soil fertility.** Much of the nitrogen fixed by leucaena is returned to the soil and used by the grass, reversing the 'nitrogen rundown' seen in pure-grass swards and improving grass quantity and quality.
- **Reduced soil erosion.** Leucaena planted across the slope with a vigorous grass encourages water infiltration and reduces run-off.
- **Reduced dryland salinity.** Leucaena is deep rooted. Whereas the roots of grass can extract water from the soil to a depth of 1.5–2m, leucaena roots can pull water from 3–5m, thus preventing rising water tables bringing salt to the soil surface.

Limitations of leucaena

Agronomic limitations

- **Only for better soils**. Leucaena does not grow productively on infertile or acid soils; it needs deep, fertile soils of neutral or slightly alkaline reaction with high levels of available phosphorus and sulphur. However, poorer soils which are deep and well drained may be suitable when nutrient deficiencies are corrected with fertiliser applications.
- **Susceptible to frost**. Frosted leaf drops and stems may be killed to ground level. Plants will regrow from the crown but need sufficient time to fully recover before grazing.
- **Slow to establish.** Leucaena seedlings suffer strongly from weed competition and often from attack by insects, kangaroos, wallabies and hares. Newly planted leucaena must be protected from weeds, wildlife and ruminants until at least 1.5m tall.

Management limitations

- **Psyllids**. Psyllid insects may attack leucaena, specially under humid coastal conditions. They can be controlled chemically or managed now by planting the psyllid tolerant variety cv. Redlands.
- **Mimosine toxicity.** Leucaena contains toxins and naïve animals need to be introduced slowly to leucaena until they become adapted. This may take two to four weeks and involve drenching cattle with a rumen innoculum.

Environmental limitations

- **Heavy seed production.** Poorly managed stands of leucaena can produce large amounts of seed resulting in unwanted volunteer plants, especially in ungrazed environments. Escaped plants need to be controlled. The Leucaena Network recommends specific management guidelines to minimise seed set in commercial plantings of leucaena.

The Leucaena Network

The Leucaena Network was formed in 2000 to promote the use of leucaena as a valuable forage plant.

With assistance from Queensland Department of Agriculture and Fisheries and The University of Queensland, the Network has developed a Code of Practice to encourage responsible management of leucaena so as to maximise beef cattle production and minimise the weed risk to the environment. The Code of Practice will help growers establish environmental credibility with the broader community.

Full details of the Code of Practice are presented in Appendix 1.

1.5 The future

There is potential to expand leucaena pastures in northern Australia. Some 5% (25 million ha) of northern Australia fits the requirements for growing leucaena with about 90% of this area in Queensland. Although most of this land will never be planted to leucaena, there is considerable potential for increasing beef productivity across northern Australia.

Leucaena is an appropriate option to address many of the current challenges facing the beef industry. It is a long-lived perennial legume which accommodates intensification (higher stocking rates on a smaller area of land), while enhancing the environment with nitrogen fixation, carbon sequestration and methane abatement. It provides drought mitigation and improved animal welfare while lifting beef productivity and profitability.

There continues to be concern about the potential of leucaena to become an environmental weed. To address this concern, factual information is being disseminated and the voluntary Code of Practice implemented for the responsible use of leucaena.

1.6. Producer experience: pioneers of broadscale leucaena pastures

John and Del O'Neill, 'Nyanda Station', Queensland

John and Del O'Neill were among the first group of innovative producers to pioneer commercial use of leucaena in Australia. They own 'Nyanda Station', 15,400ha of country nestled against the Carnarvon Gorge 65km south of Rolleston. Half of the property is mountainous and forested but around 2,600ha have been cleared for grazing.

The deep alluvial soils are high in phosphorus (~120 mg/kg) and perfect for leucaena growing. They planted their first 30ha of cv. Peru in 1980 and their last 100ha in 2005 giving a total area of 600ha of leucaena.

These original paddocks of cv. Peru still look green and lush after summer rain, with no sign of nutrient deficiency. John will plant more now that cv. Redlands seed is available. Some producers in the Carnarvon area who have planted cv. Tarramba have found that it grows too tall.

Establishment. John found that planting directly into a grass paddock resulted in poor leucaena growth. He now plants in single rows and inter-row cultivates during the first summer. Initial plantings were at a row spacing of 4.5m but later increased to 6m. He sprays a 1m wide band of a mixture of herbicides bentazone and fluazifop-P at 2kg active ingredients/ha for each herbicide, directly over young leucaena rows for control of emerging broad-leaf weeds and grass. This was effective on emerging weeds, but less so on older weeds, and allows leucaena plants to gain advantage. When leucaena plants are sufficiently advanced, cattle graze down the area before winter as leaf will be lost from frosting anyway.

Inter-row grasses. For the initial plantings, green panic and buffel were planted between leucaena rows. However, competition from the highly vigorous growth of leucaena and heavy stocking rates have weakened the grass.

Height management. Leucaena should be cut while still at a manageable height when the contractor's machines can travel through at a reasonable speed. Excess height of leucaena was controlled by driving along the rows with a bulldozer every five years. Height has also been controlled by frosting, occasionally by accidental burning. However, after a very hot burn, the stumps of the leucaena plants were burnt to 2–3cm below ground level and plants took about three years to recover.

Psyllids. In some years, infestations of the leucaena psyllid were bad and their sticky secretions reduced the palatability of the forage to cattle. For the first 15 years after planting, infestations of psyllids were severe every year, but recent infestations have been greatly reduced during the succession of dry years.

Weed leucaena. Leucaena plants have spread between rows but have been controlled by blade-ploughing. Some spread has also occurred in lane ways.

Animal management. Leucaena plants, though frosted every year, remain productive as long as they are allowed to recover. Cattle are rotationally grazed giving all paddocks 6–8 weeks of recovery. Water points are fenced off and spear traps are used to muster cattle.

Toxicity. Leucaena toxicity was an issue initially but occurs less frequently now. In the past, steers would lose hair from their tails and sheath when they first grazed leucaena but no cases of hair loss have occurred since cattle were inoculated with *Synergistes jonesii* in 1984–85.
However, several times when maiden heifers were joined with bulls while grazing on fresh leucaena, conception rates were low. John and Del now grow out heifers on leucaena after weaning, then graze them in a grass paddock for 6 months before joining. Bulls graze leucaena right up to mating with no observed negative effects on their fertility. Calves are weaned in May and grazed on leucaena, even when it is often frosted.

Target markets. The O'Neills target markets with steers at 30–33 months old, ranging from 340 to 360kg dressed weight with 70% of animals having a maximum of two permanent incisor teeth.
While leucaena pastures can be used for all classes of cattle, it is best used for fattening.

Their conclusions. Leucaena has been a major factor in the viability of 'Nyanda' as it has been highly productive for its entire life (now 40 years). This has made it a highly profitable forage resource as the only major cost was incurred at planting. John's original paddock was particularly good last year. One paddock has declined in vigour but this paddock frosts every year, and gets continuously grazed with little chance for recovery.