The PROSOIL project – ‘Promoting Healthy Soils in Wales’
The PROSOIL project
— ‘Promoting Healthy Soils in Wales’

Christina Marley, Huw Powell, John Scullion, Gareth Griffith, Rhun Fychan and Heather McCalman

Introduction

PROSOIL is an innovative project which offers the opportunity to test whether improving soil health can improve productivity and product quality in the Welsh agricultural supply chain. Soil health is a multi-dimensional concept which incorporates physical, chemical and biological properties as well as the interactions between these components. The project, led by farmers, links the latest findings in science and research to commercial farming practice and enables rapid dissemination and uptake by the wider farming industry. PROSOIL was officially launched by Elin Jones, then the Welsh Government’s Minister for Rural Affairs, at the Royal Welsh Show in July 2009.

The investigation of supply chain efficiency involves a combination of science and practice, with plot and field evaluation work being carried out at IBERS and at eight commercial development farms across Wales where the impact of different soil management methods is being investigated on participating farmers’ own land. The great strength of this project is that IBERS’ plot experiments can provide a focal point for the commercial development farmers’ involvement linking their approaches to improving soil health and allowing contrasting soil treatments to be compared on a scientific basis.

Due to the long timescales required to bring about significant changes in soil health, the work is being approached in two phases. During phase one, the emphasis is to look at the effects of different soil management regimes on soil health, forage quality and productivity. Phase two will examine the benefits of improving soil and forage health on livestock performance and product quality.

Scientific studies suggest that modern agricultural practices, such as the standard nitrogen-phosphorus-potassium (NPK) fertiliser regimes currently used on many farms, may limit the range of minerals, vitamins and trace elements required in meat and dairy products for optimum human health. A potential alternative to standard NPK fertiliser regimes is to use a soil management system based on the ‘base-cation saturation ratio’ (BCSR; also known as the Albrecht theory), which aims to balance the cation exchange capacity of a soil, thereby allowing it to provide the full range of nutrients required for soil-plant-animal health. A regime based on this BCSR theory is being evaluated as part of this project both at IBERS and on the commercial development farms.

Commercial development farms

Following the launch where farmers were invited to volunteer to be part of the project, the farms were finally selected to represent different sectors of Welsh agriculture, and include dairy farms near Pendine, Churchstoke and Mold, beef and sheep farms near Crosshands, Monmouth, Llanarth and Caernarfon, as well as an organic producer near Cerrigydrudion. They cover a diverse range of Welsh soil types and climatic conditions in different regions, and will be involved in the project for five years.

During the first year, a key aim was to work with the eight farmers to develop and record the effects of their chosen soil management practice, to share their experiences and to begin to spread the word about the project to other farmers. All farm sites are looking at the effects of a soil amendment devised according to the base-cation saturation theory and comparing results with their standard farm practices. Just as important, however, are the comparisons between the different soil management approaches taken to improve soil health, depending on the interests of the individual farmers (Fig. 1).
The different management regimes imposed on areas of the farms taking part in the project include improving soil aeration, establishing diverse herbal leys, using aerated versus non-aerated slurry applications, applying anaerobic digestate and incorporating clovers into established swards. At Bryn Gido farm near Llanarth in Ceredigion, a diverse herbal ley has been established and is being compared with a standard perennial ryegrass ley. Mr and Mrs Hughes farm 52 ha on land rising to 200 m above sea level and run a flock of 500 Lleyn sheep with Highlander rams. Their aim has always been to improve and develop their business and they are active members of local farmer discussion groups. Soils at Bryn Gido are predominantly clay loam with some drier sandy loams on the land around the farmhouse. They say, “On the whole, we feel that the grassland is in good condition, although we have noticed that the ewes will preferentially graze some land which has set us to asking questions as to why this could be. We know we could be soil testing and liming more regularly in order to contribute to improving grass growth. Through the project we would like to gain a better understanding of the effects of soil on grass growth and particularly improve grass growth where ewes aren’t grazing”.

Farmers involved in the project are learning that there is plenty that they can be doing now to check and improve their soil health, even before results from the project come in, and are enjoying sharing their experiences to date. Simply walking the farm with a spade, and knowing what to look for, is a good starting point (Fig. 2).

Soils need to be managed so that they are in optimum condition; otherwise grassland productivity will suffer leading to the farm losing out on some of the potential of its cheapest source of feed. One limiting factor to farm productivity can be soil compaction. While this is often associated with arable cropping areas, it is a familiar problem for dairy farmers on land used for growing maize, being much more common on grassland-based livestock farms than previously thought.

One of the simplest ways to check for compaction in grassland is to dig a 50 cm square hole to a spade’s depth. If you can see horizontal cracks in the soil, or your spade meets resistance, then this is a sure sign of a problem. It is important to note the depth of the compaction layer - so that the appropriate remedial activity can be implemented - and to look for signs of poor rooting depth and evidence of earthworm activity. Alternatively, there may be evidence of water-logging and other indications might include foul smelling soils or an absence of worms. You should expect to...
find around a dozen earthworms in an average spade hole if the soil is in an optimum state. Any shortfall in earthworm population will diminish the vital functions they perform, which includes the incorporation of organic matter and improvement of the physical soil structure (Fig. 3).

If roots are being inhibited by a compacted layer, productivity may be affected due to reduced uptake of nutrients and water. It is not unrealistic to expect forage yields to be reduced by as much as 50% due to such insufficient nutrient responses. You can also expect herbage quality to be significantly impaired as less productive grasses may dominate where soils are badly compacted. It is important to remember that weed grasses have lower D-values than sown species and will have a significantly reduced response to any nitrogen applied. Ultimately, therefore, poor soil condition means that a larger proportion of any fertiliser applied is will be wasted.

Restoring soils to an optimum state should therefore be the first step towards ensuring that grassland is performing to its full potential. Once soils are in good shape, first physically and then through correction of nutrient levels, the focus can be on sward management and selecting the best available varieties to meet the herd or flock’s nutritional requirements.

The aim now is to continue to develop the working relationships with the eight commercial farms and to build on these links to establish a network of farmers and stakeholders within the Welsh agricultural supply chain who can work together as a group to monitor the effects of changing soil management approaches across all types of Welsh livestock farms.
PROSOIL at IBERS sites

Work within the PROSOIL project at the IBERS sites has a different emphasis. The remit here is to determine scientifically the impact of different soil management approaches on soil health and on forage and livestock productivity/quality, using replicated experimental designs in field-based plots to compliment the on-farm development monitoring.

Small-scale plots have been established and treatments applied to mirror the different soil management approaches being undertaken by our commercial development farms. This allows a further focus of interest for the farmer group to look at the effect of soil aeration, conditioners and aerated slurry, etc., and provide scientific data to compare their effects (Fig. 4).

Field-scale plots have also been established at Aberystwyth University’s Trawscoed Farm for the livestock grazing experiments that are the focus of phase 2 of the project. Samples for the measurement of soil health (biological, physical and chemical), forage productivity and forage quality have all been collected and are currently being analysed. Several biological indicators are being assessed, including earthworm populations and microbial biomass; the effectiveness of fungal-root associations that promote nutrient (including micro-nutrient) uptake is also of interest. Physical assessments include measures of soil structure relating to aggregate stability and porosity, including the effect of pore structure on water relations.

Figure 4. Soil aerator
In phase two at IBERS, we will be aiming to test whether the quality of agricultural food products is dependent on the health of the soil on which it was produced, a concept that is central to developing sustainable farming approaches. Dairy and meat processors / retailers have identified that the sensory properties (taste, texture) and nutritional value (health benefits) of agricultural products are the primary factors that dictate how the end-consumer perceives the ‘quality’ of that product. Studies comparing data produced in the 1930s with recent government tables showed that modern agricultural products have significantly reduced levels of micro-nutrients. For example, magnesium and copper, both essential for human health, were shown to have declined in meat products by 10% and 60% respectively, and in milk products by 25% and 90% respectively. Some of these micro-nutrients have also been shown to improve the oxidative stability (shelf-life) and alter the sensory attributes of both meat and milk.

If you are interested in further information about PROSOIL, please contact our project administrator Ms Jan Newman at IBERS (01970 823000).

There are articles in the farming press (e.g. Gwlad 90, 2009, p.11, Dairy Farmer, 11 March 2011, p.16) and a website [www.aber.ac.uk/prosoil](http://www.aber.ac.uk/prosoil) for the project. A project advisory committee has been formed, with members from NFU Cymru, the Farmers Union of Wales (FUW), Food Centre Wales, Hybu Cig Cymru, farmers, DairyCo, Farming Connect, Welsh Government, Environment Agency, abattoirs, co-operatives and food processors. This forum of supply chain representatives will act as ambassadors to further promote the objectives and findings from the work as the project develops.

**Acknowledgement**

This project has received funding through the Rural Development Plan for Wales 2007 - 2013 which is funded by the Welsh Government and the European Agricultural Fund for Rural Development.