Production and water use by sub-tropical grasses in south-western Australia

Phil Ward[1], **Sarah Knight**[2], **Phil Barrett-Lennard**[3]
[1]CSIRO Plant Industry, Wembley WA
[2]Mingenew-Irwin Group, Mingenew WA
[3]Evergreen Farming, Belmont WA

Introduction

In south-western Australia, the major cause of dryland salinity is incomplete water use by annual crops and pastures, allowing excess water to leak into the water table. Many studies have demonstrated that the deep roots and perennial growth habit of lucerne (*Medicago sativa*) can reduce or prevent groundwater recharge, by creating a large buffer of dry soil (Ward et al, 2006). However, lucerne is not well adapted to acidic or waterlogged soils (Cocks, 2001), which occupy a large proportion of the wheat belt of the region. Therefore, alternative perennial species are being assessed for their ability to persist and dewater under the Mediterranean-type climate of south-western Australia.

Sub-tropical grasses, such as Rhodes grass (??), are currently being promoted as possible candidates, particularly in the warmer northern parts of the region. In this paper, we examine growth, and the vertical and temporal patterns of water use by a range of sub-tropical grasses (Rhodes grass, digit grass, finger grass, panic grass, setaria, and kikuyu) at a field site on a deep sandy soil.

Materials and methods

A field site was established near Mingenew, 300 km north of Perth, on a deep acidic sandy soil. Various perennial options including annual pasture, bambatsi, kikuyu, lotononis, lucerne (either autumn or spring sown), panic grass (cvs Gatton and Green), Premier digit grass, Rhodes grass (cvs Callide and Katambora), Signal Grass, siratro, Splenda setaria, Strickland finger grass, and veldt grass, were established in a randomised block design with three replicates in 2004. Dry matter production was assessed in June and September 2005, February, June, September and December 2006, and January and October 2007. A neutron probe access tube was installed in each plot to a depth of 4.7 m in April 2007. Soil water content was monitored monthly, with measurements made atdepth increments of 20 cm, starting at 10 cm from the soil surface.

In an area adjacent to the main experiment, a mixture of perennial grasses was established in a 10 m by 10 m plot, and another plot of annual pasture was maintained alongside. Time-Domain Reflectometry (TDR) probes were installed in each plot to monitor soil water content at 15-minute intervals, commencing in October 2004. Depths of measurement were 0.05, 0.25, 0.55, 0.85, 1.25, 1.75, 2.35 and 3.15 m.

Results and discussion

Rhodes grass (cvs Callide and Katambora) and panic grass (cvs Green and Gatton) produced similar biomass to annual volunteer pasture during the winter and spring, and considerably more biomass during summer, producing more than 3 t/ha over the whole year for two years in succession. These four grasses were the standout performers over three years (Figure 1), with production from the other perennial options being much lower. In particular, lucerne production and establishment was very low, and this was related to lucerne's poor adaptation to acidic soils.

Soil water extraction was not closely related to biomass production, as previously observed for lucerne (Ward et al 2006). With the notable exception of the lucerne plots, the presence of a perennial was reflected in the patterns of soil water storage. Water balance calculations for 2007 indicate that drainage from the annual volunteer plots was likely to be around 27 mm greater than from Rhodes grass, panic grass, Premier digit grass, setaria, Signal grass, siratro, or Strickland finger grass, and 13 mm greater than from lucerne, even under the relatively dry conditions experienced (annual rainfall 274 mm up to December 3).

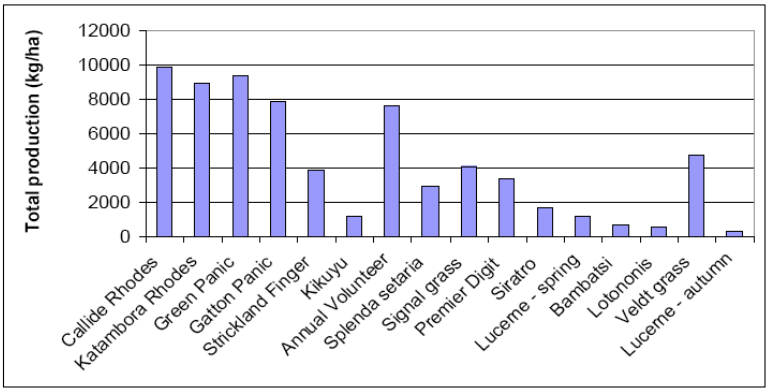

Figure 1 Accumulated dry matter production from a range of pasture species over a 3-year period

In the second summer after establishment, Rhodes grass extracted soil water from as deep as 3.3 m, and dried the soil by 60 mm relative to the annual pasture (Figure 2). Extra water use was associated with a summer rainfall event in February 2006. After this event, the perennial grass pasture used the rainfall, and then continued to extract soil water from deep in the soil profile (Figure 2). In contrast, rainfall from this event was stored in the soil under the senesced annual pasture, and there was no subsequent uptake of deep soil water. This increase in water use is comparable to that measured under lucerne pastures on favourable soil types, and is likely to have a significant impact on groundwater recharge and dryland salinity.

Modelling with LeBuM (Ward 2006) indicates that on deep sandy soils in this region, average leakage beyond the root zone of annual crops and pastures is around 75 mm per year (based on Three Springs climatic conditions on a deep gutless sand). Assuming that Rhodes' grass maintains a soil water difference of around 60 mm (compared with an annual pasture) each summer, a rotation of 3 years of Rhodes' grass, followed by three years of cropping, would reduce average annual leakage to around50 mm per year. If Rhodes' grass was established as a permanent pasture, average leakage would bereduced to about 30 mm.

Leakage reduction of this magnitude, if adopted over a large proportion of the landscape, could have substantial beneficial implications for the spread of dryland salinity in the region (Barrett-Lennard et al 2005). Conversely, the impact on freshwater sandplain seeps could be detrimental. Careful targeting will be necessary to maximise the benefits from the adoption of Rhodes' grass on the sandy soils of Western Australia.

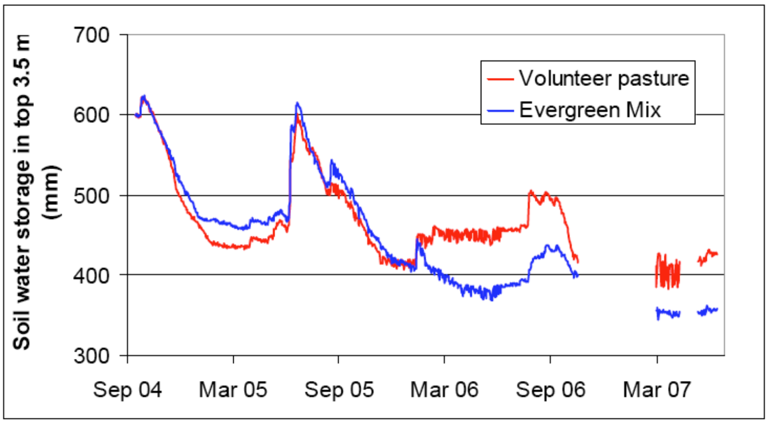

Figure 2 Total soil water storage in the top 3.5 m of soil under adjacent annual volunteer and Rhodes grass (Evergreen mix) pasture

Conclusions

Katambora and Callide Rhodes grass, and Green and Gatton Panic, show potential as productive pastures for the Northern Agricultural region of Western Australia. These pastures have proved to be as effective as lucerne (on suitable soils) for recharge control.

Acknowledgments

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