

## FAQ Nutrients/Fertilisers/Biological amendments

### Alternative fertilisers

Q: Felicity: Great work Mark. Just wondered if there is any future work (biological amendments) being done / planned in pasture based systems... particularly those with mixed legume/grass swards? (27/7/2021 Soil Webinar)

Dr Mark Farrell, CSIRO:

I can't really speak too much to funding that space. I would say there is a research need for it. Colleagues at AgVic or Unis are better placed to answer where the exact politics of funding lie.

Q: Lisa: What rates of poultry litter did you use? (27/7/2021 Soil Webinar)

A: Dr Mark Farrell, CSIRO. Grower groups agreed on 3t/ha fresh on everything across the trials, so there were varying moisture and nutrients levels. The samples we had, did not stand out chemically all much of a muchness.

Comment: Lisa Warn, Facilitator of Mid Goulburn GSSA soils group.

I have done a bit of work comparing inorganic fertilisers to poultry litter in phalaris. I got no response to humates as per your response. But with poultry litter, I got the same dry matter responses where we matched N,P,K inorganic fertilisers. So, this was encouraging, that it was just nutrient. But I got massive responses to N in pastures. Using 1 ½ t/ha as maintenance, 3 t/ha and up to 5t/ha. It was applied annually for 4 years but had to put on up to 20 t/ha before we started to build C.

### Nitrogen

Q. Will: When you refer to N is that urea and will it have a long-term effect on the N in the soil or used in the plant immediately (27/7/2021 Soil Webinar - This question is related to the N mining that has been found in cropping systems and the need for N to build organic carbon).

A: Dr Mark Farrell, CSIRO

Yes, urea or MAP/DAP. Microbes that live in soil need nitrogen and do compete for it with both pasture or crop. Your OM is ultimately recycled plant material that has been through a microbe at least once. Even in pasture systems, for example ryegrass roots there is higher C to N ratio in the roots than the soil, so when roots decompose, C is lost (*in microbe respiration*). Nothing you can do about that for the most part. But being nutrient (N) limited exacerbates it (*C loss*), microbes go to being C limited, they can't get carbon from the plant as they can't photosynthesis, (*because of low N, they can't breakdown OM to get C*), they go hunting around for nutrients in OM and that's when you see decline.

Q. Will: In our own system, N applied at 100 kg/ha applied in autumn and early winter. At that rate would you expect to see a lift in N in the soil? (27/7/2021 Soil Webinar)

A: Dr Mark Farrell, CSIRO.

Can't really answer that, I'm more familiar with inputs grains. You do need an understanding as best you can of how much N you are taking off in your livestock, how much is returned through manure and losses in higher rainfall areas. There will be rules of thumb for those. So, build as a good a guess of what your N budget is in both directions.

You might not see an issue straight away (*N deficit*) but you will have a problem in the longer term. Where a lot of broad acres systems got into problems, is and I don't think it is the supposition that we lost C relative to pre-clearing, its true in some systems but broadacre systems have lost C when they had 4 or 5 years of pasture leys (*leys without legumes, so N being further reduced*).

Comment: Felicity Turner, Facilitator Meningie Field Livestock & Pasture Healthy Soils group  
All the C emission calculators coming through are including N. For Will, one key thing we do on our farm that is part of our grazing system is that if we are applying N is to keep in mind it's using C to produce it, so make sure you are producing weight gain to try and offset it. You apply extra N to build C but it's costing you C to use it. Make sure you are maximising your return from applying it.

Comment: Dr Mark Farrell, CSIRO

That is a really good point, in pasture systems with legumes, bigger gains can be made compared to the fossil C impact with the production of urea.

Q: Brien: How valuable is the N soil test in understanding where you are at with your nitrogen?  
(27/7/2021 Soil Webinar)

A: Dr Mark Farrell, CSIRO: It will depend on what is being measured. If its nitrate, then the roots will find it quickly, its available straight away and it is vulnerable to leaching in rainfall events. But N is a dynamic pool that is filled very quickly.

The thing you want to be watching over time is whether or not N is being run down and that's when those balance measurements came from that I showed you in Rob Norton's work in grains is the total N.

The vast majority of total N, 99% of it isn't available to plants, think of it as your lump sum in your super and you're living off the interest and, you can dig into it for a bit, but if you keep taking it, eventually you can have a problem if you go too far. So, you need to manage it a bit in that way.

For a classic deep N test in crop systems, it will be a stock of nitrate N in kg/ha down to 30 or 60cm. All of that is available and likely to be available in that growing season, but it is not really telling you the whole longer-term picture. While it is something you should be keeping an eye on once every 2 to 3 years, requesting a total N and seeing if is going up or down or is static and it will give you an idea on what's going on.

Even if you have applied fertiliser and via legumes, it goes into that (*total N*) pool first then goes back out as nitrates available to plants. What you are seeing in the nitrates and what plants can see, is this tiny bit of a great ball of it (*N*). Its slowly decreasing in size over time, and the ability to supply that N is also going to decrease.

Comment: From Doris Blaesing, Facilitator Flinders Island Group:

You can test for available nitrate and ammonium via N-check or deep soil N testing.

A: Dr Mark Farrell, CSIRO

That nitrate and ammonium and some organic N is theoretically available to the pasture, but it is mostly nitrate. I'm trying to emphasise here to think of the pool as a transient thing, that you are

backfilling with N fertiliser and legume N. But it's all governed by OM total N pool. Say 99% of the total N pool in the soil isn't directly available but is what provides most of the N that is available. An example in cotton, is that up to 90% of N is coming from OM. The centrality of OM providing N and P for plant growth is really important.

Q: Jonathon: Would Nitrate value vary throughout the year, depending on testing? (27/7/2021 Soil Webinar)

A: Lisa Miller, SFS

Yes, nitrogen levels do vary over the year. Nitrogen release through mineralisation occurs when soils are warm and moist and nitrogen losses will occur under waterlogging. Sub-clover doesn't start fixing N until after about 6 weeks, slows in winter and this nitrogen in nodules becomes available to companion grasses when plant roots die in spring. So, if you were monitoring levels over time, then try and take the soil test at the same time of the year and get it to the laboratory as quickly as possible to reduce possible losses.

A: Response taken from "Understanding your soil test," by Cath Botta

Your soil test may offer up to three measurements for N. When considering these, however, it is important to note, that N levels in soils fluctuate widely, depending on seasonal conditions and rainfall. Levels greatly depend on biological activity, and the nitrate N forms is highly mobile and easily leached. This means its concentration in the soil can vary considerably over a short time, even in the same paddock and is therefore difficult to interpret the results.

There are no real target levels, but agronomists generally prefer a level of 10 mg/kg or more in pasture soils (for both nitrate or ammonium). Nitrogen recommendations are better based on regional fertiliser trials conducted over a number of years, rather than on soil test levels.

Comment: Dr Mark Farrell, CSIRO

I might have been generalised too far on strategies like James Hunt N bank approach and other recommendations. Do base decisions on an annual testing farm and targeting your theoretical top crop yield with top N demand. The presumption in drier areas, is that not too much N is lost, so can capture what is available in the following year's testing. So, testing in year 1, say applying 100 kg/ha but it's a rubbish year and so say 50 kg/ha is used by plants, so the next year you only need to apply about 50 kg/ha. So over time it's a self-balancing exercise.

Q. Jonathon: Has there been the same work within the livestock system...to see if there is a deficit of N?

Q. Brad: Great discussion. Any studies that show how well N is being used in modern grazing systems - eg leaching extent, role of pasture is mopping up N. How N efficient can we be in grazing?

Comment: Lisa Miller, SFS:

There seems to be a N deficit occurring in winter which is why pastures commonly respond to N at that time. We will follow up these questions about understanding the N balance and contributions of N by legumes and mineralisation with another webinar on understanding nitrogen in the coming months.

## **Monitoring Nutrients**

Comment: From Doris Blaesing, Healthy Soils coordinator of Flinders Island productivity group: We cannot make decisions on nutrient inputs without monitoring. It will be worthwhile to look at a complete analysis given that trace elements are low in many areas.