Growth and water use of perennial ryegrass and lucerne in summer

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Abstract

The effects of irrigation frequency, and subsoil modification including drainage, on the growth and water use of perennial ryegrass and lucerne in summer were studied. Lucerne yield and water use were much higher than ryegrass, although water use by lucerne declined markedly after harvest. The rate of leaf appearance of ryegrass was not affected by infrequent irrigation, although yield and pasture cover were lower. Water use by both species was higher when frequently irrigated.

Introduction

In irrigated dairying regions of northern Victoria, research is aiming to improve the yields of forages by improving subsoil structure (1,2). In non-modified soils, growth of perennial ryegrass is greater when irrigated more frequently (3). However, for lucerne, irrigation interval has little effect on yield until the cumulative pan evaporation less rainfall (E-R) exceeds 120 mm (4). Where the potential depth of rooting is increased through subsoil modification, forage yield may be less sensitive to irrigation interval (5).

In this paper, we report the response of perennial ryegrass and lucerne to two levels of soil modification and two irrigation frequencies. We expected that there would be an interaction between soil modification and irrigation interval in both the growth and water use of ryegrass, but not for lucerne due to its deeper root system.

Methods

Measurements of the growth and water use of perennial ryegrass (cv. Yatsyn) and lucerne (cv L69) were made on a subset of treatments from a larger experiment (1). Factors compared in this paper are soil management (a control and a soil with subsurface drainage, modified by gypsum and deep ripping) and irrigation frequency (spray irrigated when E-R reaches 45-50 mm and 90-100 mm). The experiment used a split plot design with main plots of each combination of soil management and irrigation frequency. Species were included as subplots. There were three replicates.

The period of intensive measurements spanned two weeks during January 2001. All plots were irrigated on the night of 16 January. The depth of water applied by irrigation, calculated separately for each treatment from neutron probe measurements, was sufficient to return the soil to field capacity. The frequently irrigated treatments only were watered on 21 January. Soil water content was measured every 2–3 days using a neutron probe at nine depths to 1.3 m.

Yield of each species was determined by mechanically harvesting to 60 mm. Ryegrass was harvested on 30 January 2001, after 20 days' growth. Lucerne was harvested on 23 January, after 29 days' growth. In each ryegrass plot, 10 tillers were tagged and the leaves were counted every 3-4 days. Light interception by the ryegrass pastures was also measured every 3-4 days using a ceptometer. Data were statistically compared using analysis of variance.

Results

Harvested yields are presented in Table 1. For ryegrass, soil management had no effect on yield, while the longer irrigation interval nearly halved the yields ($P<0.01$). Lucerne yields were much higher than

ryegrass (not statistically compared) and neither soil management nor irrigation frequency significantly affected lucerne yield, although yields were 0.3–0.5 t DM/ha higher under frequent irrigation.

Table 1: Yield (t DM/ha) of ryegrass (30 January) and lucerne (23 January) under two soil management treatments and two irrigation frequencies.

	Ryegrass		Lucerne	
	Frequent	Infrequent	Frequent	Infrequent
Control	0.96	0.53	3.96	3.44
Drained	1.08	0.53	3.93	3.60

The number of leaves per ryegrass tiller averaged 2.5 at harvest, and was not affected by soil management or irrigation. Light interception by the ryegrass pasture at harvest was lower when infrequently irrigated (P<0.05), being 94% compared with 79%. These differences were more pronounced prior to harvest.

Water use (Table 2) by lucerne after a full irrigation (Period 1) was much higher than that by ryegrass (P<0.001). After the frequent treatments only had been irrigated and lucerne was harvested (Period 2), lucerne water use was not significantly different to ryegrass. Soil management only affected water use in Period 2 (P<0.001). Infrequently irrigated treatments used less water than frequently irrigated treatments in both periods (both P<0.01). There were no significant interactions.

Table 2: Water use (mm) of ryegrass and lucerne over 2 frequent and 1 infrequent irrigation cycle

	Ryegrass		Lucerne	
	Frequent	Infrequent	Frequent	Infrequent
Period 1 (17–21 January) after irrigation of all treatments on 16 January				
Control	29	18	58	53
Drained	40	30	66	45
Period 2 (22–30 January) after irrigation of frequent treatments on 21 January				
Control	33	19	36	30
Drained	46	41	48	39

Conclusion

Lucerne growth and water use was much higher than ryegrass in summer. Longer irrigation intervals decreased the growth of ryegrass, even on modified soils. This yield reduction was due to lower pasture cover, as leaf appearance rates were not affected. As expected, water use by lucerne was much greater than that by ryegrass, except after cutting. The lower water use of infrequently irrigated treatments, even immediately after irrigation when soil water contents were similar, indicates that there were differences in the sward structure.

Acknowledgments

We thank Kevin Kelly and Alister Lawson for their advice, and Geoff Mundy, Kathy Dellow and Stuart Austin for their willing assistance with field measurements. Kate Sargeant's participation in this study was facilitated by a DNRE cadetship while the larger experiment was funded by DNRE and DRDC through Murray Dairy.

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