GLENCROSS, R. H. (1978)—Have fodder trees a place in modern grazing industries on semi-arid lands? *In* "Integrating Agriculture and Forestry". (CSIRO Division of Land Research Management: Perth), pp. 194–197.
GRAHAM, T. W. G., WALKER, B. and MULLER, F. W. (1982)—Fitzroy stylo, a pasture legume for northern brigalow soils. Proceedings of the 2nd Australian Agronomy Conference, Wagga Wagga, p. 187.
GRAY, S. G. (1970)—The place of trees and shrubs as sources of forage in tropical and subtropical pastures. *Tropical Grasslands* **4:** 57–62.
GUPTA, B. S. (1981)—Studies on the effect of molasses feeding on the nutritive value of siris (*Albizia lebbeck*) tree leaves. *The Indian Journal of Nutrition and Dietetics* **18:** 144–147.
GUTTERIDGE, R. C. and AKKASAENG, R. (1985)—Evaluation of nitrogen fixing trees in Northeast Thailand. *Nitrogen Fixing Tree Research Report* **3:** 46–47.
HENZELL, E. F. (1977)—Nitrogen nutrition of tropical pastures. *In* "Tropical Forage Legumes". Ed. P. J. Skerman (FAO: Rome), pp. 86–102.
JOHANSEN, C. and KERRIDGE, P. C. (1979)—Nitrogen fixation and transfer in tropical legume-grass swards in south-eastern Queensland. *Tropical Grasslands* **13:** 165–170.
JONES, R. J. and JONES, R. M. (1978)—The ecology of Siratro-based pastures. *In* "Plant Relations in Pastures" Ed. J. R. Wilson (CSIRO: Melbourne), pp. 253–367.
KALLA, J. C. (1977)—Statistical evaluation of fuel yield and morphological variates for some promising energy plantation tree species in Western Rajasthan. *Annals of Arid Zone* **16:** 117–126.
KALLA, J. C., CHAND, G., VYAS, D. L. and GEHLOT, N. S. (1978)—Techno-economic felling cycles for selected energy plantation species in the arid areas of Western Rajasthan. *Annals of Arid Zone* **17:** 42–51.
KAUL, R. N. and CHAND, G. (1979)—Forest-tree planting in arid zones. Proceedings of the UNEP Desertification Conference, Nairobi, pp. 196–202.
LOHAN, O. P., LALL, D. and NEGI, S. S. (1983)—Partitioning of total tannins in some tree fodders in condensed and hydrolysable forms. *Indian Journal of Animal Science* **53:** 1333–1335.
MCDONALD, W. J. F. and TERNOUTH, J. H. (1979)—Laboratory analyses of the nutritional value of western Queensland browse feeds. *Australian Journal of Experimental Agriculture and Animal Husbandry* **19:** 344–349.
MCKELL, C. M. (1980)—Multiple use of fodder trees and shrubs—A world wide perspective. *In* "Browse in Africa". Ed. H. N. le Houerou. (ILCA: Addis Ababa), pp. 141–149.
MISRA, C. M. and SINGH, S. L. (1981)—Seed germination studies on three predominant tree species of southern Uttar Pradesh. *Annals of Arid Zone* **20:** 193–198.
MUTHANA, K. D., ARORA, G. D. and CHAND, G. (1976)—Comparative performance of indigenous trees in arid zone under different soil working techniques. *Annals of Arid Zone* **15:** 67–76.
NEGI, S. S. (1977)—Fodder trees in Himachal Pradesh. *Indian Forester* **103:** 616–622.
PRADHAN, I. P. and DAYAL, R. (1981)—Farm forestry in agricultural economy. *Indian Forester* **107:** 665–667.
RAINA, A. K. (1984)—Acacia for arid zones. *Nitrogen Fixing Tree Reports* **2:** 9–10.
SKERMAN, P. J. (1977)—"Tropical Forage Legumes". (FAO: Rome), pp. 479–481 and 583–591.
SOMMEN, F. VAN DER (1981)—Farm Forestry. *In* "A Manual of Australian Agriculture". Fourth Edition. Ed. R. L. Reid (William Heinemann: Melbourne), pp. 277–280.
STANLEY, T. D. and ROSS, E. M. (1983)—Flora of South-Eastern Queensland, Vol. 1, p. 384. Qld Dept Primary Industries Misc. Pub. 81020.
STREETS, R. J. (1962)—Exotic Forest Trees in the British Commonwealth. (Clarendon Press: Oxford), pp. 169–170.
TOMAR, O. S. and JADAV, J. S. P. (1982)—Effect of irrigation with saline and sodic waters on the growth of *Albizia lebbeck* and soil properties. *Indian Journal of Forestry* **5:** 290–297.
VALLIS, I. (1978)—Nitrogen relationships in grass/legume mixtures. *In* "Plant Relations in Pastures". Ed. J. R. Wilson (CSIRO: Melbourne), pp. 190–201.
WHYTE, R. D., NILSSON-LEISSNER, C. and TRUMBLE, H. C. (1953)—"Legumes in Agriculture". FAO Agricultural Studies No. 21, p. 252.
WILDIN, J. H. (1980)—A management system for leucaena. *Queensland Agricultural Journal* **106:** 194–197.

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PROCEEDINGS

LEUCAENA—A LEGUME OF PROMISE

Field Meeting—November 15, 1985

The final field day of the year for the Tropical Grassland Society was held at "Arnwood", the property of Mr and Mrs J. Humphreys, at Harlin, south-east Queensland. The morning program began with talks on the usage and value of Leucaena as a forage and concluded with demonstrations of treating seed prior to sowing and drenching animals with the new "bug". Demonstrations of planting Leucaena seedlings and discussions of its benefits for animal production and the economics of its use followed in the afternoon. The day concluded with the Annual General Meeting of the Society and a BBQ catered by the Harlin P & C.

The Society launched a booklet "Leucaena the Shrub Legume for Cattle Feed" which is available for purchase from the Society at a small fee.

LEUCAENA—INTERNATIONAL EXPERIENCE

R. J. JONES

CSIRO Division of Tropical Crops and Pastures, Brisbane

Leucaena is a native of Mexico and Central America but has spread widely throughout the tropics. In many areas of the Pacific and South-East Asia, the plant occurs in thickets, particularly on calcareous islands where it may be the dominant vegetation. This weedy type of leucaena was known as the Hawaiian type or the

Acapulco type. Until fairly recent times, the main agricultural use of leucaena was as shade in plantation agriculture, particularly as shade for coffee or cocoa. In addition, the plant is used to provide stakes for propping up bananas.

The natural stands of leucaena which occur around the tropics are browsed by cattle, buffalo, and goats or may be cut for storage and fed to animals in stalls. In some but not all countries where leucaena is naturalised, the plant is also used to some degree for human consumption. In Mexico, Indonesia and Thailand, the young seed pods are used as a vegetable and the young growing tips are also eaten. In Mexico, it is claimed that the pods and seeds can be used to control worms in children, and for other stomach disorders. However, these claims have not been critically examined.

An upsurge in interest in leucaena occurred when the so-called giant varieties of leucaena were discovered and shown to be much more vigorous than the local strains of leucaena. The publication of the booklet "Leucaena—Promising Forage and Tree Crop for the Tropics" by the National Academy of Sciences in 1977 provided much needed information in a readily accessible form and rapidly became a "best seller". The report highlighted the potential uses of leucaena (sometimes too optimistically) and notified individuals where seed could be obtained for further testing. This resulted in an upsurge in the testing of numbers of leucaena accessions around the world and a greater awareness of the potential of this important tropical legume species.

At the time of that first report, most leucaena was grown on experimental stations, with very little commercial development either for forage production or for timber and fuel wood. Over the past decade, the picture has changed considerably. There are now large scale plantings, mainly of the giant tree types, mainly for fuel wood and rayon manufacture, but increasing areas are being grown for forage in various developing countries. At the present time however, most of the forage is cut for feeding to animals in pens. Some examples of the use of leucaena in various countries are given below.

The Philippines

$350,000,000 has been spent on rural electrification based on the burning of leucaena wood. Thousands of hectares are now planted for this purpose and also for producing gas for powering small engines.

Taiwan

10,000 hectares of the giant varieties have been planted for paper and rayon fibre.

Indonesia

Thousands of hectares have been planted for soil conservation, green manure and animal feed. In Timor alone, there is an estimated 400 km^2 planted to leucaena. This has been effective in controlling lantana and in providing fodder for hand feeding of cattle and goats in stalls or tethered to trees. The island of Flores has approximately 20,000 hectares grown as hedges on the contour for soil conservation purposes. The small terraces between the rows of leucaena are cropped and the cuttings from the leucaena used to fertilise and mulch these crops. It is claimed that rivers that have not run in the dry season for many, many years have started to flow all year round since the leucaena has been planted to stabilise the soil and regulate the run-off of water in the wet season.

India

Increasing amounts of leucaena are being grown by smallholders for feeding stock but in many situations it is more profitable to grow tree-type leucaenas and to sell the wood for fuel around the towns where fuel is in such short supply. One organization near Poona (BAIF) has distributed 40 tonnes of seed and 400,000 seedlings, mainly for use as forage.

Malawi

A pilot scheme has been established for growing leucaena leaf meal by smallholders, payment being based on carotene content of the leucaena material. The cultivar Cunningham has been used since this has the highest level of carotene in the green leaf.

Nigeria

Interest in the wetter parts of Nigeria has focussed on the use of leucaena for alley cropping. In this system, rows of leucaena are lopped periodically to prevent excessive shading for the crops and the cuttings are used to mulch the inter-row crops. Promising results have been obtained from the International Research Centre at Ibadan and the researchers believe that a permanent agriculture will be possible using this system. Their experimental results show that 3–4 tonnes of corn can be obtained without any use of nitrogen fertiliser. In the absence of leucaena, the yields stabilise at about 0.5 to 1 tonne per hectare per year. The work is now passing from the experimental stage to farmers who seem eager to adopt the new system. It is likely that alley cropping could have an important place in peasant agriculture in many parts of the tropical world. However, it will be necessary to assess the value of this technique under different rainfall regimes. At the moment, the system operates well in the wet tropics but it is likely that there will be severe competition for water in the more semi-arid areas of the tropics.

The Pacific Islands

Leucaena is naturalised on many of the Pacific islands such as Vanuatu and Fiji and is common on many of the islands in the Hawaiian group where the soils are not too acid or infertile. On many of these islands, the leucaena appears to be insufficiently utilised unlike the situation in Indonesia where these naturalised stands are fully utilised for feeding to ruminants.

In most overseas countries where leucaena has been grown for timber, fuel or rayon, the rainfall is far higher than that experienced in most parts of Australia. Caution is therefore needed in relating their achievements to our conditions.

In no country have I seen large areas planted for grazing purposes. In many countries such as Mexico, Cuba, Philippines and Brazil, the results of experimental work are only now becoming appreciated and larger areas being planted commercially for beef production. Of course, in South America, one of the major problems to the use of leucaena is the widespread occurrence of very acid soils low in calcium and high in aluminium. The current varieties of *Leucaena leucocephala* are ill-adapted to such conditions and in the absence of heavy lime applications are not productive. Similar acid soils occur in Malaysia and again lime is required for good production. Some acid tolerance occurs in species other than *L. leucocephala* and Dr E. M. Hutton has been working in Colombia and Brazil attempting to develop lines of leucaena which are adapted to these acid soil conditions.

It may well be that Australia will take the lead in developing leucaena for beef production on a large scale, and John Wildin will tell us about these developments in his talk.

LEUCAENA—CENTRAL QUEENSLAND EXPERIENCE

J. WILDEN

Department of Primary Industries, Rockhampton

The environment

The central Queensland environment is different to that of southern Queensland. We define five agro-ecological zones, ranging from the coastal poor quality soils, to the open downs and Brigalow soils to the west, while the spear grass zone lies in between

these extremes. Rainfall varies from over 2000 mm at Byfield and Mackay down to 500 mm in the west. North of Proserpine there are two distinct seasons, one very wet and the other very dry. South of this area, we consider central Queensland to have three seasons. From November to March, over 60% of the rainfall is received, while March to July receives some rain. July to November is a distinct dry season. So as far as growth is concerned, everything happens between November and March.

Animal performance

Liveweight increases on native pastures are a reflection of the above rainfall distribution, with good gains during the summer months when there is abundant feed available but distinct weight losses in the dry season from July to November. With improved pastures, the same weight gains are obtained in the summer but the pastures are stocked at higher rates. The big problem is in the July to November period, and also occasionally in the March to July period. Moisture limitation is the main restriction to growth although frosts around July aggravate the problem.

Alternative feed systems for the dry period

Leucaena is a tree which can tap moisture at lower depths than other pasture species, allowing growth to continue well into the drier periods. Although it can grow at this time, growth rates are restricted by climate.

Ponded pastures are a second alternative, where grass is grown on water collected from rainfall in the summer period. This allows grass growth during the dry season.

The leucaena system

The aim in using leucaena is to reduce or eliminate the dry season weight losses. Whereas it takes $4\frac{1}{2}$ years from birth to sale to fatten a steer on native pasture, it takes about $2\frac{1}{2}$ to $3\frac{1}{2}$ years to do the same thing on pasture systems including leucaena.

The critical factor in animal production is the amount of nitrogen in the green forage available per animal. Leucaena can supply a tremendous body of green material throughout the year, particularly in the dry season.

The use of leucaena commenced in central Queensland in the 1970s when Gordon Wyland's 24 ha seed plot was used as the basis for an extension program. He also subsequently planted some of the Cunningham cultivar. Gordon was encouraged to grow it as trees. Information obtained from these areas indicated that very high animal liveweight gains could be achieved, even with leucaena/native grass pastures. One particular year three group on animals were put on a 6 ha leucaena area together with 6 ha of native grass. Each group contained 10 steers and all gained about 1 kg/head/day, and all were turned off fat.

At John O'Neil's at Rolleston, which is a very cold site, 60 steers were put on 32 ha of leucaena/grass pasture in October. A similar group were put onto 123 ha of good native grass. In March, all animals were weighed. Those from the leucaena area put on 80 kg per head more than the ones off native pasture. This shows the tremendous increase obtained from the use of leucaena. For a second example on the same property, 68 animals were put on 28 ha of a 15 month old leucaena pasture and they gained 108 kg in 97 days. The owner claims that even oats can not consistently achieve these results, and he has replaced much of his oats country with leucaena, inter-sown with grass.

On a different soil type (a granitic sand), animals gained 47 kg over 69 days from April to June, when stocked at a beast per 1.5 ha. For the same period, native grass, stocked at 1 beast per 4 ha, achieved weight gains of only 13 kg. A second native pasture area, improved with another legume, Wynn Cassia, also achieved gains of only 13 kg.

How did it all start?

I have been a believer in leucaena for a long time. It was the only legume to persist in trials I ran at Brigalow Research Station. However it seemed to have some problems.

One was that it was fairly complicated to have it growing. The second was that it appeared to need rotational grazing. These two problems appeared to make it incompatible with graziers' management systems. In one trial I ran, I found that leucaena could be killed out in 5 years with continuous grazing. However, if it is given a summer spell and allowed to grow into a tree, it will not die even with continuous grazing.

Therefore, for graziers to adopt leucaena, we had to change our management practices. If it is grown into a tree, the management practices can be modified to suit the grazier's enterprise.

A further problem was establishment. Many small sowings failed in central Queensland. Some of the factors suggested from Dr Shelton's survey (see later in the Proceedings) may have contributed but I feel that wildlife are the main contributor to failure. I have seen areas of up to 4 ha destroyed by wildlife such as hares, rabbits, kangaroos, wood ducks, etc. Our recommendation now is to plant sufficient large areas (well over 20 ha) at one time so that the wildlife problem is minimised.

How much has been planted in central Queensland?

There was a total area of only 30 ha sown in central Queensland from 1968 to 1975. By 1979, still only 30 ha had been sown. In October 1979, we launched our extension campaign for leucaena. By the end of the 1979/80 season, people had started to sow leucaena, but only in small areas, and a total of 100 ha was recorded. By the next year, it had increased to 450 ha. By October 1984, 1700 ha had been sown and by March 1985, it reached 3000 ha. I predict that by December 1985, 8000 ha will have been sown and that by this time in 1986 there will be 16,000 ha sown to leucaena.

What are the reasons for this success?

The graziers are now showing confidence in the plant, and in how to get it established. Graziers have been looking at results achieved by neighbours, attending field days and generally gaining knowledge on how to handle it. We have also produced a booklet on the subject because we feel that single page handouts get too easily lost. The Tropical Grassland Society's booklet, released today, will go a long way to helping people get to know how to handle leucaena.

In conclusion, I feel that leucaena has a definite place in tropical pastures. It is certainly permanent, it offers shade and changes the environment, and because it is a high protein legume even in the tree form, leaf fall will help to fertilize the grass underneath.

SURVEYING LEUCAENA USAGE IN QUEENSLAND

H. M. SHELTON

Department of Agriculture, University of Queensland, Brisbane

Leucaena is not a new forage. It was first introduced into Australia in the late 1800s and was naturalized in parts of North Queensland and the Northern Territory by the 1920s. Research in Australia began in the 1950s and the first varieties were released in 1962. By the 1980s, over 2000 scientific papers have been published on various aspects of leucaena and they demonstrate that the plant is high yielding, produces very good quality forage, has surprisingly wide adaptation, has excellent persistence, and these characteristics together ensure good animal production.

Leucaena is a plant of proven potential world wide yet the level of adoption in Queensland appears to be quite low. Accordingly, Mr Len Lesleighter and I initiated a survey to determine the actual level of adoption in central and south-east Queensland to ascertain the underlying factors which influenced adoption. A questionnaire was sent to 1200 producers including both beef and dairy farmers. Producers were located in the Divisions of Fitzroy, Wide Bay-Burnett and Moreton, all of which were considered to be centres of leucaena research and extension.

The results showed that the level of adoption was indeed low. For instance, 35% of producers had never heard of leucaena whilst only 6% of those who replied to the questionnaire, currently had leucaena growing on their property. We felt that most of those who did not reply to the questionnaire were not growers and this reduced the level of adoption to just over 2%. However, a further 12% of producers indicated that they planned to establish some leucaena by mid-1986.

When we looked at the area planted to leucaena, we found that 76% of the current area was in the Fitzroy Division with only small areas in Moreton and Wide Bay-Burnett Divisions. The survey also showed that the planned area, by 1986, was 5 times larger than the current planted area and again, by far the majority of this was in the Fitzroy Division. There was very little expansion of leucaena in the Moreton and Wide Bay-Burnett divisions. One alarming aspect of the survey was that almost 2/3 of the plantings had failed for various reasons and I will come back to this point later on. By far the greatest proportion of planted and planned areas were to be found on beef properties with very little on dairy properties. This finding is probably related to the high level of extension activity with beef producers rather than with dairy producers. Leucaena is quite an effective legume for dairy production.

We identified a number of factors which we felt might explain the low level of adoption of leucaena. The first of these was the low level of awareness of leucaena by farmers. The second relates to disadvantages of leucaena which were perceived by producers. These were—slow growth and establishment problems (32% of replies), lack of information (11% of replies), possible toxicity to cattle (9% of replies) and susceptibility to frost (7% of replies).

There were a number of adverse cultural practices which became apparent from the survey which we felt may explain the low level of success of leucaena plantings. These were (a) only 16% of producers both scarified and inoculated their seed, (b) most plantings were too small and therefore vulnerable to feral animals, and (c) the first grazing was often delayed by up to 20 months and it was felt that during this time, producers may lose patience and plough out their leucaena to make way for alternative crops.

We concluded that adoption of leucaena could be improved if there was—(a) publicity to improve producer awareness (a media responsibility); (b) improved availability of information on agronomic and animal production qualities (an extension officer responsibility); (c) greater attention to recommended cultural practices such as scarification and inoculation (a farmer responsibility); and (d) improved strategies for quicker establishment of young seedlings (responsibility of research workers).

We further concluded that there would be a rapid increase in adoption over the next year which would involve a threefold increase in the number of producers growing leucaena and possibly a tenfold increase in the current area successfully planted to leucaena. The majority of these intending growers seem undecided on the appropriate cultural practices, and for this reason there may well be significant establishment failures. This underscores the need to collect all relevant information on the agronomy of leucaena before proceeding with development; the recent booklet on leucaena prepared by the Tropical Grasslands Society is a very useful addition to the available information.

THE USE OF RUMEN BACTERIA TO OVERCOME LEUCAENA TOXICITY

R. J. JONES

CSIRO Division of Tropical Crops and Pastures, Brisbane

Leucaena is an excellent fodder for cattle but it contains deleterious amounts of the amino acid mimosine. If fed to poultry and pigs at levels above about 5% in the ration, the animals grow poorly, have low reproductive rates, and may die. Mimosine

can also cause metabolic upsets in cattle and sheep and can cause spectacular wool shedding in sheep. However, when leucaena is fed regularly to ruminants, the bacteria of the rumen are able to convert mimosine to another compound called DHP. In the past when animals in Australia ate large amounts of leucaena, they developed goitre, and the ability of the thyroid gland to produce the thyroxine hormone was greatly reduced. Animals with very low thyroxine levels grow poorly, are lethargic, and produce goitrous calves which may die. These extreme conditions are not found in normal grazing situations. However, all deleterious effects of mimosine and DHP can now be overcome by the use of the simple procedure discussed below.

In other countries of the world such as Indonesia and Hawaii, the conditions described above do not occur even when animals are fed 100% leucaena. We now know that this is due to the presence of bacteria in the rumen of these animals which can break down the DHP and render it harmless. To overcome the problem in Australia, we have now introduced these bacteria. They have been cultured and checked to ensure that no pathological organisms were introduced with these beneficial bacteria. Experimentally, the introduction of these bacteria to the rumen of Australian cattle has resulted in the disappearance of the clinical signs of the toxicity and the absence of DHP in the urine of animals grazing leucaena. At Townsville and at the Ord River in the north of Western Australia where the toxicity has been most severe, the benefits from introducing the bacteria have been greatest. At Lansdown near Townsville, the first steer infused with the rumen bugs gained 275 kg in one year on leucaena dominant pasture and at the Ord River using irrigated pangola/leucaena pastures, we have now readily achieved average annual gains of well over 200 kg per animal. In the last experiment which CSIRO conducted at the Ord, we fattened six steers per hectare in twelve months after weaning. These animals at 20 months of age had gained an average 237 kg (1422 kg per hectare) and they killed out at 54–56%. In a collaborative experiment with DPI at "Brian Pastures" near Gayndah, cattle infused with the new rumen bugs grazing leucaena pastures year round gained more weight than cattle without the "bugs", and again achieved average gains of more than 200 kg per animal.

The bacteria can be readily transferred to cattle by culturing them anaerobically and introducing them directly into the rumen. We have drenched animals with the cultures of bacteria but a more appropriate method is to use a rumen injector gun attached to a stainless steel tank in which the bacteria are cultured. The rumen injector gun delivers 10 ml of the bacteria culture directly through the body wall into the rumen via a needle. This is a simple procedure which has proved to be effective. However, it is important that the animals have grazed leucaena for about three days before the bacteria are introduced to give the introduced bacteria an advantage over the resident bacteria in the rumen. The introduced bacteria are capable of using the DHP which is unavailable to the other bacteria. Provided animals have some access to leucaena, the introduction of the rumen bacteria *need only be done once*. We also have evidence that the bacteria spread quite rapidly within a herd so that perhaps only 10–20% of the herd need to receive the bacteria by injection. Even in the absence of leucaena feed, sufficient bacteria appear to be retained in the rumen for about nine months. If returned to leucaena pastures, the population of these bacteria will increase rapidly to degrade the toxic DHP.

We are trying to make arrangements for the multiplication and distribution of the bacteria so that the benefits of this research can be applied widely.

TRANSPLANTING LEUCAENA SEEDLINGS—MORETON REGION

G. MALCOLMSON

Department of Primary Industries, Ipswich

Mechanized transplanting of leucaena seedlings is now becoming an option for graziers in Queensland. The technique of planting "open root" leucaena seedlings has been developed over the past 2 years and has proved to be most successful. Machinery

designed for planting pine trees or vegetable seedlings has proved to be satisfactory and seedling survival rates of over 90% have consistently been obtained even with poor follow-up rains. As for sowing seed, transplanting is best carried out early in the growing season as soon as there is good subsoil moisture. Fertilizer should be applied (where deficiencies of phosphorus and potassium are known) below or alongside each seedling at transplanting. Row spacing will depend on the purpose for which the leucaena will be used but, within the rows, plants should be spaced at 1 metre intervals. A spacing of 1 × 5 m between plants requires 2000 plants per hectare. The main advantage of transplanting is that plants grow more quickly than seed-sown areas in the first year, and therefore are less susceptible to weed competition or damage from wildlife. Plants can also attain full productivity more rapidly.

The main limitations are the extra initial establishment costs and the labour required at planting, the need for rapid delivery of seedlings and the need for suitable planting machinery.

Leucaena seedlings can be sown into a fully prepared seedbed or into cultivated strips in existing native or improved pasture. Planting into strips lessens the erosion hazards associated with complete seedbed preparation on sloping country, and also reduces costs. Strips should usually be about 1–2 m wide and it is desirable to "deep rip" prior to cultivation to allow good penetration of moisture.

Suitable planting machinery is available in the market place for purchase, or alternatively some can be hired.

Planting speed is slow. An average operator can plant one hectare every 1½ hours, with row spacings of 5 metres. It is preferable to plant the seedlings within 24 hours of removal from the nursery seedbeds. If delays occur then it is most important that the seedlings are kept in moist conditions.

THE USE OF LEUCAENA BY CATTLE

D. POLLARD

Department of Primary Industries, Ipswich

Cattle in many countries thrive on leucaena and have done so for many centuries. It is beneficial to ruminants. In some countries overseas cattle can detoxify mimosine in the paunch where it is broken down by bacteria. The recent introduction to Queensland of the particular "bug" which does this has revolutionised our use of leucaena for grazing cattle in Australia.

At "Brian Pastures" near Gayndah, experiments have been carried out to test the growth rates of cattle inoculated with the "bug" versus others without the "bug". These experiments used steers on three grazing systems—

(1) Native Pastures only
(2) 25% of area sown to leucaena (3 m rows)
(3) 100% of area sown to leucaena (3 m rows)

From August '84 to February '85 (182 days), the results as average daily gain per animal were:

	Not inoculated	*inoculated*
(1)	0.53	0.51
(2)	0.64	0.63
(3)	0.78	1.02

The trial also produced information about the benefits of leucaena as a supplement and as a fattening fodder.

Over a full year on this system, the liveweight performance of the animals was:

(1) N.P. only: 110 kg L.W. gain/year
(2) 25% leucaena: 150 kg L.W. gain/year
(3) 100% leucaena: 220 kg L.W. gain/year

An interesting side-light of this trial was the accidental transfer of the bacteria from inoculated cattle to controls which were supposed to not have the bug. This occurred despite precautions, and illustrates the ability of these bacteria to move from animal to animal on a property.

From this trial, we hope that in the Moreton division, cattle on leucaena will produce the following expectations:

* when inoculated grow about twice as much as cattle grazing on native pasture
* even without the inoculation cattle growth rates should be 50% better than on native pasture alone
* continuous fattening on leucaena will be a feasible technology

In another Brian Pastures experiment, systems of managing leucaena for best production, are being assessed. Three systems are being studied:

(1) continuous grazing of a leucaena area
(2) continuous grazing March to November and then the area closed-up November to March (5 months) for the growing season.
(3) Rotationally grazed March to November. One week on: 3 weeks off.

The third option gave best results with an annual liveweight gain of 213 kg. The second gave 183 kg liveweight gain per year. The continuous grazing gave only 161 kg liveweight gain for the year and it appears that the leucaena will not survive this treatment.

A third Brian Pastures study of production systems showed that growing cattle which grazed native pasture plus a leucaena supplement from June to September each year averaged 446 kg liveweight at 30 months of age (steers 468 kg and heifers 423 kg).

At Rolleston, cattle grazed leucaena continuously for 97 days and gained 108 kg/head. The details of this demonstration are:

Steers: rising 3 year old. On native pasture only until 15/3/85 then onto leucaena at 0.4 ha/beast for 97 days.
Weight on: 405 kg
Weight gain: 108 kg = A.D.G. 1.1 kg/head/day

Points to be noted:

* The leucaena was 15 months old on 15/3/85
* Oats in this district produces about 1.0 kg/day Liveweight gain
* These cattle did NOT have the inoculation of the "bug"

Our expectations for leucaena in the West Moreton:

1. Leucaena should be giving reasonable production levels in its 3rd winter ($2\frac{1}{2}$ years after planting)
2. Management systems could:

   * Aim at Autumn-Winter-Spring supplement to eliminate weight losses

   * Fattening programmes could use leucaena for one or two autumns prior to sale with a summer growing season in between. This could fatten stores brought in at say 18 months of age at 250 kg in March. Growth rates should be:

   Year 1—introduction to leucaena in March at 250 kg
   Year 2—by March 200 kg nett annual gain = 450 kg and then in June after 100 days fattening on leucaena (giving another 100 kg gain) animal weight will be 550 kg. This should be an ideal Japanese market beast for weight at 32–34 months of age.
   This system would use about half a hectare per animal each year, 1.0 ha of leucaena per steer
3. Another option is to make use of more leucaena for the younger animal to turn off a local trade animal.
4. Other benefits could include flushing 1st calf heifers prior to joining and preparing bulls for joining.

LEUCAENA COSTS AND RETURNS IN THE MORETON DISTRICT

C. W. ROSENBERGER
Economist, D.P.I., Ipswich

Leucaena is seen as a permanent, grazing legume. Unlike annual fodder crops it is a once-up establishment operation and has greater reliability due to its deep tap root. After several years from establishment leucaena improves companion grass growth due to nitrogen fixation.

(A) Establishment

Two alternative establishment methods are costed here.

(1) *LEUCAENA ESTABLISHMENT FROM SEED*	per hectare
Land preparation (deep ripping, chisel plough, disc harrow, planting)— half of area of paddock is cultivated	$16.19
Seed (3 kg at $15/kg) + inoculant	$45.40
Fertilizer # (25 kg Mo super/ha if banded along rows)	$4.75
TOTAL ESTABLISHMENT COST PER HECTARE	$66.34

(2) *LEUCAENA ESTABLISHMENT FROM TRANSPLANTED SEEDLINGS*	per hectare
Land preparation (deep ripping, chisel plough, disc harrow)	$13.47
Transplanting costs	$30.70
Seedlings (2000 at $80/1000)	$160.00
Fertilizer # (25 kg Mo super/ha if banded)	$4.75
TOTAL COST PER HECTARE	$208.92

Maintenance fertilizer 250 kg/ha superphosphate applied every third year.

(B) Leucaena for Fattening

One method of using leucaena suggested by the previous speaker was to use it for turning off fat animals at a younger age for the local trade. The economics of such an enterprise are presented below.

Assumptions:

- Property 2000 ha all native pasture with carrying capacity of 3 ha/A.E. = 667 A.E. (Adult equivalents).
- Bullocks turned off at 42 months and 500 kg liveweight, heifers at 30 months and 300 kg liveweight.
- Reproduction rate is 75% (weaning).
- Herd composition (weaning after fats sold and 1% losses allowed per year after weaning). Breeders 269, Weaners 6–18 months 202, replacement heifers 54, cull heifers 46, steers 18–30 months 100, steers 30–42 months 99, bulls 8 = 667 A.E.

By using leucaena to fatten steers by 20–22 months, two periods of leucaena grazing are required, 0.25 ha for their first winter as weaners, and 0.5 ha the following autumn/winter for topping off after the native pasture has declined.

	Steers	Heifers
Weight (kg) of animal turned in	275	240
Weight gain	120	120
Weight when turned off	395	360

The area of leucaena required is 0.75 ha/animal fattened; in this example = 150 ha.

Herd composition with turnoff at 22 months is now:

Breeders (incl. calves to weaning) 372, Weaners 6–18 months 279, replacement heifers 18–24 months 75, bulls 11 = 737 head = 633 A.E.

Sale Stock:

(a) Without leucaena:

	No.	*L.W. (kg)*	*Price (c/kg)*	*Total*
Heifers	46	300	80	11,040
Steers	99	500	95	47,025
				$58,065
(b) With leucaena:				
Heifers	64	360	85	19,584
Steers	140	395	95	52,535
				$72,119

Increase in gross return from having leucaena is $14054 per annum.

If we allow $15 per breeder run for the extra numbers with leucaena, the gross return becomes $12509.

* Property is $83.39/ha better off with leucaena being used to fatten sale stock.

There is an establishment period before full grazing is attained. If planted in October (year 1) it is March (year 3) before full production is achieved. In March (year 1) it is recommended to graze the leucaena with weaners to promote stem development and to reduce fire hazard from a build up of native pasture. Half the full grazing potential is possible in March (year 2).

Cash flow:

The pay back period is 5 years for sowing as seed and 9 years if sown as seedlings.

CONCLUSION

If leucaena performs as well as has been conservatively estimated, there is no reason for not having leucaena on most cattle properties in the Moreton Division.