Lentil nutrition and establishment on calcareous sandy soils – Poochera, Eyre Peninsula (2025)

Location and Seasonal Context

- **Location:** Poochera, Eyre Peninsula
- **Soil type:** Calcareous sandy loam
- **Seasonal conditions:** Dry start to the season, average winter rainfall supported crop growth, dry finish. These conditions enabled good establishment and allowed nutrient and soil chemical constraints to be expressed.

What was done and why

A replicated (4 x) field trial was conducted at Poochera in 2025 to investigate how lentils respond to nutrient and establishment strategies on **calcareous sandy loam soils**, which are common across the Eyre Peninsula.

These soils are known to present several challenges for lentil production, including:

- Reduced phosphorus (P) availability due to fixation by calcium carbonate
- Low availability of micronutrients such as zinc (Zn), iron (Fe) and manganese (Mn)
- Constraints to nodulation and nitrogen fixation
- Low organic matter and limited nutrient buffering

The trial aimed to assess the impact of:

- phosphorus rate, form and placement
- micronutrient application (Zn, Fe, Mn, Cu)
- nitrogen and sulphur supply
- sowing rate and depth
- nodulation (via inoculation treatments)

Soil and plant context

Soil conditions

Soil testing (0–10 cm) confirmed typical calcareous soil characteristics:

- High pH ($CaCl_2$ ~7.7–7.8)
- Very high carbonate levels
- Moderate to high Colwell P (34–83 mg/kg) but with high PBI (134) levels
- Low organic carbon (~1.3–1.7%)

While Colwell P levels appeared adequate, the high PBI value indicates large quantities of phosphorus are unavailable for plant access. A DGT-P test would be advisable in these soil types.

Plant tissue results

Plant tissue testing showed that nutrient applied in treatment applications:

- increased nitrogen levels (2.97 → 3.33%)
- slightly increased phosphorus (0.21 → 0.22%)
- substantially increased micronutrients (Zn, Cu, Mn)

This confirmed that applied nutrients were taken up by the crop, even where yield responses varied.

Key results

Treatment	**Harvest Biomass (t/ha)**	**Yield (t/ha)**
Best bet combo + high seeding rate	1.50	0.74
Best bet combo + low seeding rate	1.19	0.50
Best bet combo sown shallow (2 cm)	1.16	0.58
Best bet combo: P + Zn + Fe + N + S + Cu + Mn	1.32	0.69
Grower standard (low MAP)	1.41	0.72
High P only	1.39	0.74
Nil inoculant + Best bet combo - + N	0.56	0.16
Nil inoculant + Best bet combo - nil N & S	0.60	0.23
Replacement P + Fe	1.37	0.71
Replacement P + N	1.32	0.67
Replacement P + N + S	0.91	0.62
Replacement P + Zn + Fe	1.53	0.85
Replacement P as phosphoric acid	1.41	0.79
Replacement P only	1.60	0.77
Split P – half MAP, half liquid	1.78	0.93
P	*<0.001*	*<0.001*
lsd	*0.34*	*0.19*

1. Strong response to management

Yield ranged from 0.16 t/ha (nil inoculant treatments) to 0.93 t/ha (split P: MAP + liquid). Treatment effects were highly significant ($P < 0.001$), indicating that management had a major influence on lentil performance.

2. Nodulation was critical

Treatments without inoculation performed very poorly (Nil inoculant + nutrients: 0.16–0.23 t/ha). Despite nutrient supply, yields remained low. Effective nodulation was essential for lentil production at this site. This reflects the paddock history, where lentils had not previously been grown and background rhizobia populations were absent.

3. Phosphorus availability drove yield

Strong yield responses were observed to phosphorus strategies:

- High P only: 0.74 t/ha
- Replacement P only: 0.77 t/ha
- Phosphoric acid: 0.79 t/ha
- Split P (MAP + liquid): 0.93 t/ha (highest yield)

Despite moderate soil test P levels, these responses indicate that phosphorus availability, not total P, was the primary limitation.

4. Micronutrients improved plant nutrition but had variable yield effects

Micronutrient applications significantly increased tissue concentrations of Zn, Cu and Mn. However, yield responses were inconsistent and benefits were greatest where phosphorus and nodulation were adequate.

5. Establishment effects were secondary

Higher seeding rate improved yield compared to low rate and shallow sowing reduced yield. However, these effects were smaller than those from phosphorus and nodulation treatments.

What does it mean?

Phosphorus

On calcareous soils, Colwell P can overestimate plant-available phosphorus and large amounts of P are tied up and unavailable to the crop. Improving phosphorus availability (rate, placement or form) is more important than relying on soil test values alone. Additional tools such as PBI and DGT-P can help better interpret P requirements in these soils.

Nodulation

The very poor performance of nil inoculant treatments reinforces that effective inoculation is essential, particularly in paddocks without a recent history of lentils. This is well understood by growers, but remains a critical risk point.

Micronutrients

Micronutrients are important in calcareous soils, but they are secondary to phosphorus and nodulation, and they are most likely to provide benefit once major constraints are addressed.

Key takeaways

- Lentils on calcareous soils are highly responsive to management
- Phosphorus availability is a major limitation, even where soil test P appears adequate
- Improving P availability (rate, placement, liquid vs granular) can significantly increase yield
- Effective inoculation is critical for successful production
- Micronutrients can contribute but are not the primary driver of yield
- Establishment factors are less important than nutrition and nodulation
- On calcareous soils, lentil yield is driven by nutrient availability and biological function, not total nutrient supply.

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