# Soils are Alive Newsletter

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The University of Western Australia

## Welcome

This newsletter was prepared by Jennifer Davis who is a PhD student at The University of Western Australia funded by the Rural Industries Research and Development Corporation (RIRDC) to investigate nutrient cycling processes in pasture used for beef production during conversion to a certified organic production system. The title of the project is ***Adding value to organic Pasture - Microbes and Minerals***

The project includes a large field experiment monitoring changes in microbial processes and availability of nutrients near Harvey in Western Australia during transition to organic production of pasture. The photos are from the field site.

See also the Soils are Alive Newsletter Volume 3 No 1. It is about organic phosphorus and explains processes related to the release of P from oganic matter.

**AUSTRALIAN SOIL CLUB**

**The Australian Soil Club was established to provide information about soils that is useful to all land users. The website for the Australian Soil Club is:**

**www.soils.org.au**

**Please check the website if you are interested in more information.**

## Acknowledgements

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www. soilhealth.com

*For further information, contact:*

**Professor Lyn Abbott**
**School of Earth & Geographical Sciences**
**Faculty of Natural & Agricultural Sciences**
**The University of Western Australia**
**Nedlands WA 6009 Australia**
**email: labbott@cyllene.uwa.edu.au**

# Balancing the Budget:

## Phosphorus in Organic Farming

**by Jennifer Davis** jdavis@graduate.uwa.edu.au

### P Availability a Challenge for Broadacre Organic Farming

There is concern among scientists and agricultural advisers that phosphorus (P) may be a problem in broadacre organic farms. Several researchers have found that in organically farmed soils in Australia, low P availability may be limiting yield of crops and pastures (see References 1).

*Pasture at the Harvey, WA site*

Is lower P availability in soil on organic farms necessarily a problem? P inputs in organic farming contain smaller amounts of soluble P, so it can be expected that organic farms will have lower available P in the soil at any one time. It is possible that this P becomes available to the plants gradually through the growing season. It has been suggested that under organic farming there is more biological cycling of P than in conventional farms. This may compensate for the lower solubility of P inputs permitted in organic farming. Also, it is possible that the lower yield on some organic farms is more sustainable in the long term than the higher yields obtained under conventional farming.

*Ground Rock Phosphate*

The lower availability of P in organic farming may be a serious problem. It may even affect the sustainability of organic farming in Australia. An organic farm that has lower yields because of lower P availability in the soil may still be viable and sustainable from an economic point of view. The higher price obtained for organic produce may compensate for the lower overall yield. However, the way that P is managed on a farm impacts on the farm's overall sustainability.

### Sustainable Management of P – Balancing the P budget.

The management of P affects the sustainability of farming. This is true for organic and conventional farming. One of the criteria for sustainability is that the resources be maintained and not allowed to decrease. P is one of the resources that must be maintained for a farm to be sustainable. Keeping a balanced P 'budget' is one way of thinking about how to maintain the P resource on a farm.

Every time products are harvested from a farm, (e.g. fruit, grains or beef) nutrients are permanently removed from the farm. If no nutrients are added to the soil, the 'bank' of nutrients in the soil will eventually be exhausted.



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# Balancing the phosphorus budget in organic farming

*from Page 1*

Sustainable farming systems rely on inputs of nutrients to replace what has been removed from the farm in the harvested products. Therefore in sustainable farming systems, the nutrient inputs must equal or exceed the nutrient outputs (losses). That is, the P budget must be 'positive'. If fertiliser inputs of P are less than the P that has been removed from the farm in the harvested produce (a 'negative' budget), the farming system is unsustainable.

**P Budgets in Australian Organic Farms – Research**

One way to determine if the inputs to a farm or paddock are sufficient is to calculate a nutrient 'budget' (see box). Some research on organic farming in Australia has reported nutrient budgets and they indicate that nutrient inputs are not always sufficient on the organic farms studied. A study of seven organic grain-livestock farms in the Western Australian wheatbelt, found all of the farms had negative P budgets. On each farm, the P output in harvested wheat was greater than the P inputs in fertilisers (poultry manure or dynamic lifter) (see Reference 2.) Results from the Roseworthy field experiment in South Australia (see Reference 3) showed that after five years the organic paddocks had positive P budgets but the biodynamic paddocks had P budgets of -20 kg P per hectare. The biodynamic paddocks had smaller P inputs as fertiliser and larger outputs of P due to the harvest of a hay crop (see Table 1).

It is vital that sufficient nutrients, especially P, are added to the soil in inputs to replace what is permanently removed from the farm in harvested produce. Failing to do this means that crops and pastures are drawing on soil reserves of P. Since they cannot do this forever, this situation is unsustainable. Using the steps outlined in the box, nutrient budgets can be used as a simple way of assessing whether outputs are balanced by inputs and a farm's nutrient management is sustainable.

***References***


1. Dann et al. (1996) Aust.J.Exp.Agric. 36: 71-78
   Deria et al. (2003) J.Sust.Ag. 21: 21-47
   Derrick & Dumaresq (1999) Aust.J.Soil Res. 37: 1047-1055
   Penfold et al. (1995) Aust.J.Exp.Agric. 35: 849-856
   Ryan & Ash (1999) Agroc.Eco.Env. 73: 51-62
2. Deria et al. (2003) J.Sust.Ag. 21: 21-47
3. Penfold et al. (1995) Aust.J.Exp.Agric. 35: 849-856
4. Berry et al. (2003) Soil Use Man. 19: 112-118


## How to Calculate a Nutrient Budget

**The Principle**

Nutrients are a resource and managing them in a sustainable way means that the amount of nutrients in the soil should be maintained and not decreased. Therefore nutrients removed from the farm in harvested products (nutrient outputs) must be replaced with nutrient inputs to the farm. Nutrient budgets are a kind of accounting system that keeps track of the balance of nutrient inputs and outputs on a farm, providing an indicator of the farm's sustainability.

**Step 1: Define the area**

Determine what area you want to calculate the nutrient budget for. There are basically two choices:

a) 'Farm-gate' nutrient budgets only take into account the nutrients that move into a farm from outside and out of a farm as products. They are simple to calculate, but don't give you any information about specific areas of your farm.

b) 'Soil surface' budgets are useful when information is required about a smaller area of a farm, such as a paddock, or about one stage in a rotation. In soil surface budgets nutrients that come from other areas of the farm are counted as inputs. Outputs are losses from the soil, not losses from the farm.

**Step 2: Decide which nutrients to measure**

Determine which nutrients you are most interested in. A nutrient budget can be performed for one nutrient or as many as you can measure.

**Step 3: Record inputs and outputs**

Measure all the inputs and outputs of nutrients to the area. Inputs are not limited to things that are typically considered 'fertilisers'. Inputs are anything brought into the area that contains the nutrient you're interested in. Therefore inputs include things such as fertilisers, stock feed and mulches. Outputs include nutrients in the harvested products, whether the product is fruit or beef. Ideally, outputs will also include measures of other losses of nutrients from the system, such as leaching or erosion, but these losses can be difficult to measure.

**Step 4: Calculate the budget**

Once you have measured the inputs and outputs, calculate the budget for each nutrient by subtracting all the outputs of that nutrient from the inputs of that nutrient. That is, nutrient budget = (sum of all inputs) – (sum of all outputs). Table 1 shows two examples of nutrient budgets.

***Table 1. P inputs and outputs (in kg P per hectare per year) from the Roseworthy Trial in South Australia (Penfold et al. 2003) and two organic beef-cropping in UK (Berry et al. 2003)***

| | | Roseworthy Trial, SA | | Organic beef-crop, UK | |
|---|---|---|---|---|---|
| | | Biodynamic | Organic | Farm 1 | Farm 2 |
| P Inputs | manure | | | 8 | 8 |
| | atmospheric deposition | | | 0.5 | 0.5 |
| | seed | | | 0.5 | 0.5 |
| | rock phosphate | | | 12 | 16 |
| | Total inputs | 21 | 40 | 21 | 25 |
| P Outputs | crop | | | 13 | 18 |
| | animals | | | 2 | 1 |
| | Total outputs | 41 | 26 | 15 | 19 |
| Budget Total inputs - Total outputs | | -20 | 14 | 6 | 6 |



Contact Lyn Abbott by email labbott@cyllene.uwa.edu.au