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Arable Extra

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N Smart: Six soil-driven steps to smarter nitrogen fertiliser decisions

1. **Set your yield goal** – review past records and decide on a realistic target yield.
2. **Calculate nitrogen (N) needs** – work out how much N is required to hit that target.
3. **Test your soil** – don't rely on guesswork; use soil tests to see what the soil will supply.
4. **Use decision tools** – compare soil supply with crop demand to know how much N fertiliser is needed.
5. **Fine-tune on farm** – trial adjustments in N fertiliser rates to find the best approach for your system.
6. **Review and improve** – record results, reflect on outcomes, and refine your plan for next season.

Background

Reaching yield targets by factoring in soil N supply reduces fertiliser use, cutting costs. For example, FAR trial results (2024) in maize silage showed that savings of $250/ha were made when soil N supply was accounted for.

Although there is a lot of nitrogen (N) in the soil, only a fraction is plant-available. Microbes release mineral N (nitrate + ammonium) from soil organic matter, a process called mineralisation. This is a natural process that occurs regardless of fertiliser use or crop demand, as microbes gain energy from carbon while releasing N. Using soil supplied N isn't "mining", but the soil organic matter pool does need replenishing through restorative phases in the rotation (see Good soil is good business, https://www.far.org.nz/resources/far-focus-15-good-soil-is-good-business).

Being N Smart means matching fertiliser inputs with soil N supply during periods of active crop uptake. Soil testing shows how much of your crop's N demand can come from the soil, while decision tools help ensure only the N made available during crop uptake is factored into fertiliser planning.

The six steps below outline how to get this right on your farm.

Step one: Set your yield goal

The first step in N smart fertiliser decisions is knowing your yield potential. Start with your own experience: what's been your average yield over the last 10 years? What were the highs and lows? Use this to set realistic yield targets, remembering your soil may perform differently from your neighbour's.

Step two: Calculate nitrogen needs

The N required to meet target yield varies by crop, so refer to crop-specific guidelines if values aren't known. For example, an irrigated perennial ryegrass seed crop typically requires 172 kg N/ha; a wheat crop, 25 kg N per tonne of target yield; and maize silage 12.5 kg N per tonne of target yield.

Step three: Test your soil

How can I soil sample myself?

To see how it's done, watch the video on the FAR website, (https://www.far.org.nz/resources/how-to-take-soil-samples-video).

You can buy affordable soil augers, spears, or step-on corers from most analytical laboratories. Identify representative transects or areas within your paddock and take about 15 cores per transect, avoiding atypical spots such as gateways or troughs. Combine samples in a bucket and mix thoroughly to get a truly representative sample—this step is critical.

Transfer the mixed soil into a clearly labelled bag, refrigerate immediately, and send to the lab within 72 hours (freeze if this isn't possible). Keeping samples cool prevents mineralisation during storage, which can give artificially high mineral N results. Most labs provide free postage labels, sample bags, and chilly pads.

For sampling depth, remember: *the deeper you go, the more you know*. If you only have a 15 cm step-on corer, that's fine, but note that crop roots usually extend deeper, so your soil N supply estimate will be conservative.

The PMN test should be taken from the 0–15 cm or 0–30 cm layer, where most mineralisation occurs. It doesn't need to be done every year, as PMN changes slowly.

Which tests?

Mineral N or "Deep N" is a snapshot of plant available nitrogen (ammonium and nitrate). Test close to when you are making a N fertiliser decision, leaving enough time for results to come back.

Potentially Mineralisable Nitrogen (PMN) is an estimate of what soil N will become available over the growing season. This test is more repeatable than the Anaerobically Mineralisable Nitrogen (AMN) or Plant Available Nitrogen (PAN) previously used to estimate N release over the growing season.

Total Nitrogen (TN) is the total amount of N in both plant available and non-plant available forms. This number can be large (>10 t/ha) and is not typically used to make fertiliser decisions.

Step four: Use decision tools

The results you get back from the lab will usually be in concentration i.e. mg/kg. FAR's Soil N Supply Calculator (https://www.far.org.nz/resources/soil-nitrogen-supply-calculator) can be used to convert these to kg N/ha, which you can then use when making N fertiliser decisions. To watch a video on how to get started with the calculator https://www.far.org.nz/resources/how-to-use-the-soil-nitrogen-supply-calculator.

After downloading the calculator, make sure to 'Enable Editing' and 'Enable Content'.

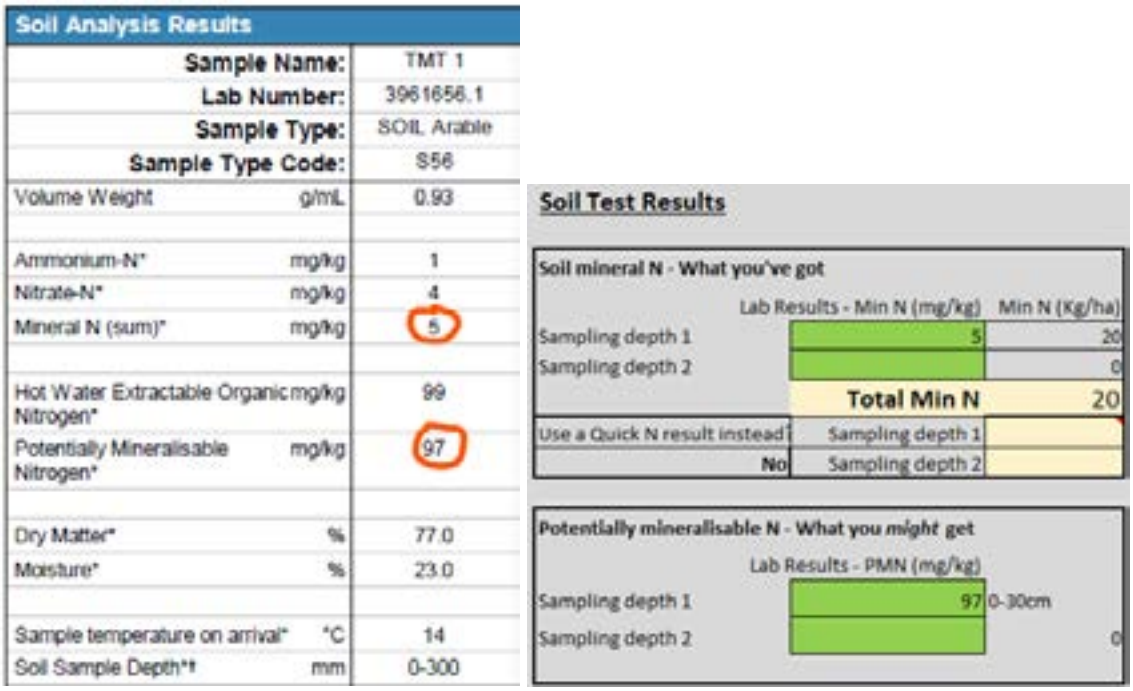
1. Enter basic information – paddock ID, sampling date, sampling depth, and bulk density.
   i. Use the information (i) button to select a bulk density (or refer to SMap), this value is needed to convert mg/kg to kg/ha. Then select the climate region closest to your location.

2. Enter crop details – input your total crop N requirement (from Step 2). For example, for a 13 t/ha autumn feed wheat crop using 25 kg N/t, enter 325 kg N/ha.

3. Add soil test results – enter mineral N and, if available, PMN results (mg/kg), Figure 1.

4. Select crop growth period – for PMN, enter the active growth months and irrigation period. The calculator only includes soil N mineralised while the crop is actively growing (Table 1). For example, for autumn milling wheat if the period September-December is entered, the calculator only factors in N made available during these months.

5. Set your confidence factor – choose the percentage of soil N supply you are comfortable including in your fertiliser decision (Figure 2). The calculator then uses this soil N supply amount with your crop's total N requirement to guide your fertiliser rate.



Soil Analysis Results		
Sample Name:		TMT 1
Lab Number:		3961656.1
Sample Type:		SOIL Arable
Sample Type Code:		S56
Volume Weight	g/mL	0.93
Ammonium-N*	mg/kg	1
Nitrate-N*	mg/kg	4
Mineral N (sum)*	mg/kg	5
Hot Water Extractable Organic Nitrogen*	mg/kg	99
Potentially Mineralisable Nitrogen*	mg/kg	97
Dry Matter*	%	77.0
Moisture*	%	23.0
Sample temperature on arrival*	°C	14
Soil Sample Depth*†	mm	0-300

Soil Test Results

Soil mineral N - What you've got

	Lab Results - Min N (mg/kg)	Min N (Kg/ha)
Sampling depth 1	5	20
Sampling depth 2		0
	Total Min N	20

Use a Quick N result instead?	
No	Sampling depth 1
	Sampling depth 2

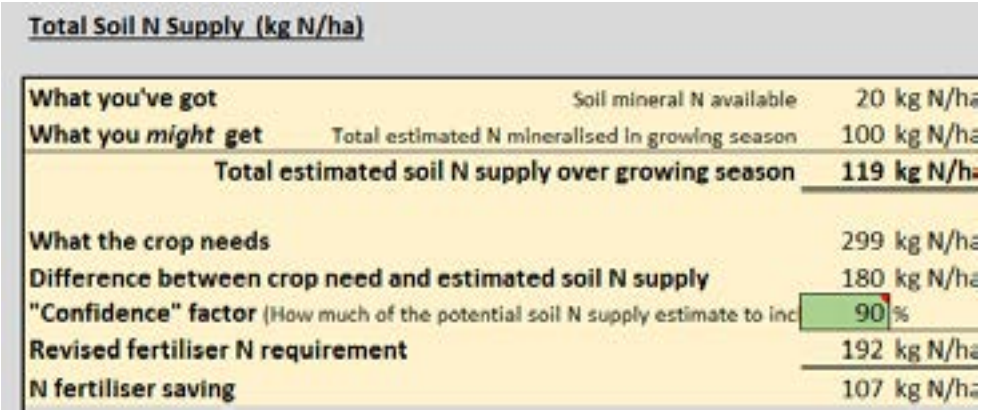
Potentially mineralisable N - What you *might* get

	Lab Results - PMN (mg/kg)	
Sampling depth 1	97	0-30cm
Sampling depth 2		0

Figure 1. Example of entering soil analyses results into the N supply calculator.

Table 1. Example of monthly and compounding Soil N supply.

Month	Monthly soil N supply (kg N/ha/month)	Compounding Soil N supply (kg N/ha)
September	16	21
October	16	38
November	16	55
December	18	73
January	18	91
February	18	109



Total Soil N Supply (kg N/ha)

What you've got	Soil mineral N available	20 kg N/ha
What you *might* get	Total estimated N mineralised in growing season	100 kg N/ha
	Total estimated soil N supply over growing season	**119 kg N/ha**
What the crop needs		299 kg N/ha
Difference between crop need and estimated soil N supply		180 kg N/ha
"Confidence" factor (How much of the potential soil N supply estimate to inc		90 %
Revised fertiliser N requirement		192 kg N/ha
N fertiliser saving		107 kg N/ha

Figure 2. Total soil N supply and confidence factor.

Where does the quick N test fit?

Cheap DIY quick nitrate tests measure only nitrate, not ammonium, but can substitute for lab mineral N in the calculator. They're also useful for mid-season or post-harvest checks. For example, if you did not reach your target yields due to a dry season and you suspect you may have a lot of residual N after harvest, then a quick N will tell you straight away how much. Kits can be purchased www.labsupply.co.nz (enter nitrate test kit or CHENITRATE-N into the search bar). The quick test nitrate guide can be found here, https://assets.far.org.nz/Quick-test-nitrate-guide.pdf.

Step five: Fine-tune on farm

For N Smart management, consider where you can make changes in your operation. If you're sidedressing, use the monthly mineralisation estimate to adjust your rate between application and the point when the crop stops taking up N. If all N is applied up front, use your soil N supply result (mineral N + PMN) to gauge how much N you already have and how much will become available, so you can refine your single application.

Some growers leave small low- or no-N strips to test how well the soil supplies N compared with calculations. Building your own farm dataset helps you calibrate your knowledge to your farm. Tracking PMN across rotations (e.g. after legumes or restorative crops vs. others) helps you decide how often to repeat the test. A guide to running your own on-farm trial can be found here, https://www.far.org.nz/resources/guide-to-running-your-own-on-farm-trial.

Step six: Review and improve

The aim of being N Smart is to start, record, reflect, and refine your approach for next season. Make notes when you think crop stress may have been caused by weather or pests. After harvest, record your target yield, how you made your fertiliser decisions, how the season unfolded, and what you learned. Being N Smart means using the tools to complement your own knowledge, staying observant, responsive, and focused on improving each year.

Where can resources be found?

FAR Focus Issue 14: Nitrogen: the confidence to cut back

FAR Focus Issue 15: Good soil is good business

Digital tools:

How to take soil samples

Soil nitrogen supply calculator

How to use the soil nitrogen supply calculator

Guide to running your own on-farm trial: https://www.far.org.nz/resources/guide-to-running-your-own-on-farm-trial

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