# An alternative method of managing perennial ryegrass for greater persistence

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**Abstract**
Perennial ryegrass (*Lolium perenne*) has been the main perennial temperate grass sown in high rainfall zones (+650 mm annual rainfall) since the release of the first varieties in Australia in the early 20th century. With the drier conditions that farmers are now experiencing in these regions, there has been a decrease in the persistence of this species. Previous grazing management methods have encouraged the use of leaf growth stage to determine the right time to graze a perennial ryegrass pasture. The appropriate time for grazing was identified to be at the 2½-3 leaf stage of growth. However, under dry summer conditions these parameters are not met as farmers push their paddocks for as much production as possible and hence persistency is decreased. This paper wishes to open discussion on identifying new methods of management, such as allowing perennial ryegrass varieties to set seed in their first year of establishment to allow greater root development and allow a seed bank that can last up in the soil for up to 3 years. This seed setting management should then be repeated every 3 years when the seed bank has expired (Oregon State University, 2003). For this management method to be successful, careful selection of the appropriate heading date of a variety to match the annual rainfall of the environment is critical.

**Key Words**
Perennial ryegrass, persistence, grazing management, setting seed, heading date, drought.

**Introduction**
Over the last 30 years there has been a decline in the annual rainfall of environments in south eastern Australia along with a combined increase in summer temperatures (Bureau of Meteorology, 2018). This has put pressure on the estimated 6 million hectares of perennial ryegrass (*Lolium perenne*) that are planted in this area (Cunningham *et al.* 1994). Where perennial ryegrass was once reliably persistent, farmers are now commenting that it no longer persists more than 3 years.

There are many reasons for the lack of persistence of perennial ryegrass, the main one being a lack of root depth. Grazing management also has an effect on persistence, especially during the late spring/summer/early autumn period (Dairy Australia, 2019). Over-grazing during this period of time can lead to a lack of stored carbohydrates in the root-crown, predisposing the species to tiller death and eventually plant death (Fulkerson and Donaghy 2001). It is recommended for perennial ryegrass grazing management to graze at the 2½ to 3 leaf stage to help maximize persistence (Fulkerson and Donaghy 2001). With the drier summers and the earlier finish of spring rains that the temperate regions of Australia are now experiencing, this parameter is not being met, leading to a decrease in perennial ryegrass persistence. This sensitivity to dry conditions is most problematic in the establishment year when maximum shoot growth is needed to optimize root depth of perennial ryegrass so that it can access moister deeper in the soil profile during dry summers (Matthew *et al.* 2012).

These conditions have lead to discussion of how perennial ryegrass persistence could be improved, possibly with grazing management. Growth in perennial ryegrass biomass follows a shoot:root ratio of 1.5:1 (Bolinder *et al* 2002). In the first year of perennial ryegrass establishment, plants could be encouraged to set seed, a tactic that may have a threefold benefit;

1. Root depth is maximised (Matthew *et al.* 2012).
2. Secondary tiller formation is maximised, increasing the chance of tiller survival over a dry summer (Waller *et al.* 1999).
3. Viable seed is set to allow the development of a seed bank that can last in the soil for up to three years (Oregon State University, 2003).

These methods are theories that require further research due to the limited information that is available about the persistence of perennial ryegrass currently.

## A consideration of alternative management strategies

There are few publications on the persistence of perennial ryegrass over summer in the Australian environment. This paper has tried to review the information available. It also presents evidence to encourage discussion for changing perennial ryegrass grazing methods to improve perennial ryegrass persistence in response to the increasingly negative effects of climate change.

*Review*

The most comprehensive paper published looking at the persistence of perennial ryegrass in a temperate environment in Australia was the PhD of Rachel Waller (Waller *et al*., 1999). She found that perennial ryegrass has a greater chance of surviving dry summers if secondary tillers are allowed to form. It is these secondary tillers that survive the summer after the primary flowering tillers die. Secondary tillers form at the base of the primary flowering tillers. One would assume that if flowering is prevented the production of secondary tillers is decreased. If a variety of perennial ryegrass is late heading and moisture or rain is not available in late Spring then the chances of secondary tiller formation is decreased due to no inflorescences being formed. This was observed in Valley Seeds pasture trials during the drought of 2014/15 in South-West Victoria.

An increase in tiller density before summer increases the chance of plants surviving summer. At the single-plant level, later decapitation of reproductive tillers in spring increased daughter tiller production from stubs of flowering tillers. These responses were linked with increased transfer of radiocarbon from parent to daughter tillers (Matthew et al., 1991; Matthew, 1992). Allowing seeds to mature on the inflorescence of early heading ryegrass varieties has been shown to have success for allowing seedling recruitment in the following autumn (Daniel Pledge, *pers comm*). This strategy gives farmers the option of pasture persistence through seedling recruitment if there is no persistence of the originally planted pasture over a dry summer.

*Traditional vs proposed management systems – a comparative budget*

A model budget has been created to investigate at the cost of resowing a perennial ryegrass pasture every 4 years versus allowing it to reseed every 3 years. The value of the DM produced is given a price of $350/tonne. The assumption is made that the plant density of perennial ryegrass will decline 25% each year until it needs resowing every 4 years when the density drops below 50%. The assumption is also made that with a decrease in stand density there is a similar percentage decrease in the dry matter (DM) yield. In the year when the perennial ryegrass is grazed after setting seed, the DM produced is classified as straw and is given a value of $200/tonne. The assumption is made that there is no loss in stand density and yield of perennial ryegrass in this treatment due to the large seed bank in the soil due to reseeding. The figure at the bottom of column four is the extra profit gained from the seedling recruitment treatment over the resowing treatment. This value is then added to the cost of the seedling recruitment treatment in column two to give the overall profitability of the seedling recruitment treatment per hectare over a nine year period.

## Discussion

The model budget shows an economic benefit for allowing perennial ryegrass to set seed every 3 years, and relying on seedling recruitment in the following autumn, compared to resowing every 3 years. The potential economic benefit shown is $213/ha over 9 years (Table 1). This management technique can only be achieved with early heading varieties of perennial ryegrass in environments where spring rain finishes early. The chance of an early heading variety producing viable seed is much greater than a late heading variety of perennial ryegrass. Allowing perennial ryegrass to set seed should be carried out in the first year of establishment and then every 3 years afterwards. This strategy will then replenish the exhausted perennial ryegrass seed bank in the soil.

**Cost of pasture renovation per hectare over a period of 9 years**

| Treatment 1 - Input costs* | |
|---|---|
| **Resowing of perennial ryegrass every 4 yrs** | |
| **Costs** | **Per Hectare** |
| **Year 1** | |
| Preparation and Sowing | $150.00 |
| Seed (25kg/ha@$10/kg) | $250.00 |
| Fertiliser (MAP@100kg/ha) | $88.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$538.00** |
| **Year 4** | |
| Preparation and Sowing | $150.00 |
| Seed (25kg/ha@$10/kg) | $250.00 |
| Fertiliser (MAP@100kg/ha) | $88.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$538.00** |
| **Year 7** | |
| Preparation and Sowing | $150.00 |
| Seed (25kg/ha@$10/kg) | $250.00 |
| Fertiliser (MAP@100kg/ha) | $88.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$538.00** |
| **Overall total cost** | **$1,614.00** |

| Treatment 2 - Input costs* | |
|---|---|
| **Allowing reseeding to occur every 3 yrs** | |
| **Costs** | **Per Hectare** |
| **Year 1** | |
| Preparation and Sowing | $150.00 |
| Seed (25kg/ha@$10/kg) | $250.00 |
| Fertiliser (MAP@100kg/ha) | $88.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$538.00** |
| **Year 4** | |
| Value of feed lost: hay-straw price | $2,600.00 |
| Fertiliser (SSP+K 3in1 @ 250kg/ha) | $145.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$2,795.00** |
| **Year 7** | |
| Value of feed lost: hay-straw price | $2,600.00 |
| Fertiliser (SSP+K 3in1 @ 250kg/ha) | $143.00 |
| Post sowing treatments | $50.00 |
| **Total** | **$2,793.00** |
| **Overall total cost** | **$6,126.00** |

| | |
|---|---|
| **Overall profit from Treatment 2** | **$19,861.50** |
| **Overall profit from Treatment 1** | **$19,648.50** |
| **Treatment 2 v 1 profit/ha** | **$213.00** |

| Treatment 1 - Grazing return | |
|---|---|
| **Resowing of perennial ryegrass every 4 yrs** | |
| **Income** | **Per Hectare** |
| **Year 1** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 2** | |
| DM T/ha | 6.75 |
| Value of feed | $2,362.50 |
| **Year 3** | |
| DM T/ha | 4.5 |
| Value of feed | $1,575.00 |
| **Total value of feed** | **$7,087.50** |
| **Year 4** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 5** | |
| DM T/ha | 6.75 |
| Value of feed | $2,362.50 |
| **Year 6** | |
| DM T/ha | 4.5 |
| Value of feed | $1,575.00 |
| **Total value of feed** | **$7,087.50** |
| **Year 7** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 8** | |
| DM T/ha | 6.75 |
| Value of feed | $2,362.50 |
| **Year 9** | |
| DM T/ha | 4.5 |
| Value of feed | $1,575.00 |
| **Total value of feed** | **$7,087.50** |
| **Overall total value of feed** | **$21,262.50** |

| Treatment 2 - Grazing return | |
|---|---|
| **Allowing reseeding to occur every 3 yrs** | |
| **Income** | **Per Hectare** |
| **Year 1** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 2** | |
| DM T/ha | 6.75 |
| Value of feed | $2,362.50 |
| **Year 3** | |
| DM T/ha | 4.5 |
| Value of feed | $1,575.00 |
| **Total value of feed** | **$7,087.50** |
| **Year 4** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 5** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 6** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Total value of feed** | **$9,450.00** |
| **Year 7** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 8** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Year 9** | |
| DM T/ha | 9 |
| Value of feed | $3,150.00 |
| **Total value of feed** | **$9,450.00** |
| **Overall total value of feed** | **$25,987.50** |

**Table 1. The potential economic benefit of allowing pastures to reseed every 3 years. See Discussion.**

*Input cost may vary due to location and seasonal variation.

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