Managing white clover for productive and profitable sheep farming in Southland

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Abstract

White clover is often listed as one of the factors contributing to profitable pastoral farming in New Zealand. The positive aspects of white clover have been presented in a balanced manner in publications by scientists, environmentalists and farmers able to exploit these positive aspects. Increasingly, pastures contain sub-optimal levels of clover, as a result of pasture management that is detrimental to clover, including the increasing use of fertiliser nitrogen. In some regions of New Zealand, farmers can legitimately point to pests such as the clover root weevil and factors such as the ryegrass endophyte as causing restrictions in clover production, but this is less the case in Southland. Environmental conditions in Southland are well suited for ryegrass–white clover pastures. Well-managed ryegrass–white clover pastures containing the best regional cultivars can achieve high financial returns. A number of trials at the Gore Research Station are reviewed; they demonstrated that on mixed ryegrass–white clover swards farmers can produce nearly 25% more dry matter, 40% more carcass weight and 25% more wool than on pastures with ryegrass alone receiving 270 kg N/ha/year. The yield advantage would have been greater still if they were compared with typical Southland pastures. Not only was 180 kg more carcass and 17 kg more wool produced per hectare on mixed swards, but nitrogen fixation by clover produced more than $300 worth of nitrogen per hectare. The yield advantage achievable from the ryegrass–white clover swards requires specific pasture management, particularly in spring–summer and the use of adapted white clover cultivars.

Keywords: cultivars, *Lolium perenne*, nitrogen, pasture production, perennial ryegrass, set stocking, *Trifolium repens*, white clover, wool

Introduction

There are several advantages of using white clover (*Trifolium repens*) in pastures. As a legume, clover fixes atmospheric nitrogen owing to a symbiotic association with *Rhizobium* bacteria in the roots. This fixed nitrogen becomes available to companion plants after portions of clover stolons and roots die off and are mineralised to release nitrogen. In nitrogen-deficient situations, the ability to fix atmospheric nitrogen gives clover a competitive advantage over non-leguminous plants. Grasses are more efficient in nitrogen uptake, which gives them an increasing competitive advantage over clover as more nitrogen becomes available in the soil (Harris 1987).

In a typical Southland year, perennial ryegrass (*Lolium perenne*) dominates in early spring owing to a lower activation temperature threshold, when soil nitrogen levels are relatively high. In late spring, when temperatures are higher, soil nitrogen levels are reduced, ryegrass becomes reproductive, and clover becomes dominant. Clover maintains dominance over much of summer and early autumn, when day length and temperatures are highest resulting in the highest levels of nitrogen fixation by clover (Carran 1979). Later in autumn, lower temperatures and increasing nitrogen levels swing the advantage back to ryegrass, in time for the start of ryegrass tiller initiation prior to pasture growth declining to a virtual standstill over winter.

A further advantage of white clover is that its high protein and digestibility levels result in a higher nutritive value than most grasses (Ulyatt 1981). This is of particular importance over summer when the quality and growth of post-reproductive ryegrass is reduced but grazing animal requirements for high quality feed are high. The high protein content of clover requires some careful consideration as it can cause bloat if improperly managed. The voluntary intake of clover by grazing animals is higher than that of grasses which results in higher growth rates (Eerens *et al.* 1998b; Merchen & Bourquin 1994). This paper reviews some Southland trials and makes recommendations for improved clover management.

Yield potential of ryegrass–white clover

The data presented in Table 1 show the level of pasture and animal production that can be achieved in Southland from mixed pastures in which clover made up ~30% of the annual dry matter produced. The data come from a

4-year sheep grazing trial carried out at Gore by Eerens *et al.* (1998a,b). That trial was intended to study the ryegrass endophyte, but the trial design was such that comparisons could be made between mixed ryegrass–white clover and pure ryegrass swards. The trial had two endophyte levels (nil and wild-type) and two clover levels (clover and clover-free) in a 2 x 2 design replicated twice (Eerens *et al.* 1998a). Each treatment paddock measured 0.5 ha and was rotationally grazed by 20 ewes/ha all year round, with lambs on the trial from early September to April. Grazing decisions were based on post-grazing herbage DM targets of 500 kg in winter, 700 kg in spring and 900 kg in summer and autumn. The clover-free swards received 270 kg N/ha/year in nine split applications, the mixed swards did not receive any nitrogen fertiliser.

Table 1 Comparison of mean pasture and animal production components on ryegrass (receiving 270 kg N/ha/year) and ryegrass–white clover mixed swards at Gore, Southland in 1990 to 1994) (Adapted from Eerens *et al.* 1998a, b).

	Grass sward	Mixed sward	Significance[1]
Total herbage production kg DM/ha/year	14200	17350	**
Ryegrass dry matter kg DM/ha/year	11900	10850	NS
White clover dry matter kg DM/ha/year	0	4700	***
Weeds (90% *Poa annua*) dry matter kg DM/ha/year	2300	1800	NS
Nitrogen added (Urea 48% N) kg N/ha/year	270	0	-
Lamb growth rates pre-weaning (g/day)	247	276	**
Weaning[2] weights (kg)	21.6	23.9	***
Lamb growth rates post-weaning	200	224	**
Lamb carcass produced (kg/ha)	450	629	***
Lamb GR grading carcass	6.2	7.0	NS
Wool production (kg/ewe)	3.82	4.69	*
Ewe weight at weaning (kg)	60.3	65.4	*

[1] NS = Not Significant; * = P<0.05; ** = P<0.01; *** = P<0.001
[2] Weaning date first week of December

The mixed swards out-performed ryegrass swards in virtually every aspect listed in Table 1. Nearly 75% of the extra dry matter production on the mixed swards occurred over summer, which allowed for a 50% higher stocking rate of lambs over summer. Even at the higher stocking rate, growth rates for individual lambs were higher on mixed than on ryegrass swards. A result was that lambs were finished 10–14 days earlier and at higher average carcass weights. Over the rest of the year, mixed swards produced 5–15% more dry matter than the ryegrass swards. The combination of lambs being finished earlier together with higher pasture growth rates, made it easier to bring ewes into prime condition for mating and lambing. On many farms, the yield advantage of well managed ryegrass–white clover pastures over existing old pastures would be greater than Eerens *et al.* (1998 a,b) achieved, as those existing pastures often contain less desirable grass species, e.g., browntop (*Agrostis capillaris*), sweet vernal (*Anthoxanthum odoratum*) and poa (*Poa annua*). The presence of some clover amongst these less desirable grasses does not raise the feed value to that of well-managed ryegrass pastures.

It can be argued that not all of the mineral nitrogen applied effectively reached the plants and that 270 kg N/ha/year was not enough. Nitrogen was applied in accordance with conventional farming practices (Barr 1995) and losses experienced in this experiment would be similar to those experienced on commercial farms. The nitrogen application rate was based on calculated rates of nitrogen fixation at Gore of 265 kg N/ha/year (Hoglund *et al.* 1979). Applying more nitrogen could lead to environmental problems, such as nitrogen leaching, none of which were measured in this trial.

Factors affecting white clover growth

1. Spring pasture management

White clover has a higher optimum growth temperature (24°C) than perennial ryegrass (18°C), the dominant grass species used in Southland. If the ryegrass growth advantage in spring is left unchecked, white clover will be shaded at a time when its carbohydrate levels are at their lowest (Hay *et al.* 1989). Also, accelerated death of older clover stolons in spring results in large numbers of small clover plants, making the plants highly sensitive to adverse growing conditions (Brock *et al.* 1988). Hay & Baxter (1984) demonstrated for sheep that increasing the defoliation frequency, from grazing every 4 weeks to continuous grazing over a 12-week period in spring increased the white clover production of pastures by 63% on an annual basis, most it in summer and autumn. Set-stocking increased annual clover DM production from 1795 kg/ha/year (total herbage production 17 t/ha/year) to 2925 kg/ha/year (total herbage production 15.5 t/ha/year) (Hay & Baxter 1984). The reduced annual herbage production resulting from set-stocking virtually all occurred in spring, but a reduction in pasture production does not always occur. Ryan (1989) measured a 57% higher clover production without any loss in production in paddocks set-stocked for a 12-week period over spring compared to rotationally grazed paddocks. Continuing set-stocking over summer proved disadvantageous to both the proportion of white clover and the total amount of herbage produced (Hay & Baxter 1984).

2. White clover cultivar

White clover cultivars have been bred for a variety of farming situations, from hill and high country sheep farming to intensive dairy farming. The network of regional research stations, operated by DSIR and AgResearch, allowed the development of forage cultivars well adapted to local environmental conditions. 'Grasslands Demand' is a cultivar developed at Gore from crosses between locally adapted clover ecotypes and Mediterranean, Huia and Pitau material (Widdup *et al*. 1989).

Ryan & Widdup (1997) studied lamb and hogget growth rates from different combinations of ryegrass with either Huia or Demand white clover. Animal growth rates were superior on Demand than on Huia white clover in years 2 and 3. The higher animal growth rates on Demand pastures were linked to higher clover content in combination with higher ryegrass yields (Ryan & Widdup 1997). Demand had no advantage over Huia in the first year, but in year 2 there was a 40%, and in year 3 a 200% advantage in clover yield in pastures sown with Demand compared to Huia. The third year was the final year of the trial and without any further measurements, it is impossible to make definitive statements on the longer term trends.

3. Factors suppressing white clover productivity

Ryegrass in New Zealand is generally infected with the ryegrass endophyte, which protects it from predation by the Argentine stem weevil (*Listronotus bonariensis*) (ASW).

However, the presence of endophyte depressed the white clover content of Canterbury pastures (Sutherland & Hoglund 1989). While no such depression was measured in Southland pastures (Eerens *et al*. 1998a), endophyte did have a negative effect on lamb growth rates (Eerens *et al*. 1998b). ASW is present in Southland, but numbers are likely to stay well below pest thresholds owing to temperature restrictions. Therefore, there seems no advantage to sowing endophyte-infected ryegrass in Southland.

In the early 1990s, clover root weevil (*Sitona lepidus*) (CRW), a serious pest of *Trifolium* spp. was inadvertently introduced into New Zealand. Adult CRW feed on clover leaves causing typical D-shaped notches on the rim of the leaf, larvae feed on clover nodules and roots and occasionally clover stolons (Eerens unpub. data). Currently, it is found in the North Island, north of Taumaranui. It spreads south at 35–40 km/year and has the potential to survive and develop anywhere in New Zealand as its area of origin ranges from the Arctic to the Indian subcontinent. Gerard *et al*. (1999) studied the impact of temperature on CRW development and predicted that at temperatures prevalent in Southland over summer, it would take CRW approximately 21 weeks to develop from egg to adult. The CRW lifecycle shows similarities to that of ASW, and is unlikely to reach pest status in Southland.

Summary

The question needs to be asked why many Southland farmers are not routinely achieving clover levels of 30% or higher. All too frequently, financial decisions (e.g., price of store lambs, fertiliser costs) influence pasture management decisions, resulting in reduced focus on optimising pasture management. Frequently, long-term sustainability is sacrificed for short-term gain, which may affect long-term productivity of pastures. The grass component of pastures appears less sensitive to inappropriate management than clover, thereby exacerbating management decisions already impairing the clover component.

Well-managed white clover–ryegrass pastures are worth the extra effort, and spring management especially, needs to be on target to achieve high farm productivity at lower cost. White clover fixes over $300/ha/year worth of nitrogen, in addition to raising farm productivity over that from low legume content pastures. Farm productivity can be further improved by selecting the best clover cultivar for the situation.

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