Some basic concepts of pasture seed mixtures for New Zealand farms

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Abstract

Seeds mixtures for New Zealand pastures developed from British practices with sowing of multi-species seeds mixtures during early years of settlement. Breeding and seed production of ryegrasses and clovers in the 1930s led to use of simple mixtures, still the most commonly used. Since the mid 1970s, new species have been released, and are now becoming more popular. Advantages and some potential problems of species mixtures are outlined, and simple concepts of compiling seeds mixtures are explained, with particular reference to seeding rate and sowing time.

Keywords species, seeds mixtures, pasture renewal, sowing rates, seedling establishment, competition

Introduction

The concept of mixing seeds of **herbage** species and cultivars for renewing pasture in New Zealand has been developed from European practice. An aura of magic and mystery has long surrounded seed mixing prescriptions, with fashion playing a much larger role than science.

New Zealand's early settlers followed European trends and used multi-species mixtures until the 1930s when the widespread use of ryegrasses and clovers began. However, since the mid 1970s, cultivars of species considered novel by farmers of this country have been released, and are now becoming more popular. The choice of both species and cultivar for pasture renewal is now **avery** wide. Abolition of farm subsidies, economic pressures and climatic extremes in recent years have forced farmers to consider much more carefully the choice of seeds for mixing when renewing pastures, to ensure that the established grassland fits the needs for the particular enterprise.

This paper is intended to explain the rationale of choosing seeds mixtures for today's pastures, replacing the legendary "Give me a mix and make it cheap" concept.

History of seeds mixtures

The concept of mixing seeds of **herbage** species and cultivars was developed largely from British farm practice. Sowing of grassland in Britain did not start until the mid 1600s, and the concept of sowing more persistent pastures developed only during last century (Davies 1952). The earliest sowings were simple mixtures of short-duration species, to fit in with crop rotations. Unreliability of seed supplies, lack of bred varieties and fertilisers made pasture establishment failure the norm rather than the exception in Britain last century.

Towards the **end of the 1800s**, trends moved towards **more persistent pastures, and seeds mixture prescriptions** comprised long lists of species, better known as "shotgun mixtures". Seeds mixture development during this period is well documented by Davies (1952) and involved people such as William Fream, who advocated perennial **ryegrass** from observations of its dominance on the best feeding pastures, and William Carruthers who opposed **ryegrass** because seed types available were markedly inferior to those seen in pastures by Fream. Elliot in 1898 was the first advocate of deep-rooted pasture species, including herbs, in very complex mixtures for long leys.

Work in the early 1900s by Gilchrist helped to rationalise seeds mixtures, stimulated by better establishment of white clover using the cheap phosphate fertiliser basic slag. Gilchrist's Cockle Park mixture was a relatively simple prescription in which he used New Zealand cocksfoot with wild white clover, late-flowering red clover as well as **ryegrass** and timothy. Stapledon then undertook research at Aberystwyth in Wales with parallel developments in New Zealand (Davies 1952).

New Zealand trends

Early settlers in New Zealand followed the British "shotgun" **approach, using** many species **and high** seeding rates. It was common practice to mix at least 20 species for sowings **on** bush-bum areas. Viewed in retrospect, this was probably the best approach, as knowledge of species performance on the wide range of soils, topography and climates in this country was lacking.

The pioneer pastoral scientists such as Cockayne

(1914,1917), Levy (1923, 1933) and British visitors Stapledon and Davies (1927) gave seeds mixtures considerable attention. As pastoral farming developed and topdressing became regular practice, the use of only ryegrass, white clover, cocksfoot and red clover was adopted and promoted by Levy (1933). Availability of seed of New Zealand bred cultivars followed suit and, until the mid 1970s, only 10 cultivars of 5 species were sold in bulk. Since then, the range has widened considerably, and over 50 New Zealand bred cultivars of 21 species are now sold in commercial quantity (Rumball 1983, 1984). However, much is still to be learned of plant competition and the use of these species in mixture (Campbell 1990).

Benefits and potential problems

In general, pastures are renewed with a mixture of **herbage** species to suit the following objectives:

- to increase total and seasonal **herbage** yields;
- to provide a nutritive balanced diet for livestock without animal health problems, e.g. **ryegrass** staggers;
- to allow for soil drainage and fertility variation within a paddock,
- grazing management flexibility for a range of livestock types;
- to supply nitrogen by biological means via legumes.

Surveys of seed use indicate a range of practices among farmers in term of seed mixing (Harris 1968; Sangakkara *et al.* 1982; Belgrave *et al.* 1990). Most New Zealand farmers renewing pastures in fertile lowland regions prefer to sow perennial **ryegrass** and white clover for long term pastures and Italian **ryegrass** for annual pastures. These are examples of grass monocultures currently being used in New Zealand's pastoral farming. Seed retailers are **the most** widely used source of advice for information on prescriptions for seeds mixtures (Belgrave *et al.* 1990).

Essentials for a mixture

The species chosen for renewing a particular pasture should be suited to the situation and the prevailing climatic conditions. (For further details, see Figure 1.4 in Scott *et al.* 1985). Species selected for the mixture should be compatible with each other, and have similar grazing management requirements and levels of palatability, so that the management applied to the new pasture does not produce a virtual monoculture within a season of establishment. For example, tall fescue and perennial **ryegrass** are incompatible in mixture together, perennial **ryegrass** being much more aggressive than tall fescue during seedling establishment. Likewise, white clover was found to be too aggressive for mixing with

the non-bloating *Lotus pedunculatus* ('Grasslands Maku') in New Zealand's fertilized pastures (Brock & Charlton 1978), though the two species appear to co-exist satisfactorily in the warmer, less intensively stocked dairy pastures of eastern Australia (G. Fenton pers.comm.).

Inclusion of too many species in the seeds mixture can result in those least compatible being present in very sparse numbers. Strong competition causes species imbalance during establishment, preventing some components from performing to their potential. Lancashire & Brock (1983) obtained considerable differences in sward content of several of the newer grazing species, depending on their being sown in autumn or spring. 'Grasslands Puna' chicory performed markedly better after spring sowing, whereas 'Grasslands Matua' prairie grass benefited from autumn sowing.

Selective grazing can quickly cause dominance by one of the component species. Jones (1933) at Jealott's Hill in Britain, managed plots in a pasture comprising perennial ryegrass, cocksfoot, other useful grasses, red clover, white clover and weeds, and obtained swards with each of the main components dominating, merely by manipulating grazing management. In New Zealand, Brougham & Harris (1967) applied set stocking or rotational grazing to a pasture comprising Grasslands Ruanui' perennial **ryegrass** and 'Grasslands Manawa' hybrid ryegrass. After 3 years, Ruanui dominated under set stocking, whereas under rotational grazing, Manawa became dominant. Lancashire & Brock (1983) showed significant differences between cocksfoot cultivars under different grazing managements.

Designing seeds mixtures

In choosing species, cultivars and seeds for a mixture, a farmer should be as painstaking as when choosing any other tools for jobs on the farm. Price should **not** be the main criterion. Anyone can compile successful seeds mixtures, given knowledge of the species, available cultivars and some general concepts. Simple principles include consideration of factors such as compatibility of species, intended use of the pasture, environmental features (soil type, fertility **and status**, weed seed levels), stock types grazing the pasture and its consequent management. Taking these into consideration, the farmer can select a list of species and varieties to include in the mixture.

Seed quality

Anyone buying pasture seeds should check the purity and germination ('P and G') certificate before purchase. This is a simple guide to seed quality. Under the New Zealand certification system, these features are tested in the laboratory under optimum conditions, specified under international agreement. Certified seed is intended

to protect the purchaser against dilution of the genetic features of the particular variety, and also against content of certain noxious weeds. Some ryegrass seed is now also tested for level of endophyte fungus.

Seeding rate

In practice the number of plants is always considerably less than the number of seeds sown, even with ideal sowing conditions. Researchers measure this as *percentage establishment*, and it varies with species, seeding rate, and environmental conditions. If the seeding rate is increased, the percentage establishment decreases (Table 1). Davies (1928) showed that increasing the number of ryegrass seeds sown by 6 times increased the

number of established plants by only less than 3 times. However, this effect does not necessarily occur with grass species of lower seedling vigour, such as timothy in Table 1.

Table 1 Effect of increasing seeding rate on percentage establishment of perennial ryegrass and timothy (from Davies 1928).

Perennial ryegrass:				
Seed rate(kg/ha)	5	10	20	30
% established	65	50	36	25
Timothy				
Seed rate(kg/ha)	3	6	12	18
% established	18	15	10	8

Table 2 Seed features of the major pasture species (based on average thousand seed weights) for use in compiling seeds mixtures.

Species	1000 Seed Wt (g)	Seeds/kg	Seeds/m ² at 1 kg/ha	Average sowing rate in mixture
Legumes:				
White clover	0.71	1,400,000	140	3-5
Red Clover:				
tetraploid	3.4	295,000	30	4-6
diploid	1.9	500,000	50	2-4
Subterranean clover	6.7	150,000	15	2-6
Lotus:				
tetraploid	0.6	1,200,000	120	1-5
diploid	0.5	2,000,000	200	1-3
Lucerne	2.0	500,000	50	6-10*
Birdsfoot trefoil	1.2	670,000	90	6-10*
Serradella	3.9	250,000	25	4-8
Sulla				
(unhulled)	11.0	91,000	9	10-12
(hulled)	5.3	187,000	19	6-7
Grasses				
Perennial ryegrass	2.0	500,000	50	10-20
Italian ryegrass:				
tetraploid	4.0	250,000	25	25-30
diploid	2.0	500,000	50	20-25
Hybrid ryegrass				
tetraploid	3.9	255,000	26	10-20
diploid	2.0	500,000	50	10-20
Cocksfoot	0.9	1,000,000	100	4-10
Tall fescue	2.6	400,000	40	12-16
Phalaris	2.0	500,000	50	1-4
Prairie grass	11.5	90,000	9	15-25
Grazing brome	11.5	90,000	9	15-25
Timothy	0.4	2,500,000	250	3-5
Yorkshire fog	0.3	3,300,000	330	1-5
Browntop	0.1	12,500,000	1250	1-2
Crested dogtail	0.6	1,600,000	160	NR**
Poa pratensis	0.4	2,500,000	250	NR**
Herbs				
Chicory	1.2	830,000	85	1***
Sheeps burnet	6.5	154,000	15	10-20
Plantain	2.0	500,000	50	2#

• generally sown alone or with non-aggressive grasses.
* not recommended in a pasture seeds mixture.
* use 3-5kg/ha for a pure stand or as the major component in a mixture with clovers.
not yet commercially available

The total number of established plants does not critically affect yield of a pasture, except in short term **swards**. **Lazenby & Rogers** (1961) recorded similar yields from **swards** with 40 and 400 plants per **m²**. Therefore, theoretically perennial **ryegrass** can be sown at 1 **kg/ha**, but because weeds would invade during early **establishment, greater seeding rates** are standard practice.

For practical purposes, Table 2 gives indications of seed sowing densities and typical average sowing rates of the species now commonly available.

Conclusion

The range of pasture species and varieties becoming available to the pastoral farmer continues to increase. This year, releases of Grasslands cultivars include two new species, strawberry clover (*Trifolium fragiferum*) and birdsfoot trefoil (*Lotus corniculatus*), in addition to new cultivars of white clover, perennial **ryegrass** and *Lotus uliginosus*. Several other new species will be released in the near future (W. Rumball, pers. comm.). In many situations these offer considerable advantage over the traditional ryegrass-clover based mixtures in the different livestock farming systems now used across this country, and also exciting possibilities for boosting our exports.

The availability of this range has coincided with diversification of livestock types and farming systems, the growth of organic farming and a marked downturn in **fertiliser use**. **New Zealand has probably the most efficient** livestock farming system in the world, and one which is also environmentally safer. The range of pasture species adds considerably to its efficiency and reputation.

However, knowledge of the species and their use in the most appropriate combinations must be learned by those involved in pasture renewal—these seeds retailer, the adviser, the contractor (who must know specific sowing requirements), and the farmer. Without this knowledge, the whole exercise can be a waste of time, effort and money.

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