Strategies for long-term soil nutrient management

Chris Dowling, Back Paddock Company

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Take home message

- All nutrients have a residual value when not taken up due to crop water deficit
- Uptake efficiency of residual nutrients can be greater than freshly applied
- Using nutrient removal rates as a basis for fertiliser addition is not appropriate for all soils, nutrients and situations
- Monitoring soil nutrient trends is essential in developing long-term strategies
- Plan nutrient tactics on a rotation basis, then apply appropriately to individual crops
- Soil P and K strategies need to include the 10 - 30 cm layer
- As seasonal variability becomes more extreme, soil-based production plasticity becomes more important
- Soil C decline is directly related to the lack of N surplus to offset annual mineralisation.

Soil fertility decline research suggests that it has taken 50-100 years to reach the current soil capability deficit, with most damage occurring in the first 20 years after first clearing and continuous cropping. It is not unreasonable to think that it takes more than a quick fix to halt and reverse the decline.

With high yield prospects of modern locally developed production systems and increased weather volatility, restoring and maintaining the soil's production capability becomes more critical to help buffer change and de-risk management decisions and associated costs.

When considering restoring soil capability, we must think of practical long-term strategies and align short-term tactics. Some of the primary considerations for the long-term management of soils in the sub-tropical grains industry include:

- ✓ All nutrients have residual value when not taken up due to crop water deficit or positional unavailability.

For example, nitrogen fertiliser uptake efficiency for a single crop in northern vertosols is commonly 10 – 30 % from a preplant fallow application for rates of 50 –100 kg N/ha (Daniel, 2021). About 65 % of what isn't taken up remains in the soil; on average, about 20 % is lost annually.

- ✓ Uptake efficiency of residual nutrients can be greater than freshly applied if not lost.

For example, allowing for an average N loss of 20 % per year and a 2 – 4 X efficiency of fertiliser N residual in the years after initial application (Daniel 2019), the efficiency of a single N application can be as high as 65 – 75 % after 3 cropping seasons.

- ✓ Reporting of single-year crop uptake efficiencies and profitability for nutrients is misleading where there is the residual value of applied nutrients

- ✓ Plan to manage nutrients initially for a rotation, then by crop

- ✓ Using nutrient removal is not an appropriate application rate for all soils, nutrients and situations, although this can work in some circumstances.

- ✓ Monitoring soil nutrient trends and balance are essential for long-term management.
- ✓ Plan for nutrients on a rotation basis, not by individual crop, to implement long-term management
- ✓ Soil P and K strategies must include the 10 - 30 cm layer in sub-tropical vertosols.
- ✓ As seasonal and nutrient cost variability becomes more extreme, soil-based production plasticity becomes more important to help stabilise income.
- ✓ Nitrogen mineralised from organic matter annually may need to be added to crop requirements to arrest further soil carbon decline.

References

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Contact details

Chris Dowling
Back Paddock Company P/L
Unit 1, 13-15 Steel St, Capalaba, Qld, 4257
Ph: 0407 692 251
Email: cdowling@backpaddock.com.au