Farmer experience of perennial ryegrass endophyte on a Manawatu dairy farm

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Abstract

Case studies of two Manawatu properties currently experiencing ryegrass staggers (RGS) are presented; a dairy farm and a run-off grazing both dairy heifers and intensive bull beef. Before its conversion from a sheep and cattle enterprise to dairying an outbreak of RGS was experienced in 1987. Tall fescue-based pastures were established to minimise the potential threat of RGS. In the intervening 12 years high endophyte ryegrass cultivars have been established and hotter, drier summers are being experienced in this region. Severe cases of RGS have been observed in the last three years. On the dairy farm in 1998/99, 21 cows were dried off in January due to severe RGS. The loss in production is impossible to measure. Sixteen heifers and weaner bulls died during that summer due to RGS and those alive were 35 kg LWT below target. Management options to reduce the effects of endophyte-related disorders include establishing non-toxic pastures such as tall fescue or forage crops to utilise during periods of the year when RGS can be experienced. While limited in cultivar choice at present, the use of novel endophytes provides long-term options for farmers wishing to reduce RGS yet still maintaining ryegrass pastures. Including herbaceous species such as chicory or plantain in pasture mixes will provide high quality summer forage and can dilute the effects of endophyte in the total daily intake.

Keywords: bull beef, dairy cows, endophyte, heifers, perennial ryegrass, ryegrass staggers

Introduction

Pastoral farming in New Zealand relies predominantly on stock grazing all year round on pastures comprised mostly of perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.) (Belgrave *et al.* 1990). Animals are forced to graze into the base of the herbage to maximise utilisation and meet the demands of the generally high stocking rates. The consumption of herbage and leaf litter at the base of the pasture has precipitated the development of a number of animal disorders that are characteristic of New Zealand farming. The most debilitating of these are facial eczema, caused by consumption of spores produced by the fungus *Pithomyces chartarum* (Parle *et al.* 1986) and perennial ryegrass staggers. The latter is caused by ingesting perennial ryegrass infected with *Neotyphodium lolii*, a symbiotic fungus living within perennial ryegrass plants, providing protection from Argentine stem weevil (*Listronotus bonariensis* Kuschel) predation (Prestidge *et al.* 1982).

The costs associated with ryegrass staggers to New Zealand agriculture are not insignificant. Indeed they have been estimated by Prestidge *et al.* (1991) as $21–30 million when assessed over the total pastoral farmland in this country. Sheep, horses and deer are more susceptible than cattle to RGS because they graze closer to the crown of the plant thereby ingesting more basal sheath material. Ryegrass staggers in dairy cattle is relatively uncommon because animals are moved to fresh leafy pasture every 12–24 hours; however, the incidence and severity is usually greater with replacement calves.

This paper will present farmer experience with perennial ryegrass endophyte and its effect on dairy cows, heifer replacements and bull beef on two quite dissimilar Manawatu farms. Management solutions to minimise the effects are also presented.

One farmer's experience of ryegrass staggers in dairy cows

Farm details

Rob Crothers farms a 300 ha dairy farm at Cheltenham, 10 km north of Feilding, in the Manawatu. Average rainfall has historically been approximately 1000 mm per annum, with good summer distribution (Table 1). It is apparent that between February and March 1998/99 precipitation was substantially less than the long-term mean.

Total production in 1998/99 was 308 000 kilograms of milk solids (MS) or just over 1000 kg MS/ha and 384 kg MS/cow from a herd numbering 802 cows at peak-milking. Heifer replacements are grazed off the farm on a run-off block that forms the basis of a separate set of observations recorded in this paper.

Table 1 Monthly rainfall (mm) over summer months at Bunnythorpe for 1996/97 and the two following years. Corresponding 30-year means are also shown (from McGill 1999).

	1996/97	1997/98	1998/99	30-year mean
December	104.8	110.2	40.7	81.43
January	62.4	46.7	89.1	66.26
February	42	65.7	18.4	59.51
March	82.8	29	41.2	74.10
April	120	92	83.6	71.52

Soils are typically Kiwitea silt loam with good fertility levels to support the intensive production expected. Average Olsen phosphate levels are 25 µg/ml and pH of 5.8. Approximately 10–15 ha of Barkant turnips (*Brassica napus* L.) are established each spring to supplement animal intakes during summer.

Regrassing history

Upon conversion to dairying 12 years ago, the property was subjected to an extensive pasture renewal programme. Under the previous sheep and cattle regime clinical signs of RGS were observed and solutions to overcome this problem were explored at conversion.

Grassline® pasture advisers were used to develop a pasture species mix that was productive, palatable, free from endophyte and resistant to Argentine stem weevil. "Triple-mix" pastures comprising tall fescue, cocksfoot (*Dactylis glomerata* L.), phalaris (*Phalaris aquatica* L.) and white clover were established in autumn 1989 on approximately 10% of the farm area to alleviate any potential threat from RGS. Sowing rates and cultivars used are in Table 2. High endophyte perennial ryegrass was established throughout the remainder of the farm. Triple mix pastures based on tall fescue persisted for seven years before regrassing was required, and reasons for this include the persistence of Grasslands Roa, and the high rate of cocksfoot in the mixture and subsequent over-grazing. No obvious effects of ryegrass staggers were observed during this time.

Table 2 Cultivars used in "triple-mix" pastures and their sowing rates.

Cultivar	Sowing rate (kg/ha)
Grasslands Roa tall fescue	12
Grasslands Kara cocksfoot	4
Grasslands Maru phalaris	4
Grasslands Pitau white clover	3

The disappearance of the tall fescue-based pastures instigated a review of the regrassing programme in 1996. The lack of RGS prompted a return to perennial ryegrass due to its relative ease of establishment and improved persistence over tall fescue. Winter productivity and late-flowering were seen as the two key attributes a ryegrass should possess. The reasons for desiring winter production are self-evident. It was felt that late-flowering would extend the period of availability of high quality pastures in spring and thus the peak milk flow would continue longer. Grasslands Impact long rotation ryegrass was subsequently established on approximately 20% of the farm area.

Summer grazing management and ryegrass staggers

By the end of November each year, the entire farm has usually been mown, either for silage or to remove seedheads and stem material from the pastures. A 30-day grazing interval is common throughout summer and early autumn and cows graze the Grasslands Impact paddocks six times within the month. A policy of 24-hour grazing is generally practised and residuals of 1300 kilograms of dry matter per hectare (kg DM/ha) remain after grazing. Given the hot, dry conditions, little white clover is available in the sward. Thus, what is in effect a perennial ryegrass monoculture is being offered to the herd. Daily intakes are supplemented with approximately 3 kg DM/cow from Barkant turnips and 2–3 kg DM/cow as pasture silage.

During the late summer/early autumn period RGS becomes apparent in the cows. The characteristic staggering gait first reported in New Zealand by Gilruth (1906) is indicative of problems within the herd. Cows may become nervous with impaired balance, this is especially noticeable when entering or exiting the farm dairy with the slippery nature of concrete under affected cow's hooves. Once cows have fallen down in the yards they are difficult to stand up and reluctant to enter the yards again. It was noted that on this farm these symptoms became more pronounced when cows grazed the Grasslands Impact ryegrass pastures. The summer/autumn period of 1998/99 was especially troublesome and ryegrass staggers was widespread throughout the herd and in stock on the runoff.

While summer turnips and silage supplement falling pasture covers, a deliberate attempt has been made to restrict animal intake of endophytic pasture, thus potentially reducing the effects of ryegrass staggers. Without these supplements it is felt that the effects of RGS would be considerably worse.

It is almost impossible to assess the lost milk production associated with grazing high endophyte ryegrass. Given the importance of perennial ryegrass–white clover pastures to dairy production in New Zealand it is incongruous that limited research has concentrated on perennial ryegrass endophyte and its effects on milk production.

An Australian study (Valentine *et al.* 1993) compared milk production from cows grazed on nil,

low, and high endophyte perennial ryegrass cultivars. Endophyte-free ryegrass produced 14% more milk than endophyte-infected treatments. Similarly, Keogh *et al.* (1999) in a split-herd on-farm trial in Northland compared the effects of pastures with high and low levels of ergovaline on milk production. They measured mean differences of 23% in favour of the herd grazing pastures with a low level of ergovaline. Seasonal differences in milk production for the two groups are given elsewhere in this volume (Blackwell & Keogh 1999). By contrast, other New Zealand work by Thom *et al.* (1994) failed to produce clear endophyte-related differences in milk yield. The lack of differences in trials reported by those authors may be partially explained, however, by the numbers of endophyte infected plants in the low-endophyte treatments increasing from 3% to 26% through contamination of pastures by a number of mechanisms.

During the summer/autumn of 1998/99, 21 cows from the case study herd were dried off as a direct response to RGS. These cows were exhibiting severe clinical symptoms of staggers and lost at least one condition score during the period. It appears that younger animals are more prone to losing condition as they generally have less body fat to mobilise in response to declining intake.

Experience with dairy heifers and bull beef animals

The farm of 160 ha from which these observations were gathered is also owned and operated by Rob Crothers and is situated on a mixture of topography ranging from flats, rolling contours and steep faces at an altitude ranging between 320 to 390 metres above sea level. The farm has approximately 1200 mm annual rainfall and has traditionally had a summer-moist climate.

Each December approximately 150 dairy heifers are moved to the run-off where they remain until calving as two-year-olds. This farm also supports an intensive bull beef system on the same block where 150 weaner bulls are taken through to slaughter at 18 months to achieve carcass weights of 270 kg. Lighter bulls are taken through a second winter and sold at 24 months of age.

Regrassing history

On taking possession of this property four years ago a regrassing programme was introduced through a combination of Cross-Slot™ direct-drilling into existing sprayed-out pasture and conventional cultivation. The same advantages of winter growth and late-flowering of Grasslands Impact ryegrass made this cultivar desirable on this property too. Grasslands Impact has since been established on approximately 30% of the farm.

Grazing management and ryegrass staggers

The bull beef enterprise operates a set-stocking policy given the inability to rotationally graze these animals. As such these animals can be grazing as low as 50 mm in the sward during the late summer/early autumn period. Heifer replacements are moved to a new paddock every 2–3 days and are obviously separated from the bulls. No summer supplements are used for either the heifers or bulls.

In the summer/autumn of 1998/99, RGS was especially evident. The majority of problems seemed to be manifest in younger stock (weaners) and these animals were displaying severe symptoms of RGS when grazing Grasslands Impact pastures. With such a large percentage of the farm in this cultivar removing these paddocks from the grazing rotation was impossible.

Reduced liveweight gain

When both bulls and heifers were weighed in April 1999 the animals badly affected with ryegrass staggers animals were, on average, 35 kg liveweight behind target. This failure to achieve target liveweights has a value of $49/head, based on the current schedule price. While compensatory growth may recover the lost liveweight before slaughter it is expected that a greater number of bulls will be sold at 24 months of age, thereby reducing the efficiency of the system

Authors including Clark *et al.* (1992) and Cosgrove *et al.* (1996) have failed to show conclusive links between endophyte and reduced liveweight gain in cattle. Their research has shown, however, that animal performance may be depressed due to low clover contents in high endophyte pastures. These conclusions are consistent with farmer observations in the summer of 1998/99 as little legume component of any sort was present in the pastures.

Stock mortality

Ryegrass staggers is the most obvious symptom of endophyte toxins. The effects of lolitrem B on nerves and muscles lead to loss of appetite and to uncoordinated movement. While outright death seldom occurs, stock affected with staggers may die through misadventure, usually by drowning in troughs or dams. In this particular case eight bulls and eight heifers died through such misadventure. The terrain of this property compounded an already bad situation as affected animals would often become cast and unable to get up, eventually rolling down hills and dying while attempting to do so.

Options to minimise perennial ryegrass staggers

Management options to reduce the short and long-term effects of perennial ryegrass endophyte on dairy farms are presented in the following section. There is no order of importance.

Non-toxic pastures

At the first clinical sign of RGS, animals should be moved to non-toxic, or "safe" pastures. This requires forward planning in apportioning a part of the farm to growing non-toxic perennial pastures such as nil-endophyte ryegrass, tall fescue (Milne *et al.* 1997), cocksfoot or brome grasses (*Bromus spp.)*. Short-term forage options include Italian ryegrass (*Lolium multiflorum* Lam.) and forage brassicas (*Brassica spp*).

Development of safe pastures requires forward planning, an understanding of the optimum agronomic management of the sown species and the appropriate soil type and fertility. Management guidelines such as those written by Milne *et al.* (1998) provide practical advice in establishing perennial pastures such as tall fescue.

Novel endophytes

The introduction of "novel" endophytes has provided options for farmers seeking to reduce the effects of animal health disorders during the summer months while still maintaining ryegrass-based pastures. The only novel endophyte currently marketed is Endosafe™ and is only available in Grasslands Greenstone hybrid ryegrass (*Lolium* x *boucheanum* syn. *Lolium hybridum* Hausskn.). Lolitrem B is not produced by this strain of endophyte and the animal health disorders normally associated with endophyte are not seen (Fletcher *et al.* 1991). While a cost premium of $0.40/kg seed is associated with the use of the current novel endophyte technology, farmers are not dissuaded from its use. It is expected that further releases of novel endophytes in perennial ryegrass cultivars will occur in the near future.

Endophyte status

While the majority of sown pastures in New Zealand are perennial ryegrass (Belgrave *et al.* 1990), seed companies are offering low endophyte seed lines to minimise the unwanted animal health effects while still ensuring some degree of plant protection from insect pests. Improved persistence of low endophyte perennial ryegrass will be experienced in regions where Argentine stem weevil pressure is low (e.g., Southland and West Coast).

Endophyte-free ryegrass

Establishing endophyte-free ryegrass is a further option, one that is generally accompanied with improved livestock performance. This is seen as a very real option in districts where the parasitoid wasp (*Microctonus hyperodae*) has established, thus reducing the risk of Argentine stem weevil attack on the pasture. While the fundamentals of making pastures more "animal friendly" and increasing production should be applauded, this strategy should be identified in the decision-making phase as having risk associated with it. Several years of grazing from endophyte-free ryegrasses may be experienced, while some regions may observe damage to the ryegrass plants, particularly where black beetle (*Heteronychus arator*) is prevalent.

Companion species

When established and managed correctly, perennial ryegrass is an especially vigorous plant, often at the detriment of companion legumes in the sward. Such legumes increase the nutritive value of pastures and can reduce the effects of endophyte intake through a "dilution" effect. A successful strategy of reducing the total perennial ryegrass intake during the summer months has been the inclusion of Grasslands Puna chicory (*Cichorium intybus* L.) at 1–2 kg/ha included in the original seed mix (A.P. Maguire pers. comm.) when the pasture was established or undersown at a later date. Animals preferentially graze the chicory which, due to its deep-rooted nature, grows strongly during summer and provides a high quality component to their daily intake while reducing the endophyte intake. The same principle applies to the addition of plantain (*Plantago lanceolota* L.) to pasture mixes.

Few herbicides, however, are registered for use on either chicory or plantain and the use of phenoxy herbicides such as MCPA or 2,4-DB after establishment or during winter to kill competing weeds will also kill these establishing herbs. Farmer experience has shown that the use of a "weed-wiper" is the safest weed control option in these instances.

Grazing height

To understand how grazing management affects the impact of endophyte, farmers need to understand how it is distributed within the plant and how it transforms during the year.

The alkaloids lolitrem B and ergovaline are concentrated in the lower 20–40 mm of pasture (1000–1200 kg DM/ha), and in the stem and seedhead, they peak between January and March, although these peaks are greater when pastures are under moisture and/or heat stress. The leaf of the ryegrass plant is, therefore, the safest part to be grazed. Given that lactating dairy cows are usually offered fresh herbage every 12–24 hours, the incidence of clinical RGS may not be apparent as these animals are not grazing low in the sward unless

the supply of pasture is limited through various reasons. A reality of the intensification of pastoral farming in New Zealand has been the increase in pasture utilisation from higher stocking rates. As a direct result pastures are often being grazed lower and the incidence of RGS may become more obvious.

On a practical level when grazing these pastures in summer and autumn farmers should attempt to avoid grazing the lower 20–40 mm. Supplementation with forages such as maize silage, pasture silage or turnips will achieve this result through a substitution effect (Holmes *et al.* 1987). Allowing pastures to "freshen" between grazings will permit more green leaf material to be placed on offer and thereby minimise the potential for RGS. Preventing pastures from developing seedhead and stem material, where the concentration of alkaloids is high, should be a priority on RGS prone farms. Frequently moving replacement heifers between paddocks will prevent hard grazing from occurring although some form of control will be required to remove the basal material. A common practice on many farms today is that of "topping" to remove such dead or low quality material from the pastures.

Other treatments

Short of moving stock from infected pastures, farmers and veterinarians have been relatively unable to provide ready solutions to RGS. Indeed veterinarians questioned for the purposes of this paper believed that effective treatment for the disorder should be high in future research priorities.

Several anecdotal remedies have been practised on farms with varying degrees of success. Perhaps the most common has been the use of the seaweed extract Nutrimol. Mortimer and Campbell (1983) and Young (1984) did not observe a response to this treatment. However, the results of McKenzie and Everest (1985) showed a highly significant response to preventative trough treatment with Nutrimol on the levels of RGS in dairy beef weaners. Veterinarians in regions of the country where RGS is prevalent also report that this form of treatment is common. Other animal remedies such as orally administering magnesium have not been so successful in preventing RGS (Allsop & Watters 1984).

Discussion

It is important to acknowledge that Grasslands Impact long rotation ryegrass has valuable attributes that are deemed desirable by many dairy farmers throughout the country. It is not the intention of this paper to denigrate this cultivar or dissuade farmers from its use.

The experiences in this paper perhaps highlight the need to follow some basic principles when establishing this cultivar in areas where RGS is likely. Sowing rates should be 10% less than normal due to its slightly smaller seed size (S.J. Bennett pers. comm), seed mixtures should also include summer active legumes and possibly herbs.

Conclusions

- Drier summers experienced in the Manawatu have resulted in RGS being experienced on farms normally described as "safe".
- These symptoms seem to be more apparent in younger cows and heifers, often resulting in premature drying-off and, in the worst-case, death.
- Summer grazing management and supplementation can reduce RGS effects.
- Farmers have a range of short- and long-term options available to minimise or reduce their exposure to perennial ryegrass endophyte on their farms.

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