Chapter 9. In: Burgess R.E., Brock J.L., editors. *Using Herbage Cultivars.*
Grassland Research and Practice Series No. 3, New Zealand Grassland Association, Palmerston North.

Chapter 9

Agronomic and environmental constraints in North Island dairying and the choice of pasture species

G. J. Gould, N.A. Thomson **and F.R. Duder**
Ruakura Agricultural Research Centre, MAF, Hamilton
Taranaki Agricultural Research Centre, MAF, Normanby
Arthur Yates & Co., Auckland

INTRODUCTION

Traditionally dairy production in New Zealand has been centred on regions with adequate rainfall and free draining, fertile soils. Within such regions however, considerable variation between properties is observed in the level of dairy production, often attributed to differences in animal management skills. In contrast, the authors of this paper believe that there are important agronomic and environmental constraints to high dairy production and the paper considers, in particular, the role which various pasture species and cultivars can play, in alleviating these constraints.

ANIMAL REQUIREMENTS AND PASTURE GROWTH RATES

New Zealand dairy pastures are expected to fulfil two major functions. First, they must produce high annual total yields since it is the total amount of grass grown every year which gives the farmer the confidence to carry sufficient numbers of cows to achieve high target production levels. Frequently, this requires reallocation of feed surpluses throughout the year, often demanding a high degree of management skills. The second function which pastures should fulfil is to provide a constant supply of quality feed throughout the lactation period which, ideally, could extend as long as 300 days post-calving.

Fig. 9.1 describes the relationship between pasture growth rates and dairy cow requirements. Cow requirements are calculated at a stocking rate of 3 cows/ha. The major problems of production in this system are apparent — there are periods of pasture deficit in winter and late summer-eariy autumn and a surplus of growth to be dealt with over spring-early summer. The constraints within the system are listed in Table 9.1. These constraints are considered in turn.

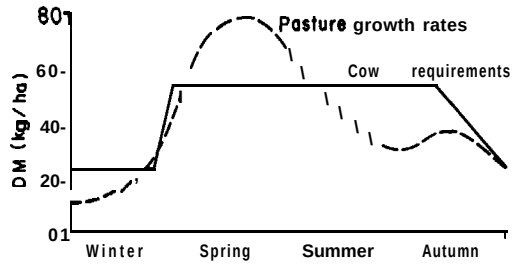

Figure 9.1 Pasture growth rates (mean of Waikato and Taranaki sites) and dairy cow requirements (3 cows/ha) over time.

ENVIRONMENTAL CONSTRAINTS

Pasture pugging

Pasture pugging is greatest on soils with high clay content and poor natural drainage and its effects are closely related to winter rainfall levels, stocking

Table 9.1 Agronomic **and** environmental constraints in NZ dairy production systems.

Constraint	Season of action	Main effect
Pasture pugging	winter	loss of DM utilization
low soil temperatures	winter/early spring	delay in growth
N deficiency	winter/spring/autumn	lower DM yields
Insect pests and diseases	late summer-early autumn	plant mortality and lower growth rates
early heading	spring	excess growth rate
pasture quality	summer	low green leaf ratios
moisture stress	late summer-early autumn	cessation of growth

rates and grazing methods. Although losses occur largely through reduced pasture utilisation of herbage grown, undoubtedly pugging can be a major factor in the opening up of pasture to allow the ingress of sub standard species such as annual Poa.' Pasture species such as tall fescue have been shown to resist the effect of winter pugging on peaty soils but the yield potential of this species is not sufficiently high to appeal in a high producing dairy farm system. Minimising this constraint appears to be best approached through drainage and grazing management control methods.

Low soil temperatures

Winter and spring herbage yields have been related to this factor (which also interacts with soil nitrogen availability), with the ryegrass species being the most suited to low temperature conditions. Further, the annual ryegrasses grow faster over winter/spring than the perennial ryegrasses, with Moata the preferred cultivar. The northern ecotype derivatives, Ellett and Nui perennial ryegrasses, have also met with success due to their increased winter activity. Thus maximum alleviation of the low temperature constraint to pasture production is achieved through the use of more active plant material in association with high soil nitrogen conditions.

Nitrogen deficiency

Nitrogen (N) deficiency can severely limit pasture yields in winter even when the desired species are present. However, significant yield depressions due to N deficiency also occur in spring and often in autumn and, in the high producing dairy farm situations, N is probably the major soil fertility factor to be considered. Plant legumes are the main N source in pastoral dairy production. The predominant legume present in high producing pastures is white clover, generally of the Huia type, which has restrictions on autumn and winter growth rates. Pitau white clover has a higher winter growth rate and has met with some success in the North Island at least. While it is desirable to have increased winter activity it is probably more important to have a white clover cultivar capable of competing with an aggressive ryegrass companion in high soil N situations, common on high producing dairy farms, and yet still be capable of fixing high amounts of atmospheric N. In this respect G18 white clover offers exciting prospects. This tall growing, large leaved white clover, selected for both cool season activity and summer growth, has performed well in the Waikato.

Another legume which has potential is Pawera red clover although to date, there is no information on its performance specifically under dairy grazing. This species is not suited to ryegrass as a companion grass and is better grown in special purpose mixtures with Matua prairie grass. The rotational grazing requirements of such a mixture enables Pawera to produce high nutritive quality herbage over the summer-autumn period helping to plug that deficit (Fig. 9.1).

Insect pests and diseases

A major factor affecting pasture vigour in many dairying regions is the periodic damage caused by pasture pests. The dramatic effects of such predators as grass grub, black beetle, Australian soldier fly, porina and crickets are well documented but the damage resulting from Argentine stem weevil and clover nematode attack often goes unnoticed. Pastures protected against various pests and diseases have almost 30% higher yields thus highlighting the extent of these problems on DM production. The relationships between various plant cultivars and their ability to resist insect attack are not well understood although the principle has been demonstrated, with perennial ryegrass selections being produced with resistance to Argentine stem weevil (high endophyte Ellett and Nui) and tolerance to grass grub (Droughtmaster and Persistor) and white clover selections being produced with resistance to stem nematode attack with higher growth and N-fixation (G18). A note of caution is needed however, since there is some evidence that the deterrent involved in the resistance of perennial ryegrasses to Argentine stem weevil is also associated with reduced pasture intakes by grazing animals and hence, may lower animal production levels.

PASTURE QUALITY

The very high spring herbage growth rates recorded on most dairy farms as plants go through a reproductive growth 'surge', often results in an undesirable accumulation of dead material which lowers pasture quality over the summer lactation period.

Mechanical topping, conservation practices of hay and silage making, increased grazing pressure, and the use of herbage growth regulators are all methods by which some degree of pasture quality control can be achieved over the reproductive growth period. However these methods are not satisfactory when green leaf material in temperate pasture swards begins to diminish in response to high summer temperatures and/or moisture stress. While

subtropical grasses like ***Paspalum dilatatum*** are undoubtedly useful over this period because of their green leaf production, they are not easily managed in mixtures with temperate grasses and legumes, and may lead to lower winter and spring yields. The real need is for temperate grass/legume mixtures which remain green over summer-autumn and allow this extension of the lactation period. The potential of Matua prairie grass and Pawera red clover mixtures in this respect should be considered.

CHOICE OF CULTIVAR

The place of pasture species and cultivars in increasing dairy farm profitability is clear. Unless a pasture is being utilised towards the maximum of its potential, no significant benefit from introducing newer herbage species into the system is likely. In general, the major limitation to increased farm production is inefficient utilisation of existing pasture and not chronic pasture deficits. Further, since many dairy pastures tend to be of an age greater than 20 years, those pastures have had the opportunity to evolve and adapt to specific managements and climates, an effect which may negate many advantages of the newer plant material. Over recent years 11 new herbage cultivars suitable for dairy pastures have become available (Table 9.2). Farmers are most familiar with Nui perennial ryegrass, Ellett perennial ryegrass and Pitau white clover, for which there is some information available on management requirements for optimum animal performance. For other species and cultivars there are scant data available on optimum management requirements. It is not surprising therefore to find that 98% of farmers regrassing in the central North Island used perennial ryegrass as the major species in their mixtures and only 7% could be considered to be interested in sowing a different species to ryegrass. Whereas in 1982 the dominant cultivars sown were Nui and Ellett, in 1969 the main cultivars sown were Manawa and Ariki. This suggests that while farmers are willing to accept a rapid change in recommended cultivar, it is only within a species with which they are very familiar.

Table 9.2 Recent introductions of grass and legume species of potential benefit to dairying areas of the North Island.

Species	Cultivar	Waikato (tonnes DM/ha/year)	Taranaki (tonnes DM/ha/year)
Perennial ryegrass	Ellett	15.9	—
	Nui	14.5	11.0
Italian ryegrass	Moata	—	- -
Cocksfoot	Wana	16.0	19.3
	Kara	—	17.8
Tall fescue	Roa	15.5	16.3
Prairie grass	Matua	17.0	—
Paspalum	Raki	11.5	—
White clover	Pitau	—	—
Red clover	Pawera	16.8	—
Phalaris	Maru	—	16.1
"old pasture"		13.5	15.4

Information on DM yield of newly released herbage cultivars has been obtained from short-term trials in Taranaki and Waikato (Table 9.2). Although the data indicate the potential for improvement in the use of the newer plant material, frequently backup information on animal performance, establishment methods and costs, and long term management requirements are lacking — factors which undoubtedly inhibit farmers from taking up these new species.

SUMMARY

1. High producing dairy farms currently produce about 17.5 tonne dry matter of herbage/ha/annum for about 780 kg milkfat. This production is mainly achieved from existing older pastures which have evolved to complement the environment and management practices.
2. The potential exists to produce herbage yields of 24.5 tonne DM/ha making 1000 kg milkfat/ha an attainable goal.
3. This target will require the selection and use of herbage species that are, first, capable of producing quality green leaf over periods of high temperature and soil moisture stress, second, responsive to high soil N conditions, yet in the case of the legumes, continue to fix N and compete with the grasses, third, naturally resistant to a wide range of insect pests and diseases and hence are persistent over time and, fourth, when managed correctly, grow throughout the year in a form more consistent with that of the animal requirement curve.
4. At the present, we are best served by Ellett and Nui perennial ryegrasses, Matua prairie grass, Moata and Tama annual ryegrasses, Pitau and G18 white clovers, and Pawera red clover in achieving this goal.