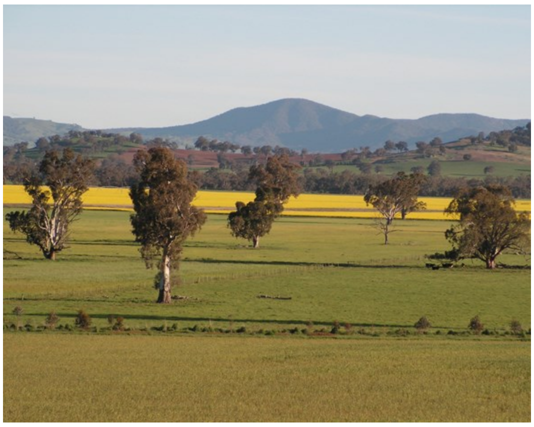
Factsheet

Phosphorus, Nitrogen & Soil Organic Carbon



Seventy percent of nitrous oxide (N_2O) produced in Australia comes from agriculture; therefore any action that landholders can take that will reduce their N_2O contribution could assist in reaching national GHG emissions reduction targets. Farming practices that lower N_2O emissions have the potential to deliver economic and environmental benefits through lower fertiliser inputs, improved natural resource management and the potential to create offsets under the Australian Government's voluntary carbon offsets scheme in the future.

One of the real conundrums in agriculture today is how to increase soil carbon and reduce GHG emissions, such as N_2O, whilst at the same time remaining economically viable. There is a close relationship between phosphorus, fixing nitrogen and maximising pasture growth. Applying the correct level of phosphorus leads to the growth of legumes; legumes fix nitrogen (which reduces the need to apply nitrogen fertiliser), which in turn reduces the release of N_2O and maximises grass growth to produce more dry matter. Holbrook Landcare Network has developed a phosphorus budgeting tool that enables you to calculate the rate of phosphorus required for your property so as to ensure the growth of a balanced legume and grass pasture.

The *Phosphorus Budgeting Tool* can be downloaded from www.holbrooklandcare.org.au/carbon.

Reducing the amount of N_2O released into the atmosphere may be achieved by the natural fixation of nitrogen by legumes, as a result of phosphorus application, instead of applying nitrogenous fertilisers. This may also result in increased production of dry matter and increase the levels of soil organic matter.

The information in this factsheet is general in nature. The factsheet should only be used as a guide and may not apply to your situation. Variables such as soil type, rainfall, grazing regimes, water logging and drought all have significant impact on the interplay between nitrogen and soil organic matter. If in doubt, check with your advisor and conduct further research for your individual circumstances.

74 Albury St (PO Box 121) Holbrook NSW 2644
T 02 6036 3181 **F** 02 6036 3183 **E** office@holbrooklandcare.org.au

Soil organic carbon (SOC) is critical to soil fertility, playing a beneficial role in various soil biological, chemical and physical properties and processes and the interaction that can occur between these different functions (Chan *et al*. 2002). The amount of carbon stored in the soil is the balance between the rate at which organic matter is added and the rate at which is decomposes, releasing carbon dioxide (CO_2) back into the atmosphere. Carlyle *et al* (2010) indicates continuous inputs of organic matter are beneficial to increasing soil carbon content.

A balanced grass and legume pasture requires phosphorus to grow the legumes which in turn fix nitrogen - this is then available for the production of grass. It is one of the great ironies of agriculture that the atmosphere is around 78% nitrogen, but not one single molecule is directly available to plants. Apart from small accessions from lightening, this nitrogen cannot be accessed without the aid of microbes.

Nitrogen could be provided by applying nitrogen fertiliser, however, this is a key source of N_2O emissions on farms. N_2O is an extremely potent GHG (about 300 times the equivalent of CO_2 (IPCC, 2007)) so understanding how to increase available nitrogen via fixation rather than artificial fertiliser has the capacity to reduce on-farm GHG emissions. Nitrogen fixing bacteria - be they are free living in the rhizosphere, confined to nodules on plant roots or existing as entophytes in leaves or stems - derive most of their energy from carbon fixed during photosynthesis.

Utilisation of organic nitrogen by mycorrhizal fungi closes the nitrogen loop and prevents soil acidity as well as preventing volatilisation of nitrogen to the atmosphere and leaching to aquifers, rivers and streams (Jones, 2010). A well managed legume-based pasture can potentially accumulate large amounts of nitrogen (30-200 kg N/ha annually) with the potential to substantially improve crop yields (Chan *et al*, 2010a).

As important as nitrogen is, it is phosphorus that is needed to grow legumes. Hague *et al* (1985) are of the opinion that phosphorus is the most important nutrient in the successful establishment of forage legumes. Phosphorus is also essential for plant growth and is vital for early root formation (Baker & Gourley, 2011). In a study by Chan et al (2010a), it was found that there is significantly higher SOC under pastures improved with phosphorus fertiliser application, compared to unimproved pastures with no history of phosphorus application. Pastures with added phosphorus had an average of 10 tonnes of carbon per hectare more than unimproved pastures. This improved carbon capture could be attributed to large pasture yileds resulting from phosphorus application (Chan *et al*, 2010b).

References

Baker, F. and Gourley, C. (2011). Understanding soil tests - pastures. *Agnote AG 1425*. Department of Primary Industries Victoria.

Chan, K.Y., Hennan, D.P. and Oates, A. (2002). Soil carbon fractions and relationship to soil quality under different tillage and stubble management. *Soil and Tillage Research*, 63: 133-139.

Chan, K.Y., Oates, A., Liu, D.L., Li, G.D., Pragnell, R., Poile, G. and Conyers M.K. (2010a). A farmers guide to increasing soil organic carbon under pastures. *Industry and Investment NSW*.

Chan, K.Y., Oates, A., Li, G.D., Conyers, M.K., Pragnell, R.J. Poile, G., Liu, D.L. and Barchia, I.M. (2010b). Soil carbon stocks under different pastures and pasture management in the higher rainfall areas of south-eastern Australia. *Australian Journal of Soil Research*, 48: 7-15.

Hague, I., Nnadi, L.A. and Mohamed-Saleem, M.A. (1985). Phosphorus management with special reference to forage legumes in sub-Saharan Africa [workshop proceedings]. *ILCA,* Addid Ababa: Ethiopia.

IPCC. (2007). Climate change 2007: synthesis report. *Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: Switzerland.

Kondinin Group. (2009). Farming ahead. *Monthly journal, June*. Kondinin Group, Perth: Western Australia.

Rowles, A., Reid, C., Johnstone, S., Campbell, L. and McKernan, G. (2012). Sustainable farming practices - soil carbon. *The impact of land management and social factors on soil carbon in northeast Victoria.* North East Catchment Management Authority, Wodonga: Victoria.

Stokes, C. and Howden, M. (2010). Adapting agriculture to climate change. CSIRO Publishing.

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T 02 6036 3181 **F** 02 6036 3183 **E** office@holbrooklandcare.org.au

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