

Field experience with new pasture cultivars in Canterbury

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Abstract

Over the last 10 years Canterbury farmers have started to diversify their pasture base in order to optimise their stock production. While ryegrass is still the base grass of our pastoral system, it is unsuited to many sites where pasture must generate high stock growth rates despite seasonally low rainfall, high soil temperatures and pasture pest challenge. On such sites, pastures based on cocksfoot, (*Dactylis glomerata* L.), phalaris (*Phalaris aquatica* L.) and tall fescue (*Festuca arundinacea* Schreb.) or prairie grass (*Bromus willdenowii* Kunth, cv. 'Grasslands Matua') or lucerne (*Medicago sativa*) or chicory (*Cichorium intybus* L.) have lifted net farming returns.

Keywords ryegrass, endophyte, tall fescue, phalaris, cocksfoot, prairie grass, chicory, pasture pests, rainfall, stock production, pasture persistence

Introduction

For 75 years we, as farmers, advisers and scientists, have attempted to make two pasture species, ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.), adapt to the huge range of climatic conditions in New Zealand. That pasture combination has been spectacularly successful as a production base to New Zealand's pastoral sector. Their success has been more evident in areas with fertile soils and reliable rainfall.

The challenge

As the economic terms of trade under which we operate in agriculture have declined, and technology has advanced in other areas, we have increased our stock carrying capacity. That increase has in turn placed more pressure on our pastures to carry stock through periods of low feed supply.

Pastures prone to attack by Argentine stem weevil and in areas with low rainfall and high summer soil temperatures, have disadvantages to overcome not experienced in the temperate European climate from where ryegrass originates.

Pasture pests and grass grub

Argentine stem weevil costs New Zealand millions of dollars annually in lost production and pasture replacement. Argentine stem weevil ranks as one of New Zealand's major pasture pests, yet farmer awareness of the pest is lower than that of, say, grass grub.

Unreliable rainfall

In low rainfall areas of New Zealand, ryegrass and white clover plants have to survive in a semi-dormant state for up to half the year. Those plants also have to be able to withstand grazing pressure, not only during dry periods, but immediately after rain when weak new tillers are being produced.

High soil temperatures

In recent years in particular the east coast areas of New Zealand have often experienced periods of soil temperatures exceeding 20°C. Optimal growth in ryegrass occurs at soil temperatures between 14 °C to 18°C; above that temperature range, growth rates progressively slow.

Most of New Zealand's past breeding work, quite logically, went into selecting ryegrass that was more drought tolerant, recovered faster in autumn and was resistant to Argentine stem weevil attack. The result has been a generation of ryegrass cultivars with increasingly high levels of endophyte, a recently discovered fungus that confers Argentine stem weevil resistance.

A new challenge

These ryegrass cultivars have been extremely important in conferring better pasture longevity. However, there have been some disadvantages resulting from their extensive use. High endophyte ryegrass pastures can suppress white clover production by 72% (Hoglund & Sutherland 1989), and endophyte can affect stock growth rates at a sub-clinical level, well before the farmer sees the clinical symptoms of ryegrass staggers (Fletcher 1983; Fraser 1985, 1989 (pers. comm.)). A reduction in stock growth rates can be permanent in some animals. The presence of endophyte and a reduction in white clover inhibits the ability of pastures based on high endophyte ryegrass to generate high animal growth rates. This reduces the profitability of pastoral farming.

An alternative

The above factors have combined to increase the need for pastures that can: (a) Survive longer by having better tolerance to droughts and pasture pests. (b) Grow at higher soil temperatures where required. (c) Generate high animal performance.

To that aim, a number of pasture species, bred largely by DSIR Grasslands, have been established in recent years in order to supplement the long standing and well documented advantages of lucerne.

I wish to outline the types of field site where such species are being utilised by farmers, and the advantages and disadvantages generated from those experiences.

Dryland Canterbury sites

Because of drought stress and its accentuating effect on pasture pests, such sites have proved to be the most difficult on which to manage pastures in recent years. In addition, heavy grazing pressure from stock is not allowing satisfactory plant recovery.

Low endophyte ryegrasses are not surviving more than 2-3 years in such circumstances. The farmer, therefore, has a choice of using a high endophyte **ryegrass** or a combination of the new non-ryegrass species (including lucerne) that have no endophyte, if good pasture longevity is required.

High endophyte ryegrasses are causing greater problems with stock growth rates and **ryegrass** staggers on these **dryland** farms because low residual grazing levels are allowing even greater ingestion of the endophyte.

It is, therefore, proving important to have a safe area of nil or low endophyte feed where young stock can be grazed safely, and breeding stock can be run at times of high **ryegrass** staggers risk (January-February-March).

If the proportion of high endophyte **ryegrass** in a pasture can be lowered by mixing some other pasture species capable of competing with the ryegrass, endophyte intake can also be lowered. However, other grass species are difficult to establish with ryegrass, because of the rapid seedling vigour of ryegrass.

Suggested pasture mixes for dry sites

Pasture mixes used have been based on:

Ryegrass mix 15 kg/ha high endophyte ryegrass; 5 kg/ha 'Grasslands Wana' cocksfoot (*Dactylis glomerata* L.); 1 kg/ha 'Grasslands Maru' phalaris (*Phalaris aquatica* L.); 3 kg/ha 'Grasslands Huia' white clover (or 'Grasslands Tahora' white clover).

Drought resistant/pest tolerant mix 18 kg/ha tall fescue (*Festuca arundinacea* Schreb.); 3 kg/ha cocksfoot; 1 kg/ha phalaris; 3 kg/ha white clover; 3 kg/ha 'Grasslands Pawera' (or 'Grasslands Colenso' red clover (*Trifolium pratense* L.)).

Pasture characteristics

High endophyte ryegrass mix The **ryegrass** is very fast to establish. Phalaris establishment has proved faster than expected, as long as the **ryegrass** is not allowed to overshadow it. Cocksfoot has proved slow but it does contribute a significant proportion to the sward after 2 years.

The cocksfoot and phalaris become dominant when a significant grass grub challenge is experienced.

Research by Sutherland & Hoglund (1988), indicating high rates of white clover mortality (up to 75%) in the first year of sward development, have been vindicated in the field.

Drought tolerant-pest resistant mix Both cocksfoot and tall fescue are slow establishing plants. In this pasture mix, phalaris can assume greater dominance in the first spring than its seeding rate would indicate.

Critical management steps in the successful establishment of such a pasture are as follows. (Many of these factors also apply to establishment of ryegrass, but are less critical.)

(i) A good fallow to ensure both reliable soil moisture during establishment and a lack of weed and volunteer grass competition. Young seedlings of cocksfoot and tall fescue will succumb quickly to dry conditions and competition from weeds and/or ryegrass. Lancashire, reported by Brock (1983), showed that 7 kg/ha of Nui seed mixed with Roa tall fescue can reduce tall fescue establishment by up to 75%.

(ii) Seed should be drilled rather than broadcast sown to ensure seedling roots reach good moisture quicker.

(iii) In paddocks low in nitrogen, N fertiliser should be applied at sowing.

(iv) Drilling should be in early spring or early autumn. With slower seedling root growth, tall fescue and cocksfoot seedlings are more susceptible to both drought stress and low temperatures.

(v) Plants should not be grazed until well established, and then grazed laxly for 6-9 months after establishment.

(vi) The above management steps are more critical when direct drilling. A chemical fallow should be used (double spray) to ensure a competition-free seedbed. Coulter type is critical to establishment, with the inverted T coulter proving much more successful than other coulter types.

Pasture growth rates on dryland pastures

The degree to which growth rate of a non-ryegrass pasture exceeds that of a **ryegrass** pasture varies, depending on the degree of grass grub and Argentine stem weevil attack, and moisture and temperature stress. Given no heavy attack, winter and spring growth rates are similar in both ryegrass-dominant and fescue-cocksfoot-dominant pastures. As the pastures run into a drought, **ryegrass** and phalaris become semi-dormant, and cocksfoot and tall fescue

become dominant, retaining their green leaf longer into a dry period than ryegrass. Part of this continuing production, after **ryegrass** has slowed, is related to the plant's ability to grow green leaf during and after seed-head production. A greater proportion of **ryegrass** tillers produce a seed-head, and once they have done so, are more reluctant to produce vegetative tillers again in dry soil conditions. Autumn production from the alternative species mix starts earlier after rain and is stronger. Under heavy attack from grass grub, autumn recovery of **ryegrass** can be as low as 10% of potential pasture production. Grass grub populations do not appear to be lower under tall fescue, cocksfoot and phalaris, but the stronger root systems seem better able to withstand attack. While growth of these species can be slowed, the roots are rarely trimmed enough to allow plants to be pulled out by stock.

Stock growth rates on dryland pastures

Sheep Animal performance data collected by Tom Fraser and Dennis Poppi (pers. comm.) over recent seasons showed lamb growth rates on various species to be approximately: **Pawera** red clover 330 g/day; lucerne 310 g/day; chicory 300 g/day; white clover 300 g/day; Roa tall fescue 260 g/day; low endophyte **ryegrass** 220 g/day; rape 200 g/day; high endophyte **ryegrass** 160 g/day. Such results are consistent with field evidence, in which differences in lamb growth rates of up to 100 g/day have been measured **between** high endophyte pastures and pastures based on low endophyte ryegrasses or non-ryegrass species.

Many farmers are achieving high stock growth **rates on** high endophyte **pastures**, by **leaving** higher residual DM post grazing than needed on low endophyte pastures (usually around 1000 kg DM/ha over mid to late summer). Unless such residual grazing levels can be obtained (irrigated or high rainfall properties) or such pastures can be **spelled** over mid-late summer, farmers should expect sub-clinical and/or clinical effects of grass staggers in their stock. I am reluctant to recommend sowing of high endophyte ryegrasses, but there are clearly some situations where new non-ryegrass pasture species cannot be established economically, low endophyte **ryegrass** will not persist, or farming economics prevent large scale resowing of properties. The new “endosafe” endophyte currently being tested in trials by DSIR shows promise of resolving a number of **these** difficulties.

Cattle Few cattle are grazed in Canterbury on dry sites. However, where mature stock are grazed maintaining growth rates has been easier after traditional **ryegrass** seed-head emergence time. More importantly, **ryegrass** staggers has a major effect on autumn growth rates of calves if residual grazing levels fall below 1000 kg DM/ha. This problem occurred this year, with large numbers of calves in Canterbury suffering significant autumn weight loss at a time when daily growth rates should have been 0.5 kg/per head.

Deer Deer are showing a particular aversion to endophyte intake. Given a choice of high or low endophyte pasture, they will graze a low endophyte pasture to an extremely low residual before grazing the high endophyte pasture,

Deer prefer legumes and herbs such as chicory (Hunt & Hay 1990), but will graze grasses, particularly in winter when pastures have low legume content. Deer appear to reject cocksfoot if other low endophyte grasses or some low endophyte ryegrasses are available.

Irrigated/high rainfall sites

Traditionally, ryegrass-white clover pastures have been the best choice for such situations. Today, with the wide range of **ryegrass** and non-ryegrass cultivars available, farmers can select a pasture cultivar to suit their stock system.

Pastures to suit the stock system and site characteristics

Where seed establishment conditions are difficult, **ryegrass** still provides the best alternative for improving pastures.

Advisers, scientists and farmers in Mid Canterbury have found huge differences in pasture growth rates between seasons despite the reliability added to growth with irrigation. Such variations appear to be caused by differences in soil temperature, pasture pest challenge and degree of rainfall. Where pastures based on tall fescue and cocksfoot or prairie grass or lucerne have been established to even out the effect **of these variables and to match some** of the requirements stated above, results have been good.

Tall fescue-based pastures mixes — results

Dry matter cuts were taken by Merrick & Francis (1988) **on one of several border-dyke irrigated dairy** farms where the following pasture mix (or similar) was sown in late March 1987: 20 kg/ha ‘Grasslands Roa’ tall fescue; 2 kg/ha ‘Grasslands Kahu’ Timothy (*Phleum pratense* L.); 3 kg/ha ‘Grasslands Pitau’ white clover.

Because of the late sowing, and the slower establishment of tall fescue, the pastures were not growing at potential till October 1987. The pastures were sown with 125 kg/ha Cropmaster 20 (NPKS:25, 12, 5, 16).

Dry matter cuts were also taken in the same season on a nearby established dairy farm-with pastures 3-5 years old. Sulphur and phosphate levels on these pastures would have been considerably higher than on the newly established pasture.

Production (kg DM/ha) from the tall fescue pasture and the nearby improved, high endophyte pastures (Ellett and Yatsyn) were as follows (1987-88 season):

	Sept	Oct	Nov	Dec	Jan	Feb	Mar
Tall fescue pasture	20'	58	54	58	82	72	N/A
Ryegrass pasture	52	80	53	56	45	59	38

This DM production trend was repeated in subsequent years. Effectively, the production off the two pasture types was very similar in all months except January-February-March, when DM production from the tall fescue pasture was consistently 40% to 80% higher. The degree of increase was correlated with increasing soil temperature. The increase in DM production was from an increase in both clover and grass production, but the percentage of clover in the pasture was higher for the tall fescue pasture.

In practical terms, cows were grazing tall fescue paddocks every 16 to 20 days, while other paddocks were grazed every 28 days during January, February and early March.

Milk production does not show the temporary decline when changing from ryegrass-based pasture to tall fescue-based pastures, which is evident when changing from **ryegrass** to prairie grass pastures. Autumn production from the tall fescue pastures under irrigation is similar to that of **ryegrass** unless a grass grub challenge is evident, when tall fescue's tolerance of grass grub allows its DM production to exceed that of ryegrass.

The potential increase in January-February-March growth rates has ramifications for other forms of livestock production where total feed demand is highest in those months. In particular, hinds with fawns at foot benefit from the additional pasture growth at that time.

Sowings of tall fescue-based pastures on irrigated farms have either been spectacular successes or miserable failures. The failures have been due almost exclusively to poor establishment.

A warning

Dryland establishment techniques should still be used. In particular: (a) The pasture should be sown early in spring or early in autumn. (b) There should be no competition, particularly from **ryegrass** and particularly with direct drilling.

'Grasslands Matua' prairie grass pasture mixes

Prairie grass (*Bromus willdenowii* Kunth) has been used in Canterbury farms for over 10 years. Despite Tom Fraser's well documented trials showing its benefits for total pasture and stock production, the area being sown is not increasing significantly.

Problems to be overcome when growing prairie grass have been:

- (a), Sowing the **awned** seed. New seed de-awning techniques have enabled farmers to drill prairie grass seed accurately. Undersowing under barley can give good establishment.
- (b) Persistence of stands which are invaded by ryegrass. Maintaining a stand of prairie grass beyond 5 years in anything but good conditions is undoubtedly difficult. The soft leaves and the raised crown make the plant susceptible to hard and/or

persistent **low** grazing. The new brome grasses, 'Grasslands Hakari', 'Grasslands Tiki' and 'Grasslands Gala', could offer solutions to this problem, for they have a tougher leaf and seem better able to withstand hard grazing than Matua. While Tiki and Hakari appear better suited to high country sites, limited paddock testing of Gala has shown the cultivar to have promise of an excellent future on east coast **downland** sites. Where Matua is being used, grazing must be started when DM availability is high, to ensure a high pasture residual post grazing. Matua should be rotationally grazed where possible to maximise the interval between defoliations. However, several stands of prairie grass in **Mid-Canterbury** that have been consistently set stocked with cattle or goats have maintained a very high residual DM. At high residual DM, leaf senescence is lower than in **ryegrass** pastures under similar management, maintaining a high degree of pasture quality.

Lack of persistence also results from lack of fertiliser. Matua has a high fertility requirement and responds well to nitrogen. It should be not grown on low fertility sites where Hakari and Gala would be better suited. It should not be used where soil drainage is poor or winter pugging occurs, and it should not be grazed when frosted.

(c) Stock adjustment. Farmers have found that stock need a **rumen** adjustment period of 7-10 days to show their potential growth rates on prairie grass. Therefore, enough prairie grass needs to be available to consistently feed stock over a long period.

The place for prairie grass

(a) Classes of stock requiring high residual DM to produce. Finishing cattle, calves, lambs, deer and goats can all be utilised in such a system. It is not as well suited to breeding ewes.

(b) Where soil fertility is lower, Hakari upland brome grass or Gala grazing brome may be more suited.

(c) Matua is proving a good companion for **Puna** chicory and white and red clover, to produce very high spring to autumn growth rates.

Chicory pastures

Field experience to date in Canterbury with 'Grasslands **Puna**' chicory (*Cichorium intybus* L.) has shown the following characteristics:

(a) Fast establishment from a spring sowing. Production over a 120-day period from sowing has been comparable to or better than that from rape sown at the same time.

(b) Highly palatable, particularly to red deer.

(c) Ability to generate spring growth rates of up to 300 kg DM/ha/day (measured at Lincoln by Fraser (**pers. comm.**)) and summer growth rates exceeding 50 kg/ha/day.

(d) Ability to generate high stock growth rates. Work at Lincoln by Fraser and **Poppi** has shown growth rates on a sole diet of **Puna** chicory to be only slightly

inferior to that on pure legume diets. Lamb growth rates of around 300 g/day are consistently being achieved on mixed pastures with a significant **Puna** chicory content, compared with high endophyte **ryegrass** at 160 g/day.

(e) **Puna** chicory appears best suited to a prairie grass type management system. It stands lax set stocking or rotational grazing with a long interval between grazings. Plants die if consistently grazed hard.

(f) **Puna** chicory is being used to carry forward a bank of high quality feed from the spring flush to mid summer when feed quality and quantity can be deficient.

Where to use chicory

Chicory has a place as an additive to a standard pasture mix of 1 kg/ha or as a dominant stand with or without some grass. Mixes used with success to date have been based on: 3 kg/ha **Puna** chicory; 3 kg/ha **Pawera** red clover; 3 kg/ha Pitau white clover.

The seed should be drilled at a shallow depth. Ten kg/ha of Matua prairie grass or 5 kg/ha Kahu timothy have been added with success, depending on soil type. Without the addition of white clover, 5-6 kg/ha of red clover is required.

Conclusions

New Zealand farmers now have the diversity of plant material at their disposal to enable them to select the best combination of pasture cultivars to suit their livestock production objectives.

On sites typified by **dryland** Canterbury regions, where the major obstacles to high pasture production are Argentine stem weevil, grass grub and drought, pastures based on nil endophyte cultivars such as tall fescue, cocksfoot, **phalaris** and **brome grasses** are proving successful. The establishment of the **non-ryegrass** species requires more care than for ryegrass.

On sites typified by high rainfall or irrigated Canterbury sites, low endophyte **ryegrass** can be profitable.

Where Argentine stem weevil is prevalent, high endophyte **ryegrass** can be used as long as residual grazing levels are high or an endophyte-free area is available for strategic purposes.

To optimise stock performance and net returns per hectare, combinations of nil-endophyte and **non-ryegrass** species have much to offer the New Zealand farmer.

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