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Soil Analysis in the West Highlands and Islands

Farm Advisory Service

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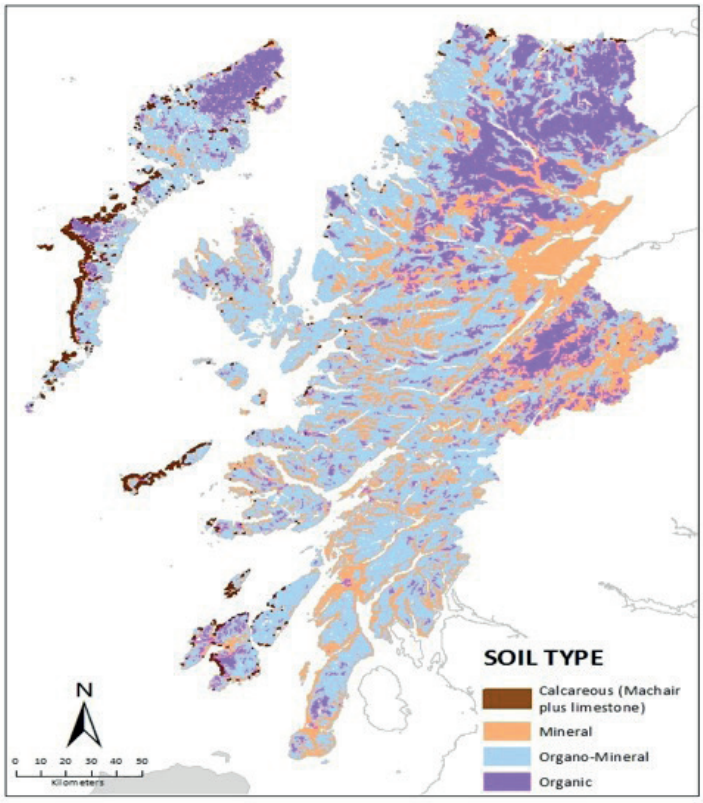
Summary

- **A wide variety of soil types are found in the West Highlands and Islands**
- **You should ensure you use the correct soil test for your soil type**
- **Using the correct soil test will ensure that fertiliser is correctly targeted, resulting in improved production and a reduced risk of pollution**

Introduction

A wide variety of soils exist within this area and spans from organic rich peat , mineral to calcareous soils formed from shell sand and found in machair areas.



Soil types

The different soil types have very different soil chemical and physical properties which affects land use and management options. Typical soil attributes are;

Table 1: Soil attributes from SAC soil tests in the region

	Peat	Mineral	Shell sand
pH	3.4	5.4	7.7
Total Carbon (%)	43.6	4.05	7 (0.33 – 9.18)*g
Total Phosphorus (mg/1)	729	97.6	1030
*range in brackets			

Historically land management/improvement required overcoming very different physical (drainage, depth) and chemical attributes (acidity and phosphorus deficiency).

Potential issues can vary; risk of copper deficiency for arable crops range from high to low over the region (TN657). Please note that machair soils can be at risk of copper deficiency and many of the locally adapted, traditional crop varieties are evolved to grow there.

Risk of cobalt deficiency for the region covers low to high (TN664). Cobalt deficiencies can impact on animal health by causing loss of appetite and reduced weight gain.

This technical note details which is the best method for analysing various soil types and what impact that would have on recommendations for grass and crop fertiliser requirements.

Which soil test should I request?

Typically Scottish soils are more acidic than the UK average and therefore the standard SAC test (Modified Morgan's solution) is most appropriate. However for calcareous soil, like that found in many machair areas, with a pH above 7 then the bicarbonate Olsen test method is more appropriate.

IT IS ESSENTIAL THAT WHICH EVER TEST METHOD IS USED THE RESULTING VALUES ARE INTERPRETED USING THE CORRECT RECOMMENDATIONS.

The European Agricultural Fund for Rural Development
Europe investing in rural areas

SAC CONSULTING

Scottish Government
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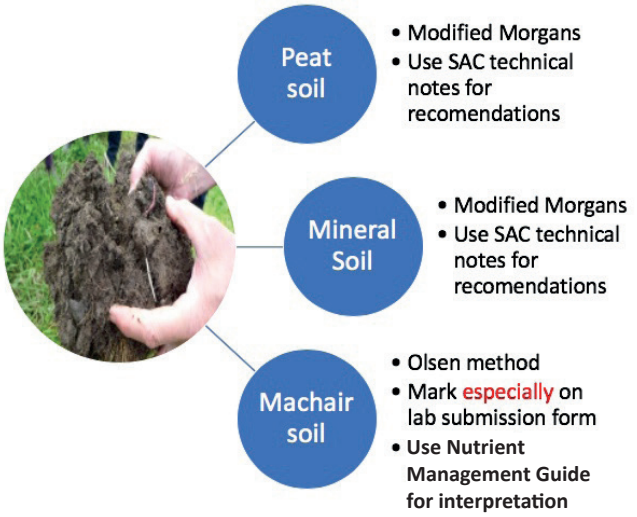

Comparing analysis from the two different tests

Table 2: Indices and concentration ranges (mg P litre-1) for Olsen and Modified Morgan's methods of soil P analysis.

	Olsen		Modified Morgan[1]
Index[2]	mg P/l	Status	mg P/l
0	0 – 9	Very low	<1.8
1	10 -15	Low	1.8 – 4.4
2	16 – 25	Moderate	4.5 – 13
3	26 – 45	High	14 – 30
4	46 – 70	Very high	>30
5	71 – 100		
6	101 – 140		
7	141 – 200		
8	201 – 280		
9	>280		

[1] Ammonium acetate / acetic acid solution.

[2] Index 0 – yield response likely, Index 1 – yield response possible, Index 2 – yield response unlikely, Index 3 – recommended upper limit to avoid eutrophication risks.

Table 2 shows that the concentrations of P typically extracted are higher for Olsen and the class ranges are quite different between methods.

What difference does it make?

Table 3: Mineral soil tested by both methods

	SAC (Morgan's)	Olsen
pH	5.4	5.4
P	2.08 mg/l (low)	7.5 mg/l (0)
K	106 mg/l (Mod)	134 mg/l (1)

The phosphate fertiliser requirement would be higher using the inappropriate Olsen test which would be wasteful in this situation.

Extractable potassium are similar using both methods but should always be checked to make sure values are acceptable.

Table 4: Machair soil tested by both methods

	SAC (Morgan's)	Olsen
pH	7.8	7.8
P	30.5 mg/l (high)	10.6 mg/l (index 1)
K	38.5 mg/l (v low)	26.4 mg/l (index 0)

The incorrect SAC test suggests there is more plant available phosphate than in reality. This could result in under applying by 50 kg/ha of P_2O_5 for both grass establishment and cropping.

As with all fertiliser applications it is important to calculate what nutrients provided by applications of farm yard manure (FYM) or seaweed.

Fertiliser Recommendations – mineral soils

Grassland Establishment

The nitrogen levels should be kept low, especially if you are trying to incorporate plants like clover for example 40 kg/ha nitrogen.

To work out the phosphate and potash requirements please refer to TN652 Table E using the soil analysis by the SAC method.

Established Grass

There is no point over applying nitrogen beyond crop potential. For further advice please see Table C in TN652.

For grass silage it is important you work out expected yield to ensure you know what the crop is removing. This is especially important for potash (K).

For example silage yield 20t/ha

This will remove 34 kg/ha of P_2O_5 and 120 kg/ha K_2O. In this example no adjustment is needed for the potash levels, as they are moderate status. However since the soil phosphate level is low then an extra 40 kg/ha of P_2O_5 is required. This will require 74 kg/ha of P_2O_5 and 120 kg/ha of potash to be applied.

Therefore a good fertiliser mixture could be

500 kg/ha of 16:16:16

70 kg/ha of 0:0:60 Muriate of potash (MOP)

Arable silage

Standard practice is to apply about 80 kg/ha of nitrogen to arable silage growing on the mineral soils through bagged fertiliser.

To calculate an offtake from a silage yield of 14t/ha we use offtake from the SAC guide on cereals yields and add 40 kg/ha of P and K to adjust for it being arable silage.

The potash level is moderate in Table 3 so we make no adjustment. However the phosphate level is low so we adjust this value up.

Therefore the application should provide

80 kg/ha of nitrogen, 74 kg/ha of phosphate and 120 kg/ha of potash.

This can be met with an application of

500 kg/ha of 16:16:16

70 kg/ha of 0:0:60

Fertiliser Recommendations – machair soils

Grassland Establishment

The nitrogen levels should be kept low especially if you are trying to incorporate plants like clover for example 40 kg/ha nitrogen.

To work out the phosphate and potash requirements please refer to Table 3.11 in the Nutrient Management Guide RB209.

For example the fertiliser requirements for the machair soil in Table 4 would be

40 kg/ha N; 80 kg/ha P and 120 kg/ha of K

This could be applied with

200 kg/ha DAP 18:46:0

200 kg/ha of MOP 0:0:60

Established Grass

There is no point over applying nitrogen beyond crop potential. For further advice please see Table 3.10 in RB209.

For grass silage it is important you work out yield to ensure you know what the crop is removing. This is especially important for potash (K).

For example silage yield 20t/ha

This is the same figure as the SAC technical guide you can find it in Table 3.2 of RB209. This will remove 34 kg/ha of P_2O_5 and 120 K_2O kg/ha.

However since the soil analysis came in at index 1 then an extra 80 kg/ha of potash is required.

Also the soil phosphate level is index 0 then an extra 100 kg/ha of P_2O_5 is also required.

This will require 134 kg/ha of P_2O_5 and 200 K_2O kg/ha to be applied.

Therefore a good fertiliser mixture could be

Nitram or FYM to meet nitrogen requirements

650 kg/ha of 0:20:30

Arable Silage

Standard practice is to apply about 80 kg/ha of nitrogen to arable silage growing on the machair through bagged fertiliser. It is important that other materials such as FYM or seaweed are applied to build the organic soil matter. This difference is reflected in the range of total C values in Table 1.

If we assume the whole crop is yielding 14t/ha then we are removing according to Table 3.2 in RB209:

25.2 kg/ha of phosphate and 75.6 kg/ha of potash. To take into account the soil Index in Table 4 we would suggest that these are adjusted to 40 kg/ha of phosphate and 110 kg/ha of potash

Therefore the application would be

400 kg/ha of 20:10:10

100 kg/ha of 0:0:60

For further information

TN652 Fertiliser recommendations for grassland

TN656 Soils information, texture and liming recommendations.

TN657 Management of copper in soils for cereals

TN664 Management of cobalt in grassland soils.

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