Matching future ryegrass varieties to climate trends in South West Victoria

Anthony Leddin

Valley Seeds, 295 Maroondah Link Highway, Yarck, VIC 3719, www.valleyseeds.com, aleddin@valleyseeds.com

Abstract
The rainfall distribution in South West Victoria in 2014 was marked by a lower than average spring rainfall. Climate change models predict that the occurrence of this kind of event will be more common in this region with less spring rainfall and also warmer winter temperatures. Ryegrass species produce the majority of their pasture biomass around their heading date in spring; therefore it seems wise to match the heading date to the rainfall distribution. Annual and Italian (*Lolium westerwoldicum* and *Lolium multiflorum)* ryegrass varieties may be more suited to a low rainfall spring due to their earlier heading date compared to Italian ryegrass varieties. Recent New Zealand and European breeding programmes for ryegrass has focused on late heading. These new varieties are expected to be less suitable for Australia in the future as the climate changes with less spring rainfall. Therefore a breeding programme targeted for Australian conditions is needed.

Keywords
Westerwolds ryegrass, Italian ryegrass, climate change, heading date, spring rainfall, pasture breeding.

Introduction
The major beef, wool and dairy production areas South Eastern Australia occur in the 500 to 1000 mm rainfall zone. The majority of these areas rely on temperate pasture species to produce fodder over autumn, winter and spring when rainfall is the highest. The rainfall distribution in South West Victoria during 2014 was marked by a lower than average spring rainfall. Climate change models predict that this condition will be more common in this region in the future with warmer winter temperatures (Cullen et al. 2009). If lower rainfall seasons become more common it would be important to gather information on the performance of different species under these conditions to determine their performance under less favourable environments.

Ryegrass species produce the majority of their biomass around heading date therefore it seems wise to match the heading date to the rainfall distribution. Any pasture species with an early to mid heading date would be assumed to have higher growth rates in the period of time when rainfall is not declining dramatically in spring. Some annual ryegrass varieties (e.g. Westerwolds) may be more suited to a lower rainfall spring due to their earlier heading date in comparison to the conventional Italian ryegrasses. The objective of this study was to assess the biomass yields of both annual and Italian ryegrass over a season where the rainfall in spring finished early and determine if early or late heading was most suitable.

Methods
Prior sowing, the experimental area was sprayed with 2 L/ha of Gyphosate (450 g/L active). On 10/4/2014 the area was mowed to the soil surface and then cultivated to a fine seedbed with a rotary hoe and then rolled for sowing. The experiment was sown on 17/4/2014 in a complete randomised block design with four replicates. There were 19 lines of *Lolium westerwoldicum* diploid (LWD) and 25 lines of *Lolium multiflorum* diploid (LMD) in separate blocks. Plot size was 0.8 metres wide by 2.5 metres long. The distance between plots was 15 centimetres and at the end of each plot tracks of a turf perennial ryegrass were sown to divide the replicates. The sowing rate for the diploid varieties was 25 kg/ha and the tetraploid varieties was 33 kg/ha. The trial was fertilised with 20 kg P/ha of Diammonium phosphate at sowing. After sowing the trial was rolled. Early vigour was visually scored 4 weeks after sowing with a score of 1-9 with 9 being the fastest to establish. The first pasture biomass (DM) measurement was taken on 13/6/2017 after plants could not be pulled out of the ground by hand. An electronic pasture probe (Jenquip brand) was used to measure the DM yields. The probe was calibrated using a linear model for each DM measurement. There were 4 DM measurements during the growing season on 13/6/2014, 12/8/2014, 15/9/2014 and 10/11/2014. Predicted means, least significant difference (LSD) ($P<5\%$) and coefficient of variance % (CV) were generated by Genstat (Version 4.1).

Results

The biomass yield of the annual and Italian ryegrass average of the varieties in the trials did not vary greatly (Figure 1). However in the last DM harvest no yield measurements were taken from the Italian ryegrass diploid trial. This was due to growth failure caused by the low rainfall at that time (Table 1). Over the season of growth the annual ryegrasses diploid ploidy types (11020 kg DM/ha) yielded 558 kg DM/ha more than the Italian ryegrass diploid ploidy types (8359 kg DM/ha).

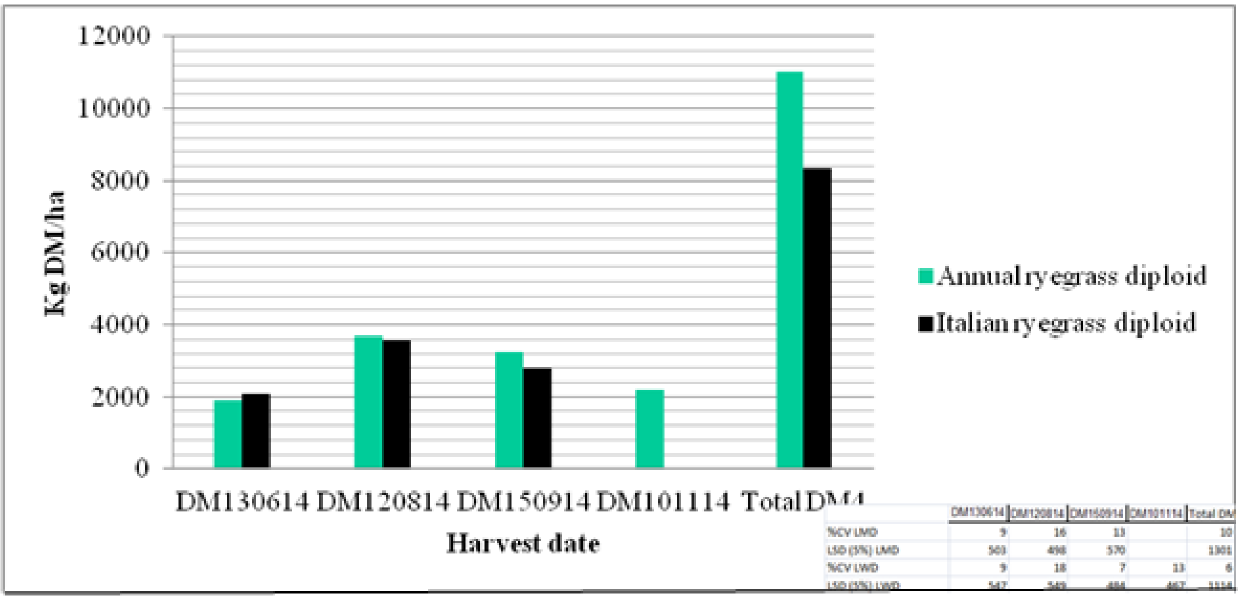

Figure 1. Comparison of annual and Italian ryegrass DM yield at Yambuk, South West Victoria, 2014. *note no last harvest of Italian ryegrass due to poor yield.

Table 1. Monthly average and reliability and 2014 rainfall for Port Fairy, Victoria. Source: Bureau of Meteorology website.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
Average rainfall (mm)	32	29	37	50	68	77	91	87	68	53	44	40	688
Reliability (%)	80	73	80	83	88	92	97	93	96	92	81	82	
2014 rainfall	19	7	56	105	79	108	84	54	25	35	21	25	621

Discussion

The later heading of the Italian ryegrass varieties do not match the rainfall pattern in many areas of South West Victoria in an average year, let alone in a year with low rainfall spring (e.g. as experienced in 2014).

A general guide to the range of heading date of the ryegrass species is that the Westerwolds annual ryegrass varieties head around the end of October and Italian ryegrass varieties head much later from mid to the end of November. In 2014 the annual ryegrass varieties were able to finish their development pattern, from vegetative to reproductive but the Italian ryegrass varieties could not. Hence there was no final harvest for the Italian ryegrass varieties.

The data showing the extra yield achieved by early heading varieties could also be extrapolated to other species such as perennial ryegrasses, with late heading varieties, not being able to produce to their maximum genetic potential biomass with a low spring rainfall. A lack of rainfall at heading time for perennial ryegrass varieties would also have an adverse effect on their persistence (Waller and Sale 2001). A greater number of perennial ryegrass tillers can survive dry conditions over summer if reproductive tillers can produce daughter tillers. If such tillers stay vegetative and do not become reproductive it is less likely that their daughter tillers will survive summer. The ideal heading date for ryegrass in this environment, in an average year, would be the end of October or 0 days heading date. With a greater occurrence of lower spring rains the ideal heading date may have to be brought forward earlier from 0 to -10 days to allow reproductive growth and daughter tiller formation. This should lead to greater plant persistence.

Conclusions

Recent New Zealand and European breeding programmes for ryegrass has focused on late heading. These new varieties are expected to be less suitable for Australia in the future as the climate changes with less spring rainfall. Therefore a breeding programme targeted for Australian conditions is needed.

References

Cullen BR, Johnson IR, Eckard RJ, Lodge GM, Walker RG, Rawnsley RP and McCaskill MR (2009). Climate change effects on pasture systems in south-eastern Australia. Crop and Pasture Science 60, 933-942.

Waller RA and Sale PWG (2001). Persistence and productivity of perennial ryegrass in sheep pastures in south-western Victoria: a review Australian Journal of Experimental Agriculture 41, 117-144.