ROOTZONE REALITY - A NETWORK OF FLUXMETERS MEASURING NUTRIENT LOSSES UNDER CROPPING ROTATIONS

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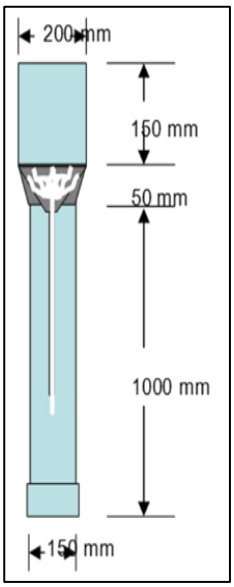
Around New Zealand, regional authorities are responding to the National Policy Statement for Freshwater Management and developing plans to improve freshwater quality. A common theme is the requirement that farmers should, as a minimum, be applying agricultural good management practice (GMP) and developing farm environment plans to assess and manage the environmental risks associated with their farm business. It is expected that a farm nutrient budget will be part of the farm environment plan to provide a measure of the environmental performance of the farm. In most cases this will be an Overseer® nutrient budget.

Arable farmers have complex farm systems, they manage a number of crops and often have pastoral components to their farm businesses. They understand that there is a necessity to use models to develop nutrient budgets but they question whether these nutrient budgets are truly representing losses from their farms. They are right to be concerned because in reality there has been little measurement of nitrogen losses from the root zones of cropping rotations and we are short of data to calibrate the cropping components of the models. Having data to do this, is a good start to building farmer confidence in the Overseer® model and its nutrient budgets for cropping rotations.

A new MPI Sustainable Farming Fund project "Rootzone Reality" will provide answers about drainage volumes and nitrogen and phosphorus losses from the root zones of a range crops and cropping rotations. MPI, FAR, HortNZ, Ravensdown and five Regional councils (Canterbury, Horizons, Hawkes Bay, Waikato and Auckland) are partners in the project. Plant and Food Research is responsible for the delivery of the science programme and the interpretation of the data being collected.

The project is funding the installation of a permanent network of fluxmeters on commercial cropping farms in Canterbury, Manawatu, Hawkes Bay, Waikato and Pukekohe. Data from a diversity of arable and vegetable rotations will be collected, with crops including grains and seeds, onions, maize, potatoes, beetroot and process and leafy, green vegetables. The data is being collected over a number of years so the impact of stock grazing within the rotations will also be captured. As well as drainage and nutrient loss data, we will collect weather data, soil moisture and crop information including biomass accumulation throughout the season, final yield and the management practices associated with the crop production.

In each region there are 3 stand-alone measurement sites. At each of these sites 12 fluxmeters have been installed in groups of 4 within one paddock. Variability between individual fluxmeters has been reduced by installing the fluxmeters within zones with similar soils and soil profiles. During installation, the soil is carefully removed preserving the soil horizons so that they can be repacked in order above the fluxmeter once it is in place.



Fluxmeter construction

After installation, the top of the fluxmeter sits at a depth of 1 metre below the soil surface, well below the cultivation management zone. Once the soil has re-settled, it will have no influence on the soil management for the crop above.

Sample collection tubes come from the fluxmeter to the soil surface, and samples will be collected throughout the season after drainage events.

There were some limitations to consider in site selection. Paddocks had to be flat with no artificial drainage, the rotation was to be representative of the main arable and vegetable rotations and the host farmer willing to sharing information about his cropping system.

Paddocks with shallow top soils and stony secondary layers were unsuitable because of the difficulty in repacking the stones and soil above the fluxmeter in a way that resembled the original soil profile to guarantee the integrity of the drainage data. Soils with high water tables were avoided because of the risk of flooding the fluxmeter with a rising water table.

During the installation process it is inevitable that the soil structure will be disturbed and there is a subsequent risk that the nutrient removal will differ from that of an undisturbed soil. However, the focus of this project relates to arable systems where soils are routinely cultivated and disturbed, sometimes at depth and experience tells us that the soil above the fluxmeters will stabilise hydraulically within 1-2 months, so we expect the leaching losses to be representative of the soil environment and the rotation. Data will be collected over a number of years capturing a range of crops and grazing activities in the rotation.

Installation has been completed at 8 of the 12 sites. It is planned that the fluxmeters at the remaining 4 sites will be installed after the autumn harvests at these sites have been completed.

At each site a water balance is being run so that drainage can be predicted. To date, over the dry summer, no drainage data has been collected from any site.

Research questions for the project

1. ***How much nitrate and phosphate is leached from a diversity of cropping rotations, climates and soils?***

   If these losses are high, what influences might we have on reducing them? Does it come down to rotation design or management practice?

2. ***How well do our models represent the actual losses from a cropping system?***

   Can we have the confidence that a modelled result, based on all of the above information for the crop rotation is a proxy for a measured result? Specifically within the project, our focus is on the performance of Overseer® but PFR will also be testing the robustness of SPASMO and possibly APSIM.

Can we partition out effects and determine which factor or combination of factors has the biggest effect on a nutrient leaching loss?

3. ***If the model estimation of the actual losses is poor; Are the losses over or under estimated?***

During the life of the project we will be running Overseer® budgets for the crop system that the fluxmeters are under. This will give us 2 data streams, the actual N and P losses from the rotation and the modelled N and P losses for the rotation from Overseer®.

As the Overseer® model calculations are based on long-term average weather data and the data collected from the fluxmeters is in response to actual weather impacts, we are not expecting the data streams to be the same. The best outcome will be that the fluxmeter results fall either side of the modelled results, averaging out at about the same number over the long term.