Group: Lowbank
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Soil technology and innovation focus

Developing and Adapting Soil Amelioration Practices to Maximise Sustainable Crop Production in the Lowbank District

The challenges and opportunities addressed by the project

Farmers in the Lowbank district face challenges due to various problematic soils that currently lack effective and tailored management strategies. A range of soil-induced, yield-limiting factors diminishes the productive potential of extensive areas of land, leaving growers with substantial risks and inconsistent returns.

Making amendments to topsoils and subsoils can yield seasonal and long-term benefits for retaining and accessing plant-available water. However, this may entail significant upfront costs and pose considerable erosion risks, particularly during the current prolonged drought period.

The challenge for many farmers is to capitalise on knowing which management strategies are both reliable and cost-effective in the short and long term, as well as how these strategies can be applied safely in marginal areas with highly variable seasons. Some soil amelioration methods have proven effective in small plot experiments but have yet to be tested on a larger farming scale to establish practical outcomes and identify necessary modifications. This will give farmers more confidence to invest in and apply these strategies.

Focus of the On-Farm Demonstrations

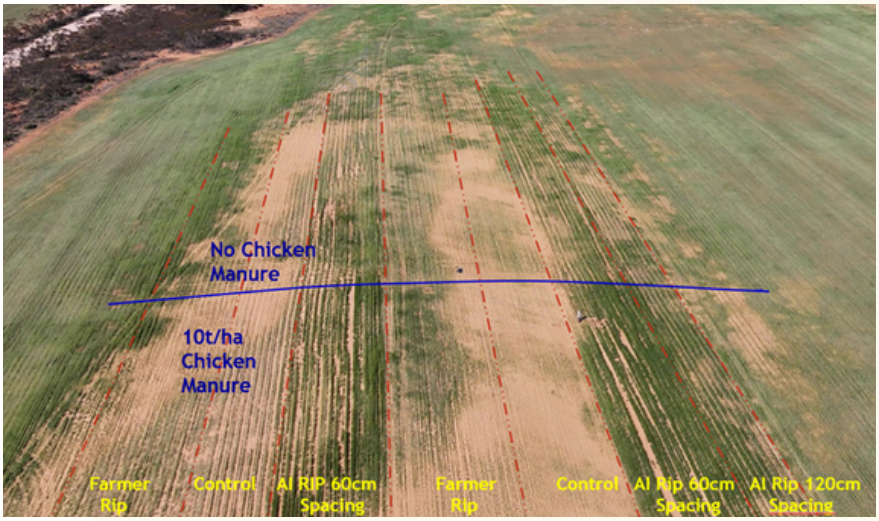
In December 2023, the project officer met with Ag Bureau representatives to discuss the issues they most wanted to address. Key concerns focused on improving crop establishment on non-wetting sands, enhancing the fertility of gutless sands to outcompete certain hard-to-control weeds, restoring blown-out sand hills for more manageable production, permanently ameliorating poorly performing “ashy” sodic, saline flats to achieve profitable outcomes more frequently, and assisting new farmers in adopting VRT.

Although each of the sand sites discussed had distinct issues to address, it was determined that Active Inclusion Deep Ripping (AIDR), which has proven successful in numerous mallee small plot experiments, should be demonstrated on a farm scale in comparison to the farmer practice of deep ripping. This demonstration should include the addition of readily available chicken manure to test whether it could effectively break soil compaction and hardness, mix and repair non-wetting surface layers, and permanently alter the sand's root zone to enhance its organic matter content, water-holding capacity, and fertility. This approach aims to expand plant root function and production through one strategic management action at three of these sites. This would provide an efficient means of acquiring the necessary machinery and operating staff to carry out these activities, particularly since this machine also offers a unique chance to improve the heavy-textured sodic, saline flat soils. The surface soil, along with the applied sand and manure, must be moved into the root zone layers without bringing any restrictive subsoil clays to the surface.

Farmer Tim Paschke with Uni SA’s Chris Saunders & Jack Desbiolles showing Active Inclusion Deep Ripper

The blown-out sandhill repair site was to be reshaped and levelled with a land plane before AIDR and farmer Deep Ripping. One non-wetting sand site was to compare the AIDR against the effects of deep disc ploughing. The fourth sand site was to test the effectiveness of various wetting agents dripped with the seeds of both lupins and barley crops using the bureau's liquid applicator mounted on the farmer's seeder frame.

The final demonstration involved assisting a farmer in setting up a block of four paddocks to operate with VRT zones and test strips for analysis. This was to be achieved by utilising available tools, conducting soil tests, and applying technical expertise to ensure the successful operation and data collection with existing machinery.



Blown out sandhill repair site treatments

Alongside the paddock-scale demonstrations, the project includes targeted communications and extension activities for farmers not directly involved with the Ag Bureau, subject to available funding. This encompasses field days in August and October for site visits, a VRT workshop, and a harvest report meeting that highlights all the results and outcomes from the demonstration sites. This added component ensures a broader community reach and uncovers further knowledge needs among the wider farming population.

Every site sparked in-depth discussions among farmers and agronomists about the practical implications of different treatments and how they could be adapted more widely across the region.

About the Field Walks

Project demonstration sites were visited during the Ag Bureau's winter crop walk and annual spring field day. The winter crop walk began at Dave Schmidt's paddock with sodic saline clay. Unfortunately, the AIDR treatment areas rendered the soils extremely soft, causing the following seeding equipment to sink and resulting in deep seeding at some locations. This led to the crop not emerging in this heavier-textured sodic saline site. Initially, it was feared that this was due to soil mixing; however, it soon became evident that the seed had been unintentionally sown at a depth of 15 cm, which was too deep for this soil type during a drought season.

Heavy sodic, saline soil amelioration site showing poor crop establishment due to deep sowing.

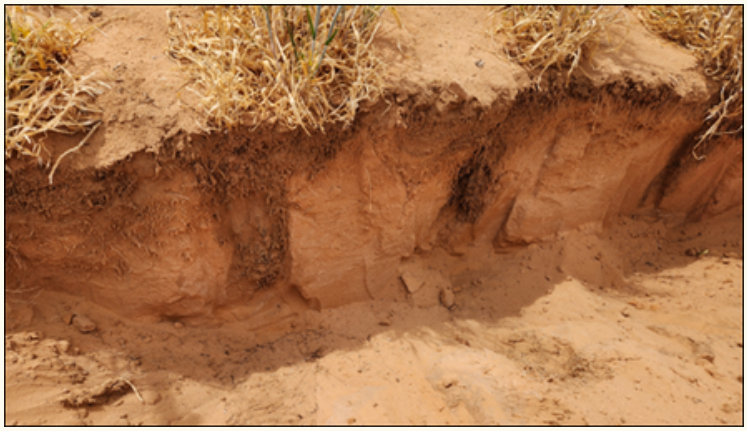
While these strips were later resown and achieved some crop cover, this destroyed any chance of making meaningful comparisons in soil treatment. However, it was clear that positive changes in soil quality were evident in the AIDR strips, and where crops were established, vigorous roots penetrated 15 to 20 cm deeper into this heavy soil compared to the sodic, saline control areas. The crop walk then examined the rehabilitated sandhill site at Time Paschke's, where the AIDR strips demonstrated remarkable deep green, vigorous crop growth. In contrast, the adjacent control area showed signs of initial crop establishment that perished after a few dry weeks, while the farmer's deep rip strips displayed moderate crop growth.

Farmers then visited the VRT trial paddocks of Kane Schutz, where we explained the processes undertaken and the tools used (including NDVI images to support zone mapping) to achieve the VRT outcomes. We sank the deep soil tester into the deep sandhill to illustrate how the opportunities and risks of each soil zone vary depending on the seasons, and how we can best manage this through VRT.

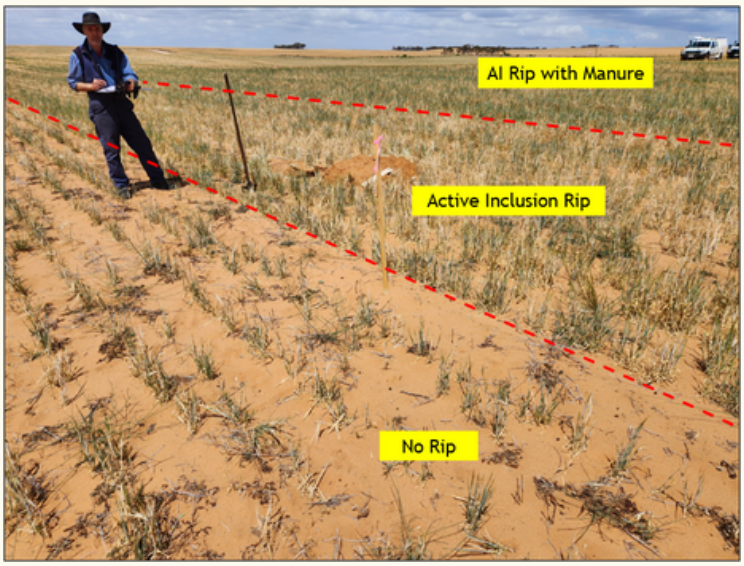
The spring field day visited Tim Paschke's property, where a rehabilitated sandhill produced a 2 t/ha barley crop, despite receiving only 62 mm of rainfall during the growing season. In contrast, untreated control strips showed no yield and very limited growth, while farmer-ripped strips exhibited moderate performance, estimated at 1 t/ha. Soil pits in each treatment revealed remarkable differences in crop root depth and vigour to all farmers present.

The group then visited Kane Schultz's property at Swan Reach, where a non-wetting sandhill trial compared active inclusion ripping with discing and untreated controls, using varying rates of chicken manure. Soil pits were opened at each treatment to examine root development and moisture retention, highlighting wet soil at a 20cm depth in control areas, even at the end of the drought season, in contrast to deep roots and dry profiles in the AIDR strips.

The harvest report meeting in late March 2025 showcased numerous drone images, photos, and graphed comparative monitoring data from all demonstration sites, except for one sandy site where the sheep were placed in the cropped paddock due to the drought. This prompted robust discussions about the key learnings from each site. The presentation was later converted into a PDF document, which was distributed to all bureau members.



Active Inclusion Deep Rip showing extensive root growth and OM through wide rip-lines to 45cm depth.

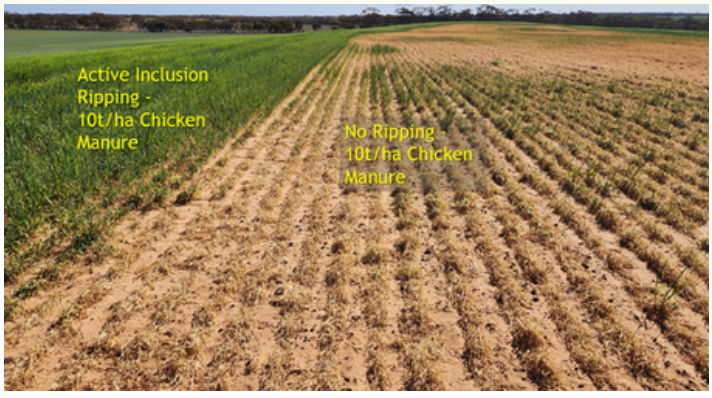


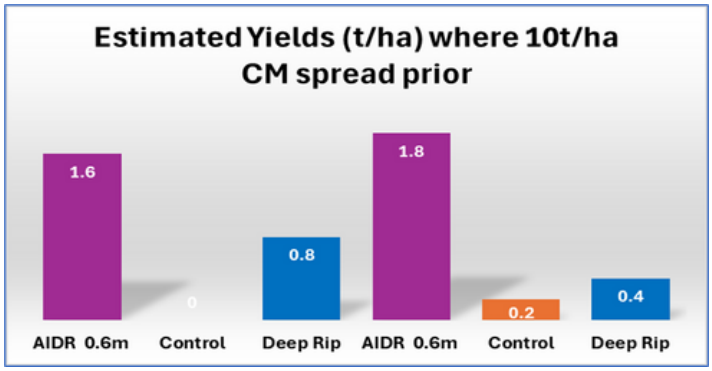
Swan Reach Non-wetting sandhill amelioration trial

Key Discoveries from the Field Demonstrations

The sand trials demonstrating AIDR produced several significant findings:

1. Active inclusion ripping significantly increased root growth and yield potential, even under dry (decile 1) conditions.
2. While deep ripping alone offered benefits, it yielded only about half the gains observed with inclusion ripping.
3. Inclusion ripping has also increased erosion risks that must be addressed before it can become a viable mainstream option.
4. Improved root penetration enhanced moisture use and provided better soil protection, especially on light, erodible sands.
5. Ongoing monitoring is crucial to determine the lasting nature of changes brought about through improvement.





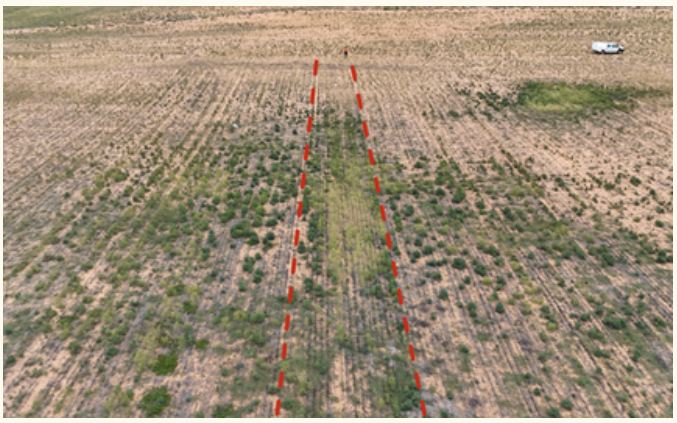
The sodic, saline clay site that was resown in the AIDR strips achieved some crop cover. While this destroyed any chance of making meaningful soil treatment comparisons, it was evident that soil changes occurred in the AIDR strips. Where crops were established, vigorous roots penetrated 15-20 cm deeper into the soil than in the control areas. This has the potential to significantly improve the productivity of these soils and will be monitored in the coming seasons to test this.

These discoveries highlight the importance of holistic soil management, which integrates physical and biological strategies, supported by solid data and careful planning. The key researchers from the University of SA who developed the AIDR have observed, monitored, and discussed all demonstration outcomes with local farmers, working on various design modifications and strategies to help minimise erosion risks and trafficking issues that arose when applying these innovative technologies at a farm scale. This may also involve targeting sandhill renovation activities to mid-season, only after sufficient summer and opening rainfalls, to significantly enhance the rapid establishment of protective cover.

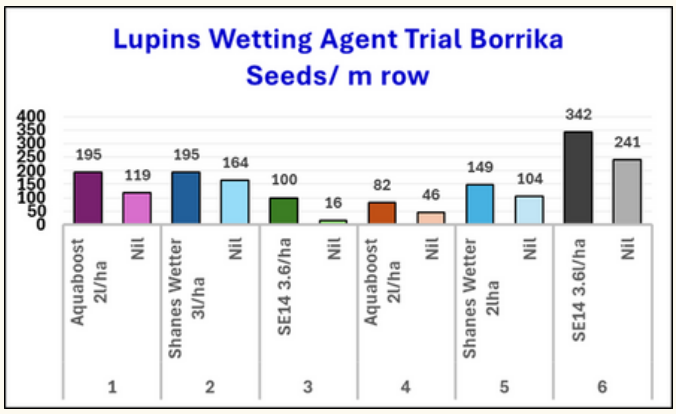
The use of three different wetting agents on non-wetting sands improved crop establishment, growth, and yield in the poorest sandy areas of a lupin crop at Borrika during the decile 1 season of 2024. However, the paddock also displayed numerous variations and inconsistencies that were not clearly aligned with the application strips. The neighbouring barley crop encountered no issues with crop establishment and did not benefit from the wetting application. This indicates that non-wetting soils can have varying impacts depending on subtle changes in topsoil, seeding depth, seeding conditions, and the application of wetters. While some benefits from the wetting application were evident, further work is necessary to better determine where and when the most consistent and worthwhile applications can be achieved.

Results from the VRT trial strip analysis revealed that, during the decile 1 GSR season, PAW was the primary limiting factor across all soils (rather than nutrition), and the lowest fertiliser rates often produced similar yields and the best gross margins. However, the sandhill to the north, as well as the heavy ground, still showed a response in both yield and gross margin to the higher zone rates.

This shows how paddock history and fertility can lead to different outcomes on similar soil types, and why
conducting further ground truthing through paddock and zone soil testing is beneficial for gaining a better understanding of the driving factors in each zone.



While inconsistent, 20 rows strips of wetting agents in lupins were clearly evident in patches.



Wetting agent strips consistently gave yield increased in most severe non-wetting areas.

Key Take-Home Messages

Several significant lessons emerged from the demonstrations:

- Amending rootzone sand with organic matter, such as manure, is more effective than simply ripping it on its own.
- Ripping treatments can influence seeding depth, even in heavier soils, which could affect crop emergence.
- Comprehensive soil testing, which includes P, PBI, and DGT, is essential for identifying P-responsive loamy soils.
- Continuous use of test strips over the years will help identify which zones respond according to soil type, season, or crop rotation, enabling better long-term decision-making.

What This All Means

Transitioning from small-plot experiments to full-scale paddock demonstrations has been a pivotal step for both researchers and farmers in Lowbank. These larger trials have revealed practical limitations, such as erosion risks, machinery challenges, and the actual costs of organic amendments; however, they have also showcased significant potential for improved productivity and resilience.

Importantly, the project has contributed to a shift in farmers' attitudes. What began with a degree of scepticism has transformed into genuine interest and optimism, driven by firsthand observation of crop responses and soil changes. Group discussions during the field days, along with individual growers' comments, reflect this change in mindset.

There remains work to be done, particularly in refining the techniques and addressing environmental risks. However, the high level of engagement and quality of dialogue among farmers, researchers, and technical staff highlights the strength of this participatory approach. The project's impact extends beyond the field trial program, fostering a community of learning and innovation that is critical for long-term adoption and success.

Summary and Conclusions

The Lowbank Soil Amelioration project addressed a pressing need to manage complex and variable soil types that limit cropping potential across the district. With the overarching goal of increasing sustainable production and reducing risk, the project focused on enhancing the use of Variable Rate Technology (VRT) and developing effective soil amelioration strategies through large-scale, on-farm demonstrations.

Key treatments included deep ripping with active inclusion, the application of organic amendments such as chicken manure, the use of wetting agents, and site-specific fertiliser strategies tailored through VRT. Demonstration sites targeted problematic soils like sodic flats and non-wetting sands, showcasing clear improvements in crop root development, yield potential, and soil moisture utilisation. Field walks provided farmers direct insight into the impact of these treatments and encouraged meaningful discussions about adoption, erosion risk, and long-term soil health.

The project also identified key barriers to adoption, including limited knowledge of effective soil management strategies, concerns about erosion, and the need for practical decision-support tools. Targeted extension activities and the assessment of non-participant needs were also included to enhance engagement.

The Lowbank project has showcased the value of translating innovative soil management practices from theory and small-scale trials into effective, paddock-scale application. The combination of active inclusion ripping, organic amendments, and VRT has demonstrated significant potential to rejuvenate underperforming soils, even in challenging seasonal conditions.

Equally important has been the shift in farmers' mindsets from scepticism to curiosity and engagement as they witnessed firsthand the improvements in crop performance and root growth. However, to fully realise the benefits, further development is needed to mitigate erosion risks and assess the long-term impacts of treatments. Continued monitoring, farmer feedback, and refining decision-making tools will be essential to ensure these practices remain agronomically and economically sustainable.

This project has established a solid foundation for significant changes in practice within the Lowbank district by integrating strong technical demonstrations with farmer-led learning. It provides a robust platform for future investment and extension efforts aimed at improving soil performance, input efficiency, and resilience in dryland cropping systems.

Lowbank Ag Bureau inspecting soil amelioration sites with project officer Chris McDonough.

Australian Government
Department of Agriculture, Fisheries and Forestry

Future Drought Fund

This project emphasised the value of targeted soil management practices to improve the performance of producing lentils on sandy soils. The opportunity to transform sandy soils from challenging, often low-producing assets into highly productive soils was demonstrated, which will provide further incentives for farmers to manage such soil types better. Through workshops, field trials, and collaborative efforts with agronomists, outcomes from the project will help foster sustainable practices and enhance regional agricultural resilience.