
# Salinity and potato production

## Impact of groundwater quality on management of centre pivot grown potato crops

1. Monitoring for improved management
2. Know your salts to better manage potato nutrition
3. **Managing hydrophobic soils in potato production**
4. Organic soil amendments, biologicals & biostimulants

**The state of South Australia is the largest producer of potatoes in Australia, growing 385,000 tonnes annually and 80 per cent of Australia's fresh market potatoes.**

**This fact sheet is the third in a series of four on salinity and potato production in South Australia.**

**In this fact sheet, we explore the impact of hydrophobic soils on potato production and options for growers to assist with their management to improve potato yields.**

## Hydrophobic soils in South Australia

Soils can vary in the major potato growing regions of South Australia, ranging from deep sands through to shallow sands and loams over light clays. This variability not only occurs within each region, but also on a much smaller scale in individual pivots.

Growers say a major limitation to potato production is the sands being cropped and their hydrophobicity, or inability to wet easily. Hydrophobic soils repel water due to waxy organic compounds that coat the soil particles, often leading to run-off from the mounds before it can infiltrate to where the plant roots require it (Figure 1). This can lead to excessive quantities of irrigation water being applied in order to wet soils sufficiently prior to sowing. Sandy soils are most susceptible to water repellency.

*Figure 1: Irrigation water pooling inter-row having run-off from the potato mound.*

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# The effects of hydrophobic soil on potato production

## Poor water infiltration and mound degration

The application of excess irrigation water in South Australia is costly to growers. Irrigation water needs to reach the root-zone of plants to make every dollar count. Nearly all irrigation water supplies in South Australia are saline, so every megalitre applied is adding salts to the soil, and potentially scorching plants along the way.

Rising temperatures in Australia are adding further stress to the system. Temperatures in excess of 40 degrees during summer greatly impact potato production. This makes it even more difficult to keep soil moist for developing tubers, or the ability to flush salts from the root-zone.

The inability to maintain soil moisture levels in hydrophobic sandy soils also leads to significant slumping and degradation of potato mounds. This can be seen in Figure 3 during the early stages of growth. This loss of mound structure and blowing of sands can cause physical damage to emerging plants, but more importantly, has been found to significantly decrease marketable crop yields by 30 per cent through elevated numbers of green potatoes for both fresh and processing markets.

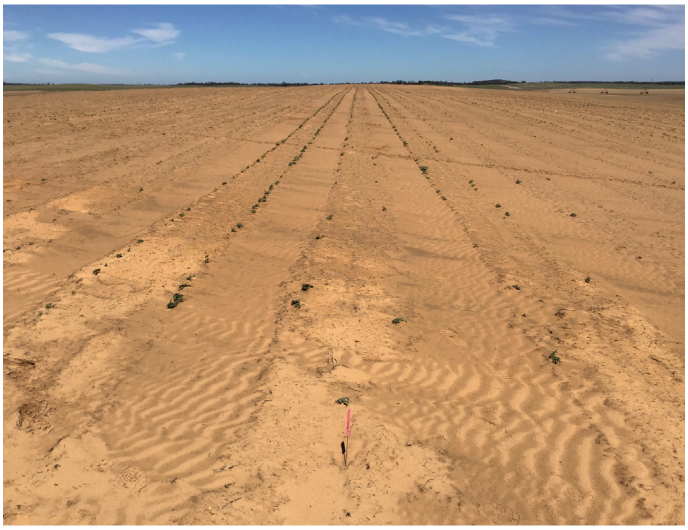

*Figure 3: Wind blown sands and degraded potato mounds occurring in deep sandy soils of the Mallee.*

*Figure 2: Examples of tuber damage and skin blemishes occurring to fresh and processing potatoes from uneven watering.*

## Tuber damage

Tuber damage can come in many different forms, a result of uneven water penetration – whether too much or too little received by the tubers. Misshapen tubers are a common result, as are retained stolons and 'lady shaped' tubers, growth cracks, and raised and burst lenticels (see Figure 2). Raised and burst lenticels can then become wounds or points of entry for disease to occur. While misshapen or blemished tubers directly affect fresh market crop yields, more severely affected processing tubers may also lead to reductions in crop yield. Common scab can also result from insufficient soil moisture levels during early tuber development, particularly in light sandy soils.

Minimising the risk of tuber damage and associated decreased yields from hydrophobic soils is achievable with applied soil management practices.



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## Cost effective management options for hydrophobic soils

Cover cropping and the inclusion of green manures is by far the preferred long-term method for managing hydrophobic soils.

This method requires you to increase soil organic matter levels and soil biological diversity by adding green manure crops into your rotation. The inclusion of green manure cover crops requires forward planning to ensure you have sufficient time to grow your crop, the resources and equipment for establishment, termination and incorporation, sufficient water allocation to irrigate your cover crop, and importantly the most suitable cover crop to deliver timely results without hosting potential diseases or pests. A great long-term option, but not always feasible or cost effective for growers.

> Sandy soils by nature can respond very quickly to the addition of organic matter. Soil carbon levels increase, soil resilience improves and subsequent crop yield will improve.

Another method is to add composts to help increase soil organic matter levels. For composts to be cost-effective, a local source is required to reduce transport costs. It is crucial you understand the nutrient analysis of local composts to ensure you are not adding additional harmful salts to your soil.

# Short-term options

While long-term options to address hydrophobicity may not be viable for many areas in South Australia, a short-term option is through the use of soil wetting products and practices. There is a plethora of products on the market, so the key is to understand how they work and how best each may suit your situation.

## Claying

Adding clay to sandy soils is one management practice that has been used to increase soil surface area and minimise the water repellency of soils. In highly sandy soils, significant quantities of clay could be required to reduce the impact of hydrophobicity, adding substantial costs on top of those to establish a crop. While claying may contribute to some long-term benefits, sandy sites are still likely to succumb to wind erosion and uneven watering within potato mounds.

## Gels and crystals

Gels and granules can be added to the soil to store water, increasing the water holding capacity of your soil. Such gels have the capacity to store large volumes of water, increasing the immediate quantity of water available to your crop, potentially increasing the time required before the next irrigation. However, once these granules and gels dry out, they will no longer assist with holding water within your root-zone. Importantly, these products will not help to alleviate the hydrophobicity of your soil, and you must first be able to sufficiently water your soil to gain this result.

## Soil Wetting Agents

Soil wetting agents assist with water penetration of hydrophobic soils by effectively stripping the waxy residues from sandy soils, lowering surface tension of the water and allowing penetration through pore spaces. The key is to find a suitable product that is safe and easy to use, along with being cost effective.

# Which products & practices?

There are many products and practices that can assist with the management of water repellent soils but it is important to understand their mode of action and select your management option accordingly. Ensure the product you select is backed by strong research and development.

Product price can vary so look at the upfront cost compared to rates of application required per hectare and examine whether the product can be introduced cost effectively into current production systems.

Many other input costs and savings could also be gained when water repellency management is applied, such as:

- Cost savings from reduced water volumes applied to wet soils up
- Reduced costs in fuel or power to run irrigator pumps
- Reduced volumes of harmful salts added to soils
- Likely improved efficacy of herbicides and fungicides applied given improved uniformity of wetting assisting the uniformity of distribution of products.



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# Soil conditioner product trial

Recent trials in South Australia looked at the effectiveness of a soil conditioner that combines natural cold pressed orange oil with a special blend of surfactants to help improve infiltration and uniformity of wetting with the root-zone.

The results of the trial were encouraging, with growers immediately commenting on the rapid infiltration of irrigation water where the soil conditioner had been applied compared to control areas. Where the product had been applied using fertigation over the sands prior to planting, these treated areas were also observed to resist blowing in strong winds. A positive early sign that sandy potato mounds may hold better.

This product was chosen above others to trial for a number of reasons:

1. Overseas research showed improved water infiltration of challenging hydrophobic soils for periods up to eight months. The longevity of the product performance in soils would enable growers to benefit from improved water penetration throughout the root-zone for the life of the crop. This would assist with plant emergence through to improved quality of yields.
2. This soil conditioner was compatible with herbicides and fungicides typically used with potato production, assisting growers with ease of application and incorporation into current programs. Furthermore, the natural composition of the product was greatly appealing for both handlers and consumers of potatoes.

Published research results from South Africa showed similar increases in quality and yield for potatoes grown using this soil conditioner in hydrophobic soils.

Differing methodologies of product application were trialled, including; broad scale application prior to planting using fertigation and spray rigs, in-furrow application at planting, and combinations of the two. All methods of product application resulted in increased yields compared to untreated areas, as seen in Figure 4 with processing potatoes. Increased yields were a result of improved potato quality, greatly minimising tuber defects and blemishes associated with uneven watering of hydrophobic soils.

The two most common blemishes observed in control areas were greening and raised or burst lenticels, strongly suggesting that the application of this soil conditioner did assist with improved water penetration as well as uniform watering within the root-zone of the tubers. In particular, this sandy site with blanket application benefited from a reduction in green potatoes close to 30 per cent compared to the control.

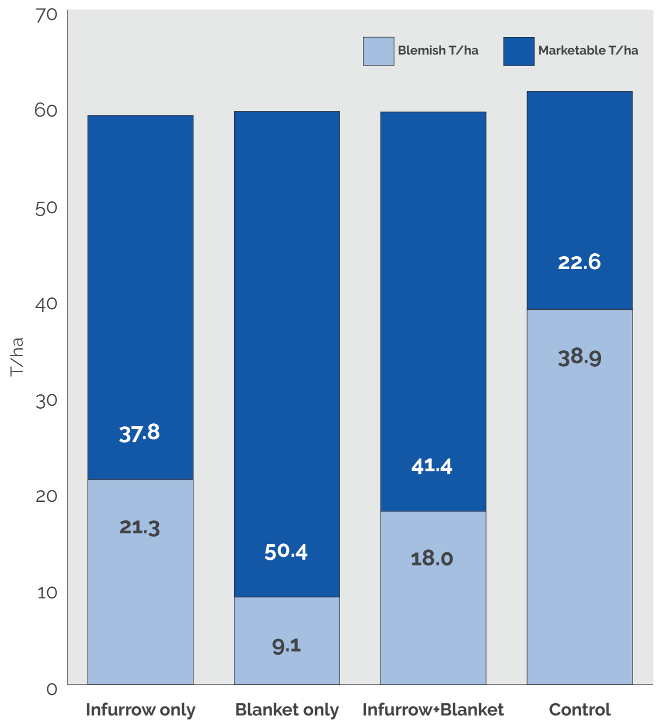


*Figure 4: Marketable and blemished yields of processing potatoes in sandy hydrophobic soils treated with soil conditioner.*

While raised or burst lenticels would not usually be rejected for processing potatoes, the reduction in skin blemishes for fresh market potatoes is highly desirable. Burst lenticels are also future points of infection, so improving uniformity of water penetration and re-wetting of hydrophobic soils would help to lower the risk of disease occurring in tubers. The reduced incidence of all blemishes associated with inefficient water penetration achieved in this trial, highlights the efficacy of the soil conditioner applied in improving water penetration and availability to tubers in hydrophobic soils.

Similar results were gained in trials with fresh market potatoes, collectively showing that soil conditioners can be very effective at improving water penetration and uniformity of wetting in hydrophobic soils.



**References and further reading**
Water Repellent Soils Case Study | Water Repellency Fact Sheet, Shepard J, Hoyle F and Murphy D. (2020) | Soil conditioner trial product information.