

GREATSOILS



Which nutrient management system to use?



Figure 1. RB209 and Scottish Technical Notes

Soil fertility is an important component of soil health

Regular soil tests and the recommendations associated with them are vital tools that must be used in order to ensure the best possible crop yield and quality from any soil type. The main fertiliser recommendation system used in the UK is set out in the recent revision of the Nutrient Management Guide (RB209). However, many Scottish growers use the SRUC Technical Notes, which have been developed specifically for Scottish soils. The Scottish Technical Notes rely on soil analysis conducted using different methods to those, typically, used in England and described in RB209 (Figure 1).

Action points

- The availability of phosphate (P) and micronutrients is heavily dependent on soil pH being optimal for production. Regular pH testing and liming (where required) will ensure optimal availability of these essential crop nutrients
- The recommendations in both RB209 and the Scottish Technical Notes are necessarily broad. Every soil, every system and every grower is different. Walk crops regularly and observe them during their growing seasons to determine whether growth, quality or yield is patchy or poorer than expected and be prepared to investigate
- Be aware that there are differences between methods used to test agricultural soils in the UK. Ideally, choose the system set out in RB209 OR the Scottish Technical Notes and stick to what you have chosen. It is much easier to compare soil test

results over time if they have all been conducted using the same method

 Keep records of weather, soil conditions during key crop management operations and the growth, appearance and yield of crops. There is clear evidence that growers who keep good records have a much better understanding of the factors affecting crop quality and yield and are better able to react with appropriate management practices when things go wrong

Consider other tests:

- Soil organic matter, micronutrients or base cation saturation ratio (BCSR)
- Precision sampling and variable rate spreading of P and potash (K)
- Soil compaction
- Plant tissue analysis for major, secondary and micronutrients

What is the difference between the recommendation systems?

The total Phosphorus (P), Potassium (K) and magnesium (Mg) content of a soil can be measured exactly but values obtained have little relevance to crop yield because only a relatively small proportion of the total P, K and Mg in soils is available to plants. Soil analysis in the laboratory, therefore, uses chemical extractants to provide an estimate of the amount of key nutrients that would be available under field conditions. The results provide the best practical guide for determining the amounts of P, K and Mg to apply.

The methods of soil analysis used in the UK have been developed over many years, specifically for UK soils. They have been correlated to crop response and, therefore, to fertiliser recommendations, on a wide range of soils in numerous field experiments.

The main fertiliser recommendation system used in the UK is set out in RB209. This was updated in 2017 and the new edition, which includes seven sections, includes revised recommendations for several crops and new recommendations for crops not previously listed.

More and more farmers and growers are considering the use of bulky organic fertilisers as a means of improving soil health and, to that end, new and more detailed information on bulky organic fertilisers has also been included in the revised edition, such as the nutrient content and availability in various organic wastes and farm-sourced whole, separated liquor and fibre digestates.

Many Scottish growers and some of their advisors use a different fertiliser recommendation system set out in SRUC Technical Notes, which have been developed specifically for Scottish soils.



Both fertiliser recommendation systems require growers to maintain soil at an appropriate pH value, and target nutrient status. Soils should be tested regularly (every three to five years) to ensure that targets are being achieved (refer to GREATsoils pH guidance factsheet, Figure 2).

Importantly, both RB209 and Scottish Technical Notes are based on the results of soil analysis using standard laboratory methods that are different. RB209 recommendations are based on an extractant of sodium bicarbonate at a pH of 8.5 (Olsen P) for P and an extractant of ammonium nitrate for K and Mg. The SRUC recommendations are based on a Modified Morgans extraction for P, K and Mg.

Many farmers and growers are unaware which methods have been used to analyse their soils or which laboratory is doing the analysis, often because an intermediate organisation is doing the sampling and sending samples for analysis. It is a good idea to find out which methods are being used on your soils, since the best plan is to choose one method (and, ideally, one laboratory) and stick to it. That way, differences between results in different fields and over time are more likely to be real (rather than artefacts of sampling, methods or laboratory) and will be more easily interpreted.

How should I collect a soil sample?

Remember that results obtained from soil analysis are only as good as the way in which sampling is done. Instructions for the W method are provided in RB209. The pH of soil can often be patchy, so spot sampling is advised. There is clear evidence for the benefits of precision sampling for pH in high-value crop rotations.

There are numerous software packages designed to help farmers manage their fertiliser applications and nutrient budgets, but these can only reach their full potential if the data that is put into them is as good as it can be. There is no substitute for regular sampling and testing using appropriate methods.

Nitrogen recommendations

The system for determining crop N requirement differs between England/Wales and Scotland. However, the principles and recommendations for crop nitrogen (N) requirement are very similar.

RB209 asks growers which crop they will grow, its intended market, soil type and likely or actual rainfall. It then guides the grower through the process of identifying the Soil Nitrogen Supply (SNS) Index so the crop N recommendation can be determined. In most cases, the Field Assessment Method is recommended for determining the SNS index, but soil mineral N testing is recommended where N reserves are likely to be large or variable.

The Scottish system guides the grower through a series of stages, and assigns to each intended crop an N recommendation, based on the crop type, the N residues left by the previous crop or grass/clover type, as well as on the soil type and recent rainfall.

Figure 2. GREATsoils 'pH and its management' factsheet

If you farm in a Nitrate Vulnerable Zone (NVZ), you must abide by the rules for applications of fertilisers and organic materials.

Colin Mitchell, Farm Manager at Meikleour Estates, uses RB209

Colin (Figure 3) manages 800ha in Perthshire and grows a mixture of arable and vegetable crops on sandy loam soils in an NVZ. He uses RB209 as a key source of information but has found that he stands to gain a lot in terms of improved crop quality and yields if he uses a mix of local knowledge and the results of additional soil tests to inform what he does. He keeps records of crop yields, crop quality, weather and soil conditions during key field operations, as well as results from precision sampling and testing soils (for pH, P, K and Mg), using the methods stated in RB209. Soils are tested every three years before each high-value crop.



Figure 3. Colin Mitchell, Meikleour Estates, Perthshire

Colin is always looking for reasons why crops do better in some fields and in some years and worse in others, and feels that the more data and records he has on soils, crops and weather, the better his understanding will be. He feels that RB209 underestimates crop requirement for K in his deep, sandy soils and has found a clear crop response to adding more K than RB209 recommends. He believes that it pays to question some of the published crop nutrient recommendations where you feel that your crop yields or quality could be better.

Additionally, Colin conducts occasional base cation saturation ratio (BCSR) testing (the Albrecht method, detailed in a GREATsoils publication, Figure 4) and feels that adhering to the recommendations that come back with the BCSR test results have helped improve the yield and quality of carrot crops. Colin also tests for essential soil micronutrients and applies them where concentrations are sufficiently low, to indicate that crop deficiencies might occur.

He must apply no more than the maximum amount of N permitted for each crop grown in an NVZ (NMax) and obtains the NMax values from the Scottish Government NMax calculator and guidance: www.gov.scot/Topics/ farmingrural/Agriculture/Environment/NVZintro

of cereals. Standard nutrient indices alone did no

William A. Albrecht and the Base Cation Saturation Ratio system William Albrecht's ideas have helped Martin Evans to match fertiliser recommendations to particular crop needs. Making decisions on whether or not to add nutrients to the soil should ideally be based on results of soil tests.

Albrecht's early work at the University of Missouri was on nitrogen fixation by soybeans, during which he discovered the importance of calcium in maintaining nitrogen fixation by legumes. Calcium was important to both the microbial partner and the plant partner in this symbiotic relationship, particularly in soils that were acidic. By the 1950s, Albrecht had come to the conclusion that when lime is applied to acid soils it is the supply of Ca that is more important than the change in pH. This led to an interest in the role of Ca in animal and human nutrition, which he explored during his retirement, travelling widely in order to promote his ideas on balanced nutrition of plants and animals based on balanced ratios of exchangeable cations (Marshall, 1977).

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The concept of ideal ratios of nutrients such as Ca and Mg in soil has been around for over 100 years but the evidence directly relating specific cation ratios to crop productivity is nsistent (Kopittke and Menzies, 2007; Johnston, 2011)⁴⁵.

Figure 4. The Albreicht System is detailed in a GREATsoils carrot production case study which is available on the AHDB website: horticulture.ahdb.org.uk/publication/greatsoils-fresh-look-soiltesting-carrot-production

Harry Black at Milton Farm uses Scottish **Technical Notes**

Harry farms 700ha at Milton Farm, near St Andrews in Fife. He grows a range of vegetable crops, including carrots, parsnips and sprouts for Kettle produce, as well as producing early potatoes, cereals and livestock. Crops are grown on a range of soil types, including loamy sands, sandy loams and sandy silt loams in an NVZ. Harry's fertiliser application rates are based on information contained in the Scottish Technical Notes.

Harry uses precision soil sampling every four years for pH, P, K and Mg, but he also samples soils in the more traditional manner, by walking across the field in a 'W' pattern, immediately before each vegetable crop and retesting the samples obtained in this way. He wants to be sure that each field is going to provide sufficient P, K and Mg for optimal crop performance. His soils are tested at SAC using the Scottish testing methods (modified Morgan's extraction for the nutrients and calcium chloride extraction for pH).

Like Colin Mitchell in the previous example, Harry feels that maintaining soils at target P, K and Mg status is only the start. He applies fertilisers and crop protection products himself and makes sure he visits every vegetable and potato crop in each field at least once a week. He keeps simple diary records of weather and soil conditions, as well as records of crop performance, soil test results and fertiliser applied, and is constantly trying to learn more about how to improve quality and yield of his crops.

Harry also spends quite a bit of time doing extra tests over and above routine soil analysis. To that end, he tests for free-living nematodes, has started to test for soil organic matter on his fields, and conducts regular test digs to look for evidence of poor soil health, including compaction. He regularly subsoils in order to break up cultivation pans in affected areas.

Which system works best?

While there is some evidence that the Scottish soil analysis method for P is more appropriate for Scottish soils, the most important thing is that growers choose a system, stick to it and understand how to get the best out of it. The key point is that both systems will work well, if properly used.

If you farm in an NVZ, you must abide by the rules for applications of fertilisers and organic materials.



Figure 5. Regular digging of holes to assess the state of soil health is recommended

Further information

The Nutrient Management Guide (RB209) is available to download at **ahdb.org.uk/rb209**. It is also available as an app for Apple and Android devices.

A range of resources to help you with soil health assessment and soil management are available on the AHDB GREATsoils website **ahdb.org.uk/great-soils** including information on how to measure and manage pH.

SRUC Technical Notes are available at **www.sruc.ac.uk/ downloads/120202/technical_notes** including a new Technical Note on how to take a soil sample.

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