The opportunities for leucaena in southern Queensland

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Introduction

Leucaena (*Leucaena leucocephala*) is a highly productive, tropical, shrubby legume. It is deep-rooted and long-lived, and needs high temperatures to perform well, being moderately sensitive to frosts. Its nutritive value is equivalent to that of lucerne (*Medicago sativa*), with the young leaves and small fresh stems containing around 30% protein. It grows well in slightly alkaline, high phosphorus soils and with adequate water, and once properly established, it is drought-tolerant. ('Properly established' here means allowing the plant to reach a height of about 1.7 m before grazing, as this ensures the plant has enough structure above and below the ground to survive defoliation, dry periods and frosts.)

Leucaena has a large seed, which allows it to be sown directly into moist soil. The hard seed coat is scarified before planting, and although seeds germinate quickly, seedlings are susceptible to weed competition and soil surface sealing.

Although leucaena is highly nutritious and palatable, ruminants require special rumen microflora (mainly bacteria) to detoxify some of the alkaloids in the leaf and to allow them to make the most of this high quality forage. Without these rumen microflora, animals eating large quantities of fresh leucaena leaf may suffer from clinical or subclinical toxicity, grow poorly and may even die.

Leucaena is usually described as a special forage system, but really it is the legume component in a permanent pasture mixture, except the shrubby legume is planted in widely spaced rows (5–8 m between rows) with grass between these rows. It requires good grazing management to provide sufficient quality and quantity of forage for cattle to achieve the high liveweight gains for which it is now famous. As a mixed pasture, grazing management must maintain a healthy grass component to provide a balanced diet and at least 50% ground cover to reduce soil erosion to a minimum.

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Effects of cold and frost

Being a tropical species, leucaena needs day temperatures above about 28ºC for good growth, with growth slowing under cooler conditions. The leaf is moderately frost-sensitive, while more severe frosts will kill all stems under about 30 mm diameter back to ground level. However, even quite small plants survive and sprout again with the return of warmer weather and rainfall, *e.g.* a March (autumn of 2008) planting reached only 30 cm high and survived a cold winter to grow away well in the spring. All other observation paddocks persisted without loss of plants in that season. Only one report was received in 2008 of plants being killed by a frost. Conformation of this report was not possible.

Leucaena in Queensland

Overcoming the early problems

After many years of developmental work, a reliable system for establishing, managing and utilising this pasture system has been developed in central Queensland. Early agronomic problems to be solved were many, including: appropriate seed treatment to break seed dormancy; suitable planting techniques, sowing rates and row widths; and effective control of soil insects and weeds. Getting the row width right is important to maximise animal production, while maintaining good grass growth between the rows.

An early catalyst to leucaena expansion was the discovery by Dr Raymond Jones of CSIRO,

Townsville of the all-important rumen microflora, *Synergistes jonesii*, which, when introduced into cattle, ensured consistently high animal production without affecting the animals' health.

By the mid-1990s, the agronomic problems were sorted out and large-scale plantings began. It is said that the most successful growers of leucaena have been farmers who understand the need for precision when planting crops; many graziers tended to hope for maximum production with minimal attention to inputs.

Major expansion

Leucaena is now established on well over 150 000 hectares in central Queensland (CQ), with the oldest stands being more than 25 years old. Almost all of the planting has been on properties in the drier inland farming districts, where grain-growing lost its economic advantage over quality beef production. Steers suitable for the Jap ox chiller trade (300+ kg carcases at 2.5–3 years old) can be produced easily from leucaena pastures. Demonstration trials at 'Connors Junction', Marlborough between 1991 and 1996 showed that steers reliably gain an average of 260 kg live weight per year, and at much higher stocking rates than can be achieved on good-quality buffel grass pastures under similar conditions. However, in CQ, leucaena is limited to fertile soil types with a minimum plant-available water-holding capacity (PAWC) of 120 mm.

Where is the southern limit?

Back in 2000, the Wandoan region was considered to be about the southern limit for leucaena. The winter period in this area was considered to be too cold and too long for leucaena, giving a productive growing season of only about 7 months.

However, the availability of the cultivar Tarramba, which was considered to have better cold tolerance, lead some innovative producers to risk planting in that area and even further south. There was no alternative productive summer-growing legume for south Queensland; other legumes, including medics and lucerne, were either winter-growing or had a short life expectancy under grazing. Now, both Tarramba and Cunningham have been grown successfully, at least as far south as the New South Wales border in that 500–600 mm rainfall belt.

PAWC and soil P

The realistic limit to leucaena's adoption is soil plant-available water-holding capacity (PAWC), with 120 mm being considered about the lower limit. PAWC is affected by soil type and depth of soil (a rough guide is that this PAWC is supplied by a light to medium clay soil with an effective rooting depth of 70 cm). This is important in regions of low and unreliable rainfall, because plants have to survive for long periods on the soil's stored water reserves.

Soil fertility is important but, if the soil has good PAWC, it is profitable to use fertiliser. The main nutrient deficiency is phosphorus, although sulphur, potassium and zinc can be limiting on old cultivation country. Nitrogen deficiency is not a concern, as leucaena inoculated with the right rhizobium at sowing will fix enough atmospheric N for its needs.

Leucaena's weed status

Leucaena is on the declared environmental weeds list for Australia. It is there because it will colonise and form thickets in wet tropical and subtropical environments, where there are no foraging animals such as cattle, sheep, goats, camels, hares, rabbits, kangaroos, wallabies or ducks, or even insects such as grasshoppers and other leaf-eating grubs.

To combat this weed status, 'The Leucaena Network' has established a set of guidelines and actively lobbies farmers to adhere to them. These guidelines include controlling any 'escapees' from the planted paddocks, not planting leucaena in paddocks close to or on stream banks, trying not to let it seed and actively destroying or alerting authorities to observed leucaena plants on public lands.

It is important that everybody planting leucaena takes care to ensure that no level of government (local, state and federal) has an opportunity/reason/excuse to prohibit planting of this valuable forage species.

Where is leucaena now?

Darling Downs and western Downs

There are leucaena plantings of various sizes around Clifton, Oakey, Kaimkillenbun, Bell, Jandowae, Brigalow, Chinchilla, Tipton (south of Dalby) and Millmerran (southern brigalow area). The greatest density is in the Chinchilla and Millmerran districts, but the largest area on a single property (610 ha) is at Square Top in the Kaimkillenbun area.

All of this leucaena has been grazed for at least 3 years, with the oldest block being in the Charley's Creek district near Chinchilla, where it has been in production for more than 15 years.

There are more plantations in the Border Rivers region on the Queensland–New South Wales border, but I do not know how successful these plantings have been and how they have performed.

The future

There are over 300 000 hectares of erosion-prone, sloping, cultivated land on the Darling Downs alone. Much of this is not suited to permanent cropping (even though it has been cropped for many years) and is in areas now considered to be suitable for leucaena. More investigation into the adaptation of leucaena is needed to find the viable limits to its expansion, while new more cold-tolerant varieties may be developed if a market exists for them. There is also a large area of country in the Border Rivers district and west of Chinchilla that has been recently (last 20 years or so) cleared for cropping. Some of this is not suitable for long-term sustainable cropping (because of low PAWC and low fertility) but may be suited to leucaena.

Any expansion of the area planted to leucaena also depends on the relative profitability of all types of dry-land cropping, including annual forages or permanent pastures for beef production. There is no doubt that the good, deep, heavy clay soils with high moisture-holding capacity will remain in grain and fibre cropping, because of the reliability of producing high-yielding crops. However, marginal cropping country will be converted to permanent pasture because of the ever-increasing costs of inputs (such as fertiliser, chemicals, machinery, seed and fuel) compared with returns received for products (*e.g.* wheat, sorghum, barley, maize, cotton and meat).

Where this marginal cropping land is on sloping landscapes, especially areas with greater than 5% slope, it should certainly be converted back to permanent vegetation because of the severe erosion risk—even with the adoption of the best cultural practices. Reasons for conversion to permanent vegetation include:

- The best rainfall use efficiency by annual crops has been measured at 20%, whereas the rainfall use efficiency by permanent pasture is estimated at 50–70% (Freebairn and Wockner 1986).
- Well anchored and growing ground cover reduces deep drainage, water runoff and soil loss. Ground cover of 30% reduces sediment loss significantly, while 50% cover reduces it to almost zero. While runoff is not reduced to the same degree (Freebairn and Wockner 1986), it carries much less sediment.

The greatest single soil loss event in Freebairn and Wockner's trial period was on February 5, 1980 when 900 tonnes of soil per hectare were lost. This was from prolonged low-intensity rainfall over an already wet catchment. Those sorts of losses were replicated in November 2008 on many farms on the southern Darling Downs.

Table 1. Runoff, deep drainage and soil loss from different land use systems (Freebairn and Wockner 1986).

	Annual crop	Permanent pasture
Water runoff (mm/yr)	82	65
Deep drainage (mm/yr)	39	9
Soil loss (all soils) (t/ha/yr)	4	0.5
Soil loss from black clay[1]	46	1.3

[1]3-year average from vertosol at Greenmount on the Darling Downs.

Most Darling Downs beef producers aim at turning off animals suitable for the local domestic market (200–250 kg dressed weight, 0–2 teeth) or 'feed-on' steers to 450 kg live weight for local feedlots. Growth rates to achieve these targets can be achieved economically with leucaena mixed pastures.

Dairy farmers can also use a leucaena mixed pasture for growing out heifers and conditioning dry cows for calving. Milking cows can be paddock-fed on leucaena, because it does not significantly taint milk. Pregnant cows are not affected by leucaena, if they have been inoculated with the recommended rumen microflora.

Productivity

Recorded data on animal performance from leucaena in southern areas are fairly rare but the average stocking rate from the oldest Chinchilla planting (Charley's Creek, 10+ years old and still vigorous) for the whole year 2007–2008 was over 2 adult equivalents per hectare. Although figures for liveweight gains are not available, young steers fed with leucaena won major prizes at the Dalby Prime Cattle Show late in 2008.

Another grazier in the Chinchilla district has weight gain information from his property over several seasons. He suggests that young steers will gain at least 1 kg/day throughout the growing season (October–May) at a stocking rate of about 1 steer/ha.

Summary of advantages of leucaena

- It is better than any other long-living, summer-growing legume for the better classes of soils in southern Queensland.
- Animal productivity from leucaena in southern Queensland appears to be better than from any other pasture mixture or forage crop.
- It can be sown directly into prepared moist soil. If treated like any other summer-growing cultivated crop (good subsoil moisture reserves, weed and soil insect control), establishment is as reliable as for any of those summer crops.
- It can be established successfully using zero-till techniques.
- If the seed is sown between October and January, grazing of the leucaena stands can start in the following spring and summer (if rainfall is average). Leucaena planted at two trial sites (each 25+ ha) in January 2008 was ready for an initial grazing by November 2008.
- Leucaena pastures are permanent and can take advantage of any stored soil moisture or rainfall event (down to 5 mm), when temperatures are suitable from late September onwards.
- It is deep-rooted and draws moisture from deep in the profile; this reduces deep water drainage to the level achieved by native trees.
- Once established, it is moderately drought-tolerant. In dry conditions, such as existed in 2007, it is often the only green material to be seen.
- With good grass between the rows, it provides good ground cover, limiting runoff and soil loss.
- The oldest stand in the region is now 15+ years old.
- It has proven to be resilient, surviving severe frosts, even when total leaf loss occurred and stems and branches were killed to ground level.

Unknowns

- Actual productivity. Both dry matter production and liveweight gains will be measured from controlled paddocks over the next few years.
- Observations on how it tolerates cold conditions and winter frosts will also be made over the next few years. Although severe frosts were recorded in the region in 2008, long-time Darling Downs residents say that there has not been a series of severe consecutive frosts (as 'used to occur') and wonder how leucaena will stand those conditions.
- How often do animals in this region have to be inoculated with the rumen bug—particularly when the leucaena may be defoliated by frost during winter? The University of Queensland is currently investigating this issue.
- What is the most desirable row spacing?
- Is there a real long-term difference between cultivars?

MLA PDS sites

To try to answer some of these questions, funding for several demonstration sites was received from MLA (Meat & Livestock Australia) (commencing April 2007 and ending April 2009). Funding may be extended to collect some measured animal performance data. Four leucaena demonstration areas have been established on the western Darling Downs; 3 sites are between 25 and 30 ha, while the fourth is about 10 ha.

All planting was into previously cropped country, which is considered 'marginal' because of soil depth, PAWC and/or excessive slope. Two of the areas were managed by zero-till techniques, while the others were planted as well prepared cultivated paddocks. All seed was treated for soil insects and the trial areas were sprayed with Spinnaker® for weed control. Both Cunningham and Tarramba cultivars have been planted in close proximity on the same soil types on each property.

Initial establishment was excellent in all cases.

1. Millmerran (30 ha site): Leucaena was planted using zero-till in January 2008 with the grass sown between the rows in September 2008. Grazing commenced on December 15, 2008. (Note that Queensland bluegrass started to reappear in the paddock in September 2008).
2. Millmerran (10 ha site): This zero-till site was planted in late February 2008; it suffered an initial set-back when grazed by wallabies from the neighbouring grass paddock.
3. Chinchilla (30 ha site): 15 ha of Tarramba and 15 ha of Cunningham were planted on December 28, 2007, and established very well. However, 9 ha of Cunningham was subsequently flooded out and has only recently been replanted. Both areas have been grazed. The Tarramba was grazed for 6 weeks by 30 yearling heifers and a bull to November 20, 2008 to reduce seeding and to control its height. The edible production from November 20 to December 16, 2008 was measured at 925 kg/ha DM. The Cunningham that survived severe flooding in January–February 2008 was completely defoliated by grazing at the same time as the Tarramba but by a different group of animals. Its measured yield of new growth for the same period was 1184 kg/ha DM.
4. Kaimkillenbun (25 ha site): the planted areas were 15 ha of a deep sandy scrub soil (sown December 2007) next to a large grass paddock, and 10 ha of a brigalow clay soil (sown February 2008) further up the slope. Again, wallabies caused severe damage to plants on the sandy soil but less so on the brigalow soil. Plants on the late-planted brigalow site were only small when winter set in. However, they survived well and grass was planted into the inter-row spacings in February 2009.

References and further reading

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