The influence of drains and perennial pastures on soil-water-nutrient dynamics of texture contrast soils down a toposquence at Keyneton, South Australia.

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Abstract

Land and water degradation issues such as salinity, acidification and eutrophication are all linked to the movement of water through the landscape. All are indications of a system that is no longer in equilibrium, with excess water draining beyond the root system in most agricultural settings, and in many instances leaching significant amounts of nitrate and other nutrients along with it. This study looked at quantifying some of these water and nutrient fluxes in a sloping duplex catchment, and examined the role of drains and perennial pastures in their potential to mitigate degrading processes.

In low and average rainfall years, lucerne was found to produce significantly more dry matter than phalaris and cocksfoot down a typical Adelaide Hills’ toposequence. Lucerne roots also penetrated deeper into the subsoil utilising water from a greater region of the soil profile including underlying sandstone. Recharge under lucerne was low (<2% of rainfall) compared to the other two perennials (>10% of rainfall).

The performance of lucerne, in terms of both herbage productivity and recharge reduction, was unexpected on these soil types. The use of lucerne in these environments should be promoted. A perennial legume better adapted to salinity and waterlogging is needed for toe-slope soils.

Drain flows from these pastures were dominated by throughflow, highlighting the importance of lateral flows. Drains removed up to 10% of rainfall in an average rainfall year. Minimal flows were recorded in below average years. Drainage in the soils varied according to toposequence position, with vertical drainage in the upper (reddish) soils, and lateral flow more prevalent in the mid and toe-slope (yellow/grey/white) soils. Drainage from cocksfoot and phalaris was up to twice that from lucerne.

Significant concentrations of nutrients were recorded in drainage water, with DOC and nitrate concentrations higher in throughflow, and phosphorus only slightly higher in overland flow. Nitrate concentrations were highest under lucerne (up to 67 mg/L) and exceeded recommended standards for drinking water. Phosphorus mainly moved in the dissolved state and is therefore likely to enter local streams.
The results have implications for the management of water in these agricultural landscapes. Replacing annual, or shallow-rooted perennial, pastures with perennials like lucerne can reduce recharge to levels more approaching that under native vegetation and at the same time provide graziers with increased pasture productivity. The use of drains can be effective in intercepting surface and through flow on these duplex soils. However, the drainage water contains high levels of nitrate and DOC, and its careful disposal is required if drains are to be a sustainable option in this landscape.