

Lentils on ameliorated duplex soils – what is really limiting yield?

Lentils are increasingly being considered on ameliorated duplex soils across the Lower Eyre Peninsula, following significant investment soil amelioration activities including lime, ripping, delving and gypsum.

A 2025 trial near Wangary/Edillilie set out to test the question: *Once soil constraints are addressed, what limits lentil yield?*

What we did

The replicated (4 x) trial was established on an ameliorated acidic duplex soil (sand over clay), sown dry on 20 May 2025.

Treatments focused on three key areas:

- Nitrogen supply and nodulation (inoculation strategies and applied N)
- Nutrient limitations (K, S, P, lime, trace elements)
- Plant population

No.	Treatment Name	Description	Justification
1	Inoculation only (Control)	Standard inoculant at sowing	Baseline treatment; assesses current rhizobia status and nodulation capacity
2	Inoculation ++	High rate or double inoculation	Tests whether increasing inoculant improves nodulation on low-survival soils
3	Inoculation + N	Standard inoculation + 20 kg N/ha (urea)	Tests hypothesis that N boosts winter vigour under poor nodulation conditions
4	N only	80 kg N/ha without inoculant (20 kg/ha @ seeding)	Assesses plant response when relying entirely on mineral N
5	Potassium (K)	K (e.g. 50 kg/ha MOP) applied pre-sowing	K deficiency suspected on sandy acidic soils; K aids stress tolerance
6	Sulphur (S)	S (e.g. 20 kg/ha gypsum or elemental S)	S deficiency common on sandy soils; required for protein synthesis
7	Additional Lime	300 kg/ha Calcilime	Evaluates whether further pH buffering supports better nodulation/growth
8	P Liquid P + SE14	50 L/ha Phos Acid + 4 L/ha SE14	Results from ironstone soils project show this may be effective
9	N + K + S + Lime (stacked)	Combined nutrient treatment	Synergistic effect of all key nutrient strategies + pH amelioration

10	90 plants/m ²	Lower sowing rate	Assesses impact of plant population on vigour and lodging risk
11	120 plants/m ²	Recommended sowing rate	Mid-range sowing density for lentils on EP
12	150 plants/m ²	High sowing rate	Tests if dense canopy helps suppress weeds or causes yield penalties
13	Fe (EDDHA)	Iron chelate foliar application	Addresses iron lock-up in high gravel/oxidic subsoil
14	Molybdenum	Mo seed dressing or foliar (e.g. sodium molybdate)	Supports nodulation and N fixation, especially in acidic soils
15	Inoc. +++ Mo + Fe	Integrated nodulation & trace elements strategy	Optimised biological N fixation and micronutrient correction

All treatments received a baseline of 100 kg/ha MAP at sowing.

Seasonal conditions were favourable for lentils in this environment with a dry start, good winter rainfall and no significant waterlogging. This created a useful test of performance when physical constraints were largely removed.

What we found

Treatment	Yield (t/ha)	Significance
Control	2.49	a
+K	2.59	ab
90 p/m ²	2.59	ab
+S	2.60	ab
x1	2.60	ab
Liquids	2.60	ab
150 p/m ²	2.62	ab
+Fe	2.63	ab
+ Lime	2.64	abc
N + K + S + Lime	2.68	abc
+Mo	2.69	abc
x 4 innoc	2.69	abc
x 4 inoc +Mo +Fe	2.72	abc
- innoc +N	2.82	bc
innoc+N	2.96	c
<i>P</i>	<0.001	

Lentils performed well where waterlogging was not a constraint

Yields ranged from 2.5 to 3.0 t/ha, confirming that ameliorated duplex soils can support commercially viable lentil production and in favourable seasons, these soils are not inherently

limiting. This aligns with earlier work in 2024, where lentils also performed well when establishment and drainage conditions were adequate.

Nitrogen supply was the main driver of yield

The strongest and most consistent responses were linked to nitrogen. The highest yields came from applied N treatments. Yield also increased with higher inoculation rates, and combined inoculation + Mo + Fe strategies.

Treatments that improved access to nitrogen consistently out-yielded those that did not.

This suggests that nodulation alone may not be sufficient, particularly early in the season, and nitrogen supply (timing and quantity) is a key limitation on these soils, however this may change in successive crops, once inoculant has had time establish a population in a soil.

Other nutrients did not limit yield in 2025

There was little to no response to:

- Potassium (K)
- Sulphur (S)
- In-furrow- pelleted lime (rhizosphere)
- Liquid P
- Iron (Fe) alone

This is despite these nutrients often being considered constraints on sandy or duplex soils.

Soil and tissue testing supported this result; no clear, consistent deficiencies were identified that aligned with yield responses and nutrient levels were generally adequate to support crop growth in this season. Reinforcing that not all “potential” constraints are active in every season.

Plant population had minimal impact

Changing plant density from 90 to 150 plants/m² had little effect on yield.

This suggests that once acceptable establishment is achieved, increasing population alone is unlikely to drive yield, and the focus should remain on crop health and resource availability, rather than pushing plant numbers.



Above: Jake Giles, EPAG Research, presenting the Lentils on challenging soils trial site at Wangary on the AIR EP Lower EP crop walk in October 2025.

What does this mean in practice?

1. Amelioration changes the rules

Before amelioration, lentils are typically limited by pH, structure and waterlogging. In this trial, those constraints were largely addressed.

2. Nitrogen is a key risk in soils that haven't previously grown lentils

Lentils are often assumed to meet their own nitrogen requirements through fixation. However, this trial shows that yield can be limited when nitrogen supply is insufficient and inoculation strategy in the first year of growing a new type of legume can be important.

3. Don't assume all constraints are limiting

Despite expectations, K, S, Fe and P did not limit yield in this trial, highlighting the importance of using soil and tissue tests to guide decisions and avoiding blanket nutrient strategies.

4. Waterlogging remains the key underlying risk

This was a low waterlogging year, which allowed lentils to perform well. However, these soils still carry inherent waterlogging risk and in wetter seasons, this is likely to become the dominant constraint again.

Key takeaways

- Lentils can yield 2.5–3.0 t/ha on ameliorated duplex soils in favourable seasons
- Nitrogen supply was the main driver of yield in 2025
- Other nutrients were not limiting, supported by soil and tissue testing
- Plant population had minimal impact once establishment was adequate
- Waterlogging remains the biggest long-term risk on these soils

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