USING LEY PASTURES TO IMPROVE INFILTRATION

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Abstract

Cropping systems in the cereal cropping areas of south-eastern Queensland and northern New South Wales have resulted in run-down of soil infiltration capacity. We measured the effectiveness of pasture for ameliorating degraded soils. The response of three soil types, previously cropped for more than 20 years, to period of pasture was characterised. Change in hydraulic conductivity of surface seals, and change in saturated hydraulic conductivity of the 10-20 cm deep soil layer was measured. Pasture successfully improved hydraulic conductivity of these two soil layers for soils with more than 35% clay, but the rate of amelioration varied. The improved soil structure was quickly lost if intense tillage is used when the ley is re-cultivated.

Keywords: Soil structure, infiltration, pasture

?Soil structure in the cereal cropping areas of south-eastern Queensland has been degraded as a result of continuous cropping (1). Degraded soil structure causes restricted water entry which leads to less efficient storage of rainfall and subsequent reduced crop production. One practical way to improve soil structure, and hence infiltration, is the incorporation of a pasture or legume ley into existing cropping systems. In the longer term, improved infiltration can lead to increased levels of production because of more efficient use of rainfall (3).

Leys add organic matter to the soil and encourage cracking and soil faunal activity. Increased organic matter can lead to improved soil aggregation and stability under rainfall, particularly if cover is maintained on the soil surface. Cracking, root penetration and soil fauna all encourage the formation of macropores, vital for improved infiltration. Increased aggregation, stability and macroporosity naturally lead to improved infiltration while the ley is in place, and also after the ley has been returned to cropping.

Methods

Measured soil permeability are presented here for three soil types - Sodosols, Light (35-55% clay) and Heavy (> 55% clay) Vertosols. Soils were measured after varying periods of cropping and ley pasture and relationships describing the expected behaviour of the soils to cropping and ley rotations were developed. The predominant cropping practice consisted of tillage over a fallow for weed control and to prepare a seedbed, with one summer or winter crop grown per year. Measurements of infiltration were made several times during a six year period. Measurements were normally made in May to August.

Sites in ley pasture had been cultivated for at least 20 years prior to establishment of a ley. Pastures were a mix of improved and native pastures containing *Cenchrus ciliaris* (buffel grass), *Bothriochloa* cv. (blue grass), *Dicanthium sericeum* (Queensland blue grass), *Chloris gayana* (rhodes grass), or *Setariaporphyrantha* (purple pigeon grass). Leys were grazed. Stocking rates were not controlled, and at times pastures suffered considerable trampling and vegetation denudation from sheep and cattle.

Permeability of the surface (0-10 cm) and sub-surface (10-20 cm) soil layers were characterised. Hydraulic conductivity of surface seals, K_{seal}, was measured on disturbed soils in the laboratory with a rainfall simulator and tensiometers (2). Soils were transported and stored in drums and air dried prior to testing. Saturated hydraulic conductivity of the 10-20 cm soil matrix, K_{matrix}, was measured in the field with disc permeameters (1), (4).

Results and discussion

K_{seal} and K_{matrix} declined quickly with period of cropping (Fig. 1 and 2). From an undisturbed condition, K_{seal} declined by half in less than 6 years. K_{matrix} declined in a similar fashion, but at a slower rate (< 13 year half-life). Steady state values of K_{matrix} were higher in the Heavy Vertosols than the other two soils.

Fig. 1 and 2 also show the response of the three soils to a ley rotation, imposed after 30 years of cropping. A five year pasture followed by five year cropping rotation improved K_{matrix}, in the longer term (Fig. 2). For the surface seal, though, an initial 10 years of pasture followed by a 5 year pasture/3 year cropping rotation was not adequate to improve soil condition in the longer term (Fig. 1).

The results given here indicate that leys have benefits for infiltration. It is also likely that improved infiltration will lead to benefits such as reduced erosion and improved economic gain as a result of improved soil water storage and crop growth.

Leys, however, are not the only tool that should be used to maximise infiltration. For soils that tend to form seals and crusts when bare, maintenance of surface cover, as well as incorporation of a ley rotation, is important to improve infiltration.

Ley effectiveness varies depending on soil type, climate, ley composition and management. For implementation on-farm, the duration and composition of a ley need to be customised for soil type and climate. Grazing also will most likely influence ley effectiveness. Leys need to be repeated regularly and incorporated into an overall cropping system, as the benefits of a ley are quickly lost with the re-commencement of intense tillage.

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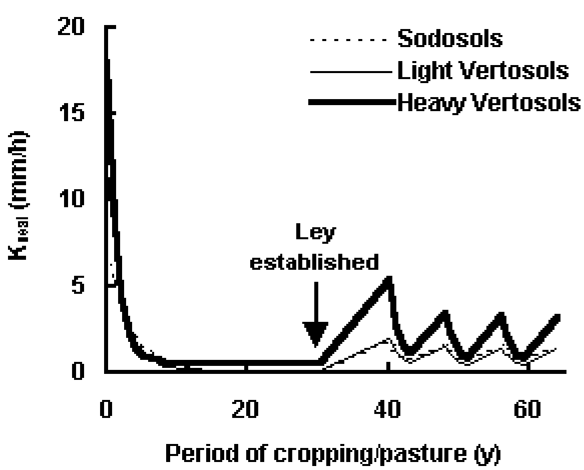


Figure 1: Effect of a pasture ley on permeability of the surface seal on degraded soils.

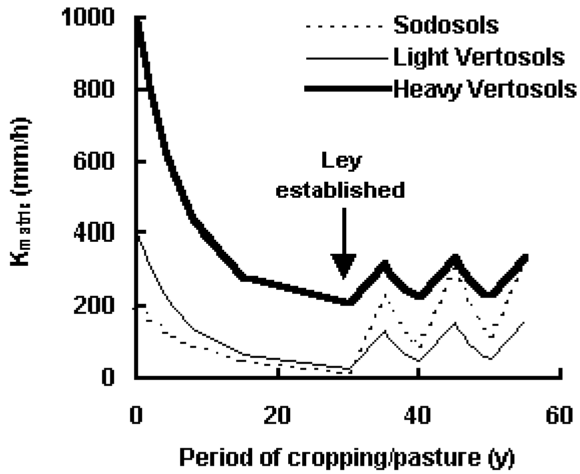
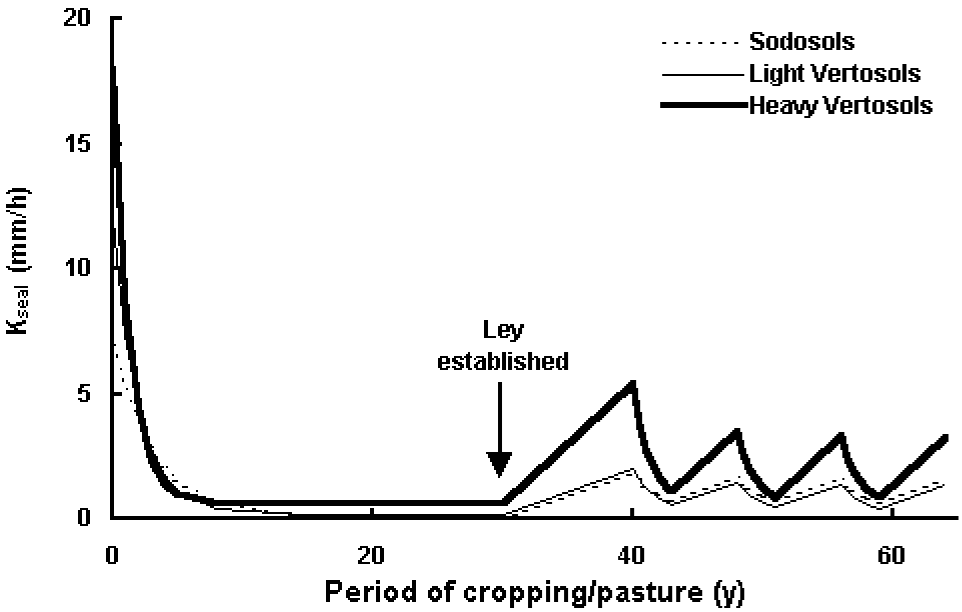


Figure 2: Effect of a pasture ley on permeability of the 10-20 cm soil layer of degraded soils.



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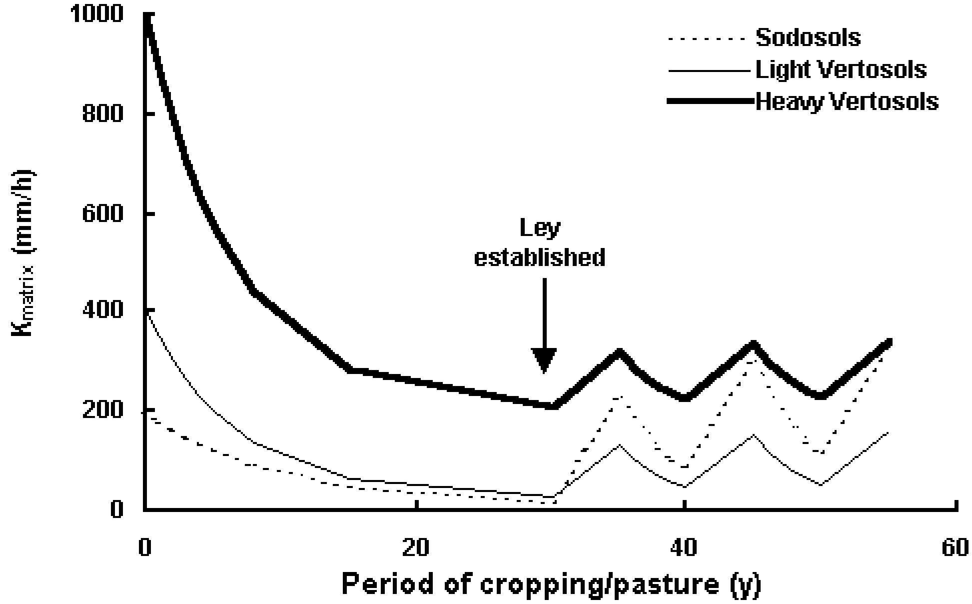

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