ARGOS

AGRICULTURE RESEARCH GROUP ON SUSTAINABILITY

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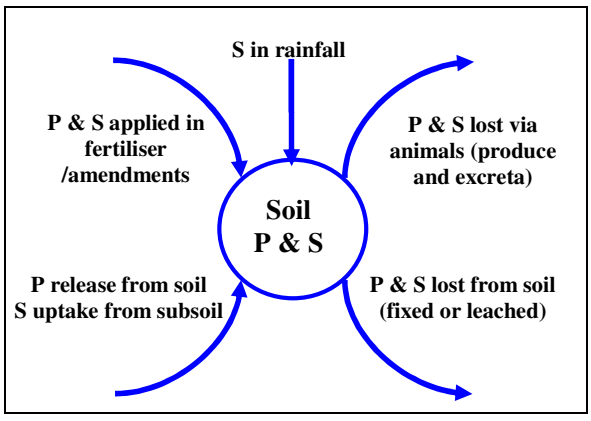
Soil Phosphorus and Sulphur Levels in Dairy Farms

Phosphorus and Sulphur in NZ soils

Phosphorus (P) and sulphur (S) are probably the two most common nutrient deficiencies found in the soils of NZ. Most New Zealand soils have naturally low amounts of P and S because these elements are either not present in sufficient amounts in the parent materials (minerals and rocks) or like sulphate-S, are highly soluble and easily leached. P and S are retained in soil organic matter (SOM) but are released only slowly. The use of P and S fertilizers to overcome these deficiencies has enabled NZ agricultural and horticultural industries to flourish. The pastoral industries in particular, have had a strong reliance on superphosphate fertilizers to increase the legume content and in turn, soil nitrogen (N) that can then be utilized by the other pasture species to increase both quality and DM yield.

Fig 1. Soil P and S cycle



Farm trials have shown for some time that the optimal P limits for dairy farms is 30-40 (mg P/L; Olsen test) but many farms exceed these levels despite the evidence that they are highly unlikely to be achieving any extra production or response.

Conventional vs. Organic

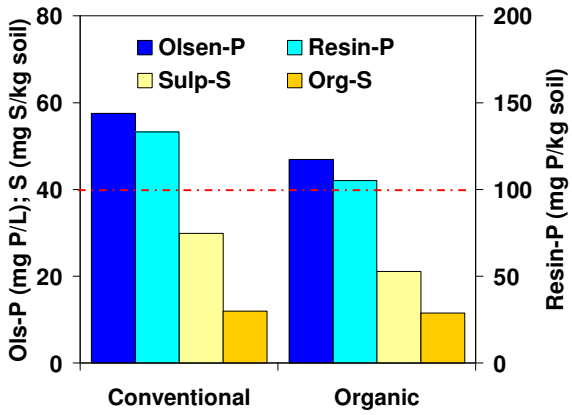
In 2005, ARGOS initiated a comparative study of 12 clusters of dairy farms with matched Conventional and (converting to) Organic Dairy farms mainly in the Waikato and Taranaki regions. Soil testing of the main landforms within each farm was carried out for a range of chemical, biological and physical properties to measure differences between systems at time zero and into the future. Soil tests for P and S include Olsen-P, (NZ std. P soil test), Resin-P, (used to measure both available and slowly-available sources of P), Sulphate-S, (immediately available S) and Organic-S (long-term supply).

One of the main differences between Conventional and Organic systems is the withholding of soluble P and S fertilisers from Organic farms. P and S can still be added but must be either slowly-soluble or slowly-reactive materials like reactive phosphate rock (RPR) or elemental sulphur. However, whatever the form of the nutrients added, they must still be in an available form for the plant to use otherwise deficiency symptoms may occur and/or production reduces if nutrients levels decline too far.

Effects of conversion to organic

Initial soil testing has shown that both conventional and organic dairy farms are currently well above the top of the optimal range (40 mg P/L) as indicated by the dotted line in Figure 2 below. Conventional, however, is considerably higher than Organic indicating that the converting farms may be already seeing an effect of withholding soluble P after 1-2 years although they may, of course, have been lower to start with. Of the Conventional farms, 75% were higher than the top optimal guideline P value whilst 57% of Organic farms were. We would expect Organic soil-P values to be able to continue to decline further with no immediate effect on production. Resin-P values showed no current stores of unreacted RPR in the Organic farms. High soil P values (>60) are of concern because farm runoff can contain both dissolved P and P-rich soil particles which, once in streams and rivers, can lead to poor water quality and algal blooms.

Fig. 2 Mean P and S soil test values for Conventional and Organic dairy farms.

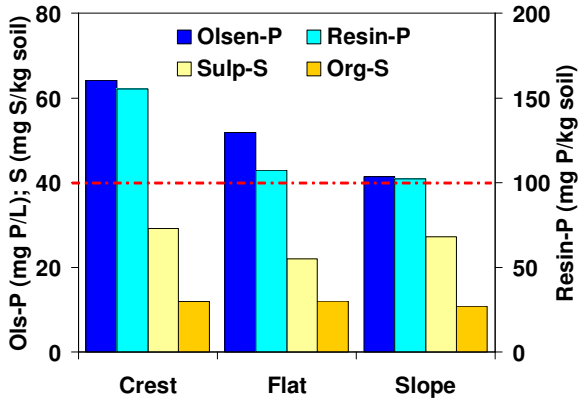


Sulphate-S values generally reflected similar differences between Dairy systems as for P although S is not usually of environmental concern. Organic-S was also marginally lower for Organic farms which may suggest that regular monitoring of both inorganic (sulphate) and organic-S would be wise to ensure S reserves don't become depleted over time. With less S being added in fertiliser there is less incorporated in SOM so S should be applied in Organic farms in products such as elemental sulphur.

Nutrient distribution around paddocks

Sampling of each farm meant getting representative samples from each major landform ie. flats, slopes and crests (flatter areas above slopes). A major issue that arises in terms of hill farms that affects both Conventional and Organic farms is of excreta transfer. Stock tend to camp on the flatter areas of hill farms overnight so that there is a transfer of nutrients from slope areas, where stock graze, to crest sites (see Figure 3 below). The resulting transfer can see soil test values for slope soils become depleted of P, S and other nutrients over time and this may affect Organic systems disproportionately more because of lower nutrient inputs. Crest sites on the other hand can become nutrient enriched so less fertilizer is required on these areas.

Fig. 3 Mean P and S soil test values for Crest Flat, and Slope Landforms for Dairy.



Future work

We will continue to monitor these sites to see how nutrient status changes over time and to investigate what effect P & S levels have on the sustainability and resilience of each system and whether over-fertilisation continues to be an issue.

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