



Soil technology and innovation focus

Increasing the productivity and resilience of sandy soils through targeted soil testing, amelioration, and adoption of higher-value break crops, including lentils and beans.

Background to the project

Understanding soil constraints via soil testing and applying the appropriate amelioration practices can improve the resilience of farming systems. This soils-based focus is based on the following principles;

1. Identifying and adopting various best management practices in a group learning environment.
2. Increasing the value (and profitability) of crops that can be grown on the same total area of cropping land.
3. Increasing the diversity of crop selection depending on seasonal conditions (and adapting to such conditions as part of a risk management framework).
4. Improving water holding capacity and production potential of the poorer performing soils through adopting such practices as soil amelioration.
5. Increasing biomass production on erosion-prone sandy soils to reduce the potential for soil erosion risk as well as potentially increasing soil organic carbon levels

Justification for the project

The key focus is on farmers' growing higher-value break crops (such as lentils) and improving the productivity of sandy soils. Such break crops offer the opportunity to return higher profits than wheat or vetch, but due to poor soil conditions, they face agronomic and soil erosion-related risks.

Farmer experience has demonstrated that the current production of lentils yielding (at 0.3-0.4t/ha) provides higher financial returns than average wheat yields. Field peas are too risky to grow on the lighter sandy soils, whilst vetch provides a good break but has low economic returns. Some farmers are avoiding lentil production on the lighter sandy soils and just growing them on the heavier soil types; this creates issues with managing multiple crop types within one paddock. Therefore, this project aims to address such challenges by identifying how best lentils can be grown on lighter sandy soils consistently with minimal agronomic and soil erosion risks. Anticipated outcomes include improving paddock profitability, managing problem soils, and increasing system efficiency.

The project has been developed through the need as identified by farmers to address the following challenges and opportunities;

1. The opportunity to produce higher value break crops than current medic pastures.
2. There is a need to improve cover and production on sandhills.
3. The opportunity to provide disease and nutrition benefits to the following crops.
4. To improve overall paddock profitability and make the system work as a whole.
5. To identify how best soil amelioration practices can be used on the lighter sandy soils to enhance the productivity of subsequent legume and cereal crops

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Key outcomes and discoveries

1. From an AIR EP perspective, our key goal, more recently, has been to better engage with the retail agronomists on EP. This project has enabled us to work directly with eight Elders agronomists on the Eyre Peninsula and has worked extremely well.
2. Lentil production is not suited to soils having higher salinity levels or those having “magnesia patches”
3. Soil amelioration (deep ripping) is advantageous to the following pulse crops compared to cereals, but there are potential issues with a lack of soil cover.
4. On-row sowing is seeing better establishment (increased moisture, diluted salt). Potential issues include increasing disease pressure (sowing on stubbles, but there is uncertainty about how long this benefit will last).



Barriers to adoption

The barriers to the adoption of improved soil management practices, such as soil amelioration and improved use of fertilisers through soil testing, include the following;

1. Lack of awareness and knowledge

Farmers are not sure where to start – some are adopting practices because it has worked on the neighbour's place without being clear on constraints they need to address. Research expertise was accessed to help identify and explain the impacts of soil constraints in small farmer group settings. These were conducted within local environments that allowed shared discussions and learning between farmers and technical experts.

2. Lack of time and cost

Farmers believe soil testing is expensive (an extra cost and time requirement). Farmers will develop an improved understanding and awareness of soil testing processes by working with local retail agronomists. This needs to be viewed in the context of the opportunity for potential gains to be made or losses avoided through accessing information to assist with decision-making (relating to fertiliser and soil nutrient management).

Engagement strategy

The project engaged with local retail agronomists (Elders) to identify and coordinate small local groups comprising mainly young farmers. The focus of activities related to undertaking soil testing, soil constraint diagnosis and recommended practices to improve overall productivity and systems sustainability. These activities were undertaken throughout the 2024 growing season. This was an innovative approach for engaging commercial agronomists in delivering technically focused workshops and field activities with local farming communities.

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- Built relationships with Elders retail agronomists on EP and AIR EP
- Increased facilitation skills and capacity of Elders agronomists through training with Beck Burgess (delivery of Jeanette Long's facilitation training)
- Delivered timely and relevant information to farmers through the engagement of subject experts
- Increased farmers' knowledge of
 - soil constraints – how to identify, correct, and manage such constraints.
 - growing lentils on more difficult/challenging soil types.
 - lentil nutrition requirements.
- Increased farmers' willingness to use soil tests to understand their soils better
- Increased AIR EP exposure to different farmers who may not normally have been engaged with us



Promotion and Facilitation

Tools and approaches to promoting the project activities and engaging with the wider community included the following;

- Use of social media (Twitter, Facebook, Instagram) and newsletters.
- Direct promotion through agronomists.
- Technical support from experts, including Dr. Mel Fraser and Dr. Sean Mason.

Project Activities

The following summarises the activities and events that were implemented as part of the project.

1. Extension and Facilitation Training:

The Elders agronomists received training to enhance their skills in project facilitation. The participants valued this experience and gained important skills.

2. Workshops

A series of workshops were conducted at each of the three locations. These included the delivery of a range of presentations as well as paddock visits. Topics covered included (1) soil constraints for lentil production: salinity, pH, compaction, nonwetting sands; (2) amelioration techniques: deep ripping, fertiliser placement, and paddock zoning; (3) nutrient management and tissue testing insights and (4) Interpreting soil test results.

3. Field Demonstrations

A range of field demonstrations linked to focus paddocks (that were previously ameliorated) were undertaken to help evaluate break crop growth. Activities included soil testing for constraints and monitoring plant establishment, crop vigour, and yield.

Key Findings from the three demonstration sites

Wirrulla

There are issues with salty flats, sandhills, and soil erosion. There was a demonstration of VRT (Variable Rate Technology) and the impact of straw spreading on salt-affected areas. Wirrulla Focus Paddock visit: There was a magnesium patch with sand applied in a strip, sheep yard trash in a strip, and straw in a strip. Lentils germinated, okay in straw but less in sand visually. It will be interesting to check back later in the season.

Wudinna

A one-hectare area was deep ripped in early March to a depth of 50-60 cm deep with 45 cm row spacing. The cost for the deep ripping was approximately \$200/ha. The fertiliser applied was 50kg DAP SOA on the flats, whilst 100kg DAP SOA was applied to the sandhills. A low phosphorus requirement was identified for the site, reflecting a good fertiliser history with a low PBI measurement. Challenges identified with the sandy soils within the paddock included a patchy germination. Deep ripping showed improved crop establishment.

Lock

The Lock site focused on soil amelioration for non-wetting sands and saline soils. Discussions on lentil biomass management and sequential crop planning were a feature of the farmer events. General discussions highlighted that compaction doesn't appear on a soil test. It is, therefore, necessary to conduct a penetrometer when soil is wet, usually to a depth of around 20-30cm. Often, there is a second compaction layer at a 45-60cm depth. Non-wetting sands can be tested in the paddock or alternatively in a soil laboratory where the degree of repellence is assessed.

Key discoveries from the field demonstrations and paddock walks

1. Soil Constraints and Lentil Production:

- Lentils struggle in saline soils and benefit from precise sowing methods like on-row sowing.
- Deep ripping significantly improves pulse crop returns compared to cereals.
- Fertiliser placement is critical; MAP (lower salt index) is better for lentils on flats, while DAP suits cereals on sandhills.

2. Amelioration Techniques:

- Deep ripping enhances soil structure but raises concerns about reduced ground cover and erosion.
- Spading and delving improve clay distribution and long-term productivity.

3. Nutrition and Testing:

- Lentils require phosphorus (P) but no nitrogen (N). Tissue testing is essential for identifying nutrient deficiencies.
- Salinity tolerance varies by crop (barley > wheat > lentils).

Key Technical discoveries

1. Crop nutrition

- Trace elements requirement for lentils are the same as for cereals
- Nitrogen is not required for lentils
- Phosphorus is important for selected soil types; conducting soil tests is critical.
- Lentils remove about 3-3.5 kg of phosphorus per tonne. They also remove more copper per tonne produced, which equates to about the same total amount removed as wheat (double the yield of lentils).
- MAP vs DAP for Lentils is also an economic win potentially other than the slightly lower salt index, no point adding to the N bank with DAP when lentils perform better in low N ground.

2. Saline soils

- Lentils hate salt
- On-row sowing is seeing better establishment (increased moisture, diluted salt). Potential issues include increasing disease pressure (sowing on stubbles) and how long the effect lasts. It can also be tricky to sow on-row consistently.
- Fertiliser placement needs to be distant in placement from the seed (fertiliser is salty).
- MAP is less salty (salt index 30) than DAP. It is generally used on flats and is preferable for lentil crops.
- DAP is saltier (salt index 35) than MAP, used on sandhills and is preferable for cereals (they tolerate salt better than lentils).
- Phosphorus is required in responsive lentil sites; just keep it away from the seed.
- Salt tolerance (EC): Barley (10) > Wheat (7) > Lentil (3.5).

3. Amelioration:

- Farmers are getting better returns on pulses after straight ripping than cereals, but a lack of soil cover can cause issues. In areas where higher disturbance treatments are applied (for example, spading or delving), sow with cereal for soil cover.

4. Lentil production:

- Setting up the paddock is a step-by-step process.
- Consider herbicide residues, soil amelioration, weed burden, and crop safety vs control (avoid more mobile herbicides).
- Don't stack operations that may impact lentil biomass; there is the need to wait for recovery after each operation (for example, broad leaf spray, wait, grass control, wait, roll).

Maximising biomass is correlated to increased crop yields on the Upper Eyre Peninsula.



Key take-home messages from the field demonstrations and extension activities

1. Soil Constraints and Lentil Production

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4. Agronomic and soil management

- Salinity significantly limits lentil establishment; management strategies like straw mulching improve results.
- On-row sowing increases germination rates due to better moisture retention and reduced salinity effects.
- Sequential crop selection post-amelioration (for example, cereals for soil cover and pulses for economic return) is essential.

Evaluation and Feedback

- Farmers reported gaining valuable insights into soil management and lentil production.
- Peer-to-peer knowledge sharing was evident, and participants expressed interest in adopting new practices.
- Engaging with agribusiness (such as Elders) to coordinate the groups was valuable. It brought in a cohort of farmers who may not have normally been involved in such group extension activities).
- Drought conditions impacted on the project. The late rainfall affected germination and biomass production.

Future opportunities

- Long-term (5-year) projects are necessary for sustained practice changes.
- Improved tools for mapping and VRT integration are required.
- There is a range of innovative tools for mapping complex soil types within paddocks (constrained flats, profitable loams/mid slopes, sands). Therefore, a training opportunity for agronomists and growers to show them how to use these tools (even if it's just the ability to zone a paddock for monitoring purposes) would be a worthwhile initiative.

Conclusions

- 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



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.