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BIRDSFOOT TREFOIL (LOTUS **CORNICULATUS**) AS A POTENTIAL **DRYLAND HERBAGE** LEGUME IN NEW ZEALAND

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Abstract

Observations in trials over a decade are now showing that birdsfoot trefoil *(Lotus corniculatus)* has the particular characteristics of high persistency and continued production under moderate soil fertility conditions on drier hill and high country sites. Hence it may have a role in the agriculture of such areas, probably as late summer or autumn feed. The species is seen as a 'poorer land grazing lucerne' rather than as a hay species as it is overseas. One particular disadvantage is likely to be its slow establishment from seed.

In evaluations of introductions and overseas cultivars, some of the unselected introductions, showing early spring growth and an upright habit, performed better than cultivars.

Keywords: Birdsfoot trefoil; *Lotus corniculatus*; infertile hill country; lucerne

INTRODUCTION

Maku lotus *(Lotus pedunculatus* Cav.) has emerged in recent years as a suitable herbage legume where soil pH, phosphate levels and grazing pressures are low. **Another perennial *Lotus* species, birdsfoot trefoil *(L. corniculatus* L.), is used extensively in North and South America and Europe (Seaney & Henson 1970, Seaney 1973). Although introduced to New Zealand during the early 1900s** (Levy 1918), it was not widely used, and naturalised only in a small area, mainly because suitable rhizobia were not present in New Zealand soils (Greenwood & Pankhurst 1977).

There has been a large breeding effort on birdsfoot trefoil overseas (Twamley 1970, Seaney & Henson 1970), and this has renewed interest in this species as a potential legume for some New Zealand grassland situations. Seed supplies of some overseas cultivars have appeared in New Zealand.

The following is provisional guidance on its likely place and use in New Zealand, based on overseas experience, and observation more than measurement in New Zealand. Its main characteristic in New Zealand of high persistence and continued moderate production has often only become apparent in old trials as fertiliser effects diminish and as the species of higher growth rate requiring higher **fertility die out.**

CHARACTERISTICS OF BIRDSFOOT TREFOIL

Birdsfoot trefoil is a perennial, similar to lucerne *(Medicago sativa)* in appearance, with a well developed crown, ascending stems and five light green leaflets per leaf, which are usually hairless. It differs from Maku lotus in that it is non-**rhizomatous. Flowerheads are similar to those of Maku, with yellow florets, but there are fewer florets per flowerhead (3-9 c.f. 6-16) (MacDonald 1946,**

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Armstrong 1974). Seed pods are also larger and each head in the pod stage resembles an inverted bird's foot, hence its common name. Seed is brown, larger than Maku, with approximately 900,000 seeds/kg.

The species is generally winter-dormant, as is lucerne. Peak growth occurs in summer, more so than most other common pasture species (Suckling 1960, Scott & Maunsell 1981). Its summer growth exceeds that of Maku lotus, which

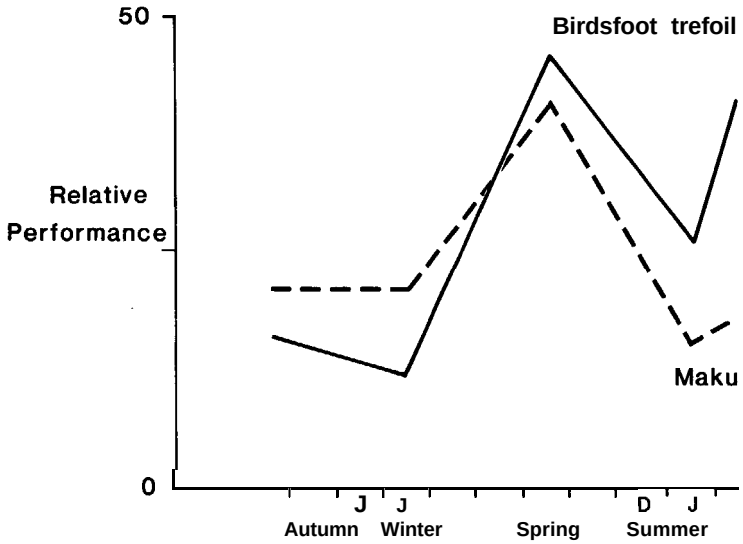

Fig. 1. *Comparison of seasonal growth scores of Maku lotus and birdsfoot trefoil (four best cultivars) at Flock House, Bulls.*

is more productive during winter under North Island conditions (Fig. 1). Birdsfoot trefoil is less drought tolerant than lucerne, but more tolerant of soil acidity and lower soil fertility (Seaney 1973).

Its Likely Role

Each pasture species is best adapted to particular combinations of soil moisture and fertility, over which some control by management is possible, and of temperature (altitude) over which there is little control (Scott 1979). The major decision for farmers is which species to sow for optimum use of available soil fertility, soil moisture and management effort.

At low fertility the legume most likely to be present in dry zones is haresfoot trefoil *(Trifolium arvensel* and in wetter conditions suckling clover *(T. dubium)* (Fig. 2). Under high fertility red and white clovers *(T. pratense* and *T. repens)* are the most suitable legumes in moist regions, and lucerne in dry regions (Scott 1979).

Where soil fertility is moderate, *Lotus* species are more likely to play a major role. Maku lotus is emerging as a productive legume on wet, moderately fertile soils where soil pH and phosphate levels are too low for white clover (Armstrong 1974, Nordmeyer & Davis 1977, Charlton & Brock 1980), such as the Otago uplands (Scott & Mills 1981). In contrast, the role of birdsfoot trefoil is likely to

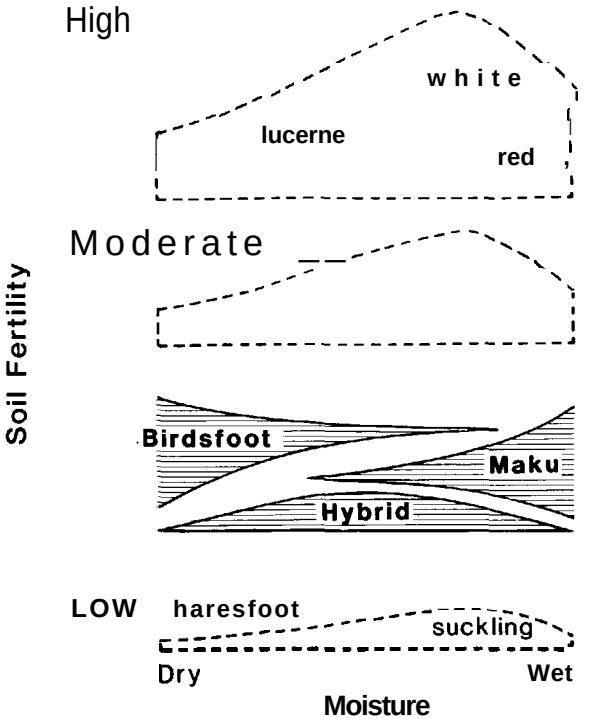

Fig. 2. *Potential place of birdsfoot trefoil and some other legumes in relation to the environmental gradients of moisture and fertility.*

be on moderately fertile but drier soils, as a species for introduction into tussock grassland, or on danthonia grassland on brown-grey earths, yellow-grey earths and possibly drier yellow-brown earths of low to moderate fertility. An interspecific hybrid between *L. pedunculatus* and *L. corniculatus,* being developed by New Zealand plant breeders, may have a role in the intermediate rainfall zone.

These conclusions have been drawn from observations, published and unpublished, of New Zealand trials on a range of climatic and soil fertility sites at Palmerston North, Flock House, Craigieburn, Hurunui and other dry north Canterbury trials, and in an extensive series of trials in the high country in the McKenzie Basin. Table 1 gives some comparative data for the McKenzie Basin.

Most comparisons made under high fertility conditions show birdsfoot trefoil to be less productive than lucerne or clovers. But, as already mentioned, where soil fertility is low to moderate in dry regions, it is the most persistent legume and often the only remaining productive legume when grazing pressure is lax, in old trials after fertility has been depleted.

As one of the main uses of birdsfoot trefoil overseas is for hay, most available overseas cultivars are of a hay type. There is little doubt that other species, particularly lucerne, will generally be more productive for hay production in New Zealand. Thus birdsfoot trefoil is likely to have a role as a grazing species in the less fertile drier regions, as does Maku lotus in the less fertile wetter regions. However, both species have a wide tolerance of environmental conditions and

their requirements and use could overlap. The growth pattern and reseeding characteristics of birdsfoot trefoil indicate it will most probably be used for late summer/autumn/early winter feed, in the drier hill and high country.

Table 1: COMPARISON OF GROWTH AND PERSISTENCE OF BIRDSFOOT TREFOIL AND OTHER LEGUMES ON THREE HIGH COUNTRY SITES. RELATIVE TO A MAXIMUM OF 10.

	SITE					
	Deep brown-grey earths		Shallow yellow-grey earths		Yellow-brown earths	
Species	no fert.	fert.	no fert.	fert.	no fert.	fert.
2nd Year Growth*						
birdsfoot trefoil**	6	9	4	4	5	9
Maku	7	8	6	7	6	10
lucerne	10	9	3	3	3	7
white clover	8	9	5	7	6	7
red clover	9	8	3	3	9	10
alsike clover	7	8	4	4	4	6
5th Year Persistence (10 = 100%)						
birdsfoot trefoil	7	7	5	9	6	6
Maku	5	1	4	3	–	–
lucerne	9	10	3	1	–	–
white clover	0	1	0	0	–	–
red clover	0	0	0	0	–	–
alsike clover	0	0	0	0	–	

* Visual scoring in November, February and May,

** Best three cultivars

HERBAGE QUALITY

Birdsfoot trefoil gives satisfactory yields of good quality herbage in North America (Seaney & Henson 1970) and Scotland (Charlton 1971). Livestock find Lotus herbage somewhat less acceptable than other common legumes, but they readily consume it once they are accustomed to it (Henson & Schoth 1962). This lower acceptibility is attributed to its content of condensed tannins, which also prevent it causing bloat. The same feature could also improve the digestion and utilisation of nitrogen (John & Lancashire 1981).

In overseas trials Charlton (1971) found that digestibility of birdsfoot trefoil was significantly higher than that of *L. pedunculatus*, both in vegetative and in flowering stages of growth. Yield of digestible organic matter was greater than that of *L. pedunculatus* (Charlton 1971). Observations made under New Zealand conditions suggest that birdsfoot trefoil's early growth is more acceptable to grazing livestock than late stemmy growth, though the latter is eaten more readily than that of lucerne.

EVALUATION OF CULTIVARS AND INTRODUCTIONS

About 200 introductions from many overseas sources have been screened during recent years (Nordmeyer & Davis 1977, Charlton et *a/* 1978). This material ranged widely in performance at dryland sites in both North and South Islands. Seventeen of these introductions were named cultivars, and of these the following proved most promising:

Franco (Italy)	San Gabriel (Brazil)
Tana (USA)	El Boyero (Uruguay)
Cascade (USA)	Ginestrino (Chile)
Granger (USA)	Maitland (Canada)

Other cultivars tested but found unsuitable were:

Carroll (USA)	Lot (Poland)
Cree (USA)	Quimey (Chile)
Empire (USA)	Taborsky (Czechoslovakia)
Viking (USA)	Gelsvis (Lithuania)
Vega (USA)	Leo (Canada)
Winnar (USA)	Fargo (USA)

Evaluation of unselected introductions from various parts of the world has revealed that some of these showed superior production to the cultivars listed above (Fig. 3). This material should be the basis of any New Zealand development of this species. Forms with upright growth habit and early spring growth were found to be generally most productive under New Zealand grazing conditions.

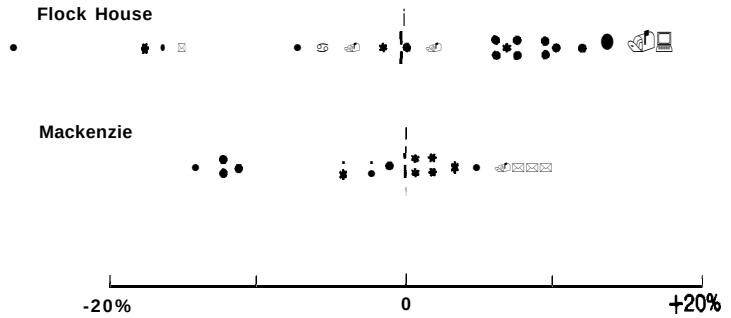

Fig. *3. Relative yields of cultivars (*) and non-related lines (•) of birdsfoot trefoil at Flock House (Charlton et al. 1978) and McKenzie Country.*

ESTABLISHMENT

Birdsfoot trefoil is slow and non-competitive during establishment compared with most New Zealand pasture species. In tussock grassland, the most suitable site for establishment is thus likely to be an open sward, which may require preparation by removing excessive herbage competition by grazing, burning or herbicide spraying, but with retention of ground cover to prevent frost heave, and tussocks to provide shelter. In dry hill country there is little experience of

establishing birdsfoot trefoil, but probably the same principles apply. Birdsfoot trefoil is unlikely to establish in browntop or danthonia swards until they are opened up. In most situations birdsfoot trefoil should be sown alone, as companion species tend to reduce its establishment chances (Charlton 1971). However in fully cultivated seed beds it may be necessary to use short-lived species in mixtures with birdsfoot trefoil where weed invasion is likely.

Like all legumes in marginal grasslands, birdsfoot trefoil requires inoculation by effective rhizobia to realise its potential. Charlton et *al.* (1981) found that 6 of 11 strains tested in North Island hill country performed satisfactorily, whereas uninoculated plants were small and stunted. The strain recommended for birdsfoot trefoil in New Zealand is NZP2238, which was also found to be the most effective of strains tested in South Island high country (J.F.Crush, pers corn.). Sheath et *al.* (1977) reported nodulation failure with birdsfoot trefoil in North Otago dryland, though in subsequent evaluation of the species in Central Otago no nodulation failures have occurred (D.Brash pers. comm). Inoculation should be carried out, preferably commercially (coated seed) in the South Island, or else on-farm, with a New Zealand inoculum immediately before sowing, This inoculum is different from that used for Maku lotus. For the type of site being suggested for birdsfoot trefoil, coating with elemental sulphur should also be considered (Scott & Archie 1978).

Experience to date suggests that time of sowing should be the same as for lucerne, generally late winter or early spring. Seeding rates of 3-5 kg/ha are suggested in oversowing. A pure stand in cultivated soils may require up to 10 kg/ha of viable seed. While overdrilling at a shallow depth (5mm) will generally give better establishment (Seaney 1973), surface sowing will probably be more widely practised for the species in the suggested New Zealand sites. Seed samples often contain much hard seed, but this may not be a drawback as such seeds usually become germinable after frosts, and improve establishment (Charlton 1971).

Fertiliser requirements for establishment have not yet been defined but if high fertiliser usage is contemplated then lucerne or other legumes may be appropriate. Because of its slow rate of establishment growth, birdsfoot trefoil should not be grazed during-the year following sowing, and may need two or even more years of lenient management before full use.

MANAGEMENT

Extensive overseas research indicates that birdsfoot trefoil should be managed similarly to lucerne, with mob stocking and uninterrupted regrowth (Washko 1961, Templeton et *al.* 1967, Van Keuren *et al.* 1969). It can be defoliated more frequently than lucerne but is less tolerant of defoliation than clovers. Its regrowth emerges primarily from axillary buds or shoots remaining after cutting or grazing, hence the need for lenient management, with defoliation no lower than 8 cm. If conserved as hay then like lucerne, a pure stand would be required with cutting at early flowering.

The seasonal production of birdsfoot trefoil suggests that its major role in farm management is likely to be as a major source of feed some time between January and early June. Some reseeding takes place if established stands are permitted to flower, with the seedlings becoming effectively nodulated under South Island conditions.

PERSISTENCE AND PEST RESISTANCE

Once established, birdsfoot trefoil rivals lucerne and cocksfoot for persistence under South Island conditions (Table 1). Evaluation in the North Island has shown that some introductions have excellent persistence combined with high production (Charlton et *al. 1978).*

Unlike Maku lotus, birdsfoot trefoil is not resistant to attack by pasture pests grass grub *(Costelytra zealandica)* and porina caterpillar *(Wiseana cervinata)* (Farrell & Sweney 1974). Examination of samples from overseas introductions grown at Flock House in the North Island (G.S.Grandison, pers. comm) did, however, reveal a wide range of infection by cyst nematode *(Heterodera trifolii)* on birdsfoot trefoil roots, which indicates that selection of nematode-resistant material may be possible, should nematodes be a problem in New Zealand.

CONCLUSIONS

Observational trials over a decade or so have shown that birdsfoot trefoil has high persistency and continued production under the moderate soil fertility of the drier hill and high country. Hence it may have a role in the agriculture of such areas, probably as late summer or autumn feed. We have tried not to "oversell" the species at this stage; only further trials and farmer experience will determine its ultimate place.

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