INFLUENCE OF GRAZING MANAGEMENT ON AUTUMN SOIL WATER DEFICIT BELOW PERENNIAL GRASS PASTURES

C.A. Clifton[1], P.M. Schroder[2] and J. F. Graham[2].

[1]Centre for Land Protection Research, Department of Natural Resources and Environment., PO Box 401, Bendigo, 3550. Victoria, Australia

[2]Pastoral and Veterinary Institute, Department of Natural Resources and Environment, Private Bag 105, Hamilton, 3300. Victoria, Australia

ABSTRACT

An assessment was made of the influence of a Phalaris based pasture which was either continuously stocked, rotationally grazed or spelled during summer on the autumn soil water deficit. Soil remained close to saturation at 120 cm under continuously grazed pasture. Rotationally grazed and summer spelled pastures maintained the soil profile at 120 cm in a dry state during summer and autumn. Differences between years and sites could be partly explained by differences in summer rainfall, solar radiation and the amount of green plant material which grew when stock were excluded over the summer-autumn period. Periodic spelling appears to improve the effectiveness of Phalaris based pastures in dryland salinity management.

KEYWORDS

Grazing management, perennial pastures, soil water, dryland salinity

INTRODUCTION

Replacing native perennial vegetation with a broad-acre pasture based grazing system has contributed to the development and spread of dryland salinity in south-west Victoria. The Mediterranean environment of the region results in mismatch between rainfall and evaporative demand. Creation of a large autumn soil water deficit is critical in minimising the passage of water through the soil profile to groundwater. Community Salinity Management Plans (e.g. Glenelg Salinity Forum 1993) promote the replacement of annual pastures with productive perennial pastures in the expectation that they will help reduce groundwater recharge. Clifton and Schroder (1996) found that perennial pasture dried the soil to a greater depth than an annual pasture by the end of the growing season. However, in the absence of green foliage during summer, rainfall during this period almost fully wet up the soil profile under both pastures. As the pastures were grazed continuously, any green leaf produced by the perennials over summer was quickly eaten, eliminating the opportunity for transpiration. This paper describes investigations to assess the impact on autumn soil water deficits of periodically excluding sheep from perennial pasture during summer.

METHOD

Investigations were carried out on the Dundas Tablelands of south-western Victoria, Australia (142° E, 37.5°S; elevation 250 m). This deeply weathered landscape consists of broad, gently sloping crests and wide valleys. The crests, where these experiments were conducted, typically have deep yellow duplex (texture contrast) soils. Secondary dryland salinity affects much of the valley floor throughout this landscape. Average annual rainfall is 650 mm, with over 60% falling in the cooler months between April and September.

The two sites studied (Cavendish and Balmoral) were part of a national project to examine the effect of a wide range of grazing management strategies on pasture (Avery, this conference). Pastures at the two sites were based on Phalaris (*Phalaris aquatica*) and Subterranean Clover (*Trifolium subterraneum*) and were grazed by merino wethers. Three grazing management strategies were studied; continuous grazing, rotational grazing (2 weeks grazing, 6 week spell), and summer spell (no stock during December-February).

Soil water depletion was measured using gypsum blocks (after Johnston, 1993) installed at various depths in the soil profile (to 120 cm). Four blocks were installed at each of four depths and connected to a single channel of a Monitor Sensors (Caboolture, Qld) gypsum block logger. Values of soil matric potential were recorded daily. Replicate measurements were made with a hand held meter on both sites. Measurements commenced in March, 1994 and October, 1995 at Cavendish and Balmoral respectively. Rainfall was recorded daily at each site and solar radiation at a nearby research site.

Residual green biomass on the rotationally grazed plots was determined prior to each grazing period during the summer and autumn of 1995/6. Four 50 X 50 cm quadrats were harvested to ground level and weighed after drying at 100°C. Pasture composition (based on dry matter) was assessed periodically during the growing season.

RESULTS AND DISCUSSION

Patterns of soil water depletion at 120 cm at the Cavendish site are shown in Figure 1. The results at this depth best reflect the extent to which the pasture management treatments are able to influence the autumn soil water deficit. The soil profile below all treatments remained at or close to saturation (≤30 kPa) for long periods during the cool season in 1994 and 1995. The soil profile dried rapidly to 120 cm during late spring (November and December) 1994 under the influence of warm and dry weather and a vigorous plant canopy in the rotationally grazed and summer spelled plots. This soil water deficit was maintained above 40 kPa until early May in the summer spelled plots and until early June in the rotationally grazed plots. Soil matric potential below continuously grazed pasture remained close to saturation (<40 kPa) for the entire study period.

Rotationally grazed and summer spelled pastures dried the soil profile to a greater extent than the continuously grazed pastures during the following summer, but the differences were not as pronounced as in the previous year. December to March rainfall was greater during the second year (112 mm c.f. 92.6 mm) and average daily total solar radiation lower (16.0 MJ/m^2/d c.f. 20.4 MJ/m^2/d). Despite the reduced extent of soil water depletion, matric potentials in excess of 100 kPa were maintained at 120 cm until at least June, 1996 under rotationally grazed and summer spelled pastures.

Measurements of soil water depletion at the second site (Balmoral; not shown here) were consistent with those at Cavendish, although the difference between treatments was more subdued. This may be due in part to the greater summer production (and hence leaf area index) at the latter site. Average residual green biomass at the end of each spelling period was 57 kg/ha of dry matter at Cavendish and only 28 kg/ha at Balmoral.

No green foliage was present on continuously grazed plots between mid-December, 1995 and the following break of season in about April, 1996 (similar patterns were observed, but not measured during the previous summer). Further, the perennial species (Phalaris) made a lesser contribution to the pasture sward under continuous

grazing than under rotational grazing or with spelling in summer (Graham unpubl. data).

This work supports the contention of Clifton and Schroder (1996) that, at least in the Dundas Tablelands environment, continuous grazing of Phalaris based perennial pastures is not consistent with their proposed role in reducing groundwater recharge. Partial or complete spelling in the period of high evaporative demand in summer results in a longer effective growing season for the perennial species, greater abundance of those plants in the pasture sward and improved capacity to dry out the soil profile. Maintaining a greater soil water deficit into autumn and early winter should result in reduced levels of groundwater recharge relative to continuously grazed perennial pastures.

REFERENCES

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Figure 1

Changes in soil matric potential at 120 cm below continuously and rotationally grazed and summer spelled perennial pastures at Cavendish, Victoria, Australia.