

The range of pasture species in New Zealand and their use in different environments

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Abstract

The 29 different species of pasture plants, now commercially available to farmers in New Zealand, may make the choice of pasture seeds and seeds mixtures much more complicated, but their particular features can add significant value to farming. The suitability of these species is presented for the main categories of New Zealand's pastoral land: summer-moist lowland, east coast **dryland**, hill country, and the South Island's high country. Important features of each species are **summarised**. Invested returns from animal production on modern pastures can be more than 200%. However, **farmers** are advised to seek specialist advice before they invest

Keywords species, environment, suitability, compatibility

Introduction

Twenty-four different species of pasture plants bred in New Zealand, and five imported species, are now available to farmers from seed retailers (Table 1). Most can be regarded as **being** 'new' to the grassland farming industry (Rumball 1984). Within these species, the current catalogues include 55 New Zealand-bred pasture cultivars and 23 overseas cultivars.

The range has been augmented in recent years by the release of improved cultivars of the established pasture species, mainly ryegrasses and clovers. **Private** plant breeding has been encouraged by plant variety rights, which enables plant breeders to obtain a return on their efforts, and the development of proprietary marketing of pasture cultivars, whereby a company has exclusive sales of a particular cultivar, providing farmers with more technical support from the head licensee.

For the farmer, the choice of pasture seeds and seeds mixtures has become **much** more complicated during recent years, because of the rapid increase in numbers of **species** and cultivars. At the same time, the economic downturn in farming, and climate extremes such as drought, have made the choice of suitable seeds mixtures **much more important**.

This paper aims to inform those selling and using

these species about **their** suitability for the different grassland environments in **this** country. A previous paper described some basic concepts for using species in pasture seeds mixtures on the farm (Charlton 1992). Twenty species that are most widely available are discussed, the others being considered to be either for limited special-purpose use or currently very limited in seed availability (Table 1).

Use of species

A survey of farmers (Belgrave *et al.* 1990) revealed that farmers knew much about familiar species such as ryegrasses and clovers, but little of recently introduced species. Adoption of these newer species has **been much** slower (Lancashire 1985).

On-farm demonstrations were reported by Belgrave *et al.* (1990) to be the best means of informing **farmers** of the success of new species in their own area. **This** concept was adopted in the recent drought relief **programmes** in east coast regions of both South and North Islands (Milne & Fraser 1991). Demonstration paddocks of the drought tolerant species in mixtures were established **and used** for technology transfer. As a **result** of this approach, the adoption rate of these species has increased dramatically in a very short period.

Proprietary marketing of pasture species and **cultivars** has developed **during** recent years, and head licensees now provide the farmer and the seed retailer with better technical information on aspects of their new **herbage** cultivars.

Extending the species range

In the early years of pastoral research, plant scientists such as Levy (1933) emphasised the use of only the best species, in particular perennial **ryegrass** and white clover. Levy's concept was based **on the** availability of cheap fertiliser, especially superphosphate, and the wide adaptability of these two species (Burgess 1987). They were cheap to buy, established very rapidly and easily, and were adapted to a wide range of management systems.

This concept worked well during the prosperous period after World War II. But when the plant breeders during this **period realised** that other **herbage** species

Table 1 Species of pasture plants commercially available to farmers in New Zealand in 1992. Those species asterisked have very limited seed availability at present, or are only for restricted use in special situations.

Legumes	Grasses
white clover (<i>Trifolium repens</i>)	Perennial ryegrass (<i>Lolium perenne</i>)
Red clover (<i>Trifolium pratense</i>)	Italian ryegrass (<i>L. multiflorum</i>)
Strawberry clover (<i>Trifolium fragiferum</i>)*	Hybrid ryegrass (<i>L. boucheanum</i> syn <i>L. hybridum</i>)
Lotus (<i>Lotus uliginosus</i> syn <i>L. pedunculatus</i>)	Cocksfoot (<i>Dactylis glomerata</i>)
Birdsfoot trefoil (<i>Lotus corniculatus</i>)	Tall fescue (<i>Festuca arundinacea</i>)
Lucerne (<i>Medicago sativa</i>)	Phalaris (<i>Phalaris aquatica</i>)
Serradella (<i>Omithopus sativus</i>)*	Prairie grass (<i>Bromus willdenowii</i>)
Sulia (<i>Hedysarum coronarium</i>)*	Grazing brome (<i>Bromus stamineus</i>)
	Smooth brome (<i>Bromus inermis</i>)
Herbs	Upland brome (<i>Bromus marginatus</i>)
Chicory (<i>Cichorium intybus</i>)	Timothy (<i>Phleum pratense</i>)
Sheep's bumet (<i>Sanguistuba minor</i>)	Browntop (<i>Agrostis capillaris</i>)
	Yorkshire fog (<i>Holcus lanatus</i>)
	Paspalum (<i>Paspalum dilatatum</i>)*
Imported species	
Subterranean clover (<i>Trifolium subterraneum</i>)	
Alsike clover (<i>Trifolium hybridum</i>)	
Perennial ryecorn (<i>Secale delmaticum</i>)*	
Pubescent wheat grass (<i>Agropyron trichophorum</i>)*	
Oat grass (<i>Arrhenatherum elatius</i>)*	

offered particular features which could extend the economic base of this country's pastoral farming. they started breeding improved varieties of some of the other grasses and legumes considered to have potential.

DSIR Grasslands consequently released several new species during the 1970s and early 1980s, such as prairie grass, lotus, tall fescue, phalaris, smooth brome grass, and upland brome grass.

Other species have been added to the list in recent years, including chicory, grazing brome grass, strawberry clover, birdsfoot trefoil, **sulia**, serradella, browntop, sheep's bumet and **paspalum**. These species were released because they had particular combinations of features which add significant value to pasture for animal farming in some particular way. Some, such as **paspalum**, serradella and strawberry clover, have more potential for export to countries such as Australia.

During the same period, improved varieties of the more conventional species were released, including varieties of ryegrasses, **cocksfoot**, red clover and white clover.

Suitability of species for farming

We have graded the relative suitability of all these species for the five main categories of New Zealand's pastoral land • summer-moist lowland, east coast **dry**-land, the North Island's moist hill **country**, **dry** hill country, and the **South Island's** high country (Table 2). Some species are highly suited to each particular pasture environment. **Recommended species are printed in bold**, in both the **text** and in Table 2. Table 3 shows the major features of each species, given its overall **suitabil-**

ity for that particular pasture environment. Table 4 shows the relative seasonal production of each species, which is perhaps the most valuable feature of the range. Plant breeders have encountered difficulty with increasing total annual yield of pasture, whereas seasonal yield increases are still possible and necessary, to add value to the farm production base.

1. Species for summer-moist lowland

The fertile, intensively farmed pastures support **dairy**-ing, sheep and beef farming, deer farming, and other livestock types such as thoroughbred horses. This is the prime grazing **land** of the country, where the species developed in the early years remain the most valuable • **the ryegrasses, cocksfoot, red clover and white clover** (Harris & Chu 1985; Goold *et al.* 1985). **Timothy** has traditional use in the warm, moist summers of southern South Island regions, particularly where pasture is conserved as hay or silage, but fails to persist in drier summers further north. In recent years, new species such as **chicory, tall fescue, phalaris and prairie grass** have been shown to be valuable additions to the range of species for mixtures.

Dairying. The first choice for dairy pastures is **perennial ryegrass and white clover**. These species give highly productive pasture of excellent quality in most regions where dairying is **practised**. They are fast and relatively easy to establish on such fertile soils. A wide range of varieties of both species is now available, so those bred to suit dairying should be chosen and used, eg Grasslands Kopu white clover. Some varieties of **ryegrass** with high levels of the endophyte fungus can

Table 2 Suitability of available pasture species to the main pasture environments in New Zealand (Scale: 5 = high; 1 = low, recommended species in **bold**).

SPECIES	Summer-moist lowland	Dryland*	North Island moist hill country	Dry hill country	South Island high country
Grasses					
Ryegrasses:					
Perennial ryegrass	5	3	3	2	1
Hybrid ryegrass	5	1	2	2	1
Italian ryegrass	5	1	1	1	1
Cocksfoot	3	5	5	5	4
Tall fescue	3	5	2	3	3
Phalaris	2	5	3 10 4	5	2
Brome grasses:					
Prairie grass	4	4	2	2	1
Grazing	3	5	5	5	3
Smooth	1	2	3	3	5
Upland	1	3	2	2	4
Browntop	1	3	5	3	4
Yorkshire fog	1	2	4	2	3
Legumes					
White clover	5	2	4**	3	2
Red clover	5	3	2	4	4
Lucerne	3	4	1	2	2
Lotus	1	2	5	2	4
Birdsfoot trefoil	3	5	1	2	4
Sub clover	2	5	4	5	1
Herbs					
Chicory	5	5	2 10 3	3	3
Sheeps burnet	1	3	1	1	5

* When irrigated, refer to summer-moist lowland.

. * Newer cultivars selected for this situation will perform best.

Table 3 Major characteristics of the pasture species currently available in New Zealand (5 = high; 1 = low).

SPECIES	Fertility needs	Heavy soil tolerance	Drought tolerance	Insect tolerance	Mixture compatibility	Ease of Establishment	Ease of management	Animal acceptance	Persistence
Graesae									
Ryegrasses:									
Perennial ryegrass	3	3	2	3	3	5	4 10 5	3	4
Hybrid ryegrass	4 10 5	3	1	2	4	5	3	4	3
Italian ryegrass	4	3	1	1	4	5	3	4	2
Cocksfoot	110 2	2	4 10 5	3	2	4	3	3	5
Tall fescue	4	5	4	3	3	2	4	3 10 4	5
Phalaris	1	3	5	5	4	3	3 10 4	3	5
Brome grasses:									
Prairie grass	4 10 5	1	3	3	2	3 10 4	1 to 2	4	3
Grazing	3	2	4	3	3	3 10 4	3	4	4
Smooth	2	2	3	3	3	2	3	4	4
Upland	3	2	3	3	3	3	3	4	2
Browntop	2	3	3	3	3	3	3	3	5
Yorkshire fog	2	4	3	4	2	3	3	4	3
Legumes:									
White clover	4	4	2	3	4	3 10 4	4	4	5
Red clover	4	3	4	3	4	4	4	5	2
Lucerne	4	1	5	3	2	3	3	4	2
Lotus	2	4	3	3	1 to 2	2	3	3	5
Birdsfoot trefoil	2	2	5	3	110 2	3	3 10 4	4 10 5	2
Sub clover	2	1	1	3	4	4	4	4	4
Herbs									
Chicory	4	1	4	4	3 10 4	4 10 5	4	5	2
Sheeps burnet	2	2	4	3	1 to 2	2 10 3	4	3	3

Table 4 Seasonal growth of New Zealand pasture species (Scale 1=poor to nil, 3=good).

SPECIES	Summer growth	Autumn growth	Winter growth	Spring growth
Grasses:				
Ryegrasses:				
Perennial ryegrass	1	2	2 (3)	3
Hybrid ryegrass	1	2	3	3
Italian ryegrass	1	2	3	3
Cocksfoot	3	3	2	2
Tall fescue	3	3	2	2
Phalaris	1	3	3	2
Brome grasses:				
Prairie grass	3	2	3	2
Grazing brome	3	2	3	2
Smooth brome	3	2	1	1
Upland brome	3	2	1	1
Srowntop	2	2	1	2
Yorkshire fog	2	2	1	2
Legumes:				
White clover	2 (3)	2	2 (3)	3
Red clover	3	3	1 (2)	2
Lucerne	3	3	1	3
Lotus	3	2	1	2
Birdsfoot trefoil	3	3	1	2
Sub clover	1	1	2	3
Herbs				
Chicory	3	3	0	3
Sheep bumet	3	2	1	1

• Values for newer cultivars selected especially for improved seasonal growth in brackets.

suppress clover growth (Sutherland & Hoglund 1989). Addition of cocksfoot and/or phalaris to a perennial ryegrass/clover seeds mixture can improve animal performance in some situations (Moloney 1992).

Italian ryegrass and hybrid ryegrass are also used widely by dairy farmers who may need extra herbage of top quality in the cooler seasons. Chicory offers considerable advantage as a very high quality forage to boost feed supply when ryegrass growth is slow, in mid to late summer. Dairy farming has recently developed in some regions not traditionally known for this industry, such as South Canterbury and Southland. In these regions, the choice of species for the most suitable pastures may need to be different from those in existing grassland, especially in terms of cultivar type.

Meat production The extended species range is proving most valuable for farmers in finishing, as it can provide pastures more suited to seasonal needs, enabling liveweight deadlines to be met more easily. Farmers are now more able to select a pasture species mixture that boosts meat production and quality. As in dairying, perennial ryegrass, hybrid ryegrass, Italian ryegrass, white clover and red clover are the most popular species for meat production pastures. Chicory has become a favourite species, giving faster growth rates in sheep, cattle and deer. Up to three times as many lambs

can be carried during summer when grazing chicory, and growths can be up to twice as fast as on ryegrass pastures (G. Milne, pers. comm.). Selling stock earlier can boost levels of winter feed. With as little as 5% of their farms in chicory, some farmers have lifted average lamb carcass weights by 2 kg. Deer farmers can meet liveweight targets much earlier with new pastures containing red clover, chicory and Westerwolds ryegrass, compared with their existing perennial ryegrass-based pastures. The short-lived ryegrass boosts winter pasture growth (W. F. Hunt, pers. comm.).

Pastures for racehorses should not contain much ryegrass with high endophyte levels, because of the long term effect that the disorder ryegrass staggers can have on their racing performance (T. Field, pers. comm.). Grasses such as prairie grass and cocksfoot are preferable for horse paddocks, used along with white clover and chicory (Hunt & Hay 1990).

2. Species for dryland

The pastures of eastern regions regularly suffer seasonal droughts, which can be much more extensive in some years, yet these regions can also suffer flood and storm damage, especially the eastern North Island. One of the worst droughts on record occurred in 1989-1990, and this showed the value of species other than shallow-rooted ryegrass. Additional stress is exerted on drought-hit pastures by pests such as grass grub and Argentine stem weevil, whose attack coincides seasonally with drought. After the 1989-1990 drought, many dryland pastures were seen to consist largely of low-producing grasses such as crested dogstail (*Cynosurus cristatus*) and sweet vernal (*Anthoxanthum odoratum*) which are very early flowering and produce copious quantities of seed, enabling them to survive the dry summers.

The newer perennial grasses are now alternatives to the traditional perennial ryegrass in these situations (Rumball 1983; MacFarlane 1991). Tall fescue, cocksfoot and phalaris in mixture together are proving most effective in regions where dry summers, pasture pests and ryegrass staggers threaten milk production (Moloney 1992). Tall fescue has become more popular as an alternative perennial grass to ryegrass since the last drought, as it increases summer feed production (Brock 1983). Not only is it more productive during summer, but its herbage remains green and very acceptable to grazing stock. It is also more compatible with clovers than ryegrass, and tolerates grass grub and drought better, once it is established. Addition of phalaris to mixtures for dryland has proved beneficial, especially when combined with cocksfoot. Together in mixture, these two grasses have increased pasture production significantly in east coast dryland, and the two species are compatible for use on less fertile soils in dry hill country.

Prairie grass is the most winter active perennial grass, but needs free-draining, high fertility soils and more Careful *grazing* management (than for existing **pasture**) for optimum performance (Fraser 1985). **Grazing brome** is showing high potential for closer grazed pastures in **dryland** regions of the east coast. Attack by **hessian** fly in northern North Island pastures may affect persistence.

Lucerne remains a most valuable legume for fertile **dryland** pastures. **Red clover** has been shown to be valuable for deer farming, as it meets summer feed demands (Hunt & Hay 1990). **Subterranean clover** should be used for finishing pastures where it provides winter and early spring feed. **Birdsfoot trefoil** has good potential as a replacement for less fertile **dryland** soils, without any danger of causing bloat (Scott & Charlton 1983).

Chicory boosts feed supplies for all types of live-stock systems during spring, summer and autumn on fertile **dryland** soils. It can be used in mixture with only **clovers**, or can be a component of grass-clover mixtures.

When **dryland** pastures are irrigated, then the species recommended for summer-moist lowland should be used.

3. Species for hill country

A large area of hill country has been developed for animal farming, aided by aerial oversowing with perennial **ryegrass** and white clover and topdressing. However, much of the pasture on this land comprises lower fertility species such as browntop, Yorkshire fog, sweet vernal and crested **dogstail** (Charlton 1984). **Aerial** topdressing, to maintain the ryegrass-based pastures, declined significantly during the 1980s as fertiliser costs escalated. Pasture renewal in North Island hill country almost ceased after subsidies were withdrawn.

Since then, farmers have limited reseeding to their improved, more fertile pastures, using the species mentioned in the section on summer-moist lowland. In such situations where fertiliser can be applied easily, **perennial ryegrass**, **cocksfoot** and white clover mixtures are still appropriate (Chapman & Macfarlane 1985).

Newer species with potential use in less fertile, unploughable hill pastures include **cocksfoot** (especially the dense, prostrate Grasslands **Wana** variety), **phalaris** (always in mixture with other grasses, especially cocksfoot), **browntop** and grazing **brome**, especially in drier east coast regions (Table 2). Legumes for these pastures including white clover (especially Grasslands Tahora and Grasslands Prestige, bred for less fertile closely-grazed sheep pastures), **subterranean clover**, and **lotus** (Grasslands **Maku** and Grasslands Sunrise).

4. Species for South Island high country

Large areas of extensive animal farming in high country experience hot, dry summers and cold winters. They generally supported tussock grasslands before **colonisation** began. Farming is mainly extensive, with improvement of smaller areas near the homesteads. In recent years, invasion by rabbits and the **flatweed** *Hieracium* has severely limited pasture renewal.

A wide range of pasture species has been evaluated in this environment, and plant breeding programmes have been conducted by joint MAF/DSIR teams. Species used for this environment to date include grasses such as **smooth brome**, **upland brome**, the legumes **lotus**, **birdsfoot trefoil**, **alsike clover** (*Trifolium hybridum*), and **lupin** (*Lupinus*) species, and herbs such as **sheep's burnet**. Scott *et al.* (1985) gave a detailed account of species in these situations. For pasture renewal of improved **flatland** pastures, **perennial ryegrass**, **cocksfoot**, **white clover**, **red clover**, **birdsfoot trefoil** and **lucerne** are important species.

Summary

New Zealand now has a more suitable range of pasture species available to meet current needs. By careful selection of pasture component species from the increased range, value can be added to animal production systems when pasture is renewed. The invested returns from animal production on modern, productive pastures can be more than **200%**, based on an average renewal cost of \$350 per hectare (G. Milne, pers. comm.). However, the increased range of species also makes decisions more difficult, and farmers are advised to seek specialist advice before they invest.

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