

Soil-nitrate after drought

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Key Points

- Soil-nitrate increases following a drought
- Enough rain falls during a drought for mineralisation to occur.
- After drought, soil sampling is the most reliable method for determining soil-nitrate levels.
- To determine a fertiliser rate, soil-nitrate levels need to be balanced with target yield and protein.

Mineralisation of nitrogen

Rainfall events do occur during droughts. Whilst these events may not be of sufficient intensity and occurrence to wet the profile for sowing a crop, they appear to be enough for microbial-induced mineralisation. While mineralisation occurs in burst of activity, the cumulative effect is a soil rich in nitrate.

Data from long-term no-till sites in northern NSW (Warialda and Breeza) and south-eastern Queensland (Warra) shows that soil-nitrate levels increased during drought. The data was generated on deep black vertosols, however the principles should be relevant in all soil types.

During 1994, Breeza received 295 mm rainfall. There was some rain during the 1994/5 summer (about 180 mm), but it wasn't until May 1995 (92 mm) when the drought really broke.

Soil-nitrate, however, kept accumulating (Figure 1A). By the time the 1995 crop was sown, soil-nitrate levels were very high, particularly in the top 60 cm. Soil-nitrate levels to 1.2 metres increased from 30 kg N/ha to 195 kg N/ha. Normally, it would have been around 80 kg N/ha.

The story was much the same at the Warialda site (Figure 1B). Total soil-nitrate (0–1.2 metres) at the end of the 1993 season was just 9 kg N/ha. By the time the drought was over and the next crop sown in July 1995, total soil-nitrate was 170 kg N/ha. In normal years, it would have been 60–70 kg N/ha.

There was no evidence of nitrate leaching out of the bottom of the profile. Most of the nitrate

accumulated in the top 90 cm of the profile, rather than the 90–120 cm part of the profile.

At the Warra long-term site, soil nitrate levels increased by between 90 (after wheat) and 280 kg N/ha (after a 4-year grass/legume ley) in the 20-month drought-induced fallow. There was no evidence of leaching below 1.2 m or other losses.

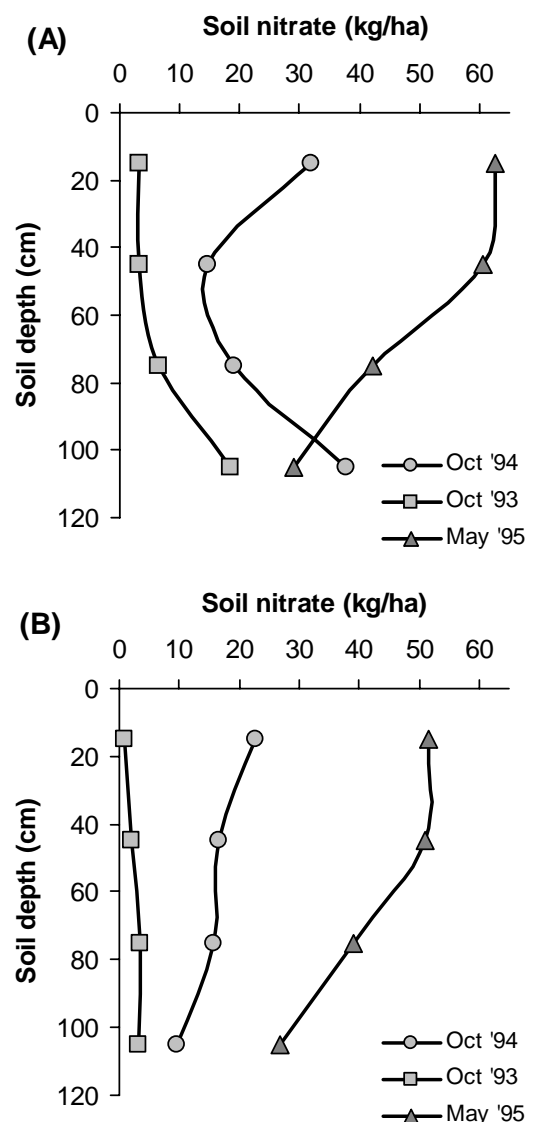


Figure 1: Soil nitrate profiles from the (A) Breeza and (B) Warialda long-term no-tillage sites at the start and end of the 1994 drought (Source: Felton, Marcellos, Schwenke and Herridge, unpublished data).



Using soil tests to estimate available nitrogen

Estimating the amount of soil nitrate your paddock can supply can be done either of two ways: soil testing for nitrate in the profile or using historical yields and proteins.

After a drought, long fallow, pulse crop or pasture, soil tests are the most reliable method to determine soil-nitrate levels.

To be effective, soil tests must sample areas of similar soil type, cropping history and moisture status. Because levels of nitrate in the profile fluctuate, 6 to 7 cores need to be taken to obtain a reasonable degree of accuracy. Above 10 cores there is only a marginal improvement in accuracy, but below 6 cores error increases dramatically. It is also important to sample to a depth of at least 90 centimetres to include the whole root zone, or at least to the depth of wet soil.

The location of nitrate in the profile and the depth of wet soil should be compared. If there is a 'bulge' of nitrate at 90–120 centimetres, but the soil is only wet to 80 centimetres, then this nitrate may not be available to the crop unless further rainfall wets the profile to this depth.

Soil tests have to be conducted early for practical reasons (for example March), but won't account for:

- late fallow mineralisation for the period between soil sampling and sowing (March – May); and
- in-crop mineralisation up until flowering (June – September).

Determining nitrogen fertiliser rates

To determine a nitrogen fertiliser rate, nitrogen supply from the soil needs to be balanced with nitrogen demand by the next crop. To do this, you need to know:

- target yield and proteins for the coming season can be calculated
- the amount of available soil-nitrogen needed for the target yield and quality
- the amount of available-nitrogen in the soil
- the difference between nitrogen needed in the soil and nitrogen available.

These steps are shown in Table 1.

Table 1: The steps in nitrogen budgeting process.

Step	Calculation
1. Fallow water storage (mm)	Fallow rainfall x 25%
2. In-crop rainfall (mm)	
3. Total available water (mm)	Fallow water storage + in-crop rainfall
4. Target grain yield (t/ha)	From paddock history or WUE calculation
5. Target grain protein (%)	Using paddock history or marketing strategy
6. Grain nitrogen yield (kg N/ha)	Yield x protein x 1.75
7. Nitrate-nitrogen needed in the soil (kg N/ha)	Grain nitrogen yield x 2
8. Soil-nitrate supply (kg N/ha)	From soil test or paddock history
9. Extra nitrogen required (kg N/ha)	Nitrate-nitrogen needed – soil nitrate supply
10. Fertiliser-nitrogen required (kg N/ha)	Nitrogen needed x 1.25 to convert to fertiliser-nitrogen
11. Required fertiliser rate (kg/ha)	Fertiliser-nitrogen required x analysis percentage

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (December 2006). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Primary Industries or the user's independent adviser.