

Establishment, persistence, productivity and herbage quality of *Lotus pedunculatus* in eastern Australia

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Introduction

In recent years *Lotus pedunculatus* cv. Grasslands Maku has been sown widely in eastern Australia (Harris *et al.* in press). It has been estimated that over 50,000 hectares have been sown on the north coast of New South Wales alone (Bede Clarke, personal communication). Much of this has been sown on a broad scale at low sowing rates on beef properties; however, about 25% has been sown on dairy farms.

One of the major problems in the dairy industry in eastern Australia is the shortage of high quality autumn feed, as pastures are based on summer growing C4 grasses, such as kikuyu (*Pennisetum clandestinum*) and paspalum (*Paspalum dilatatum*). Annual and biennial rye grass cultivars can be utilised in winter; however, such pastures are only establishing in autumn. 'Maku' *Lotus* has great scope for improving the availability of high quality autumn feed. To investigate this proposition a team has been formed to examine the effect of environment (latitude, temperature and rainfall) on -

- i) Dry matter production
- ii) Quality (digestibility and tannin levels)
- iii) Seed bank dynamics
- iv) Rhizome dynamics

in a range of *Lotus pedunculatus* lines and cultivars and compare these to 'Haifa' white clover *Trifolium repens*, currently widely used in the dairy industry.

Both the quantity and quality of feed are important when determining how *Lotus* or other legumes may meet the autumn 'feed-gap'. Persistence via a seed bank, rhizomes or stolons is important to maintain the feed supply. Tannin levels can determine whether bloat is prevented, but if levels are too high milk production may be reduced.

Methodology

Sites have been chosen from the major dairying districts in eastern Australia at Samford (27°30'S), Grafton (29°40'S), Taree (31°54'S), Bowral (34°28'S), Nowra (34°54'S), Bega (36°41'S), Cann River (37°35'S) and Warragul (38°11'S) (Figure 1). Most sites are on acid alluvial soils and on lower slopes subject to occasional waterlogging but not flooding.

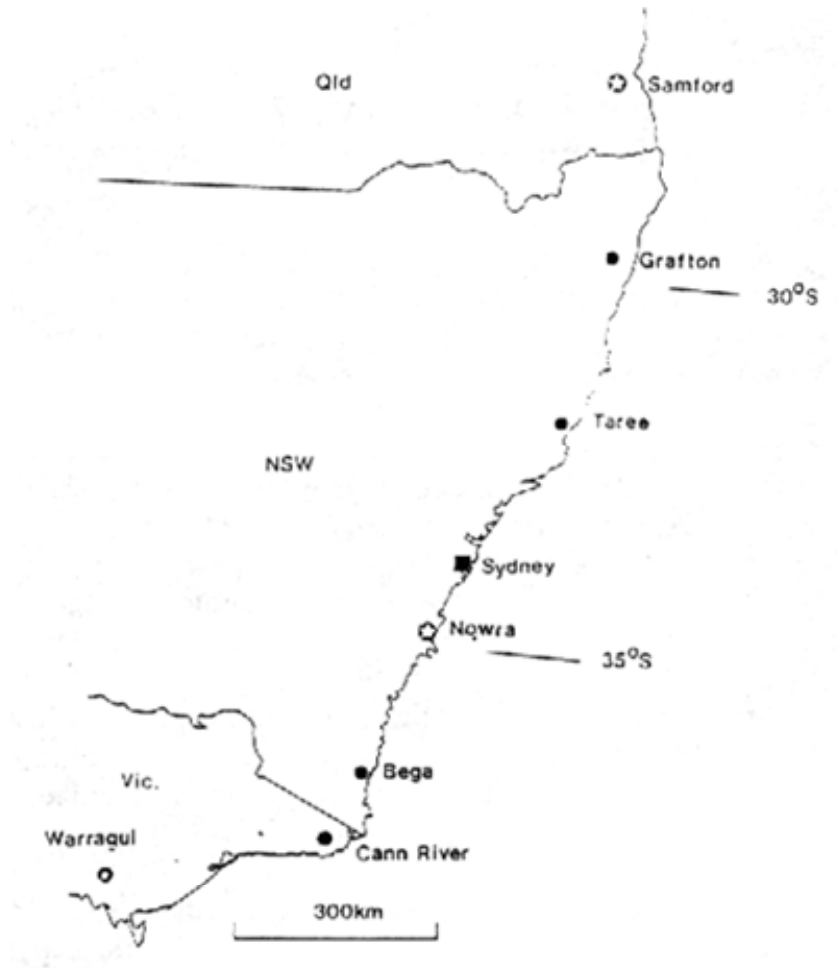


Figure 1. Location of field sites: (■) signifies sites of more detailed measurements; Sydney included on map as a landmark only.

Three *Lotus pedunculatus* genotypes, cv. Maku, 'Algarve' (submitted for registration to the NSW Herbage Plant Liaison Committee as 'Sharnae') and a New Zealand bred line near commercial release (G4704) are being compared to *Trifolium repens* cv. Haifa at all sites. Other genotypes have been included that may be adapted to specific sites. For example, *Arachis* has been sown at Samford and Grafton and white clover cv. Pitau has been sown at Warragul. Genotypes were sown with an adapted grass at each site. In addition to these mixed swards, 'Maku' *Lotus* and the appropriate grass are being maintained in monospecific swards. Each of the genotype and mixture treatments is duplicated, one with superphosphate (500 kg/ha) and the other without P.

The experimental areas were prepared over the 1990-91 summer and maintained as a weed free fallow prior to sowing into a fine seedbed in May 1991. Legume seed was inoculated and treated with Coopex [R]. 'Maku' *Lotus* seed was sown at 5 kg/ha, rates of the other genotypes were determined so that equal numbers of germinable seeds of all genotypes were sown. A basal application of Mo and K was applied at sowing and will be applied in summer in subsequent years and maintenance P will be applied each year in the P treatments.

Measurements

Establishment and population counts: Established sown legume, sown grass, non-sown white clover and weeds were counted at 2 and 6 weeks after emergence. Frequency estimates of sown legume, sown grass, non-sown white clover and weeds, will be made at each dry matter harvest.

Dry matter production: Estimates of dry matter production will be taken every 6 weeks from cuts to a height of 5cm. Fresh material will be sorted into sown legume, sown grass, non-sown white clover and weeds. Plots will be grazed and then mown to a height of 5 cm following each dry matter harvest.

Seed reserves: The amount of residual white clover seed has been estimated at all sites just prior to sowing the experiment, to give an indication of the base level of white clover in the seed bank. At three sites (Samford, Nowra and Warragul) seed reserves will be sampled in March each year to follow the dynamics of the seed bank in the sown legume and non-sown white clover populations. Seed will be recovered from soil samples using the technique of Jones and Bunch (1988).

Rhizome density and stolon density: At three sites (Samford, Nowra and Warragul) samples are being taken to estimate rhizome density at each dry matter harvest. Samples will be washed and divided into old, new and intermediate aged rhizomes or stolons.

Dry matter digestibility: Samples for dry matter digestibility will be taken at three sites (Samford, Nowra, Warragul) at three times during the year (spring, summer and autumn).

Tannin levels: One kg of fresh material will be harvested from all sites at three times during the year (spring, summer and autumn) for determination of tannin levels.

Preliminary results and discussion

Rainfall at most sites has been well below average in 1991 with severe drought occurring at the northern sites. Irrigation was needed at Taree, Grafton and Samford to ensure that the swards established. Severe drought at Bega meant that the trial did not establish and will need to be resown. The Nowra, Cann River and Warragul sites have been established without the aid of irrigation.

Preliminary results suggest that 'Maku' *Lotus* had the most rapid establishment at all sites. Grass competition over winter was severe at sites south of Nowra, as a result of sowing with a temperate grass. Some Maku *Lotus* growth has occurred even in winter at Grafton and Samford with irrigation.

In addition to the multi-site testing of *Lotus* lines more detailed trials are taking place on *Lotus* agronomy.

- i) The effect of temperature and daylength on dry matter production, rhizome development and tannin levels. This work should help in understanding the mechanisms involved in rhizome development in the field in different environments.
- ii) Seed bank survey. Observations were made by district agronomists and farmers in northern NSW that Maku *Lotus* may not set seed in this environment. In response to this, a survey has been carried out aimed at quantifying the size of Maku *Lotus* seed banks in farmers fields over a wide range of environments in NSW and south-east Queensland. The results should indicate just how important the 'Maku' *Lotus* seed bank is and may help farmers to determine how to best manage Maku *Lotus* pastures for persistence.
- iii) Germination, emergence and establishment. Detailed studies on the effect of temperature and moisture on germination, emergence and establishment will be carried out in a range of *Lotus* lines, as this appears to be the phase most limiting the success of Maku *Lotus*.

An understanding of how well *Lotus* establishes, grows and persists in different environments will allow strategies to be developed to maximise the production of high quality feed in late summer and autumn. Agronomic criteria will be developed to aid in determining breeding objectives in existing *Lotus* (Schachtman and Kelman 1991), and white clover (Ayres 1991) breeding programmes.

References

- Harris, CA, Blumenthal, MJ. and Scott, J.M. (1992). Adoption and use of *Lotus pendunculatus*. cv. Grasslands Maku in eastern Australia. *Proceedings of the 6th Australian Agronomy Conference*, Armidale (In Press).
- Jones, R.M and Bunch, G.A. (1988). A guide to sampling and measuring the seed content of pasture soils and animal faeces. Tropical Agronomy Technical Memorandum No. 59. (CSIRO Division of Tropical Crops and Pastures, St Lucia.)
- Schachtman, D.P. and Kelman, W.M. (1991). Potential of *Lotus* germplasm for the development of salt, aluminium and manganese tolerant pasture plants. *Australian Journal of Agricultural Research* **42**, 139-49.
- Ayres, J. (1991). Collaborative Research for white clover improvement in Australia. *National White Clover Improvement Programme Newsletter*, **4**, 3.