Tall fescue

In brief

The role of tall fescue (*Festuca arundinaceae*) in southern Australian dairy systems was investigated as part of the 3030 Project. The objective was to identify how it could complement perennial ryegrass in terms of production and adaptation to stressful environments.

The low rate of adoption of tall fescue by dairy farmers in the past has been associated with older cultivars and issues of low nutritive value and palatability. However, with new cultivars and a better understanding of its management, dairy farmers in southern Australian should re-assess its potential.

The information here relates to new cultivars of summer-active tall fescue.

Key features

- Tall fescue has greater summer growth than perennial ryegrass, with at least similar nutritive value.
- Grazing of tall fescue needs to be more strictly managed than perennial ryegrass to achieve its potential nutritive value.
- It is better adapted to hot and dry conditions than perennial ryegrass due to its deeper root system and higher temperature ceiling. This gives it a potential role in low rainfall regions.
- It can grow in less-fertile soils, is tolerant to a wider range of pH and waterlogging conditions, and can achieve higher persistency than perennial ryegrass.
- There is a clear need for further research into tall fescue management, including responses to N fertiliser and grazing management.

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Dairy Australia Your Levy at Work

Tall fescue vs. perennial ryegrass

Advantages

- **Higher summer production:** Trials of the 3030 Project on three sites in south-western Victoria with different soil types showed that a tall fescue pasture produced 1.3 tonnes DM/ha more than perennial ryegrass during summer (Table 1). Tall fescue can provide a consistent feed supply for six weeks after the spring peak of perennial ryegrass. The growth of ryegrass declines rapidly after this peak, but fescue production can be maintained at above 50 kg DM/ha/day. This was seen in 3030 Project trials and supported by a modelling simulation study over 40 years of climatic conditions (see Figure 1).

Table 1. Seasonal herbage accumulation (t DM/ha) of different pasture types in south west Victoria (Tharmaraj et al., 2008).

	Autumn	Winter	Spring	Summer	Total
	(t DM/ha)				
Italian ryegrass-based pasture	2.5	3.7	4.1	2.1	12.5
Winter active fescue-based pasture	2.5	3.7	3.9	2.1	12.2
Summer active fescue-based pasture	2.7	2.8	4.4	3.9	13.8
Perennial ryegrass-based pasture (high N)	2.7	3.8	5.4	2.6	14.4
Perennial ryegrass-based pasture (low N)	2.5	3.6	4.5	2.6	13.2

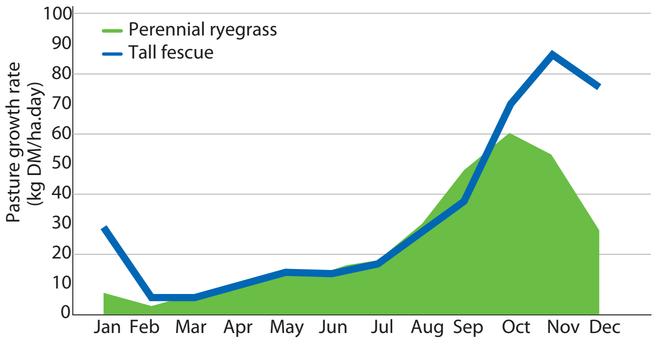

Figure 1. Average pasture growth rate (kg DM/ha.day) for perennial ryegrass and tall fescue simulated over 40 years at Terang.

- **Higher drought tolerance:** One of the most important factors in drought tolerance of perennial grasses is the volume of soil that plant roots can explore to extract moisture. Studies across Australia (Boschma et al., 2003; Nie et al., 2008) have shown that among the perennial pasture species, fescue has one of the largest and deepest root systems, extending to 2 m soil depth.

  Stored carbohydrate reserves and the area of the plants base (length and width), have also been correlated with survival of fescue, perennial ryegrass and cocksfoot plants during summer and autumn (Boschma et al., 2003). In this study tall fescue had one of the largest basal areas and, when a severe drought was simulated in spring-summer, no plant losses were recorded for tall fescue whereas ryegrass lost between 10 and 44% of plants.

- **Higher persistency:** In summer-dry environments such as south west Victoria, the persistence of deeper rooted perennial grasses, including tall fescue, cocksfoot and phalaris, is better than perennial ryegrass (Nie et al., 2004). In this study, perennial ryegrass tiller densities had declined by 55–63% after four years, while the tiller density of an alternate deeper rooted pasture mix (including tall fescue) was maintained over that period. The deeper root system of tall fescue compared to perennial ryegrass allows it to access moisture deeper in the soil profile that enhances its summer survival.

  Another factor adding to the superior persistence of tall fescue is its tolerance to waterlogging. Research has found fescue to be less sensitive to low levels of oxygen in the root zone than other pasture species such as perennial ryegrass (Rogers and Davies, 1973). Anecdotal evidence from commercial dairy farms in southern Victoria indicates that the density and productivity of tall fescue pastures is less affected than perennial ryegrass when grazed while the soil is waterlogged. Tall fescue's potentially lower sensitivity to pugging damage could be due to the size and strength of the plants base.

- **Temperature ceiling:** Tall fescue is more tolerant of high temperatures than perennial ryegrass (Reed 1996). This contributes to tall fescue's higher summer production compared to perennial ryegrass.
- **Soil requirements:** Tall fescue can grow on soils that are marginal for perennial ryegrass in terms of pH [tolerates soil pH ($CaCl_2$) from 4.9 to 8.5] and it can tolerate salinity [up to 10 dS/m electrical conductance (ECe), whereas ryegrass does not tolerate more than 6 dS/m ECe].
- **Compatibility with white clover:** Anecdotal evidence suggests that tall fescue is more compatible with white clover than perennial ryegrass. This may be related to the fescue's capacity to extract moisture from deeper in the soil, whereas the shallower root systems of ryegrass and white clover compete for the same portion of soil moisture. Another reason could be that perennial ryegrass plants can produce a biochemical that suppresses the white clover's growth (Sutherland and Hume, 1999). However, there is disagreement among researchers about this hypothesis.

Disadvantages

- **Grazing management:** To consistently provide high-nutritive value feed throughout the year, tall fescue requires stricter grazing management than perennial ryegrass (see details below). Fescue is less 'forgiving' than perennial ryegrass in terms of loss of nutritive value due to lax grazing. The requirements for different grazing management strategies for perennial ryegrass and tall fescue can make the overall grazing system more complex to manage.
- **Slow establishment:** Tall fescue takes longer than perennial ryegrass to become established and start producing a substantial amount of feed. Germination is normally slower and soil temperature has more influence (Figure 2).

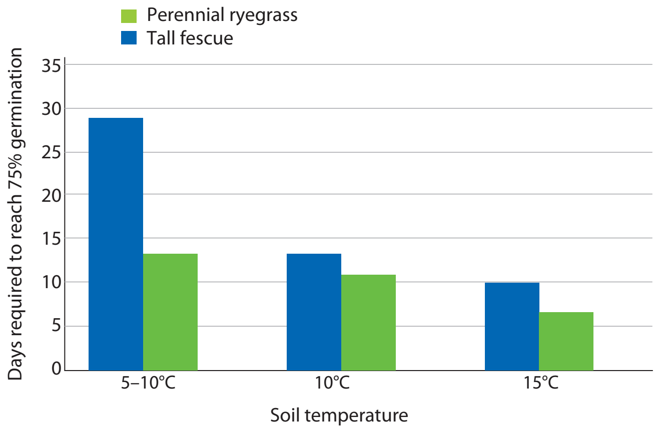

Figure 2. Days required for germination by tall fescue and perennial ryegrass seed at different soil temperatures (Dairy NZ Farmfact, 2010).

In the first year, the yield of DM from a tall fescue pasture is normally lower than for a perennial ryegrass pasture. A 3030 Project three-year plot study on three sites in south-western Victoria compared the production of pastures based on tall fescue, perennial ryegrass and Italian ryegrass (Tharmaraj et al., 2008). In their first year, the pastures based on Italian ryegrass (cultivar Marbella), perennial ryegrass (cultivar Samson) and a mix of perennials (cultivars Samson and Aries HD) plus a hybrid ryegrass (cultivar Impact) yielded 2.2, 2.8 and 2.6 t DM/ha/year more than the tall fescue based pasture (cultivar Advance). A similar study conducted in the same region (Nie et al., 2004) also reported yields of ryegrass-based pastures between 2.3 and 2.9 t DM/ha higher than fescue in the year of establishment.

Care must be taken during the first year of a tall fescue pasture to ensure a successful establishment. The first grazing should not occur until the plants are at least 10 cm in height and firmly rooted. A light stocking rate should be used leaving a post-grazing residual of not less than 5 cm height (see Figure 3). If the tall fescue pasture is grazed more intensively and/or more frequently, the plants will not be able to develop a strong base and root system.

If sown in a mix with other grasses, tall fescue may be out competed by other species that establish more vigorously.

- **Lower winter production:** 3030 Project trials found that summer-active tall fescue-based pastures produced, on average, 0.8 to 1 t DM/ha less than perennial ryegrass during winter (from June to August; Table 1).

Figure 3. Regrowth of tall fescue pasture grazed at an adequate height (March 2011; commercial farm, Gippsland).

- **Potentially lower response to N:** A series of replicated small-plot experiments at the 3030 Project farmlets in Terang, Victoria, quantified the response of tall fescue to N and compared it to perennial ryegrass. The study, during October-November of 2005, and May–July of 2006, found that pastures based on tall fescue were less responsive than perennial ryegrass pastures when 15 to 80 kg N/ha was applied within two days of grazing. The mean response of tall fescue to N applications was 7.3 kg DM/ha per kg N (see Figure 4). Further experimentation at the paddock or on-farm level is needed to determine which practices can optimise N responses in grazing conditions.
- **Higher risk of nitrate toxicity:** Tall fescue has higher nitrate-N concentrations in stem and leaf tissue than perennial ryegrass in the absence of N fertiliser, and this is exacerbated when N fertiliser is applied. There is a greater risk of nitrate-N poisoning of animals if high rates of N fertiliser are used on tall fescue. However, high N rates (above 30 kg N/ha per application) are not likely to be economic and the risk of poisoning is probably small in practice. The link between the timing of grazing and the level of nitrates in tall fescue is also not completely understood.
- **Body of knowledge:** The amount and depth of information about tall fescue's agronomy, nutritive value, response to nutrients and grazing management is considerably lower than for perennial ryegrass.

Where does tall fescue fit into a feed plan?

Late spring-summer feed gap

Tall fescue can provide green feed during late-spring and over summer, when the production and nutritive value of perennial ryegrass tends to decline. The potential production of a summer-active tall fescue in Terang was simulated for a series of 40 years as part of the 3030 Project studies (Figure 1) and showed an advantage over perennial ryegrass during summer. For the additional growth of tall fescue to be captured as high-value feed, a 'tight' grazing management needs to be applied (see grazing management section on the next page).

Figure 5 shows how tall fescue can supply feed to meet the

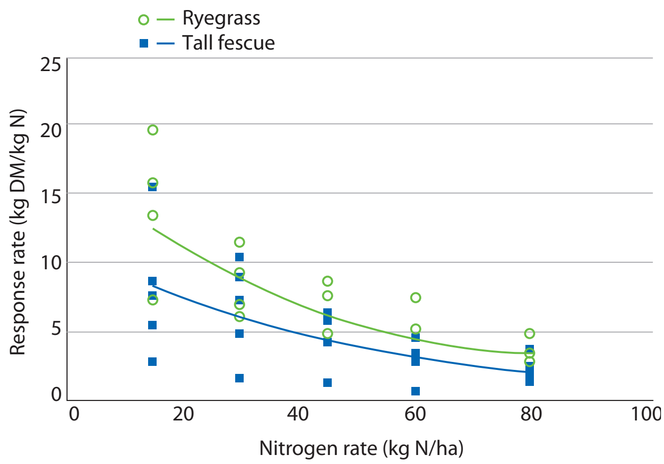

Figure 4. Nitrogen response rate (kg DM/kg N) of perennial ryegrass (open symbols) and tall fescue (solid symbols) from different rates of N applied two days post-grazing. Results are mean of five experiments (spanning October–November 2005 and May–July 2006).

Tall fescue and perennial ryegrass growth and consumption were measured at paddock-level at a 3030 Project partner farm in Poowong (Gippsland). Where subsoil moisture was present, the tall fescue based pastures (mixed with chicory) outperformed perennial ryegrass based pastures (also with chicory) through late spring, summer and autumn. However, in the absence of subsoil moisture, tall fescue has not outperformed ryegrass heading into summer. This was also seen during the driest years at the Terang farmlet study from 2005 to 2009.

intake requirements of winter-calved herds during late-spring and early-summer (the requirement curve assumes a maximum intake of tall fescue of 15 kg DM/cow/day).

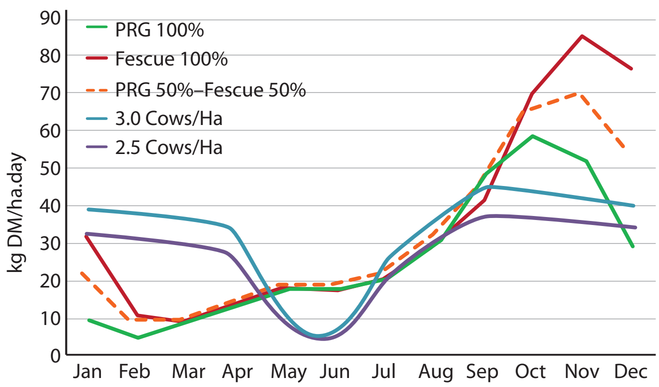

Figure 5. Supply of pasture with 100% of milking area on perennial ryegrass (PRG), 100% on tall fescue or 50%–50% perennial ryegrass-tall fescue grazed by a winter-calved (July) herd at two different stocking rates.

Paddocks with poor performance of ryegrass (low-high pH and/or risk of waterlogging)

Perennial ryegrass can be limited by the soil pH and/or the risk of long periods with waterlogging in winter, but tall fescue can tolerate those adverse conditions with a lower penalty in production and persistence. In addition, in both the farmlet studies at Terang and partner farms of the 3030 Project, fescue-based pastures were less physically affected by pugging during winter than perennial or annual ryegrasses.

Paddocks with subsoil moisture

Where there is regular subsoil moisture accumulation between 0.6 and 1.5 m of soil depth, tall fescue is a more suitable option than perennial ryegrass because its deeper root system will be able to access that moisture. This has shown to be a comparative advantage of tall fescue over other pasture species during spring–summers with limited rainfall.

Feeding

Grazing management

During early-mid spring, tall fescue pastures must be grazed more frequently and severely than for the rest of the year to control pasture cover and seed head formation. Failure to do so leads to a loss of pasture nutritive value and associated palatability issues, which will affect both the cows' intake and the post-grazing residuals.

Figure 6. Pre-grazing cover (left) and regrowth (right) of a tall fescue paddock (March 2011; commercial farm, Gippsland).

No specific grazing management guidelines based on relevant research have been developed for summer-active tall fescue pastures. In the 3030 Project farmlet studies, the strategy to increase grazing frequency and severity in spring was to reduce rotation length to around 15 days in September and October and aim to leave a post-grazing residual of around 4 cm height, or 1,400–1,600 kg DM/ha (see Figure 6).

Although a shorter rotation than for perennial ryegrass is recommended for the early removal of the stems and seed heads initiated in early spring, there is evidence that suggests that this shorter rotation should not be maintained throughout the rest of the year. The lifespan of tall fescue (time between a leaf's initiation and its death) is 1.7 times that of perennial ryegrass (Lemaire et al., 2009), suggesting that a longer grazing rotation may be required to maximise growth. Anecdotal evidence from commercial farms in Gippsland supports this; however the concept is yet to be evaluated experimentally for southern Australian dairy systems. Further work on grazing management of tall fescue is required to develop recommendations for industry.

Nutritive value

In south-west Victoria, a three-year study replicated on three sites showed that the average nutritive value of tall fescue based pastures was similar to either perennial ryegrass or short-rotation Italian ryegrass based pastures (Table 2). In summer, the tall fescue based pasture had lower NDF and higher ME content compared to the other pasture types reflecting its higher growth rates (Table 1) and lower proportion of dead material in this pasture at this time of year.

Table 2. Average annual crude protein (CP), neutral detergent fibre (NDF) and metabolisable energy (ME) content of perennial pastures in south west Victoria (adapted from Tharmaraj et al., 2008).

	CP	NDF	ME
	(% DM)	(% DM)	(MJ/kg DM)
Tall fescue based	20.4	53.0	10.5
Italian ryegrass based	18.9	55.0	10.3
Perennial ryegrass based	17.5	55.8	10.5

Milk production

The 3030 Project trials by Chapman et al. (2008) at Terang found that cows grazing summer-active tall fescue produced significantly more milk than those on perennial ryegrass during part of the summer period (see Figure 7). In this study, however, the chicory pasture showed greater milk production than all other pastures evaluated.

In this 3030 Project study, evaluation of the complete lactation found that the rate of decline in production of milk solids per cow after the peak was lower for cows grazing the tall fescue-based pasture than for those grazing the perennial ryegrass-based pasture (Figure 8).

There were no significant differences in the nutritive value of the available pasture between fescue and ryegrass throughout the year. However, when selection by the cows was taken into account, the ME value of the consumed fescue-based pasture was 1.3 times higher than that of the available fescue-based pasture. This selection factor was only 1.05 for perennial ryegrass (Chapman et al., 2008). This suggests that cows were able to select green leafy material of fescue-based pastures more easily than in the perennial ryegrass pasture, where green and dead matter may have been more closely intermingled in the pasture. Another factor that may have contributed to lower milk production in the perennial ryegrass treatment was the negative effect of endophyte alkaloids, since both lolitrem B and ergovaline were above the levels at which milk production can be affected.

Establishment and agronomy

Paddock preparation

The target soil fertility for a good establishment of tall fescue is from 20 to 30 ppm Olsen P, 15 ppm sulphate S (KCl40) and 250 ppm Colwell K. Weed control before sowing is crucial because tall fescue's establishment and growth during the first year is slow and any competition from weeds can reduce the density of the pasture. Tall fescue can be sown either by conventional or direct drilling, going no deeper than 10 mm.

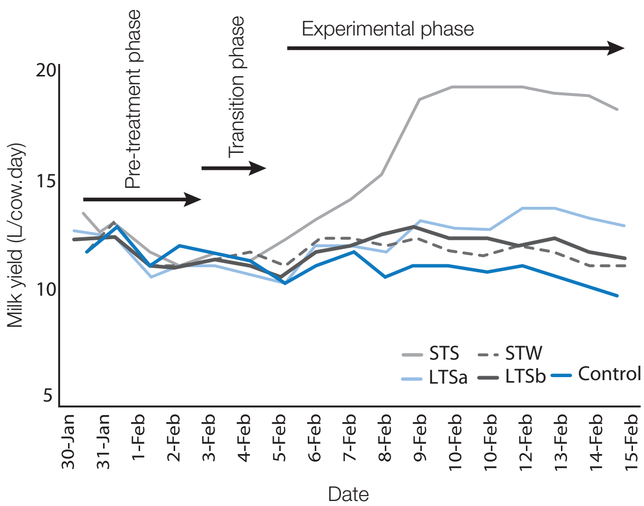

Figure 7. Summer milk yield for autumn-calved cows offered 45 kg DM/day of swards of chicory-white clover (STS), summer-active fescue-based pasture (LTSa), Italian ryegrass-based pasture (STW), winter-active fescue-based pasture (LTSb) and perennial ryegrass-based pasture (control). Source: Chapman et al. (2008).

Sowing times and rates

The normal sowing rate for tall fescue is between 20 and 30 kg of seed/ha. The ideal soil temperature is between 12 and 15°C. The choice between autumn and spring sowing depends on the cultivar's seasonality of growth, the region's reliability of seasonal rainfall, the weed management plan and the soil's capacity to retain moisture from the previous crop.

In general, spring sowings are quicker to establish but weed infestations can be a problem and the plants are more exposed to summer droughts. Autumn sowings are slower to establish but less exposed to weeds and drought as the plant will have a more developed root system by the start of the summer period.

Cultivars

The main differences between tall fescue cultivars are in the seasonality of growth. There are two main types of cultivars:

- Summer-active, also known as 'continental' cultivars.
- Winter-active, also known as 'mediterranean' cultivars (with more or less summer dormancy depending on the cultivar).

Summer-active cultivars are recommended for south-west Victorian regions with rainfall of more than 750 mm/year as these cultivars can provide valuable summer feed in higher rainfall regions (Reed et al., 2008). Winter-active cultivars appeared to show better overall persistency in areas with rainfall below the 500 mm/year.

Some of the recently released tall fescue cultivars are infected with a novel endophyte: the AR542 strain of *Neotyphodium coenophialum* (e.g. MaxP®). This endophyte does not produce ergot alkaloids that were the cause of toxicity problems in older tall fescue cultivars but it does maintain the increased stress tolerance characteristics (to both drought and over-grazing) of the older endophyte-infected cultivars.

Another feature that differentiates the recently released cultivars from the older cultivar is the softer leaves. The soft-leaved cultivars are normally more palatable for cattle.

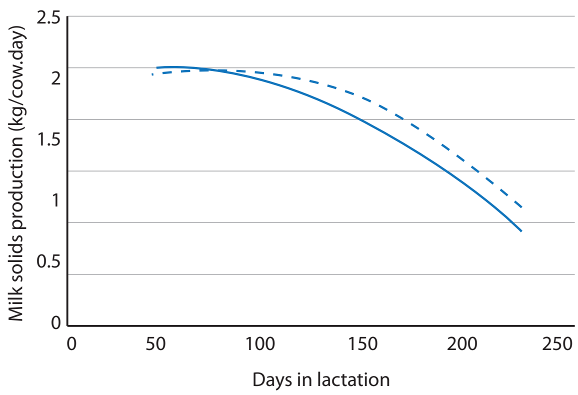

Figure 8. Trend in production of milk solids of autumn-calving dairy cows grazing summer-active fescue-based (---) or perennial ryegrass-based (—) pastures. Source: Chapman et al. (2008).

A brief description of some of the summer-active cultivars is provided here:

- **Advance:** Very palatable with soft leaves. Requires soil salinity below 10dS/m. This cultivar was used for most of the trials and farmlet studies of the 3030 Project. It is commercialised with MaxP®.
- **Vulcan II:** Soft leaves and better palatability than AU Triumph or Quantum, but lower seedling vigour than AU Triumph.
- **Typhoon:** Suited to areas with at least 625 mm and summer rainfall. It also has soft leaves and high palatability.
- **Jesup:** Can be used where soil conditions and climate are not suitable for Advance. It tolerates heat and drought better, and is more persistent, than Advance, but is less palatable. It is also commercialised with MaxP®.
- **Dovey:** Its main advantage is a rapid emergence and establishment vigour. However, it has lower palatability and poorer nutritive value than other soft-leaved cultivars.
- **Quantum:** This cultivar originated from AU Triumph and has good winter growth but is not as palatable as Advance. It is an early flowering type and is commercialised with MaxP®.
- **Demeter:** A resilient Australian cultivar that has poor seedling vigour and winter growth, with low palatability. Some lines can have endophyte infection.

In the plot study conducted by Reed et al. (2008) on two Victorian sites the addition of the MaxP® to some cultivars showed beneficial effects in terms of extra growth during summer–autumn (up to 35% more DM), but this was not consistent across sites and cultivars. Table 3 shows results from the Warrak site, where yield differences between endophyte-infected (MaxP®) and not infected fescue were found for the Quantum cultivar, but not for the Resolute cultivar.

Table 3. Seasonal and annual yield (t DM/ha) of fescue cultivars with and without Max P® endophyte infection in Warraki (adapted from Reed et al., 2008).

	Autumn	Winter	Spring	Summer	TOTAL
	(t DM/ha)				
Quantum	1.6	3.1	4.5	0.8	10.1
Quantum MaxP	2.1	3.7	5.2	1.1	12.1
Resolute	2.4	4.2	3.3	0.5	10.3
Resolute MaxP	2.3	4.3	3.1	0.6	10.4

Oversowing with ryegrass

Annual and hybrid ryegrasses can be successfully oversown into tall fescue pastures in the autumn. This was trialled in the 3030 Project farmlets in Terang in 2007. In this year, the tall fescue pasture oversown with Italian ryegrass produced 11.4 t DM/ha compared to 9.4 t DM/ha from tall fescue pastures that were not oversown. This system presents an opportunity for an additional grazing in winter plus a possible early silage cut (early or mid-October).

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See also

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About 3030

PROJECT 3030 aims to help farmers achieve a 30% improvement in farm profit by consuming 30% more home-grown forage (pasture plus crop). It is aimed at dryland farmers in southern Australia who have mastered the challenge of growing and using ryegrass pasture for dairy-cow feeding.

For further information

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