



Resilient Cropping

Nutrient Losses

Have my nutrients gone?

After a heavy rain event farmers question what has happened to the nutrients in their soils. This is important but it is not easy to assess how much nutrient has been lost because there are many variables to consider.

We must think about:

- The crop and the stage it is at
- The applied fertiliser and the way it was put on
- The soil, its texture and water holding characteristics
- The intensity and duration of the rainfall event.

Nutrients can be lost in a number of ways. Soluble nutrients like nitrate and potassium can be lost in runoff and drainage water, whereas less soluble nutrients like phosphorus are more likely to be lost with sediments moving in eroding soils and run-off water.

Run-off and volatilisation

Broadcast fertilisers on the soil surface are at risk. Farmers often broadcast urea when rain is forecasted to wash it in to the soil. If you are unlucky and the small rain event you were expecting turns into a deluge, then losses in the run-off water may be high. Intense rainfall can cause significant erosion in cropping ground, particularly if the ground is sloping and cultivated, the crop is young and there is little protection from the canopy. Topsoil and soil sediments in run-off carry phosphorus reserves into the drain.

Volatilisation of ammonia from broadcast urea happens when conditions are hot and windy. Losses can be as high as 60% in the worst of conditions. It is often less risky to knife-in your side-dressing applications.

Denitrification

Nitrogen can be lost by denitrification processes in soils that are saturated. Soils with high clay contents or in poor physical condition are slower draining and more likely to become saturated and anaerobic. These conditions favour anaerobic micro-organisms which convert nitrate N into gaseous forms, such as nitrous oxide, which are lost to the atmosphere.

The amount of nitrogen lost by denitrification depends on how long the soils are saturated and the soil temperature. When the temperature is between 13-16°C losses are about 2% / day. As the soil warms losses increase to 5% /day.



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Leaching

Highly soluble nutrients like nitrate and potassium are prone to leaching. Leaching occurs when the soil is saturated and can't hold any more water and drainage occurs. The drainage water dilutes and disperses the nutrients down the soil profile. Deep rooting crops like maize can access nitrates from as deep as 180 cm, but once nutrients are below the rooting zone, they are no longer accessible.

The following equation gives a rough estimate of how far nitrogen will move in the profile

$$\text{N movement (cm)} = \frac{\text{rainfall (mm)} \times 10}{\text{Soil field capacity \%}} \quad \begin{array}{l} \text{sandy soils field capacity} \approx 30\% \\ \text{silty clay soils field capacity} \approx 38\% \end{array}$$

This assumes the soil is already at field capacity when the rain starts. If the soil is dry, some of that rain will be needed to fill the soil up to field capacity.

Worked Example

Assume a sandy soil with a field capacity of 30% and a rainfall of 50mm.

If the soil is already at field capacity, then

$$\begin{aligned} \text{N Movement} &= \frac{50}{30} \times 10 \text{ mm} \\ &= 17 \text{ mm} \end{aligned}$$

If the soil is at 50% field capacity, then

$$\begin{aligned} \text{N Movement} &= \frac{50-15}{30} \times 10 \text{ mm} \\ &= 11.6 \text{ mm} \end{aligned}$$

Knowing how far the nitrogen has moved helps with the decision of whether or not to apply more. It may still be accessible to the crop if the roots are well down