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Prospects for
LEUCAENA
on the Ord

By David Pratchett, Beef Cattle Adviser and
Tim Triglone, Technical Officer, Kununurra

For the past few years, the Department of Agriculture has been fattening cattle on the forage shrub leucaena which is grown under irrigation with pangola grass. About 400 ha of leucaena is under commercial production in the Kimberley. Cattle grazing leucaena show promising growth rates but other problems need to be overcome before its use is more widely adopted. Leucaena establishes slowly. It is also costly to transport fattened cattle to southern abattoirs.

About the plant

Leucaena leucocephala (LAM) de Wit, or simply leucaena, is a Mexican forage plant that has spread throughout most tropical countries. It is a leguminous tree with a highly specific rhizobium requirement. Leucaena's leaves are bipinnate; the flowers are white and the seeds are produced in thin flat pods.

There are three main types of leucaena.

• Common type. This is a short bushy shrub less than five metres high. It flowers year-round in Hawaii, where it is an aggressive weed, shading out all under-growth.

• Peru type. A medium-sized tree growing to 10 m with little trunk but prolific branching and leaf production.

• Giant type. This is a tall tree up to 20 m high, with larger leaves and seeds than the other types.

The common type produces the most seed, the Peru type the most forage, and the giant type the most timber.

Leucaena produces small powder-puff like flowers which are typical of the family Mimosaideae. Other well known members of this family are the wattles. Flowers are produced on the ends of new shoots. These shoots are highly palatable so that leucaena rarely flowers under grazing. If left ungrazed, leucaena will flower year round but the peak is in May.

Leucaena produces seed in long strap-like pods. Seed yields exceeding 2 tonnes per hectare have been achieved in Queensland. However, no reliable data on seed yield is available for the Kimberley.

Uses

Leucaena produces excellent yields of high quality forage. In many countries it is cut and carried to livestock as well as being collected, dried and used as a high protein, high carotene supplement in pig and poultry rations. In Australia, to date, its use is confined to forage production for cattle.

In many parts of the world leucaena is used extensively for firewood and charcoal production. In the Philippines, grid electricity is generated by burning the timber. The timber is used for fencing and building, while the giant types are grown as shade trees in coffee plantations.
Cultivation in Australia

There are substantial plantings of leucaena in Queensland from Townsville in the north, to as far south as Brisbane. By early 1988, more than 16,000 ha had been planted. Planted areas are confined mainly to the coastal regions, with plantings rarely extending more than 200 km inland because total rainfall, as well as reliability, declines rapidly away from the coast. Leucaena needs about 750 mm of rain a year to establish, but once established it can survive on less rain and will persist through drought by dropping its leaves. It is poorly tolerant of waterlogging and flooding.

For maximum yields, temperatures should range from 30 to 40°C. If night temperatures drop below 17°C, yields are reduced severely. In Western Australia, commercial plantings under irrigation are confined to the Kimberley region.

Early Ord River plantings

Leucaena was first planted in Western Australia nearly 20 years ago at CSIRO's Kimberley Research Station, now known as the Frank Wise Institute of Tropical Agricultural Research and run by the Western Australian Department of Agriculture.

In early trials the leucaena was cut and fed to cattle in yards. The cattle grew well enough at first but developed symptoms of mimosine (an amino acid) poisoning after about six weeks. This poisonous component of the plant severely restricted its use in Australia until recently.

Low mimosine strains of leucaena that had been bred in Queensland were tested in the Kimberley in 1978, but these strains lacked vigour and yielded poorly. Cattle did not develop symptoms of poisoning, but they did not grow well either. This programme has ceased.

Mimosine toxicity

Mimosine is an unusual amino acid that has no apparent function in leucaena but which occurs in all parts of the plant, particularly in the actively growing young tips. Its concentration in the plant varies throughout the year and from year to year. Leucaena plants growing in the far tropical north of Australia tend to have higher mimosine levels than those growing slightly further south.

In the past, cattle grazing leucaena on the Ord have sometimes grown well, though in other years production has been poor because of severe symptoms of mimosine poisoning. High levels of mimosine are associated with periods of rapid plant growth when temperatures are high and water is plentiful. CSIRO research showed that leucaena growing on Kimberley Research Station produced the highest levels of mimosine recorded in Australia (4 per cent of the total nitrogen in the plant was made up of the amino acid mimosine). Stock were far more prone to poisoning in the Kimberley than in central and southern Queensland.

Mimosine poisoning results when the cattle’s rumen microbes break the mimosine down to another toxic compound 3 hydroxy-4-(IH) pyridone or DHP. This substance modifies cell division, resulting in loss of hair, loss of appetite (and subsequent weight loss), goitre and in some cases even death.

Fortunately, Dr Ray Jones of CSIRO’s Division of Tropical Crops and Pastures in Townsville, Queensland, solved this problem. He noted that in some countries ruminants could eat large amounts of leucaena without suffering ill-effects.

The usual variety of leucaena grown in the Kimberley is Cunningham. It can grow 3 to 4 m high, however grazing keeps it about 1.5 m high.
Table 1. Production from cattle grazing irrigated leucaena and pangola pastures (mean of data from 1984 to 1987)

<table>
<thead>
<tr>
<th>Stocking rate (animals/ha)</th>
<th>Gain/day (kg)</th>
<th>Carcass wt (kg)</th>
<th>Fat thickness at 12-13th rib (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.72</td>
<td>223</td>
<td>7.0</td>
</tr>
<tr>
<td>3.5</td>
<td>0.68</td>
<td>203</td>
<td>5.5</td>
</tr>
</tbody>
</table>

Table 2. Cattle weight gain on stocking rate x row spacings trial from 31/7/87 to 26/4/88

<table>
<thead>
<tr>
<th>Row spacing (m)</th>
<th>Stocking rate (animals/ha)</th>
<th>Weight gain (kg)</th>
<th>Gain/day (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>6.25</td>
<td>190</td>
<td>0.70</td>
</tr>
<tr>
<td>1.8</td>
<td>6.25</td>
<td>187</td>
<td>0.67</td>
</tr>
<tr>
<td>2.7</td>
<td>6.25</td>
<td>181</td>
<td>0.69</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>186</td>
<td>0.69</td>
</tr>
<tr>
<td>0.9</td>
<td>7.5</td>
<td>176</td>
<td>0.65</td>
</tr>
<tr>
<td>1.8</td>
<td>7.5</td>
<td>161</td>
<td>0.60</td>
</tr>
<tr>
<td>2.7</td>
<td>7.5</td>
<td>148</td>
<td>0.55</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>159</td>
<td>0.59</td>
</tr>
</tbody>
</table>

Table 3. Cattle weight gain on stocking rate x row spacing trial from 26/7/88 to 16/12/88

<table>
<thead>
<tr>
<th>Row spacing (m)</th>
<th>Stocking rate (animals/ha)</th>
<th>Weight gain (kg)</th>
<th>Gain/day (kg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9</td>
<td>6.25</td>
<td>104</td>
<td>0.73</td>
</tr>
<tr>
<td>1.8</td>
<td>6.25</td>
<td>112</td>
<td>0.78</td>
</tr>
<tr>
<td>2.7</td>
<td>6.25</td>
<td>102</td>
<td>0.71</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>105</td>
<td>0.74</td>
</tr>
<tr>
<td>0.9</td>
<td>7.5</td>
<td>95</td>
<td>0.66</td>
</tr>
<tr>
<td>1.8</td>
<td>7.5</td>
<td>85</td>
<td>0.59</td>
</tr>
<tr>
<td>2.7</td>
<td>7.5</td>
<td>80</td>
<td>0.56</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>85</td>
<td>0.59</td>
</tr>
</tbody>
</table>

* At the two stocking rates tested, cattle maintained the necessary liveweight gains only when the leucaena was planted in rows 0.9 m apart. The stocking rate of 8.75 animals per hectare was reduced to 6.25 animals per hectare in November 1988 for leucaena planted in rows 1.8 and 2.7 m apart.

One of the exciting aspects of Dr Jones’ work was that these DHP-degrading microbes can spread between cattle via droppings, thus building up a herd’s immunity to mimosine poisoning. Only 10 to 20 per cent of a herd would need to be treated for general protection against mimosine poisoning and within weeks the microbes would spread throughout the herd.

Recent grazing trials on leucaena

The Department of Agriculture started a long term stocking rate trial in 1984 with cattle grazing irrigated paddocks of leucaena and grass. Stocking rates of 2, 3.5, 5 and 6.5 animals per hectare were tested. Cattle grazed leucaena growing in rows 4.5 m apart with pangola grass (Digitaria decumbens) between the rows, or verano (Stylosanthes hamata) with pangola grass. Planted areas were fenced into two paddocks so that a grazing pattern of two weeks’ grazing followed by two weeks’ rest was possible.

The stocking rates of 5 and 6.5 animals per hectare could not be sustained for more than two years. In the first two years animals grazing at these rates did not grow fast enough to produce carcasses with enough fat cover at the 12 to 13th rib to satisfy the market for quality table beef. In the third year, growth was so poor and the leucaena grazed back so hard that the cattle were removed after four months. Table 1 shows production results for the lower stocking rates of 2 and 3.5 animals per hectare.

Cattle prefer to graze leucaena rather than grass. Cattle stocked at 2 and 3.5 animals per hectare rarely grazed grass, and at the higher stocking rates they only started grazing grass.

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To cut a long story short, Dr Jones took Australian goats that were suffering mimosine poisoning to Indonesia where he gave them an infusion of rumen liquor from healthy Indonesian goats that graze leucaena safely. Within three days the DHP levels in the treated Australian goats had dropped - indicating the DHP-degrading microbes were working in the Australian goats - and their appetites increased.

After further successful tests using imported cultures of DHP-degrading microbes on a goat and steer in strict quarantine in Australia, Dr Jones tested the method on steers at Townsville and in the Ord River Irrigation Area, with similar success.

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when the leucaena had been eaten off. As the DHP-degrading microbes were working efficiently and making leucaena a non-toxic plant, cattle could graze leucaena alone.

In another trial started in 1986, the leucaena was planted in closer spaced rows 0.9 m, 1.8 m and 2.7 m apart. We believed that leucaena yields could then be increased, perhaps with minimal competition between plants, and stocking rates could be higher than previously. Stocking rates ranged from 6 to 18 animals per hectare, increasing at rates of two animals per hectare.

The grazing pattern was also altered to one week's grazing followed by a three-week spell. Under the two weeks' grazing - two weeks' spell pattern previously tested, the new leucaena leaves did not fully develop before they were eaten off. We believed the three-week spell would allow the leucaena to grow more strongly, perhaps yield more, and so support a higher stocking rate.

Our original hypotheses about leucaena growth rates were incorrect and the stocking rates were far too optimistic. Stocking rates were adjusted in 1987 and ranged from 6.25 animals per hectare to only 10 animals per hectare. Table 2 shows the results achieved in 1987-88. Animals grazed at stocking rates of 8.75 to 10 per hectare were removed in January 1988 as they were not growing fast enough to produce quality table beef.

The stocking rates for the 1988-89 trial were again adjusted, with the highest being 8.75 animals per hectare. Table 3 shows the results to date. Again the highest stocking rate had to be reduced on all but the closest spaced rows.

It is possible that these production results could improve in time. The 1984 trial showed that after three years the optimum stocking rate for the production of quality table beef was 3.5 animals per hectare grazing leucaena planted in rows 4.5 m apart. In the 1987-88 season, all paddocks were stocked at a slightly higher rate of 4 animals per hectare. The cattle gained weight at a rate of 700 g/day but the leucaena grew away from them. In the 1988-89 season, paddocks are stocked at 5 animals per hectare and to date (December 16, 1988) the mean liveweight increases are 700 g/day.

Throughout the stocking rate x row spacings trial started in 1986, it seems that areas which were heavily grazed early in the trial have had trouble maintaining production. Areas which were grazed less heavily are producing well, and at stocking rates as high as 7.5 animals per hectare the leucaena is again growing away from the animals. This is especially obvious in paddocks in which the leucaena is planted in rows 0.9 m apart.

**Nutritional usefulness**

Leucaena is extremely high in protein nitrogen (4.4 per cent), the main reason why it is so valuable as a forage. It has adequate levels of phosphorus, potassium, manganese and zinc.

Table 4 shows the annual dry matter yields of leucaena at the different stocking rates used in the trial started in 1984. The high stocking rates have reduced the vigour of the plant, leading to low yields. Even at the low stocking rates of 2 and 3.5 animals per hectare, yields are not as high as those quoted elsewhere. However yields in Table 3 are under grazing and from rows 4.5 m apart.

On the Ord River Irrigation Area leucaena is grown in rows and flood irrigated twice a month. Rows as close as 0.9 m have been tried but the best spacing appears to be about 1.8 to 2.7 m.

Leucaena is extremely palatable to cattle. The paddock on the right had as much vegetation as the other paddock a week earlier. Fortunately leucaena recovers quickly from grazing, and provided stock are removed a new flush of leaves will be available in three to four weeks.
Table 5 shows the dry matter production yields of leucaena from the row spacings x stocking rate trial over a nine-month period between 1987 and 1988.

Some problems

Marketing cattle

In 1987 cattle grazing leucaena were sold to a southern buyer for $2.30 per kilogram carcass weight. However this price was agreed only after protracted negotiation with the meatworks. The cattle spent two days in Broome for dipping, they arrived in good order and the top price was paid.

Cattle fattened on leucaena on the Ord River Irrigation Area can realize top prices, but a new producer will have to establish credibility in the meat trade. The trade is still wary that cattle of such quality can be produced in the Kimberley and that they can travel long distances without suffering damage.

The cost of transporting cattle south at about $100 a head is a major constraint. Preliminary budgets are promising with cattle stocked at eight animals per hectare if transport costs are only $30 per head, the price to truck them to Darwin. Recent inquiries indicate that buyers in the Northern Territory would take this class of stock at these prices, provided supplies were regular.

If cattle have to sold on the Perth market, then these other costs would have to be reduced or a higher stocking rate achieved.

Establishment of leucaena

Leucaena and pangola grass are costly to establish. Land preparation costs can range from $215 to $645 per hectare. Pangola grass has to be planted by hand, at a cost of about $200 per hectare.

Leucaena seedlings are difficult to establish under dryland conditions and under irrigation. Germination and emergence are usually not a problem, provided the seed is treated with hot water to break dormancy. Once the seedlings are two to three centimetres high, growth slows down and weeds can compete with and smother them.

Inefficient phosphorus uptake can cause early slow growth because of a link between a fungus called VA mycorrhiza that forms a symbiotic relationship with the leucaena and assists in uptake of phosphorus and zinc. These fungi are not always able to infect leucaena roots quickly, and in some cases the most effective strains may be absent.

Plant growth is thus held back by phosphorus deficiency. It can also suffer from a shortage of nitrogen because, without adequate phosphorus, nitrogen fixation is depressed. In some areas providing nitrogen in strips at planting time helps seedling establishment, but this has not proved to be particularly beneficial on the Ord.

Pangola grass can only be propagated from runners as it does not produce viable seeds. It produces strong runners which cattle can walk on in wet conditions without causing damage. This is the main reason why pangola grass is preferred to other grasses.

A grass with a similar growth habit to pangola but which produces viable seed should reduce establishment time and costs, but none is available.

Conclusions

High growth rates for cattle grazing irrigated leucaena and pangola grass paddocks at high stocking rates can be achieved. Production of 1,500 kg of beef from one hectare of irrigated leucaena on the Ord River Irrigation Area has been achieved.

However, the establishment costs of leucaena pastures and the time taken to establish the crop are major problems. The Kimberley’s isolation and thus the high cost of transporting finished cattle to market are also severe constraints to the overall profitability of the enterprise. The recent allocation of an abattoir licence in Kununurra could well overcome the transport problem and provide an impetus to future commercial development.

Further reading