Stony dry saline land restored to full production with sand mulch

SNAPSHOT

Farmer name: David Schmidt
Location: Waikerie, SA
Farm size: 10,000 ha
Enterprise: Cropping and Sheep
GSR: 165 mm (average GSR), 194 mm (2022 GSR)

Key messages

- Adding 8 cm of sand mulch to dry saline enables immediate crop establishment and growth.
- The sand mulch provides a non-toxic layer for seeds, while the coarse particles act like a surface mulch that, along with the restored plant cover, restricts salt rising to the surface over the dry summer months.
- The original saline surface layer starts to improve immediately, and can return to good soil health after a single season.
- Soil salinity has remained low for at least 9 years. There is no sign of the salinity returning.

TREATMENTS

Sand mulch

David Schmidt farms with his brother Anthony and father Glynn. The soils across David Schmidt's farm at Waikerie, South Australia, range from deep sand through to stoney/reefy flats and some red loams. Patches of dry saline land form on the flats on either the red clays or the grey ashier soils. Patches range from small, new scalds up to large severe scalds that can no longer support plant growth.

SAND MULCH - APPLIED IN 2015

David has been experimenting with sand mulch to treat the dry saline land since 2015. In 2015, David paid a contractor to spread approximately 10 cm of sand over a particularly bad patch which had not supported a successful crop for many years (Figure 1). The sand provided a non-saline layer for the crop to establish in, and once covered, the soil continued to improve over following seasons (Figure 2).

In 2020 the sand-mulch treated patch from 2015 grew a successful wheat crop of 2.4 t/ha compared to 0.1 t/ha in the adjacent untreated areas (Figures 3 and 4). "It had really excellent results," David said.

Five years after the sand application, the original topsoil (under the sand mulch, tested in 2020) had much lower salinity levels than the adjacent, untreated bare areas. Under the mulch, soil salinity was 0.64 dS/m from 10-20 cm depth and 0.71 dS/m from 20-30 cm depth. In the untreated area, soil salinity was highly toxic, at 3.5 dS/m (0-10 cm) and 1.7 dS/m (10-20 cm; Figure 2).

From 2020 to 2022, salinity increased further in the untreated bare areas, up to 4.4 dS/m from 10-20 cm and 3.8 dS/m from 10-20 cm. Salinity in the original topsoil under the sand mulch dropped to <0.4 dS/m (Figure 2).

Previous studies in Mallee soils have shown that cereal root function is slightly affected above 0.2 dS/m (EC1:5), with increasing impacts up to 0.8-1.0 dS/m. Levels above 1 dS/m become very toxic to most crops and pastures.

The sand mulch improved the dry saline land in four ways:

1. The sand provided a non-toxic layer for plant germination.
2. New plant growth provided soil cover to limit saline water rise in dry periods.
3. The growing plants used moisture in the rootzone, preventing it from rising to the surface, evaporating, and leaving salts in the topsoil.
4. The coarse sand particles greatly reduced the amount of moisture wicking to the surface compared to clayey soils.

Figure 1. Glynn Schmidt between 2015 sand applied strip and untreated scald, March 2020

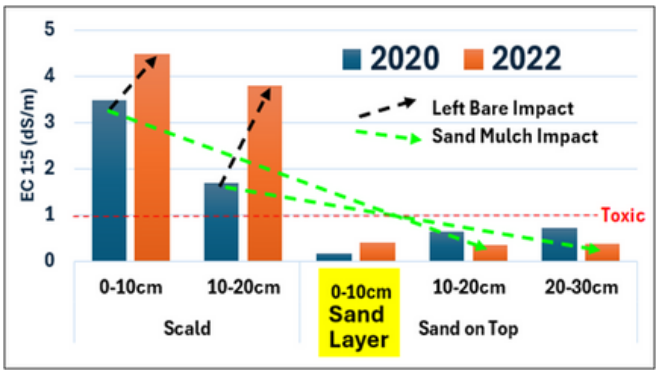

Figure 2. Soil salinity impacts after sand mulch applied in 2015

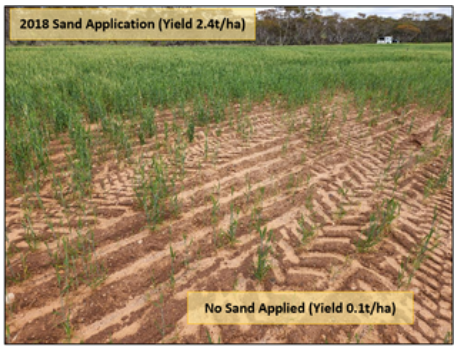

Figure 3. 2022 wheat crop comparison between 2015 treated and untreated areas

Figure 4. Sand application area still showing far superior growth after 7 years

Figure 5. 8 cm of sand mulch still clearly visible, protecting and improving the layer below

How quickly can a sand mulch repair the soil?

In 2019 the Schmidt's bought a laser bucket (Figure 11) and in March 2022 spread several 8 cm sand mulch strips on patches across the paddock. Soil tests were taken in March 2022 and March 2023. The impact was immediate. Crop establishment and yields were noticeably different (Figures 6 and 7), with a 1.5 – 2.5 t/ha yield advantage on sand treated areas in 2022.

Figure 6. Wheat crop in 2022 after sand mulch application

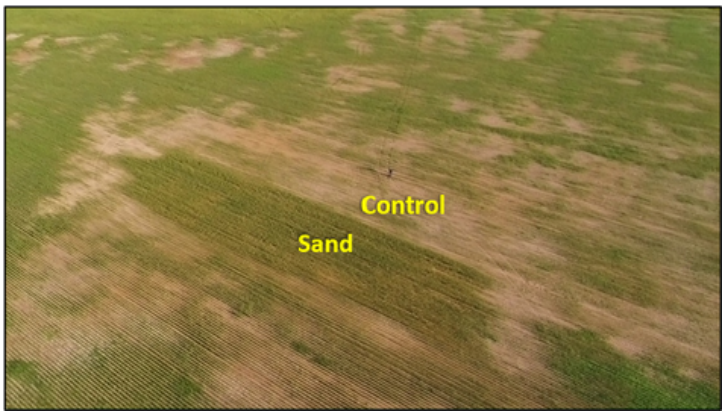

Figure 7. Drone image of sand mulch strip in paddock 2022

The changes in soil health were remarkable after only one growing season and one summer – see Figure 8. The salinity of the original surface layer (now at 10-20 cm) went from a highly toxic 2.5 dS/m to a very low 0.35 dS/m, with similar reductions in the layer beneath (20-30 cm). Salinity increased in the same soil left bare and exposed at the surface.

Impacts of large summer rainfall

A 50 mm rainfall event in November 2021 led to a large area remaining under water for several weeks (Figure 9). This reduced soil salinity by about 50% in the top 20 cm of soil, suggesting significant leaching had occurred. The increased soil moisture would have also diluted the impacts of the remaining salts, resulting in consistent crop establishment.

The positive impacts of establishing growth over this previously patchy saline land could be lasting if soil cover is maintained, particularly over future summers. However, if this cover is lost to overgrazing or drought, the saline patches could return.

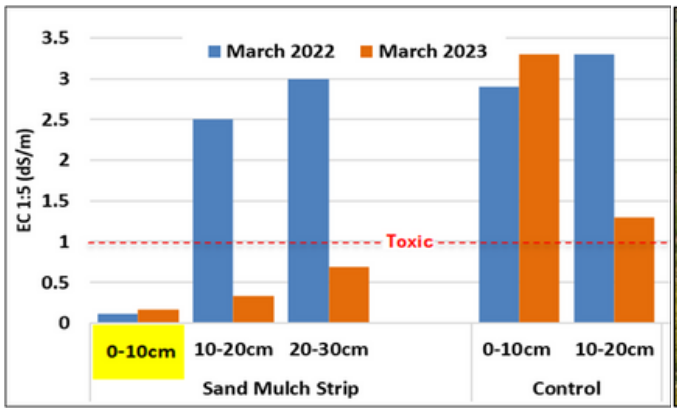

Figure 8. Soil salinity repaired after only 1 year of surface applied sand

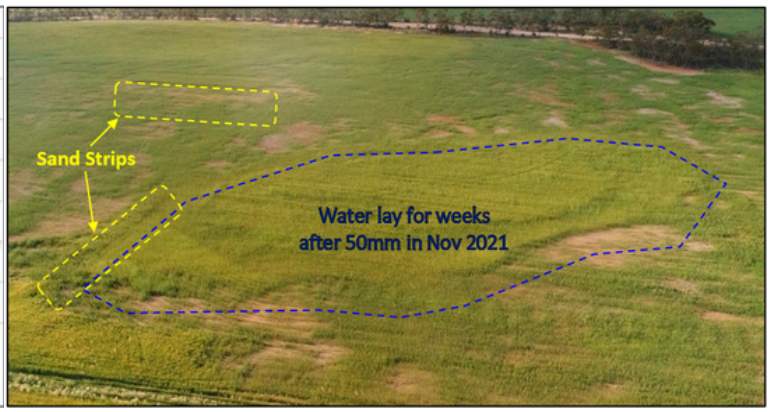

Figure 9. Area of improved growth of 2022 wheat crop following large Nov 2021 rainfall

Figure 10. Wheat growth and yields at paddock sand strip, 2022 season

Sand mulch vs rainfall

The sand mulch application has had a far greater impact on yield than the summer rainfall impacts alone (Figure 10). It also has provided a more permanent fix to the problem, while the improvements from summer rain will rely on continued soil cover to keep the salinity deeper in the soil profile.

Source and Process

While the sand mulch has worked very well at David's farm, the biggest challenges are sourcing and spreading the sand. David owns a laser bucket to use for levelling which makes the process easier, but still finds spreading the sand laborious (Figure 11).

"It's not too bad with a bucket as we can drop it where we want it, but it is time consuming so the cost is reasonably high," he said.

The sand used in these trials had drifted in from the edge of a scrub many years ago. One option is to scrape the sand off the sand hills, but this leaves the soil prone to erosion.
"We would have to bare the hills we've spent a long time getting covered," David said. "Once you open a hill up, you're vulnerable to erosion for a year or so."

David finds it better to first scrape and stockpile the sandhill topsoil with its increased fertility and organic matter, then take the sand layers below to use on the saline scald, then return the original topsoil to the sandhill surface. He finds the scalds need at least 6 mm of sand sitting on top to get results.

NEXT STEPS

David will work to rehabilitate the dry saline land patches if they can find the sand. David aims to treat patches before they become a problem.

"When the opportunity arises, we try to cover an area. Or if we see an area just starting with a few patches at the bottom of a hill or rise, we try to nip them in the bud fairly quick. If we spread the sand early, we fix it almost instantly."

“If you can get a seed sown into less hostile soil, it seems to germinate and the soil underneath doesn’t bother it so much. Once you have it covered it pretty well goes away and recovers immediately,” David said.

It then critical to maintain that cover over the hot summers and not allow sheep to bare them out.

Figure 11. Laser bucket used to spread the sand

This project is being led by Mallee Sustainable Farming and has been funded through the Australian Government’s Future Drought Fund, and is supported by the South Australian Drought Resilience Adoption and Innovation Hub. Project delivery partners are AIR-EP, Primary Industries and Regions South Australia (PIRSA), South Australian Research and Development Institute (SARDI), Trengove Consulting, Ag Consulting and Research, Northern Sustainable Soils, and Insight Extension for Agriculture. Case studies compiled by Alluvio Pty Ltd.

PROJECT INFORMATION

Trial run by Chris McDonough, Insight Extension for Agriculture.
Thanks to David Schmidt for hosting the trial.

Building resilience to drought with landscape scale remediation of saline land.
Activity ID - 4-H8FU6SC

Produced June 2024