WHAT PERENNIAL RYEGRASS SHOULD YOU SOW?

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Summary

- Choosing the right perennial ryegrass or combination of perennial ryegrasses is an important decision to increase the production, persistence and quality of pasture harvested on your dairy farm.
- Perennial ryegrasses are best classified simply by endophyte presence (strain), flowering time and whether a tetraploid or diploid.
- Endophyte strain should be chosen relative to the known or expected insect pests on your property.
- Using paddocks of ryegrasses with different flowering dates on your farm will help to improve early spring and late spring growth and make it easier to sustain high pasture quality and DM intakes throughout spring and into summer.
- Tetraploid ryegrasses offer high quality feed, easy management and high utilisation but are particularly prone to pugging and treading damage on wet soils in the early part of spring.

Introduction

There is in excess of 30 perennial and long rotation ryegrasses that you may choose to sow on your farm (Table 1). Choosing the right ryegrass or combination of ryegrasses may increase the production, persistence and quality of pasture harvested on your farm. Given the strong positive link between pasture harvested and profit on dairy farms (van Byvesstervelt, 2006), choosing the right cultivar is therefore an important decision. But, how do you tell them apart and determine which is best for your farm? Ryegrass selection is currently made on retailer advice, marketing information from seed companies, consultant advice, previous history with particular ryegrass, other farmer opinions, ryegrass availability and published information. The aim of this paper is assist with choosing the right perennial ryegrass. A simple classification of perennial ryegrasses according to endophyte strain, flowering time (heading date in spring) and ploidy (tetraploid versus diploid) is provided and examples will be given of how this classification can be used to choose perennial ryegrasses wisely on your farm.

Endophyte strain

Perennial ryegrass endophyte (*Neotyphodium lolii*) is a fungus that can greatly affect pasture performance, animal health and cow performance through the production of secondary compounds called alkaloids. Endophyte is found in perennial ryegrass and some long rotation and hybrid ryegrasses (crosses between annual and perennial ryegrass plants). Endophyte grows inside the plant, with no visible signs and can be dispersed with the seed, where it grows into new seedlings.

The traditional standard or wild type endophyte produces a range of alkaloids within the plant that give the plant protection against a number of insect pests, and in summer dry, pest-prone environments endophyte infected plants consistently out-yield plants lacking endophyte. However, the standard or wild type endophyte can also cause animal health problems such as ryegrass staggers, heat stress and depressed DM intake. To address this dilemma, plant breeders have developed novel endophyte strains, such as AR1, AR37 and NEA2. These are designed to provide resistance to insect pests but reduce or eliminate impacts on animal health and performance. Choosing the right option will help improve pasture persistence on your farm.

Table 2 indicates insect control ratings for the different endophyte strains. These ratings are indicative only. Ratings may vary between cultivars carrying the same endophyte strain due to interactions between the host plant and the endophyte strain which can alter the concentrations of alkaloids produced. A publication in the 2011 Pasture Persistence Symposium (Popay & Hume, 2011) provides a great deal of further background information on endophyte strain and pest resistance.

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Table 1. Flowering time, ploidy level and endophyte strains available in a range of perennial ryegrass cultivars available. SE = standard endophyte, WE = without endophyte. Note this is not the complete list of perennial ryegrass cultivars

Cultivar	Flowering time Days relative to Nui = 0)	Flowering code	Ploidy	Endophyte strain
Kingston	-3	**Standard**	diploid	SE, WE
Nui	0		diploid	SE, WE
Bronsyn	0		diploid	SE, LE, AR1
Extreme	0		diploid	WE, AR1, AR37
Kamo	0		diploid	AR37
Commando	+1		diploid	WE, AR1, AR37
Pacific	+1		diploid	SE, WE
Samson	+3		diploid	WE, AR1, AR37
Hillary	+4		diploid	AR1
Helix	+6		diploid	AR1
Arrow	+7		diploid	WE, AR1, AR37
Ohau	+8		tetraploid	WE, AR1
Stellar	+8		diploid	WE, AR1
Alto	+14	**Late**	diploid	WE, AR1, AR37
Supreme PLUS	+15		diploid	SE, WE, AR1
Aberdart	+15		diploid	WE, AR1
Abermagic	+15		diploid	WE, AR1
Indiana	+15		diploid	WE
Trojan	+16		diploid	NEA2
Banquet II	+18		tetraploid	LE, Endo5
Revolution	+19		diploid	WE, AR1
Ultra	+19		diploid	WE, AR1
One50	+20		diploid	WE, AR1, AR37
Expo	+21	**Very late**	diploid	AR1
Impact	+21		diploid	AR1
Matrix	+23		diploid	SE, WE
Halo	+25		tetraploid	AR37
Sterling	+25		tetraploid	WE
Bealey	+25		tetraploid	WE, NEA2
Quartet II	+25		tetraploid	Endo5

What endophyte should you select?

This choice will depend on the extent of major insect pests on your farm, namely Argentine stem weevil, porina, root aphid, black beetle and grass grub. In the South Island, you are fortunate there is no black beetle. There may be grass grub, but currently available endophytes do not provide resistance to grass grub (Popay & Hume, 2011); although note that tall fescue has higher natural resistance to grass grub than perennial ryegrass and could be considered as an alternative species. Thus, the choice of endophyte strain largely comes down to how important Argentine stem weevil and porina are on your farm.

Ryegrass without endophyte is a niche option for areas of very limited pest attack. This may include parts of Southland where there is less Argentine stem weevil damage due to smaller populations. Pastures will have to be treated favourably with nitrogen fertilizer, water and grazing management to get persistence without endophyte.

Ryegrass with AR1 produces the alkaloid peramine and will provide good control of Argentine stem weevil and pasture mealey bug, and unless there is significant porina damage evident or expected, this is a suitable endophyte choice. You can guarantee no animal health problems, but damage may still occur from root aphid.

Ryegrass with AR37 produces the alkaloid janthitrem and provides a very wide spectrum of insect resistance and should be considered in particular where porina and root aphid are a problem. AR37 is the only endophyte to provide a level of porina. While ryegrass staggers have been reported in sheep grazing this endophyte, there are no reported instances of ryegrass staggers in cattle and dairy cows.

Ryegrass with NEA2 contains low levels of lolitrem B and ergovaline and will give good protection against Argentine Stem weevil and root aphid but the effect on porina has not been tested.

Ryegrass with wild type or standard endophyte produces peramine, lolitrem B and ergovaline. While it gives wide protection against inscet pests, it is not recommended as it causes ryegrass staggers and may reduce milksolids production.

Flowering time or heading time

It is possible to choose when your ryegrass will flower and go to seed in spring before you sow it. Current cultivars differ in flowering time by about 6 weeks in spring. Flowering date (also known as ear emergence date) is genetically controlled, with flowering triggered by cool temperatures in winter followed by longer days. Grazing management may be used to stop the

expression of flowering (e.g. visible sign of seedheads) but not the urge to flower; that is decided much earlier in spring.

The flowering date of perennial ryegrass cultivars is labelled relative to day 0, which is the date that traditional ryegrass varieties such as Nui flower. Day 0 is around 22-25 October for Nui at Lincoln. Plants are classified as standard and late flowering cultivars (Table 1).

Table 2. Insect control rating for different endophyte strains. These ratings are indicative and may vary slightly between cultivars. If Argentine Stem Weevil or black beetle are present at sowing, an appropriate seed treatment is recommended, to improve insect resistance during establishment. These tables were compiled by AgResearch, Agriseeds, Grasslandz, PGG Wrightson Seeds and Agricom.

Diploid ryegrasses

Insect	*AR1*	*AR37*	*Standard*	*Without*
Argentine stem weevil	♦♦♦♦	♦♦♦♦[1]	♦♦♦♦	-
Pasture mealybug	♦♦♦♦	♦♦♦♦	♦♦♦♦	-
Black beetle	♦	♦♦♦	♦♦♦	-
Root aphid	-[2]	♦♦♦♦	♦♦	-
Porina	-	(♦♦♦)[3]	♦[3]	-

Tetraploid ryegrasses[4]

Insect	*AR1*	*NEA2*	*AR37*	*Endo5*	*Without*
Argentine stem weevil	♦♦♦	♦♦[1]	♦♦♦[1]	♦♦♦[1]	-
Pasture mealybug	♦♦♦♦	(♦♦♦♦)	♦♦♦♦	♦♦♦♦	-
Black beetle	♦	♦♦♦	♦♦♦	♦♦♦	-
Root aphid	-[2]	(♦)	♦♦♦♦	(♦♦)[5]	-
Porina	-	**Not tested**	**Not tested**	(♦)[3]	-

Notes on tables:

[1]These endophytes control Argentine stem weevil larvae, but not adults. While larvae cause most damage to pastures, adults can cause damage to emerging grass seedlings, so use of an appropriate seed treatment is recommended for sowings in stem weevil prone situations.

[2]*AR1* plants are more susceptible to root aphid than plants *Without* endophyte.

[3]Control of porina in pastures only applies to the ryegrass component. Other species that are palatable to porina (such as white clover) will still be damaged.

[4]There is much less information on their effect of endophyte in tetraploid ryegrasses on insects than for diploids. Tetraploids are generally more susceptible to Argentine stem weevil and the insect resistance provided by endophyte may not be as strong, although this may vary between varieties. These ratings are based on available data but require further confirmation.

[5]Control of root aphid by tetraploid cultivars with *Endo5* varies. *Banquet II Endo5* has moderate resistance (♦♦), whereas *Quartet II Endo5* has no control.

Key to tables

-	**No control.**
♦	**Low level control:** Endophyte may provide a measurable effect, but is unlikely to give any practical control.
♦♦	**Moderate control:** Endophyte may provide some practical protection, with low to moderate reduction in insect population.
♦♦♦	**Good control:** Endophyte markedly reduces insect damage under low to moderate insect pressure. Damage may still occur when insect pressure is high.
♦♦♦♦	**Very good control:** Endophyte consistently reduces insect populations and keeps pasture damage to low levels, even under high insect pressure.
( )	**Provisional result:** Further results needed to support the rating. Testing is ongoing.

Why is flowering time important?

Flowering time is important as it controls the extent of early spring production and late spring quality. There is a strong relationship between early spring growth and early flowering (Kemp & Culvenor 1994). Broadly, standard flowering cultivars have better early spring growth (late August and September) and this coincides with a crucial feed demand in most August calving herds. Plant breeders will continue to work to break the link between late winter and early spring growth and early flowering.

Although flowering makes pastures grow faster in spring (partly reflecting greater light interception), it is associated with a drop off in quality. As stems develop, fibre may rise and energy content (ME) may drop. With late flowering varieties, the decline in quality occurs later, so allowing better quality and potentially higher cow DM intakes in the late spring period. Later flowering varieties also have a tendency for less aftermath heading (a second wave of flowering after the main flowering period)

What flowering time should you use on your farm?

This is an important choice and the balance should be considered at the whole farm level. With the whole farm in standard flowering ryegrasses, you are likely to satisfy feed supply in early lactation but will end up making plenty of silage and run the risk of poor pasture quality in late spring over the entire farm. With the whole farm in late flowering varieties, there is likely to be a requirement for greater supplement use in early lactation to make up for the feed supply pinch and you may struggle to reap the benefits of improved quality later in spring.

The right balance of early and late flowering ryegrasses will depend on your farm type (e.g. level of supplement type and stocking rate). However, a mixture of 50% to 60% of standard flowering ryegrasses and 50-40% late flowering ryegrasses is about right.

The standard flowering ryegrasses are good for the late August-early spring growth and will carry the farm through the typical spring feed pinch which often occurs around the second to third

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round of grazing. By mid spring (October), growth rates are often high and the feed supply often changes to a surplus; here pasture quality may deteriorate if grazing management is not precise. At this point late flowering ryegrasses may come into their own, with little decline in quality. Further, high DM intakes can be maintained through this critical period. Low post grazing residuals can still be maintained on the standard flowering ryegrasses through good grazing management at this time; alternatively, these are ideal paddocks for conservation, with high quality silage made if cut below 3.5 t DM/ha. In November, new leafy material available post silage-making should provide high quality forage to complement the late flowering ryegrass paddocks.

This balance of standard and late flowering ryegrasses can be adjusted for each farm and through the pasture renovation process. For example, high input, grain feeding farms, may place less reliance on standard flowering ryegrasses, because grain and supplements may help alleviate the early feed deficit. Here a higher proportion of late flowering ryegrasses may be used.

Further, within the overall balance of flowering types, think wisely about which paddock on the farm is sown in a particular ryegrass. For example, sow standard flowering ryegrasses in paddocks that are prone to drying out in mid-spring (e.g. shallow soils) to ensure benefits of early spring growth. Later flowering ryegrasses can be sown in sown in paddocks with more reliable soil water until late in the season.

A final question is whether it is sensible to mix flowering times within a paddock. This is appealing as it may spread both the high growth and high quality period over longer time frames in spring. However, on the other hand it is does extend the period which grazing management (e.g. post grazing residuals) has to be very precise (as flowering takes place over longer time periods).

Ploidy – tetraploid versus diploid

It is also possible to choose whether your ryegrass is a diploid or tetraploid. Diploids are normal plants which have two sets of chromosomes per cell (like humans). Tetraploids have four sets of chromosomes per cell and this leads to some important differences relative to diploids. Due to the double chromosome number, tetraploids have: larger cells generally giving them bigger darker green leaves, larger but fewer tillers, larger seeds, a higher ratio of water soluble carbohydrate (cell contents) to fibre (cell wall), higher quality (ME) and are more highly preferred by livestock . Although note that well managed diploid perennial ryegrasses can be sustained at high ME (> 12 MJ ME/ kg DM) through grazing targeted to keep low residuals and leafy pasture. It is noteworthy that many of the tetraploids are later flowering ryegrasses (Table 1).

When should tetraploids be sown?

Tetraploid ryegrasses should be sown where high per animal performance is sought and are a very useful as a component of the farm assigned to late flowering ryegrasses. In return for sowing tetraploid ryegrasses, the following advantages would be expected: greater preference and improved ease of management for high utilisation, meaning better quality at subsequent grazing; high DM intake and diet quality; and a high clover content through an open and erect growth habit. The high preference and lower tiller numbers does, however, make tetraploids more susceptible to grazing abuse; in particular, pugging and treading damage associated with wet soil conditions in early spring will greatly reduce the persistence of the pasture. Look after these pastures in early spring (i.e. avoid over grazing) if you expect them to deliver quality pasture in late spring and summer.

Other factors in choosing ryegrasses

Ryegrasses may also be distinguished on the level of water soluble carbohydrate (WSC) content in the leaf blades (e.g. high sugar grasses). The development of perennial ryegrass cultivars with high WSC represents a substantial effort to progress industry goals of greater production with an eye to environmental concerns. Reviews of the importance of the high sugar trait for dairy systems (Edwards et al. 2007; Parsons et al. 2010) revealed substantial variation in livestock milksolids production responses, with few occasions of greater milksolids production in the high sugar than control ryegrass; however, the effect on milksolids was never negative. A more consistent response of improved nitrogen utilisation (more N in milk, less N in urine) was noted across studies, indicating valuable potential prospects for reducing the environmental impacts of dairy farming. However, this may be a significant challenge in the high crude protein forages typically found in South Island dairy pastures. Leaf size and tiller density are common 'market terms' to describe cultivars and along with leaf number these comprise the total leaf area index (LAI). The LAI is important because it determines light interception and pasture

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yield. However, all ryegrass cultivars can alter their leaf size or tiller density depending on the grazing management in order to maintain a fairly constant LAI (Matthew et al. 2000). Tiller size and density is more important when using the same grazing management for diploids and tetraploids. The high palatability of tetraploids often results in almost complete removal of leaf area during grazing and insufficient recovery time for these large tillers will result in reduced LAI.

Where do you get data from?

Once you have decided on what endophyte, flowering time and ploidy combination is desired for each paddock, you may want to delve deeper to separate cultivars. There a range of trials conducted to provide some data. These include benchmarking trials such as the National Forage Variety Trials established by the New Zealand Plant Breeding Research Association. Member seed companies conduct a majority of the NFVT plot trials measuring DM yield. Examples of published information are available at. www.nzpbra.org. While these provide robust sets of pasture production data using standard protocols from sites spread across New Zealand, they do have constraints including: most studies use pure swards rather than the grass-clovers typically sown on farms; fertilizer and grazing management is constant across cultivars so may not allow differences in seasonal growth patterns to be adequately captured; ryegrasses may be tested under a different endophyte strain from that being sold; limited pasture quality measurements are made; and generally only of three years duration with limited persistence data. Nonetheless, they provide a valuable source of information for comparing cultivars for your farm.

Conclusions

Choosing the right perennial ryegrass or combination of perennial ryegrasses is an important decision to increase the production, persistence and quality of pasture harvested on your farm. Perennial ryegrasses can be effectively classified according to endophyte strain, flowering time and whether a tetraploid or diploid. Endophyte strain should be chosen relative to the known or expected insect pests on your property. Using paddocks of ryegrasses with different flowering dates on your farm will help to improve early and late spring growth and make it easier to sustain high pasture quality and DM intakes throughout spring and into summer. Tetraploid ryegrasses offer high quality feed, easy management and high utilisation but are particularly prone to pugging and treading damage on wet soils in the early part of spring.

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