

Flexible forage systems for variable water supplies

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Introduction

The dairy industry in northern Victoria, Australia is primarily based on the border check irrigation of temperate forage species over the spring to autumn period. Traditionally, dairy cows have grazed the perennial species (white clover and perennial ryegrass) and annual pastures (based on short-lived ryegrasses and subterranean or Persian clover). However, due to a more variable climate – particularly a period where the annual rainfall has been significantly less than the long-term average – the summer irrigation allocations have been substantially lower and more variable than the preceding 20–30 years. Under this climate scenario, dairy farmers are re-evaluating their feed base to ensure that they are optimising forage production under conditions of less water (both rainfall and irrigation - Greenwood *et al.* 2006; Lawson and Kelly 2007).

Research at the Department of Primary Industries at Tatura in northern Victoria is focussing on identifying forage species and management systems that are better adapted to the predicted future climate (of higher summer temperatures and greater plant water stress) than perennial ryegrass. Research on lucerne is evaluating the flexibility of this species to perform when both rainfall and irrigation vary greatly across seasons and years. The aim of research on tall fescue is to develop an effective grazing management system that will capitalise on its high dry matter potential through the summer.

Methods

Lucerne

A field experiment is being conducted at the DPI Tatura Centre in northern Victoria (36°26' S; 145°15' E, elevation 110 m on a red-brown earth or red sodosol), where the effects of a range of different irrigation treatments on the production and water use of lucerne cv. SARDI 7 is being evaluated. The site was established in May 2009 and nine irrigation treatments, which vary in the timing and application of irrigation water over 5 consecutive seasons, are being imposed on the plots.

The treatments are:

- **Treatment 1:** Full irrigation at an interval of 75–90 mm evaporation less rainfall (E–R)
- **Treatment 2:** Fully irrigated until a harvest in January in Years 2, 3 and 4 and then no irrigation until the following irrigation season

- **Treatment 3:** Fully irrigated until a harvest in January Years 1, 2, 3 and 4 and then no irrigation until the following irrigation season
- **Treatment 4:** Fully irrigated until a harvest in November in Years 2, 3 and 4, and then no irrigation until the following irrigation season
- **Treatment 5:** Dryland for 1 year, in Year 4
- **Treatment 6:** Dryland for 2 years in Years 1 and 4
- **Treatment 7:** Dryland for 2 years in Years 2 and 3
- **Treatment 8:** Dryland for 3 years, Years 2, 3 and 4
- **Treatment 9:** Full irrigation, using a sub-surface drip system (SSD), aiming to keep the soil water deficit between 30 and 50 mm.

All treatments plots will be fully irrigated in Year 5 (2013/2014). Measurements made on the plots include: climatic data, plant establishment, dry matter production (DM), nutritive characteristics, botanical composition, plant persistence, irrigation and water run off, soil water content and groundwater depth.

Tall Fescue

An experiment is being conducted on a commercial dairy farm at near Tatura in northern Victoria, Australia to determine the effect of a range of grazing management regimes on the dry matter accumulation, forage removal, species composition, nutritive characteristics and persistence of tall fescue-based pastures. The site on a red-brown earth or red sodosol, was sown to tall fescue cv. Advance Max P in October 2010 and six grazing management systems have been imposed in September 2011 for a three year period.

These treatments are:

- **Treatment 1:** grazed at the 1-leaf stage
- **Treatment 2:** grazed at the 2-leaf stage
- **Treatment 3:** grazed at the 3-leaf stage
- **Treatment 4:** grazed according to the “best-management practices” outlined in Milne *et al.* (1998)
- **Treatment 5:** similar to Treatment 4 but with “lax” grazing over spring
- **Treatment 6:** Perennial ryegrass treatment grazed according to the best management practices outlined for perennial ryegrass (Lawson and Hildebrand 2003).

Results

Lucerne

In Year 1 (2009/10), dry matter yields ranged from 5.0 to 15.5 t DM/ha. Dry matter yields in Year 2 (2010/2011) ranged from 12.2 to 14.1 t DM/ha, with the two treatments not irrigated this year (Treatment 7 and 8) yielding less than all other treatments ($P < 0.005$). Yields in 2010/2011 were lower than expected because the extremely high seasonal rainfall (766 mm – the highest on record) affected site access and resulted in one less harvest. Dry matter yield in Year 3 (2011/12) ranged from 5.2 to 17.4 t DM/ha, again with the two treatments not irrigated this year (Treatments 7 and 8) yielding the lowest dry matter (average 5.6 t DM/ha – $P < 0.05$).

Total plant water use in Year 1 (2009/10) was 6.8 ML/ha greater in the fully irrigated treatments compared with the water use for Treatment 6, that only received a single spring irrigation (14.9 vs 8.1 ML/ha). Total water use (irrigation plus effective rainfall plus depletion of soil water) in Year 2 (2010/11 season) ranged between 10.6 ML/ha for the non-irrigated treatments (Treatments 7 and 8) to 12.7 ML/ha for the fully irrigated treatment (Treatment 1). The total water use in Year 3 (2011/12) ranged between 6.1 ML/ha for the non-irrigated treatments (Treatments 7 and 8) to 13.8 ML/ha for the SSD treatment (Treatment 9).

Tall Fescue

In the first year (September 2011 to August 2012) pasture consumption from the 3-leaf treatment (14.8 t DM/ha) was not different ($P > 0.05$) from the 2-leaf treatment (12.9 t DM/ha) but was significantly higher ($P < 0.05$) than the other four treatments (*viz.* plots grazed at the 1-leaf stage had an average of 11.0 t DM/ha) which did not differ ($P > 0.05$) from each other. Results to date for the second

year (September 2012 to January 2013) again show that pasture consumption from the 3-leaf grazing treatment (8.5 t DM/ha) was significantly greater ($P > 0.05$) than for all other treatments with the exception of the 2-leaf grazing treatment.

Conclusion

This research on both species will continue until June 2014. Results to date from the lucerne experiment have varied across years and have been influenced by rainfall. In Years 1 and 3, when the rainfall was close to average, there was a close relationship between DM production and total water-use. However, in Year 2, under record rainfall, a maximum of 4.1 ML/ha of irrigation water was used and there were only small differences between treatments in both total water-use and DM production. Two more seasons of data will be necessary to fully understand the effect of intermittent irrigation on lucerne productivity as well as to evaluate how this species responds again to full irrigation. Research on grazing management of tall fescue will also continue for another irrigation season so that the advantages and disadvantages of each grazing treatment can be fully assessed.

References

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