

Chapter 5

Environmental and agronomic constraints in dryland pasture and choice of species

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INTRODUCTION

In the summer-dry east coast of New Zealand, from Hawkes Bay in the north down to North Otago, the duration and intensity of summer drought is **unpredictable** and variable. Within this region, winter temperatures are generally high enough to allow slow growth of pasture but summer drought can completely halt growth in most years, particularly on the commonly found shallow free draining soils. On these soils, moisture stress can develop very quickly because of the limited available soil water. Nearer the foothills, rainfall is greater and severe moisture stress less common. On sunny aspects in hill country however soils are commonly below wilting point for over six months of the year.

Spring moisture stress is variable, depending on the frequency and intensity of spring north-west winds and cold southerly fronts. Spring rainfall has been shown to influence not only the current spring production, but also total annual pasture production to an even greater extent. Clover in particular does not recover well from early spring drought, even with subsequent higher rainfall.

Pasture production and the plant species in pastures are both determined by the prevailing climate, soil type and management imposed. Most important to pasture production are soil moisture, temperature and fertility, and grazing frequency and intensity. We will describe the farming systems found in this region and the associated plant species in terms of these components. This will help each farmer to arrive at his/her own specific solution.

FARMING SYSTEMS

Climate and soil type largely determine the nature of the farming operation.

Mixed cropping

Mixed cropping has tended to develop on the deeper, moisture retentive soils (e.g. Wakanui silt

loam) and in areas with higher summer rainfall (e.g. Methven). Traditionally pasture was used in rotation with cash crops to restore soil fertility and structure. However, although grazing animals are useful to the mixed cropping farmer for cleaning up residues and as an out-of-season cash crop, very intensive grazing should be avoided as it will reduce the rate of soil fertility restoration compared to less intensive utilization. The current trend is for reduction in pasture for grazing as cropping is intensified to make best use of skills and machinery and to maximise net returns. Modern **herbage** seed production techniques also call for less grazing prior to closing than was previously practiced. Where grazing is practiced, the main requirement is for opportunist winter greenfeed between summer crops. Successful winter greenfeed depends on early autumn establishment of grass seed crops. On mixed cropping farms, early grass establishment is aided by the common availability of sprinkler irrigation systems, as autumn rain is generally too late to ensure the success of this practice on **dryland**, unless a summer fallow is practiced.

Full scale irrigation on shallower soils effectively transforms the environment and the associated farming objectives. As a consequence, these swards do not share the major problems of **dryland** pasture, but have more in common with farming in moister regions (see Chapters 7 and 8).

Dryland pasture

Dryland pasture systems have evolved on the shallower, stony soils which are unsuitable for cropping, to take advantage of a comparatively short high growth season. These soils are ideally suited for intensive sheep production particularly with the trend to higher fertility ewes which enables close matching of seasonal feed demands. A prime requirement is for early lambing in order to finish lambs before the onset of drought. To be successful, intensive production needs good supplies of early greenfeed for pre-lambing feeding of twin bearing ewes. This greenfeed is often difficult to grow because of variable and often late autumn rain which reduces

the options for sowing of annuals. These late rains also make it difficult to accumulate feed reserves from perennial pastures. For this reason rapid recovery from drought coupled with an ability to carry good quality feed through the winter are desirable characteristics of pasture species for this system.

Spring/summer drought can severely limit clover growth and nitrogen fixation, which in turn limits soil fertility building. Good autumn/winter growth can thus also be limited by available nitrogen, and nitrogen fertiliser may be necessary to get the best out of winter active grasses. Under conditions of severe water and nitrogen limitation, lucerne yields can be double those of ryegrass/clover pastures and some successful grazing systems have been developed based on this alternative. Cultivation and summer fallow can allow accumulation of adequate moisture and nitrogen for successful early autumn establishment of annual grasses for greenfeed, but does increase the pressure on remaining permanent pasture.

Adequate flushing of ewes is also normally difficult under drought conditions. There is a role for a deep rooted species capable of accumulating quality feed over the summer period. Conserved feed, particularly silage, can fill this role but lower cost options would be attractive. At high stocking rates it is difficult to grow sufficient feed to rear good **hoggets** despite good lamb growth up till early summer. Ewes however, can thrive because of their

low maintenance requirements over summer.

Hill country which can embody both the extremes of **dryland** on the sunny faces, through to potentially highly producing shady faces will be covered elsewhere (see Chapters 1, 2, 3 and 4).

RYEGRASS AND WHITE CLOVER AS ADAPTABLE STANDARDS

In all but the environmental extremes of the region, ryegrass and white clover provide the standard with which to assess the performance of new introductions (Fig. 5.1). This is because of the wide environmental tolerance shown by these plants, in part due to the wide variability within these outcrossing species, the range of cultivars available, and their ability to survive all but the extremes of mismanagement.

The greatest advantage white clover has over many of its possible competitors is its ability to self repair any loss in plant population through either rapid vegetative spread or re-establishment from hard seed when conditions are favourable. The environment is generally not suited to autumn/winter active types of Mediterranean origin (e.g. Pitau) but favours types with greater spring activity (e.g. Huia).

Generally the annual (e.g. **Tama**) and biennial (e.g. **Paroa**, **Moata**) ryegrasses are more winter active than perennial ryegrass or their intermediate hybrids and are commonly used as a source of early spring greenfeed. However, best use can only be made of this potentially greater cool season activity where soil

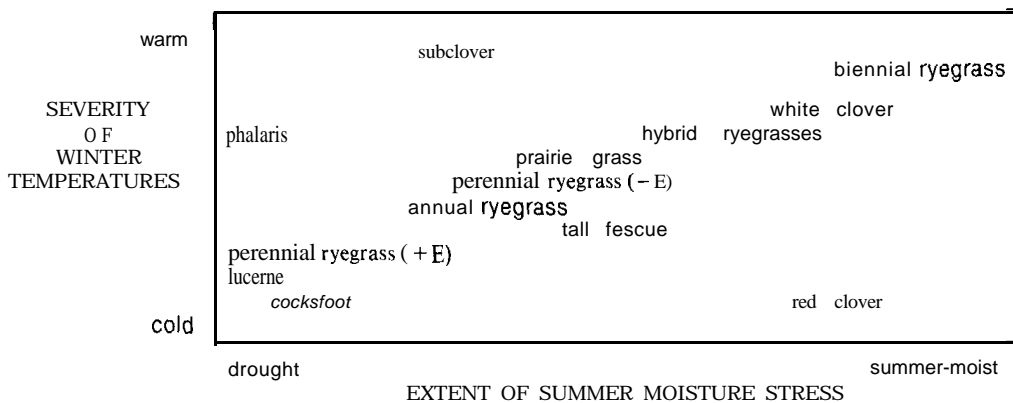


Figure 5.1 Environmental zonation of pasture species with respect to maximum advantage over competing species on an annual basis.

KEY:

- E= *Lolium* endophyte
- case = indicates high available nutrient demand
- case= indicates moderate nutrient demand
- case= indicates low available nutrient demand

Note: Short term high nutrient status can be induced by cultivation. Legumes mainly respond to P and S, grasses to N.

moisture allows early autumn establishment and where soil fertility, particularly nitrogen, is not too low. The biennials do not survive extreme summer droughts with sufficient plant density for an adequate second year crop. Hybrids between biennials and perennials (e.g. Ariki, Manawa) are generally less tolerant of summer drought than true perennials (e.g. Ellett, Nui, Ruanui).

Recent evidence suggests that, on the most drought prone sites, the presence of endophyte in some lines of perennial ryegrass cultivars confers a survival advantage by protecting against Argentine stem weevil attack. Persistent ryegrass ecotypes from droughty areas invariably have high endophyte levels. However, except on the most weevil prone sites, this advantage is offset by reduced animal performance also caused by endophyte. The discovery of the role of endophyte in determining the performance of ryegrass has necessitated a re-evaluation of the relative performance of available cultivars of perennial and some hybrid ryegrasses, including Ariki, Ellett and Nui, all of which can be obtained with or without endophyte. Seedlines containing endophyte are likely to be of most advantage on the shallowest soils where extended drought reduces the scope for tiller replacement. On all but the most drought prone soils however, reduced lamb growth rates on high endophyte pastures will extend the time required to finish lambs and thereby increase the pressure on pastures over summer relative to low endophyte pastures.

ALTERNATIVE PASTURE SPECIES

Most medium to high fertility niches are adequately filled by ryegrass and white clover. There is little evidence that other species out yield these standards on an annual basis, even at the extremes of drought or cold (Fig. 5.1). What is not often

appreciated is that ryegrass/white clover also responds to improved management. Indeed perhaps the greatest problem associated with increasing the management awareness of these species is their tolerance of mismanagement. That is not to say that other species have no role to play. Rather this reflects the performance of many farms below the level needed to benefit from the introduction of other species. Also, although management requirements of other species are not onerous, they are in many cases quite different to those for the standard species (Fig. 5.2). This highlights the need for good advice on how to get the best out of some potentially valuable alternatives.

Lucerne is a good example of a species with specific management requirements which was once widely used on dry free draining soils. Although requiring later lambing to balance its later growth pattern, lucerne proved to be a reliable feed for finishing iambs. Under lower moisture and nitrogen conditions, lucerne provides a more predictable annual feed supply than ryegrass/clover. Where soil nitrogen is adequate to support vigorous cool season grass growth and stem weevil is not a problem, perennial ryegrass/white clover mixtures can support higher annual animal production than lucerne on all but those sites most favourable to lucerne. Generally 30% more dry matter yield is needed if lucerne is to economically replace pasture because lucerne is of overall lower digestibility than ryegrass/clover. In a few localities, where access to water 2-5 cm below the surface is not impeded by a soil pan or by low pH, lucerne has the ability to produce double the yield of ryegrass/clover pastures.

Attempts to combine the summer growth potential of lucerne with cool season activity of grasses in mixed swards have met with varied success. A high degree of management skill is required to

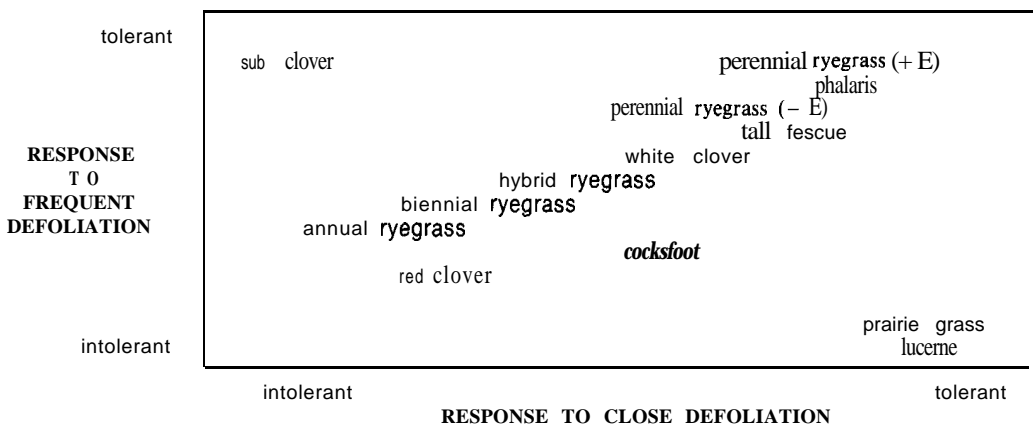


Figure 5.2 Relative tolerance of pasture species to grazing pressure. See Figure 5.1 for key.

Table 5.1 Pest and disease resistance of lucerne cultivars.

Cultivar	Pest/Disease							
	Blue-green Aphid	Pea Aphid	Spotted Alfalfa Aphid	Bacterial Wilt	Stem Nematode	Verticillium Wilt	Phytophthora Root-rot	Leaf Diseases
AS 13R	S	SR	(R)	R	R	—	R	S
P521	S	MR	(R)	R	—	—	(S)	SR
P524	(S)	MR	(R)	(R)	—	—	(S)	MR
Oranga	R	R	R	R	—	SR	—	MR
Rere	R	R	R	MR	S	—	—	S
Saranac	S	MR	S	R	S	S	(S)	MR
Wairau	S	S	(S)	S	S	S	—	S
Washoe	S	MR	(R)	R	R	SR	(R)	S
WL311	SR	R	(R)	R	—	—	(S)	MR
WL318	SR	R	(R)	R	—	—	(R)	MR

Abbreviations: R = resistant; MR = moderately resistant; SR = slight resistance only; S = susceptible; — = **no** information available.

Values in brackets are based on overseas data but probably apply in New Zealand.

maintain an appropriate balance. In these mixed swards, Maru phalaris has probably been the most successful perennial grass component while overdrilling with Tama annual ryegrass has also met with some success. Systems incorporating pure swards of Matua prairie grass will offset the cool season deficiency of lucerne. In part the decline in popularity of lucerne occurred because of the appearance of new pests and diseases and the attendant publicity. However with the advent of new disease and pest tolerant cultivars (Table 5.1), lucerne may once again have a wider role to play. In Canterbury, Sitona weevil is currently causing widespread damage, particularly in young lucerne stands.

Most of the alternatives offer the possibility of increased production at specific times of the year without necessarily greatly increasing annual production. An apparent exception to this is Matua prairie grass. This cultivar has the ability to outyield perennial ryegrasses in most seasons excepting spring when it has similar performance. These features when combined with high quality, even in the seedhead stage, offers possibilities for flushing, prelambling greenfeed and finishing lambs in dryland systems. These advantages however may only be available in higher fertility situations. Both prairie grass and lucerne have similar specific management requirements, in particular the need to avoid frequent grazing. Both also show a very high tolerance of close defoliation (Fig. 5.2), but combined sowings with lucerne have not generally been successful. Mid-winter grazing of prairie grass should be avoided, not only because of possible frost damage, but also so as not to compromise its winter growth potential. This latter point is of relevance to all winter active species, including annual and biennial ryegrasses. For these reasons Matua should

not be mixed with other grasses but could usefully comprise up to 50% of pasture in systems based on lucerne or ryegrass.

On lower fertility sites, particularly at lower stocking rates, the standards are cocksfoot on the drier and browntop on the moister sites. Cocksfoot has generally shown poor tolerance of grazing pressure, although Wana cocksfoot offers greater tolerance than Apanui. Cocksfoot however is generally less acceptable to stock than ryegrass, and often does not combine well with clovers. Cocksfoot would seem to have an important role on the lower fertility sunny faces in hill country, provided pastures have adequate spelling between grazings.

On areas with severe summer moisture stress there is a shift in emphasis from summer active perennial legumes to winter active annuals, particularly on warmer sites nearer the coast or on sunny faces in hill country. This means white clover giving way to sub clover on the higher fertility sites, while on low fertility sites a range of naturalised annuals predominate. On extreme sites, shrubby species may be the only option for an increased legume presence. A greater appreciation of the specific management requirements of sub clover could well see wider use, especially considering the range of as yet not widely tested recent cultivars. Sub clover is intolerant of hard grazing during seedling establishment in autumn, and again in late spring during seed setting, especially if early-spring spelling has caused growing points to become elevated.

Red clovers are not cool season active and therefore cannot make a major contribution to annual yield except on moister soils nearer the foothills. Management limitations are also a problem as red clovers are less tolerant of frequent grazing than white clover and also less tolerant of hard grazing than both white clover and lucerne.

Tall fescue is slower establishing than **ryegrass** from autumn sowings, but can be readily established from spring or autumn sowings provided moisture and fertility are adequate. The slower establishment precludes mixed sowings with ryegrasses. Its performance once established however, suggests tall fescue could replace perennial **ryegrass** on high fertility sites, particularly if endophyte free tall fescue cultivars (e.g. Roa) are used. Because tall fescue appears to have alternative mechanisms of pest tolerance, endophyte free cultivars avoid damage from Argentine stem weevil without the stock health problems associated with endophyte. When mature it also tolerates grass grub despite a similar susceptibility to that of **ryegrass** in the seedling stage. Roa tall fescue is highly acceptable to stock in all seasons with a particular advantage over **ryegrass** in summer. It also responds well to irrigation. The newer tall fescue cultivars have not been widely tested under farming conditions, but are known to be free of the worst problems associated with the old 'wild type' tall fescues. What evidence exists suggests

tolerance of grazing pressure is similar to that of ryegrass.

Phalaris has also only had minimal testing but appears to combine better with lucerne than other perennial grasses because of relatively slow spring growth. Despite establishment problems it also appears to persist and produce well on dry sunny hill faces and shows resistance to grass grub.

There is no apparent role for alsike, *Lotus pedunculatus*, red clover or timothy in this summer-dry region.

Species other than prairie grass, tall fescue, lucerne, **ryegrass** and white clover need further evaluation before firm recommendations on their use can be made. In particular the relative magnitudes of weevil and animal health problems need evaluation before any judgement can be made on the merit of endophyte in ryegrass. Additional resources are needed to adequately test these alternatives under realistic farming situations and, in the short term, individual farmers may have to do much of this system scale experimentation.

SUMMARY

Although there is much promise shown by some alternatives to ryegrass and white clover, there is scant evidence except for lucerne and prairie grass, upon which to base firm recommendations.

1. Matua prairie grass could comprise up to 50% of systems based on ryegrass or lucerne provided soil fertility is adequate and Matua's intolerance of frequent grazing appreciated.
2. Tall fescue shows promise as an alternative to perennial ryegrass particularly in intensive, high fertility situations but must not be sown in association with ryegrass.
3. Lucerne still has a role on low fertility free draining sites.
4. The relative merits of plus and minus endophyte ryegrasses has yet to be resolved.

FURTHER READING

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