

Vivonne Bay Drainage Trial

Background

Ironstone soils have a range of limitations to crop root exploration and as a result water use and yield. Hard gravel and impermeable clay layers below the top 15cm can cause seasonal perched water tables and waterlogging is the result.

Following consultation with the Island's Graingrowers' Association it was decided that a demonstration site would be established on the Pontifex property at Vivonne Bay to test the ability of a range of drainage treatments to improve crop yields in soil prone to waterlogging. We also wanted to investigate the potential environmental effect of these drainage treatments by monitoring soil profile moisture, drainage volume and water table depth and salinity.

What was done

Soil Properties

We took soil samples from across the drainage site and in a 1.5 m deep soil pit. We measured a range of physical and chemical soil properties to identify soil factors that are likely to limit crop growth. We used these measured properties, and a state government data set to develop a soil type map that shows the relevance of results of trials on this soil type to the Kangaroo Island region.

Drainage Treatments

The following drainage treatments were installed in April 2007.

Table 1: Drainage treatment details

Drainage Treatment	Spacing (m)	Depth (cm)
Raised Bed	8	50
Gravel slot	8	50
Gravel Mole	8	50
Control	0	0

Hybrid canola 45Y77 was sown at 2 kg/ha, with 10" row spacing in the first week of June across all treatments. The site was harvested on 30th of November.

Water Monitoring

We installed a rainfall and temperature gauge to measure climatic factors, piezometers to measure the depth and salinity of the perched water table, moisture probes to monitor soil moisture down the soil profile, and tipping-bucket flow-sensors to monitor drainage over the growing season.

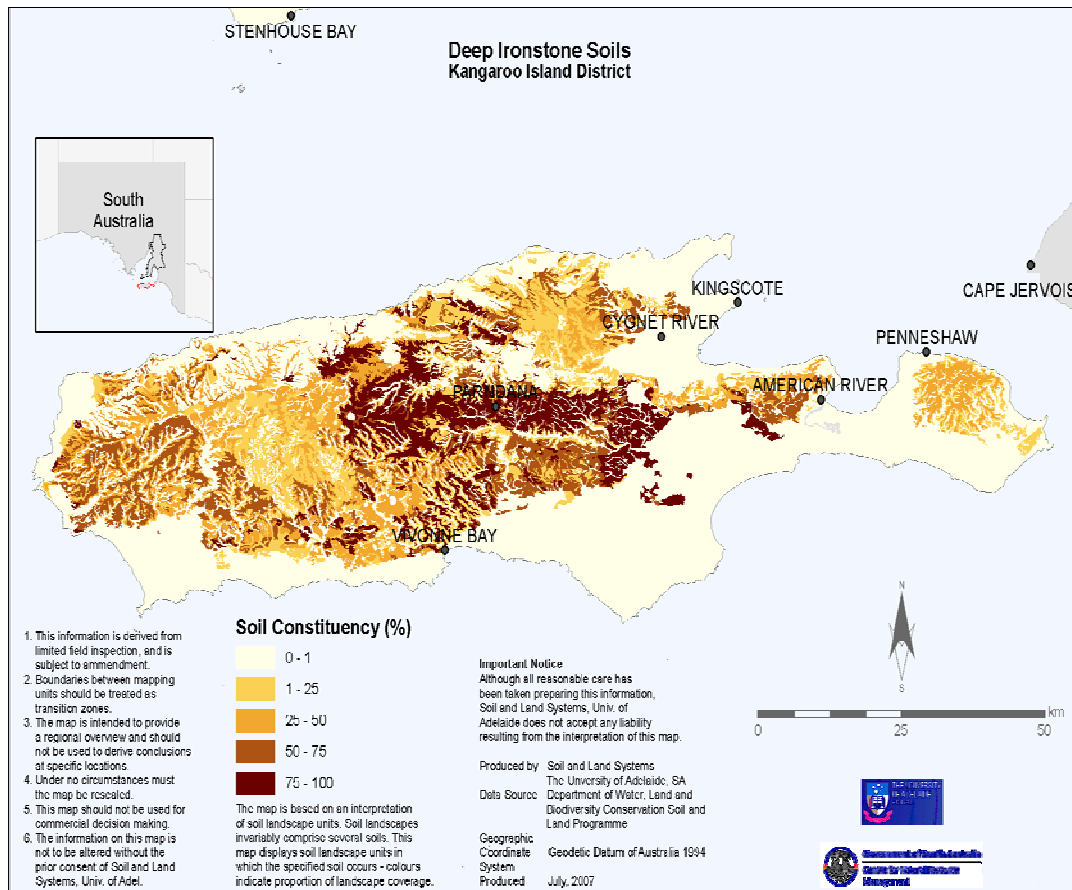
Results

Soil Properties

The main constraints of the ironstone soil type were found to be the poor drainage due to impermeable layers. This soil is mildly acidic with a pH of 5.9 in water. The soil is quite saline at depth with a high concentration of chloride in the clay layer. The ironstone soil type map is shown overleaf. The map shows that a significant proportion of central Kangaroo Island is occupied by ironstone soils. Most treatments yielded very similarly to the undrained control, in a growing season where there was not a prolonged period of waterlogging in the undrained control. The lowest yielding treatment was the gravel slot-drains. This is also the most expensive treatment to install and drained the most water in 2007.

Table 1: Canola Yield with different Drainage treatments

Drainage Treatment	Canola Yield (t/ha)
Raised Bed	2.89
Gravel slot	2.20
Gravel Mole	2.86
Control	2.79



*Figure 1. Deep Ironstone soils in the Kangaroo Island District.
Drainage Treatments*

Water Monitoring

Climate

The growing season (May-November) rainfall was 357mm with an average temperature of 12.2°C, maximum temperature 31.2°C and minimum temperature 0.6°C.

Piezometers

The perched water table was closest to the soil surface on the 2nd of August, 28cm from the soil surface in the raised bed treatment and 37 and 56 cm from the soil surface in the gravel slot and gravel mole treatments respectively. The salinity of the perched water table was highest on the 30th of August with total dissolved solids averaging 3708 ppm (5.8 dS/m) across treatments. There was no perched water table measured above 1m from the soil surface after the 30th of August.

Soil moisture probes

An example of the soil profile moisture monitoring is given in Figure 2. The soil moisture monitoring showed the effect of the drainage on the soil profile moisture, where the profile filled to a saturation point, after which the profile drained. This pattern did not occur after the end of August when drainage did not occur.

Tipping bucket flow meters

The volume of water drained for each treatment was only recorded for August in 2007. Unfortunately technical issues prevented the flow meters operating before 1st of August and the lack of follow up rain meant that no drainage occurred after 31st August.

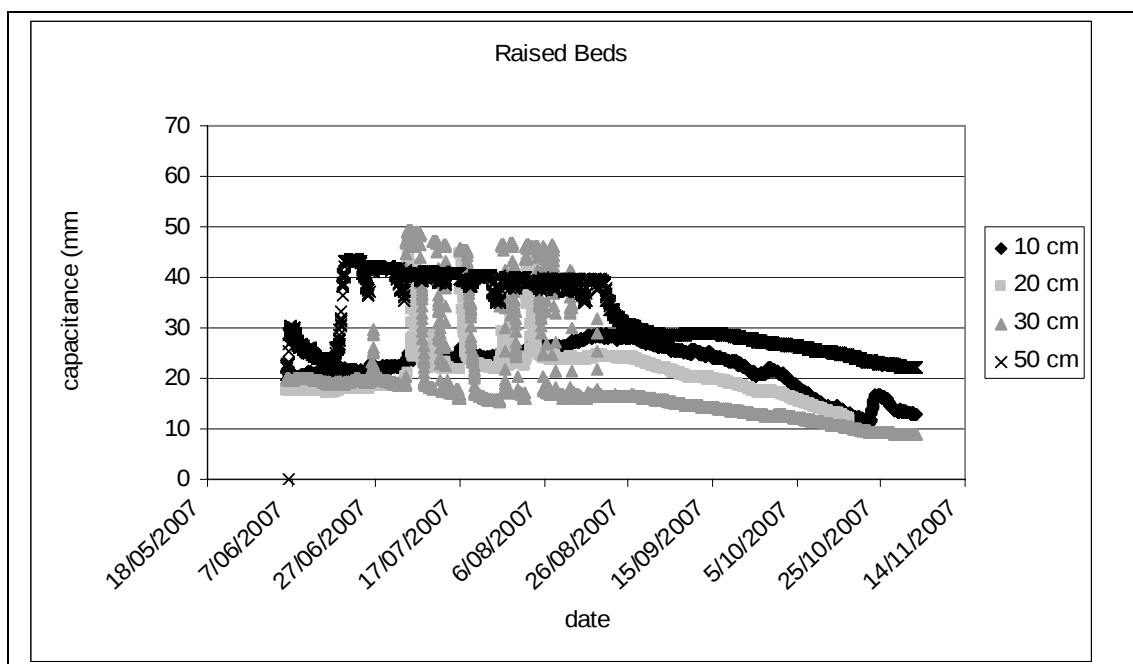


Figure 2. Soil profile moisture measured using capacitance probes in the raised bed treatment.

The gravel slot treatment had 4 times more water drain from it than the gravel mole treatment and 10 times more than the raised bed treatment.

Table 2: Estimated Amount of water drained from each treatment (L/ha) in August, 2007.

Drainage Treatment	August Drainage (L/ha)
Raised Bed	160
Gravel slot	16620
Gravel Mole	3360

What next?

In 2008, delving and conventional mole drains will be installed. We will refine our monitoring techniques using lessons from the 2007 growing season. The site will be sown to wheat and monitored again in the 2008 growing season.

Funding/Sponsors

- Centre for Natural Resource Management (DWLBC project 054129)
- National Landcare Program
- Pontifex family

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Take Home Message

- Most drainage treatments did not cause a yield penalty in 2007 when waterlogging was not a constraint to cropping
- The gravel slot treatment had the lowest yield in 2007, drained the most water, and was the most expensive to install
- We now have a site established to evaluate a range of drainage treatments for their effect on crop yield and the amount and quality of water draining from the paddock