

Non-wetting to high performing: Improving sands on Yorke Peninsula



Damien Adams of Redwing Farm at Arthurton, Yorke Peninsula.

Background

Damien Adams (Redwing Farm) and family purchased their Arthurton property in 2019 after having leased it for several years. Large areas of non-wetting sandhills had historically caused poor crop establishment and productivity. Clay spreading by the previous owner 30 years prior had improved some sandhills on the farm to productive cropping land, and this commenced Damien's interest in clay spreading. Starting in 2017, he began utilising clay spreading and ripping and spading to improve the productivity and sustainability of the farm's sandy soils. The goal was to run the property as a wheat-lentil rotation block.

He has now implemented a successful soil management program within his farming system.

About the area

The property is located near Arthurton, on the Central Yorke Peninsula. The landscape contains sandhills, sandy loams over red yellowish clay and calcareous clay loams. In early 2023 a soil profile on the property was characterised (Figure 1). The profile is a sandy loam over clay with a moderate to low inherent fertility. The topsoil is water-repellent.

What happened?

Why clay spread?

Within the sandy landscape zones of the Yorke Peninsula such a SW of Arthurton, Stansbury Scrub (east of Minlaton) and Sandilands there is a potential of these areas to benefit from delving and clay spreading.

On Damien's property, upon purchase the sandy rises were achieving wheat yields of 1.5 t/ha.

Following significant claying efforts in 2017 and 2019 these areas now achieve wheat yields of 4.5 t/ha. In a period of high grain prices, the treatment costs were paid for within the first season.



Figure 1. Soil profile on Damien's farm. Note the bleached sand layer at 14-25 cm and the reddish-yellow clay at depth.

These yield gains were made possible by overcoming water repellent sands, reducing wind erosion, improving soil fertility and overall available water holding capacity.

The **available water holding capacity (AWHC)** is the amount of water available to plants, which can be held between **field capacity** and **permanent wilting point** (Figure 2). It is colloquially referred to as the 'bucket size'. The AWHC in the characterised profile was 81 mm.

Soil texture (the proportion of sand, silt and clay) is directly linked to the AWHC.

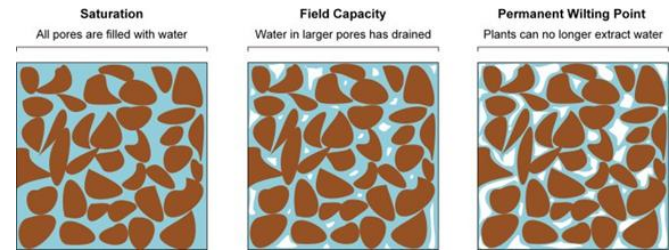


Figure 2. Soil water content concepts. Saturation, field capacity and permanent wilting point. Source: Datta et al. 2017

Sands have a limited capacity to store water and nutrients (small bucket), and commonly are water repellent. However, what water sands do hold, is readily available to the crop.

Clays have a high water and nutrient storage capacity (large bucket), but water is held more tightly and can be difficult for plants to access.

Mixing clays into sandy soils can increase the 'bucket size' by providing greater water storage ability. Claying has shown long-term (>20 years) positive effects on cropping land in several regions of South Australia. At Arthurton, Damien has observed the positive effects of claying for more than 15 years (Figure 3).



Figure 3. Clayed land on Damien's farm. Left: Clayed 2 years prior. Middle: Untreated. Right: Clayed >15 years prior.

Soil amelioration in practice: 8 years of lessons learned

Sourcing the materials

Proximity to a clay source can be a major barrier to those wanting to ameliorate sandy rises. Clay sources can be assessed by using

tools such as post hole diggers or front-end loaders.

As a rule of thumb, if an appropriate clay source is within 500 mm of the soil surface it may be delved (some modern machines can go deeper). If the clay is deeper than this then clay spreading may be the only option.

Ideally it is best to spread the clay well before seeding. This gives time for the clay to breakdown on the surface. The clay can be incorporated throughout the soil profile by ripping or spading.

It is uneconomical to cart clay from more than 400 metres away from the treated area (Grocock, personal communication, 26/06/2025).

Because the previous owners had clay spread years prior, Damien had the knowledge on where clay was located, and how deep it was in the profile.

What's in a soil test?

Having access to a clay source is a major benefit, however not all clays are equal. Damien learned this early on in his endeavours after spreading a "grey clay" on several sandhills, which was later found to contain high levels of calcium carbonate and consequently a high pH. This caused the tie-up of essential plant nutrients, especially phosphorus, on these rises. Zinc and manganese can also get 'tied-up'.

Damien now stresses the importance of "knowing your clays" to avoid creating issues.

Soil testing is crucial to understand the benefits and risks of spreading different clays. Clay properties can affect the soil physical, and chemical properties and prior to any spreading operation, the clay(s) should be sent for a nutritional analysis. A list of properties to test for is included in Table 1.

Damien considers himself fortunate having access to "reasonable clay" in the flats on the property and has since started utilising the reddish/yellowish clays on his property, believing it was worth searching for the better clay pits.

Table 1. Soil properties to test for prior to spreading clays.

Soil property	Description
Boron	Toxic when exceeding 15 mg/kg for most crops (5mg/kg for sensitive crops).
Carbonate	High levels (>8%) increase soil pH and can reduce the availability of phosphorus, zinc, manganese and copper. Most crop roots are restricted in clays with >20% carbonate.
Exchangeable Sodium Percentage (ESP)	Excess sodium (sodic) causes soil to disperse when wet and set hard when dry. ESP >6 is sodic. Dispersion tests are a way to measure the effects of sodicity. Dispersive clays are good for clay spreading.
pH	Affects nutrient availability. Low pH (5.5 and less) indicates soil acidity and high pH (8 and above) indicates alkalinity. pH below 5.5 and greater than 8 can tie up plant nutrients.
Salinity	Yields of many crops are affected with ECe values of 4 dS/m and above.

Incorporation for best results

Clay is best incorporated by spading. This is key to improving soil properties and allows for greater mixing throughout the profile. *Figure 4* shows the difference in moisture retention in incorporated and unincorporated topsoils.

Table 2 shows the chemical properties of soils collected from Damien's farm in 2025. The samples were collected from a sandy rise previously planted to saltbush, which had been burned in a bushfire in 2019 and since been removed. The rise has since been clayed.



Figure 3. Topsoil from a sandy rise on Damien's farm. Left: Spaded on the day of the photo. Right: Spaded immediately post-claying and once more on the day of the photo. The crimping shows the increased WHC gained from spading.

Parts of the rise had been ripped to 450 mm and others had been ripped then spaded.

Soil pH results for the untreated sand were inconclusive, however previous testing has found the sandy topsoils on Damien's farm to be acidic ($\text{pH} \leq 5.5$). Additions of alkaline clay increased the soil pH. Ripping by itself increased the pH slightly more than ripping followed by spading.

The clay was highly sodic. Sodicity can be beneficial for clay spreading as it allows the material to disperse and cover more surface area when wet. Sodium was diluted to acceptable levels in the spaded area however may need monitoring to keep the ESP below 6%.

Boron was increased by clay additions but within an acceptable range.

Table 2. Soil test results from claying treatments on Damien's farm in 2025.

Soil	pH	Boron	ESP (%)
Sand (untreated)	N/A	0.2	3.2
Clay (spreading material)	8.3	7.4	22.8
Rip only	8.4	5.5	18.2
Spade + rip	8.2	1.3	4.8

Damien describes that leaving clay unincorporated on the surface results in an unfavourable topsoil environment for the crop. It is particularly important to incorporate clay when applied at high rates ($>250 \text{ t/ha}$), as otherwise this will create a significant "crust" layer on top of the soil surface which is difficult for plants to grow through (5).

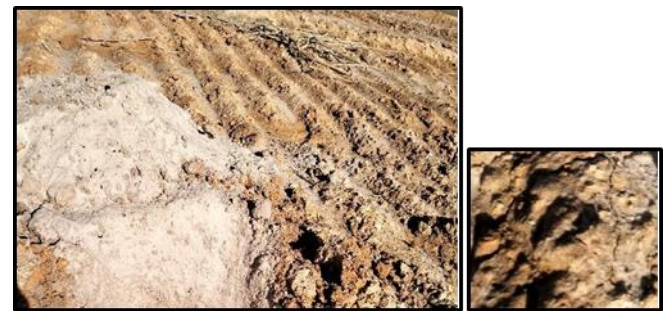


Figure 4. Clayed (unincorporated soil) and the clay crust on top.

Incorporating soil amelioration into the farming system

Eight years on, Damien and his team have since done more clay spreading, spading and ripping. Now a solid part of the farming system, Damien states that the lentil phase is "generally the best indicator" of any poor performing soils which require amelioration, which will be done prior to the next cereal phase.

Conscious of soil stability, Damien plants a barley crop every five years for high biomass and added erosion protection.

Soil amelioration comes with challenges. Proximity to an appropriate clay source and the economics of transporting the material are major considerations. Contractor availability is another limitation.

This season, Damien made the decision to purchase his own 3m Farmax spader due to difficulties finding a local service provider. Sourced from the Netherlands, the machine mixes soil to a depth of 450 mm, and has a capacity of 1.8 ha/hour ($\sim 4 \text{ km/hour}$ working speed). A high upfront cost, it will allow greater flexibility for future operations on the property.

Damien also notes that having access to a track tractor is ideal as regular tractors can

become bogged in the powdery topsoil after treatment.

Current and future goals

In 2019 Damien hired a local contractor who operated a spader with a seeding attachment towed behind and was “blown away” by the results. This configuration is particularly useful in dry springs, when crops fail to emerge despite significant moisture in the profile below the seedbed (Figure 6).



Figure 6. Crop emergence (without clay spreading).

Damien is not finished learning – going forward he would like to investigate ways to raise the good-quality clays underlying bleached sands on his property. He is considering using a delver for this operation, followed by his spader.

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