

Non-ryegrass pastures - the science and farmer practice

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Note from the editor: The anecdotal content from farms in this manuscript has not been reviewed as a science paper. The content reflects the author's experience and interpretations.

Abstract

A review of recently published science demonstrates that relatively simple non-perennial ryegrass mixtures have performed well in environments as diverse as under deer grazing in Dunedin and the Manawatu, under sheep grazing in dryland mid-Canterbury, and under both irrigated and dryland dairy cow grazing in the Waikato and Northland. Animal productivity has been lifted by up to 30% in milk solids and 50% in deer liveweight gain in non-perennial ryegrass mixtures compared to perennial ryegrass-based pastures. In some cases, the ryegrass pasture has produced similar or more dry matter, yet animal performance has been greater on the non-perennial ryegrass pastures. In other cases, dry matter productivity from complex non-ryegrass mixtures has been around 30% higher than from perennial ryegrass pastures. Interviews with farmers from South Canterbury to Northland have all reported positive experiences with non-ryegrass pastures and most have said they will not be planting perennial ryegrass-based pastures again.

Introduction

In the late 1980s I applied my experience, gained over 20 years as a professional pasture agronomist, to designing pastures for my own farm that did not have the inherent limitations of perennial ryegrass (*Lolium perenne*)(PR)-based pastures.

I started from the following premises:

1. Natural and planted pastures become a combination of grasses, legumes and herbs (weeds).
2. No one grass had all the attributes (persistence, drought tolerance, grass grub resistance, high productivity) I wanted and PR had none of them.
3. I would not remain healthy if I only ate two different foods, so why would livestock be any different?

So I designed a clover-based mixture of five different grasses, red and white clovers and chicory. The difference in sheep health when grazing this

mix, compared to grazing high-endophyte PR pasture was obvious immediately and the initial dry matter production and negative effect on thistles was impressive. This experience encouraged me to apply the same principles to designing a lucerne-based pasture including the same five grasses and a small amount of red clover and chicory. Again, it was very productive pasture; weed free and the stock were healthy.

I then started recommending similar mixtures to my farmer clients, who managed irrigated dairy and sheep farms or dryland sheep/cattle farms. These mixes all worked well for the farmers involved, but the concepts were not taken up widely because of the industry-wide investment in the *status quo*. In 2004, I reviewed the published science around non-PR pastures and concluded there were worthwhile benefits arising from their use (Musgrave & Daly 2004).

Research studies on simple mixtures

Since the early 1990s there have been many studies looking at the benefits of mixtures of one or two grasses and a legume. These have given increased pasture and animal production in a number of situations including:

1. Fraser *et al.* (1999) compared lambs grazing on dryland mid-Canterbury PR hybrid ryegrass, tall fescue, and chicory pastures with those grazing solely on perennial ryegrass (Control farmlet). Numbers of lambs finished increased by about 70% in both years and fleece weight increased by about 11% over those on the Control. Interestingly this increase in animal output occurred in spite of the PR pastures producing similar dry matter (DM) production and recording significantly higher cover levels most of the year. This clearly illustrated that more PR DM on offer does not necessarily translate to increased animal production – the improved quality of other species does translate into better animal production.
2. Thomson & Kay (2005) compared cows grazing on irrigated Waikato pastures of PR with timothy pastures. Milk solids per hectare production on the timothy pastures were 30% higher.
3. Moorhead & Piggot (2009) compared the on-farm production of PR compared to PR/plantain pastures in Northland. There were no differences

in winter and spring production, but the increased summer and autumn production from adding plantain ranged from 6 t/ha in Year 1 to 1.2 t/ha in Year 3.

4. Woodward *et al.* (2008) compared farmlets based on PR with nitrogen fertiliser and forage crops with annual ryegrass, lotus, red and white clover-mix and lucerne crops. Total DM production was higher on the PR farmlet, but milk solids production was between 5.5 – 9.5 % higher on the mixed forage farmlet and profitability 12.5 and 8% higher. Again, this illustrated that more PR DM on offer does not necessarily translate to increased animal production – the improved quality of other species does translate into better animal production.
5. Milne *et al.* (1997) reviewed the literature on the use of tall fescue on dairy farms and recorded the positive experiences of three farmers from Taranaki and the Waikato who have milked cows on tall fescue-based pastures.
6. Hoskin *et al.* (2006) in Palmerston North compared deer production from PR pastures with chicory- or plantain-based pastures. Liveweight gain on chicory was 40–48% higher than PR or plantain in the spring and liveweight gain was 14% higher than PR in the autumn. They also recorded gains in mineral status from both the chicory and plantain.

In summary – the above results confirm the conclusion I reached in my 2004 review that pastures other than PR are able to have a considerable impact of on the animal health and productivity of different farming systems.

Research studies on more complex mixtures

There has been little by way of formal study done on complex mixed pastures such as those I use and recommend:

1. Daly *et al.* (1996) compared the DM production of PR pastures with a 17-species mix and a 10-species red clover and lucerne-based pastures. At the mid-Canterbury site the mixed pastures out yielded the PR pasture in all 3 years – averaging a 32% increase. In Marlborough, the average increase from the mixed pasture was 26%, but the difference was only significant in 1 year. The treatment differences were greatest over the summer, but there were no significant differences between the three mixes.
2. Ruz-Jerez *et al.* (1991) in Palmerston North compared the production of a 20-species mix with PR plus white clover or PR plus 400 kg N. The mixed pasture yielded 30% more than the

PR pasture over 2 years, but was about 90% of the yield of the PR plus N.

In summary – there are no data to suggest a financial benefit from establishing the more expensive, highly complex mixes compared with simpler mixes. The DM production of such mixes, in three widely differing environments, was around 30% more than PR pastures.

Have the new endophytes changed the picture?

Certainly the new endophytes, like AR37, have contributed to better production and persistence of PR. Hume *et al.* (2009) in Northland reported an average 12% increase in dry matter production in year 1 from AR37 compared to standard endophyte, a 17% increase in year 2 and a 35% increase in year 3 of the trial. The Hume *et al.* (2009) report was consistent with the need to replant half the AR1 and standard endophyte pastures after 3 years (albeit the third year included a severe drought) in the Waikato (Popay & Thom 2009) and 17% of the paddocks with AR37.

Thus, even the latest endophytes do not completely protect the PR from insect damage, nor do they consistently prevent ryegrass staggers (Fletcher & Sutherland 2009) or maintain lamb growth rates similar to endophyte-free PR pastures. The evidence so far is that while there has been some improvement, to date the new endophytes have not overcome the risks of insect damage and ryegrass staggers that can occur on ryegrass-based pastures.

What has been the experience with these pastures on farm?

Timaru

This 210-ha property is situated on the clay downlands about 20 km South of Timaru and has an average rainfall of 750 mm/yr. Stocking rate is about 6 SU/ha, which is low for the district, but there are zero fertiliser inputs. Mixed pasture use started 8 years ago and now covers 80% of the farm – mixtures as recommended by D.J. Musgrave. The pastures were established from heavily browntop dominant swards by arable cropping for 2 years before re-planting. Pasture management now involves rotational grazing, and pastures have been grazed hard at times, with stock needs being given higher priority than the maintenance of pasture health. Features of the pastures on this farm:

- There are lucerne-based pastures on both the stony flats and on the clay downs. The stony flats are 8 years old and have about 30% lucerne DM in the spring, but as that area dries out in the summer the lucerne becomes more dominant. On the clay downs, the lucerne is not as dominant.
- There are red clover-based pastures on the clay downs. The red clover provides substantial bulk

in the first 2–3 years, after which the white clover becomes the dominant legume and provides about 30% of the DM.

- There is little browntop present after 8 years, even after no fertiliser input and lax management.
- Chicory has performed well in the early years, but little is left after 4 years.
- Pastures were topped once in the second year which has given full control of Californian and nodding thistles.
- There is little visible evidence of plant damage from grass grub.

Geraldine

This 120 ha mixed cropping property (D J Musgrave) is situated on the Canterbury plains about 40 km North of Timaru in an 800-mm rainfall zone. The soils range from deep Templeton silt loams to Eyre stony silt loams. Lime is applied regularly, as well as occasional rock phosphate/sulphur. Stocking rate is 12–15 SU/ha, which is about average for the district. The first red clover-based mixed pasture was planted in 1989 and the first lucerne-based pasture in 1990. No lucerne pasture has been kept for longer than 10 years and no clover pasture for longer than 9 years before being cultivated for cropping. The pastures were established after arable cropping for 2–6 years and are generally planted in early – mid spring. Pasture management is to rotationally graze year round, with intensive strip grazing of stored feed and hay for winter-feed.

Features of the pastures on this farm are:

- 65% of the farm is in lucerne-based pastures, which have persisted for 10 years totally weed free and productive, with about 50% of the DM from lucerne.
- Chicory is productive in the early years and has persisted for up to 10 years in lucerne and 5 – 6 years in clover pastures.
- Tonic plantain has only been added in the last 8 years and has persisted for up to 6 years before cultivation.
- An experimental short-term *Bromus* (Gala) ley is the only pasture to have been cultivated because the plant population was depleted after 3 years.
- A slight lack of growth in one patch (about 50 square meters) (over 600 grubs/ m² present) has been the only sign of grass grub damage in 21 years.
- Red clover contributes to dry matter production for 3 – 4 years.
- All the *Bromus* cultivars available grow most dry matter in winter, but none have persisted in the mix for more than 2 – 3 years – this still provides a great economic return from inclusion in the mix.
- Californian and nodding thistles have almost

been eliminated, especially in the lucerne mixes.

- Stockpiled feed lasts well over the winter with minimal frosting, except for the lucerne.

Putaruru

This 410-cow dairy farm (Hamish Putt) in a 1400-mm rainfall zone, was converted to an organic system 3 years ago but is still using 500 kg/ha RPR, 100 kg/ha muriate of potash, 400 kg/ha lime/serpentine and 500 kg/ha salt. As part of the conversion, large areas of lucerne/tall fescue/timothy/herbs mixed pastures were sown.

For the last 3 years they have recorded pasture covers every 10 days.

Features of the pastures on this farm after 3 years are:

- 18 – 20 t/ha from new lucerne-based pastures.
- 8 – 10 t/ha from older PR pastures.
- Change to a longer rotation – 22 to 24 days vs. 18 days.
- Water and nutrients are utilised better.
- Plantain is still good, and chicory is still going.
- Timothy and tall fescue are still good.
- Tall fescue is dominating the lucerne; red and white clover still great.
- AR37 PR has some gaps that wireweed has filled.

Paeroa

This 88-ha dairy and deer farm (Gavin Fisher) in a 1400-mm rainfall zone has been run for 18 years with no fertiliser and some lime. Soils range from peat to iron pan, sands and clays. There is some old PR, but new pastures are sown with cocksfoot, timothy, red and white clover and herbs. Lots of edible trees provide shading and shelter for animals.

Features of the pastures on this farm are:

- Animals are grazed on a 38-day round over summer which allows pasture residuals to provide shading and slow down the drying off of pasture.
- They don't experience facial eczema (they used to) or see ryegrass rust, black beetle or staggers.
- The cow empty rate is 1 – 3% - there was one case of mastitis this year.
- Chicory and comfrey were still green during the 2008 drought – chicory lasts 4 – 6 years.
- Dairy Insight Profit Watch showed profitability nearly double the Waikato average.

Blenheim

This 200-ha finishing property (Peter McCormick) is in a 600-mm rainfall zone. The farm is used for finishing cattle and lambs with some process pea cropping.

For the last 5 years they have been planting lucerne-based pastures with tall fescue, timothy, red clover and chicory included.

Features of the pastures on this farm are:

- Winter-active tall fescue has taken over to some extent.
- There is still red clover after 5 years – standing hay used over dry autumns has probably allowed some reseeded.
- PR doesn't handle the occasional wet winter and will never be used again.
- Often don't get any autumn growth.
- Lucerne does really well in the spring.

Awatere

This high country property (Kit Sandall) is 30 minutes up the Awatere valley south of Blenheim in a 700-mm rainfall zone and has about 200 ha of cultivatable ground. Kit has been using mixed pastures for about 15 years and has found having a range of grasses to be very important. He uses tall fescue, timothy, phalaris, red and white clover, chicory and plantain.

Kit Sandall also sprayed and burned the grass residue on shady hill country and sprayed with microbials (Effective Microorganisms™) to help break down the thick thatch. Then he has oversown with cocksfoot, ryegrass, *Lotus corniculatus*, chicory and plantain. PR in this situation is “a waste of money”, Kit says.

Features of the pastures on this farm are:

- Establishment by direct drilling, usually in autumn.
- Grazing with both sheep and cattle.
- Use of “tender” grazing for first graze.
- Chicory lasting 3 – 4 years
- Production of baleage, sometimes 2 years in a row.

North Auckland

This 80-ha dairy farm (Wayne Bratton), with two small runoff blocks is situated in a 1100-mm rainfall zone on peat soils and supports 180 cows plus replacements. Wayne uses lime on crops and RPR with some chicken manure on crops. He has been using tall fescue/plantain, red and white clovers for 12 years and has tried cocksfoot, but was not impressed.

Features of the pastures on this farm are:

- They last 7 – 10 years.
- Cropping about 14% of the farm each year and planting after crop.
- Effluent is applied on new grass.
- Cows are well fed and do not gorge themselves after milking.
- Grazing rotation is sometimes only 15 days.
- Using early, medium and late flowering white clovers, which are lasting well.

North Canterbury

This 2000-ha hill country property (Andrew Heard) is in a 650-mm rainfall zone. Andrew has autumn planted 120 ha of lucerne-based pasture over the last 4 years, with tall fescue, prairie grass, chicory, plantain, white clover and rape.

Features of the pastures on this farm are:

- Spring growth is much better than before replanting.
- Green matter cuts from 2010 – relative to 4-yr-old AR1 PR:

	Winter	Spring	Summer
4-yr-old AR1 PR	100	100	100
2-yr-old lucerne mix	133	141	118
Old PR	236	87	67

- Andrew is happy with the performance of his new pastures – chicory is still persisting and is productive.
- Andrew used to look after pasture carefully in first year, but since adding rape he has been able to graze more aggressively with no harm to the lucerne or other species in the mix.

Conclusion

There is a widespread perception in NZ agriculture that the extensive use of perennial ryegrass on farms is backed up by data demonstrating increased productivity compared to other species. Having reviewed all the papers presented at Grassland Conferences since 1990 I have found no data from any environment that substantiates this belief.

The reality is quite the contrary - the experimental data, as reviewed in this paper, demonstrate that substantial increases in dry matter and animal productivity have occurred when other species have been tested.

The on-farm experience from using non-ryegrass pastures has also been positive and farmer interest is increasing rapidly - to the extent that one medium-sized seed company is now selling very little seed for ryegrass-based pastures.

Most of the research data and on farm experience has been relatively short term, but in situations where non-ryegrass pastures have been used long term, persistence and productivity have continued to be impressive.

Interestingly, ryegrass pastures have relatively superficial root systems compared to the alternative species. Observations on my farm suggest that soil carbon levels have increased usefully over the last 22 years – these observations need to be tested for their potential to mitigate pastoral farming's potential liability for carbon credits.

As a scientist and practical farmer, there is no doubt in my mind that New Zealand agriculture could benefit hugely from more widespread adoption of mixed pastures – this would require a mind shift within the science community to focus their research and plant breeding away from trying to fix perennial ryegrass.

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