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Soil Health/Soil quality – what is it and how do we measure it?

Bryan Griffiths

Bryan.Griffiths@sruc.ac.uk

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What is a healthy soil?

Looks good
Feels good
Smells good

Easy to work
Supports lot of life

What is soil?

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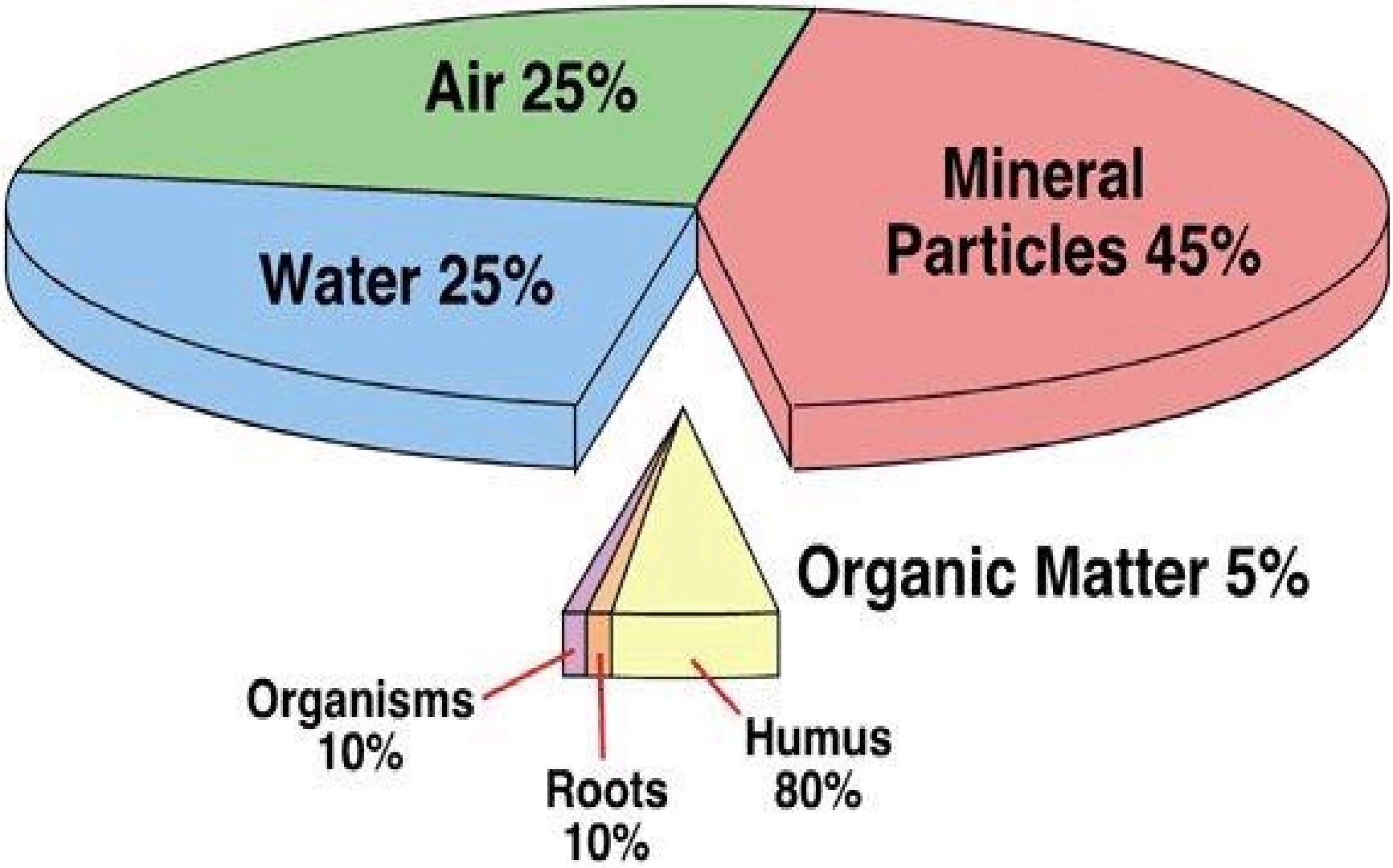


Living soils

- Huge quantity of organisms

  - Fauna: 1-5 T/ha
  - Fungi: 3.5 T/ha
  - Bacteria: 1.5 T/ha

F. Ippolito

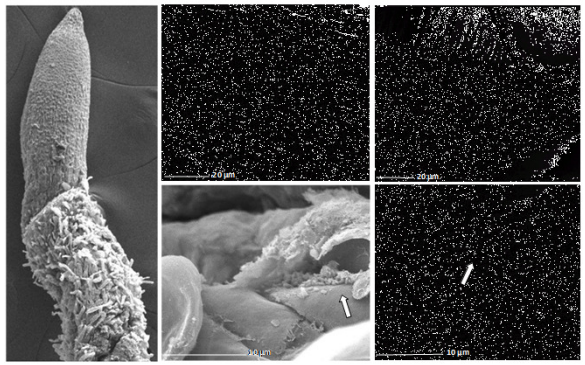
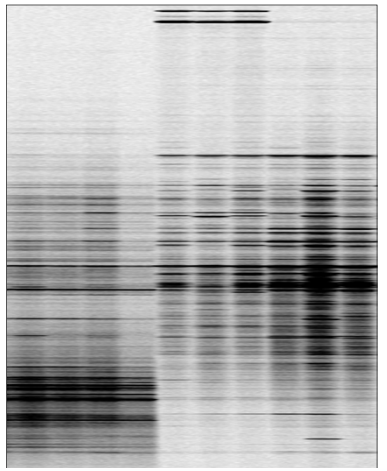
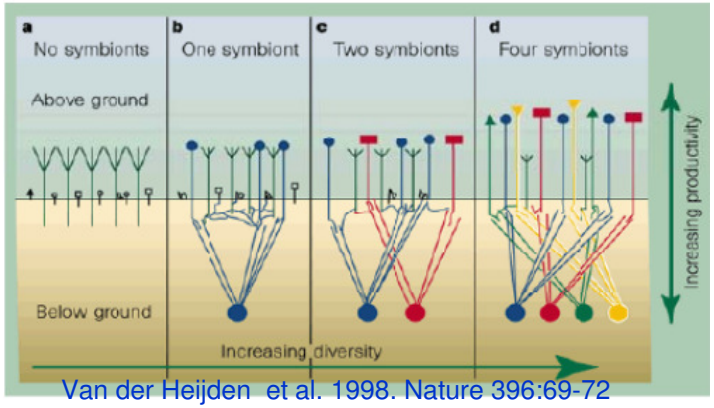


Photo : L. Avoscan & A. Viollet



- Fantastic diversity
  - Until recently: only access to culturable microorganisms
  - Methodological progresses
    ⇨possibility to extract DNA from soils
    ↳ 10^4 – 10^6 bacterial genotypes / g sol

- A lot to be explored on the relations between below & aboveground diversity



Van der Heijden et al. 1998. Nature 396:69-72

Soils deliver many ecosystem services

Soil ecosystem services

Food & biomass production

A. Richer de Forges (CA 45)

Infosol (INRA Orléans)

Habitat, gene pool

Infosol (INRA Orléans)

J. Moulin (CA 36)

Storing, filtering & transformation

A. Richer de Forges (CA 45)

Source of raw materials

J. Moulin (CA 36)

Physical & cultural environment for mankind

C. Schvartz (ISAL)

Courtesy of Antonio Bispo, ADEME

Ecosystem services

- **Supporting** — Nutrient recycling, primary production and soil formation, make it possible for the ecosystems to provide other services
- **Provisioning** — Food, crops, raw materials (including timber, fodder, and fertilizer), genetic resources (including crop improvement genes), water
- **Regulation** — Carbon sequestration and climate regulation, waste decomposition, purification of water, pest and disease control
- **Cultural** — Spiritual, historical, recreational

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Ecosystem services

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Ecosystem Services Provided by Soil Biota
Regulation of biogeochemical cycles
Retention and delivery of nutrients to primary producers
Maintenance of soil structure and fertility
Bioremediation of pollutants
Provision of clean drinking water
Mitigation of floods and droughts
Erosion control
Regulation of atmospheric trace gases
Pest and pathogen control
Regulation of plant production via non-nutrient biochemicals

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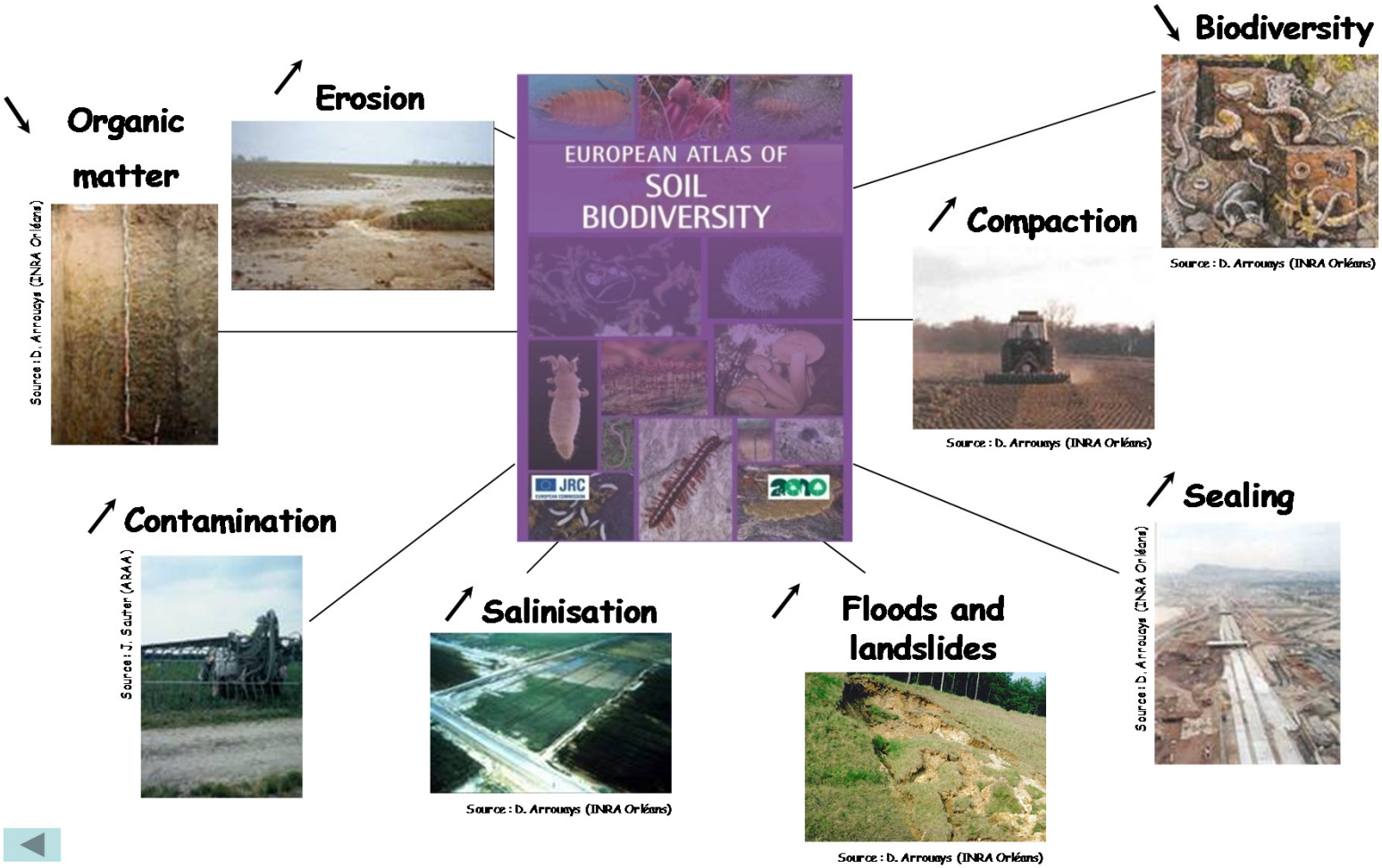
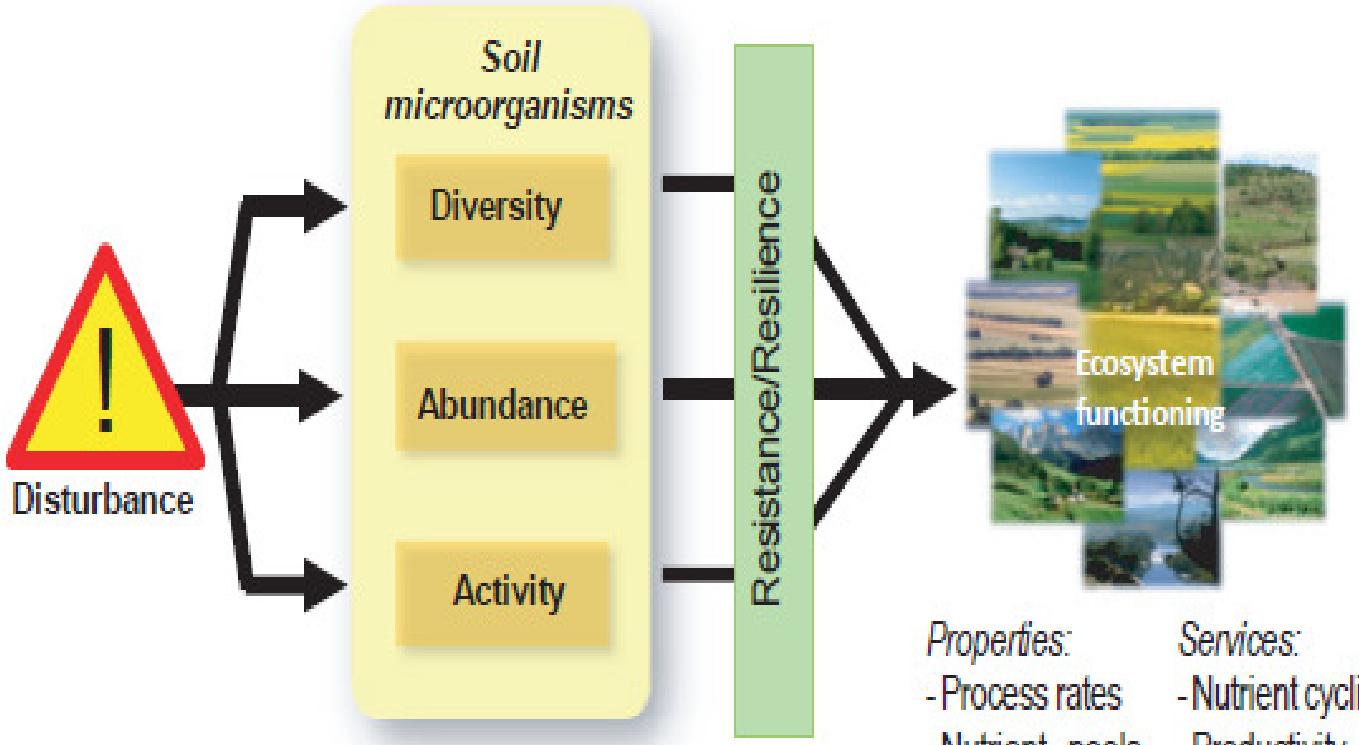
Soils and biodiversity are submitted to major threats



- **Erosion:** 115 million hectares subject to water erosion, 42 million hectares to wind erosion.
- **Contamination**: 3.5 million sites could be contaminated
- **Decrease of organic matter:** About 45% of European soils have low organic matter content
- **Soil sealing:** 1990-2000: 1,000 km² of soil/year , 2000-2006, the average loss increased by 3%

http://ec.europa.eu/environment/soil/

So why is thus important



Why measure soil quality?

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- Think of it in terms of:

- An MOT for your soil Or A check up at the doctors

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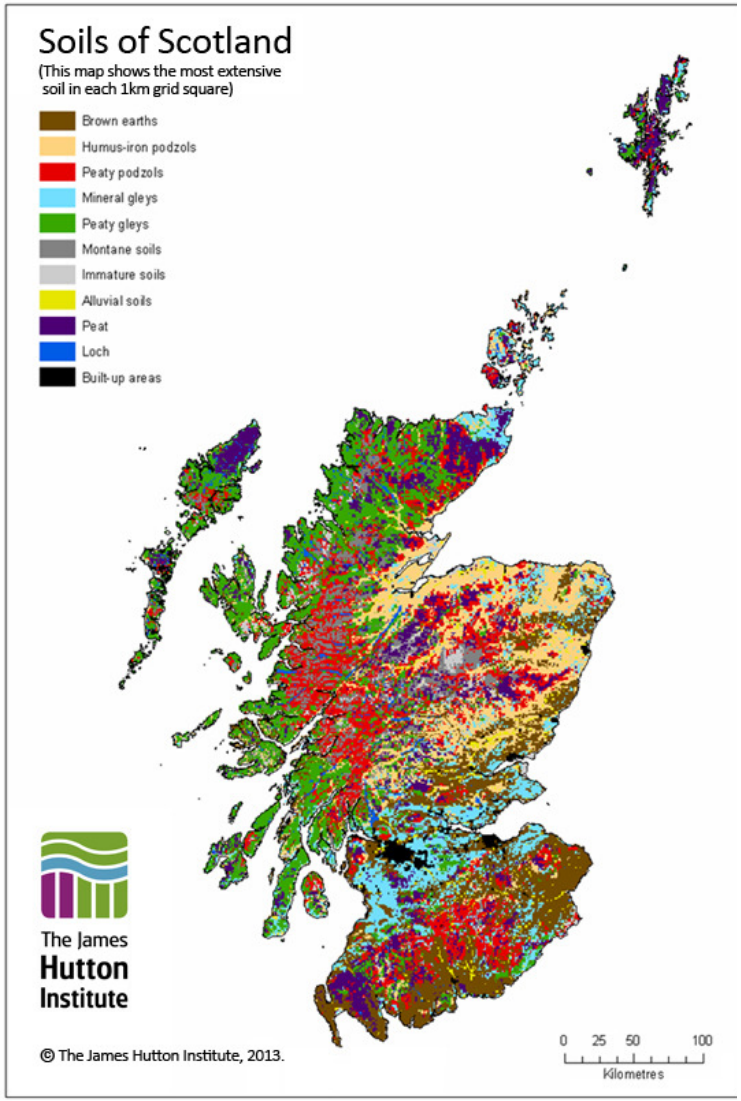
Scottish soils – information available



http://www.soils-scotland.gov.uk/

https://horticulture.ahdb.org.uk/greatsoils-resourcesmaterials

http://www.crew.ac.uk/publication/valuing-your-soils

https://dairy.ahdb.org.uk/resources-library/technical-information/grass-management/healthy-grassland-soils-pocketbook/#.WeSwYv6WymQ

https://www.opalexplorenature.org/earthwormguide

https://www.sruc.ac.uk/info/120625/visual_evaluation_of_soil_structure

Notes

the '+' in the middle of the map click on the button below the map to find the soil unit at the location. Alternatively if you already know the soil map unit you can select it from the menu to the left of this text.

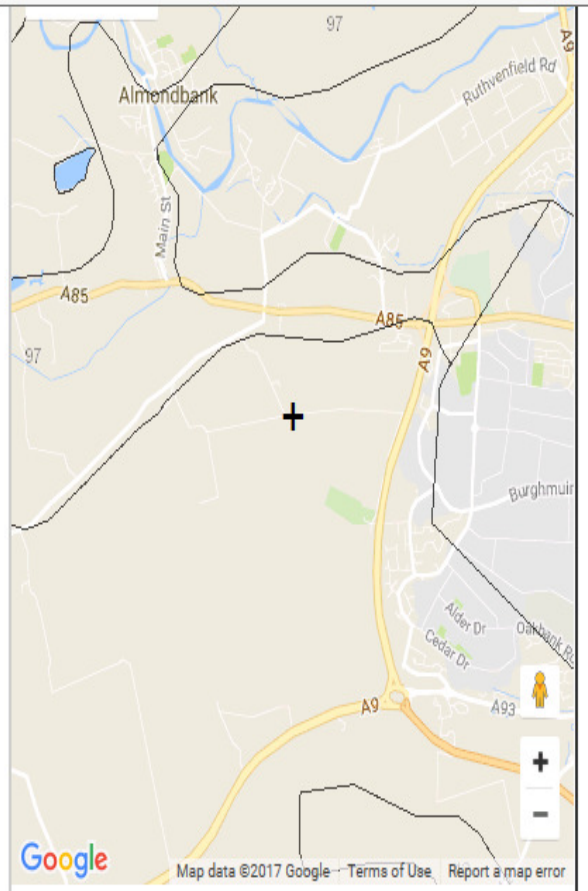
When SIFSS has identified the soil map unit it will display a menu with the soil types that make up the map unit. The soil types are named after the area where they were first found, thus Forfar soils were first mapped around Forfar.

In the results section, you will see a brief description of the different soils found in that area to allow you to select the one that most closely matches your own sample. You are then able to select a range of soil properties for that specific soil type and choose whether to display results for cultivated or semi-natural soils.

If your soil sample has a value for a specific soil property that lies within the box surrounding the red dot (which is the median value), then your soil has a value in the same range as 66% percent of all those particular soil types. If it is outwith the box but lies along the line then it is close to the maximum (above the box) or minimum (below the box) values recorded in our database.

For properties such as pH, carbon content, loss on ignition and calcium content which all affect plant growth, it is important to try to maintain these at optimum levels. If your sample is below the box on the graph, particularly for topsoils (Ap horizons) then you may need to think about adding lime or organic matter to you soil.

You can restart the process by selecting from any menu or by reloading the page.



Get soil unit of map centre

http://sifss.hutton.ac.uk/SSKIB_Stats.php

Soil Information For Scottis...

File Edit View Favorites Tools Help

About Us | News | Research | Consultancy | Education | Jobs | People | Contact |

The James Hutton Institute

Soil Information For Scottish Soils (SIFSS)

Home > Research > Soil as Natural Capital > SIFSS

Introduction

Select Soil Map Unit for Whole of Scotland

41
42
43
44
45

Select Soil Map Unit

Select Soil Series for Soil Map Unit 41 (association: Balrownie)

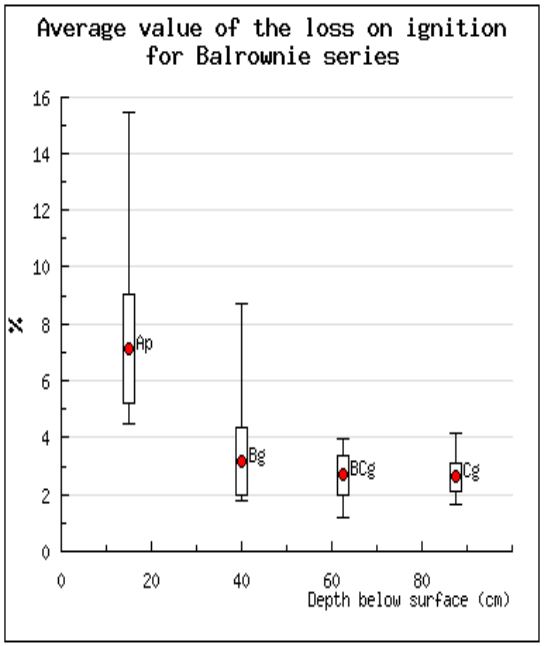
Balrownie

Select Soil Series

Notes

For this soil the following number of observations have been made for the selected attribute:
Ap: 97
Bg: 62

Results



Area (in km^2) of soil series Balrownie in Whole of Scotland

Click chart for values

Select Soil Attribute

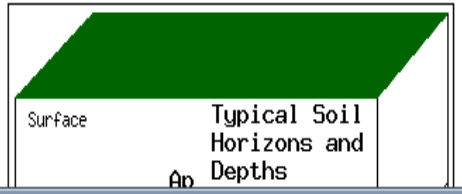
Configure output

- (•) **Cultivated soils**
- ( ) **Semi-natural soils**

Average value of total phosphate
Average value of the loss on ignition
Average value of the magnesium content
Average value of the sodium content
Percentage base saturation
Average value of elemental nitrogen
Average value of the % silt (2- 50/60 microns)
Sum of median values of exchangeable cations

Display Results

Your soil attribute value (or leave blank):
(no units please)



Sent Items - Mail... | SLIDES | Soil Information F... | FAS Nov 2017.ppt...

19:16
05/12/2017

Examples of information

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Valuing Your Soils

Practical guidance for Scottish farmers

Download and discover the financial savings and business benefits of good soil management

www.farmingandwaterScotland.org

The brochure, pull-out sheets and videos contain a mix of practical and research experience, problem and action-specific farm case studies, useful check lists (e.g. how to take soil samples and check for compaction), images and web-links.

Practical pull-out guidance sheets:

- ✓ **Taking soil samples for testing**
- ✓ **Visual evaluation of soil structure (VESS)**
- ✓ **How to check for and alleviate soil compaction**
- ✓ **Checking soil drainage status**
- ✓ **Grassland rejuvenation**

Brochure contents:

- ✓ **Soils and income**
- ✓ **Know your soil type**
- ✓ **Soil - a living resource**
- ✓ **Soil structure**
- ✓ **Soil compaction and drainage**
- ✓ **Soil erosion**
- ✓ **Soil pH and nutrients**
- ✓ **Organic matter**
- ✓ **Reduced tillage**
- ✓ **Managing farm soils**
- ✓ **Tools to help you**

Below is a taster summarising some key facts

Cost savings

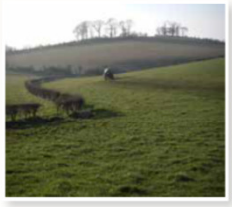
Standard soil testing for pH and nutrient status is simple and low cost (~ £20 per sample).

For soils that vary within fields, GPS sampling (~ £25/ha for soil pH at 4 samples/ha) and variable lime and fertiliser applications could reduce bills by ~ 15%.

Controlled traffic farming could reduce fuel and time costs by ~ 40%.

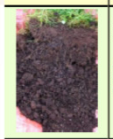
Compacted or poorly drained soils can reduce yields by ~ 25%. Using a spade to identify soil structural problems (FREE!) and undertaking necessary soil loosening (~ £30/ha) will avoid unnecessary drainage maintenance (~£35/hr) and new drainage system/repair (~ £4000/ha) costs.

For suitable soils, reduced tillage or no tillage could save ~ £70/ha/year and protect soils from compaction and erosion.



Keep a minimum of 10m back from a watercourse when spreading slurry.

Soil structure, compaction and drainage

Appearance after break-up: various soils	Structure quality
	**Sq1 Friable** Aggregates readily crumble with fingers
	**Sq2 Intact** Aggregates easy to break with one hand
	**Sq3 Firm** Most aggregates break with one hand
	**Sq4 Compact** Requires considerable effort to break aggregates with one hand
	**Sq5 Very compact** Difficult to break up

Simple VESS assessments of soil structure take minutes to conduct.

Assessments can identify compaction and impeded drainage which can reduce crop productivity and increase run-off and loss of nutrients from the soil.

Download the brochure for guidance on

Healthy Grassland Soils – Four quick steps to assess soil structure

DairyCo

Step one: **Surface assessment**

Look at sward quality to identify potentially damaged areas which require further assessment.

Good
- Sward intact
- No poaching
- Few wheelings

Moderate
- Surface poached
- Wheelings in places
- More weed species

Poor
- Surface compacted
- Soil exposed
- Poaching
- Poor sward quality

Step two: **Soil extraction**

- Dig out one spade-sized block of soil (depth approx. 30cm). Cut down on three sides and then lever the block out leaving one side undisturbed
- Lay soil block on a plastic sheet or tray

Tip: When starting out it is useful to dig in an area where you know there may be a problem (eg a gateway) and get familiar with signs of soil structure damage.

Remember: Sample when the topsoil is moist – if the soil is too dry or too wet it is difficult to distinguish signs of poor soil structure.

Step three: **Soil assessment**

Gently open the soil block like a book to break it up

- If the structure is uniform – assess the block as a whole
- If there are two or more horizontal layers of differing structure identify the layer with the poorest structure
- Carry out the rest of the assessment on this **limiting layer**

Step four: **Soil scoring**

Break up the soil with your hands into smaller structural units (known as aggregates)

- Assign a score by matching what you see to the descriptions and photos overleaf
- A score of **1 or 2 is Good**; a score of **3 Moderate**; and **4 or 5 is Poor** and requires management action
- Record depth of limiting layer to assess management options

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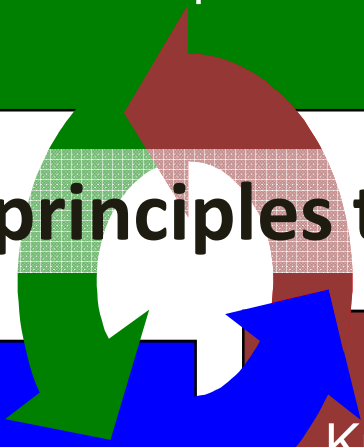
KNOW YOUR SOILS; principles to improve soil health

Biological

- Feed the soil regularly through plants and OM inputs
- Move soil only when you have to
- Diversify plants in space and time



Chemical

- Maintain optimum pH
- Provide plant nutrients – right amounts in the right place at the right time
- Know your textures and minerals – buffering capacity, free supply!

Physical

Know your textures and understand limits to workability, trafficability

- Optimise water balance through drainage if necessary
- Improve soil structure – effective continuous pore space

General effects of management on soil health

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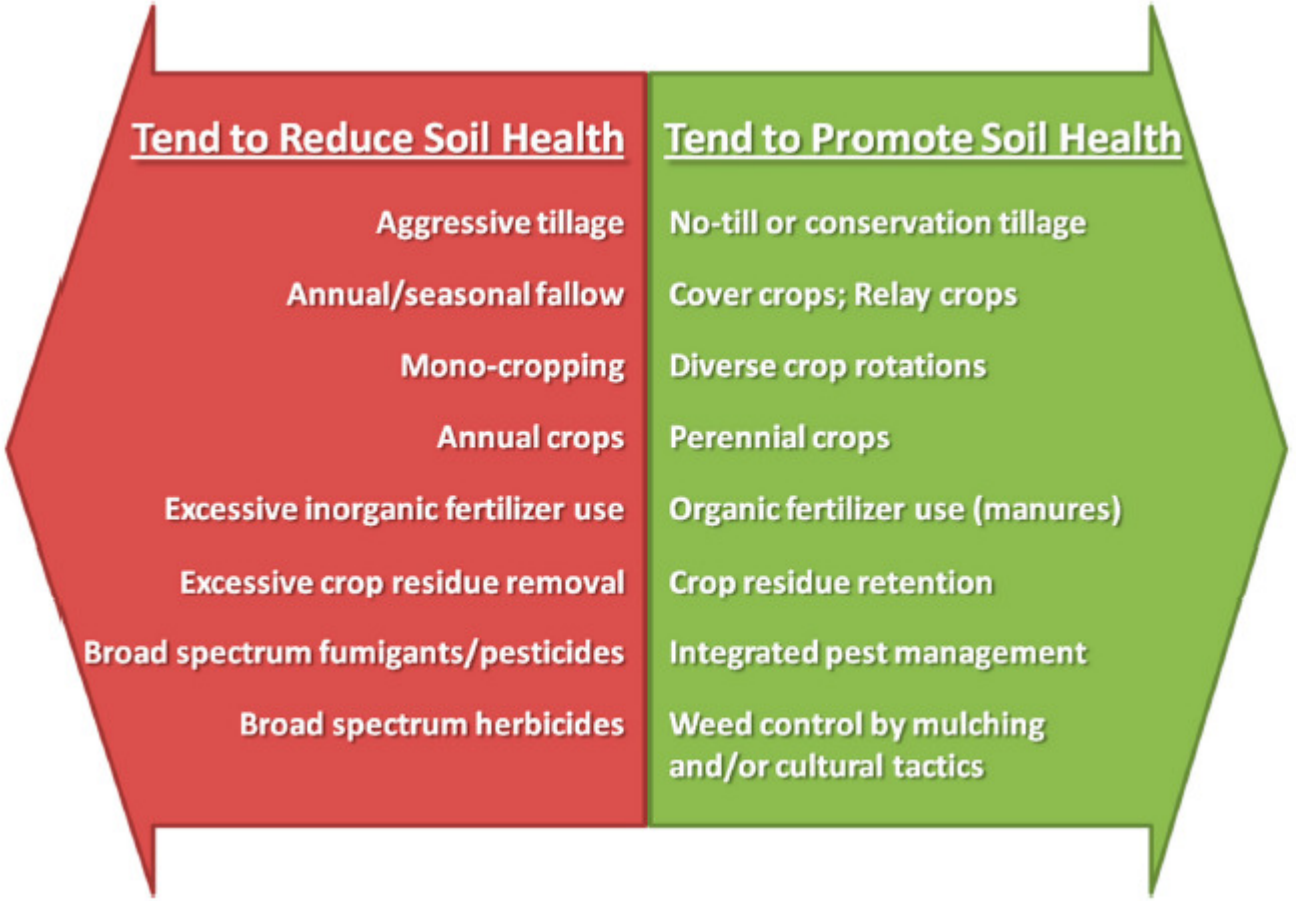

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The benefits of improving soil quality…

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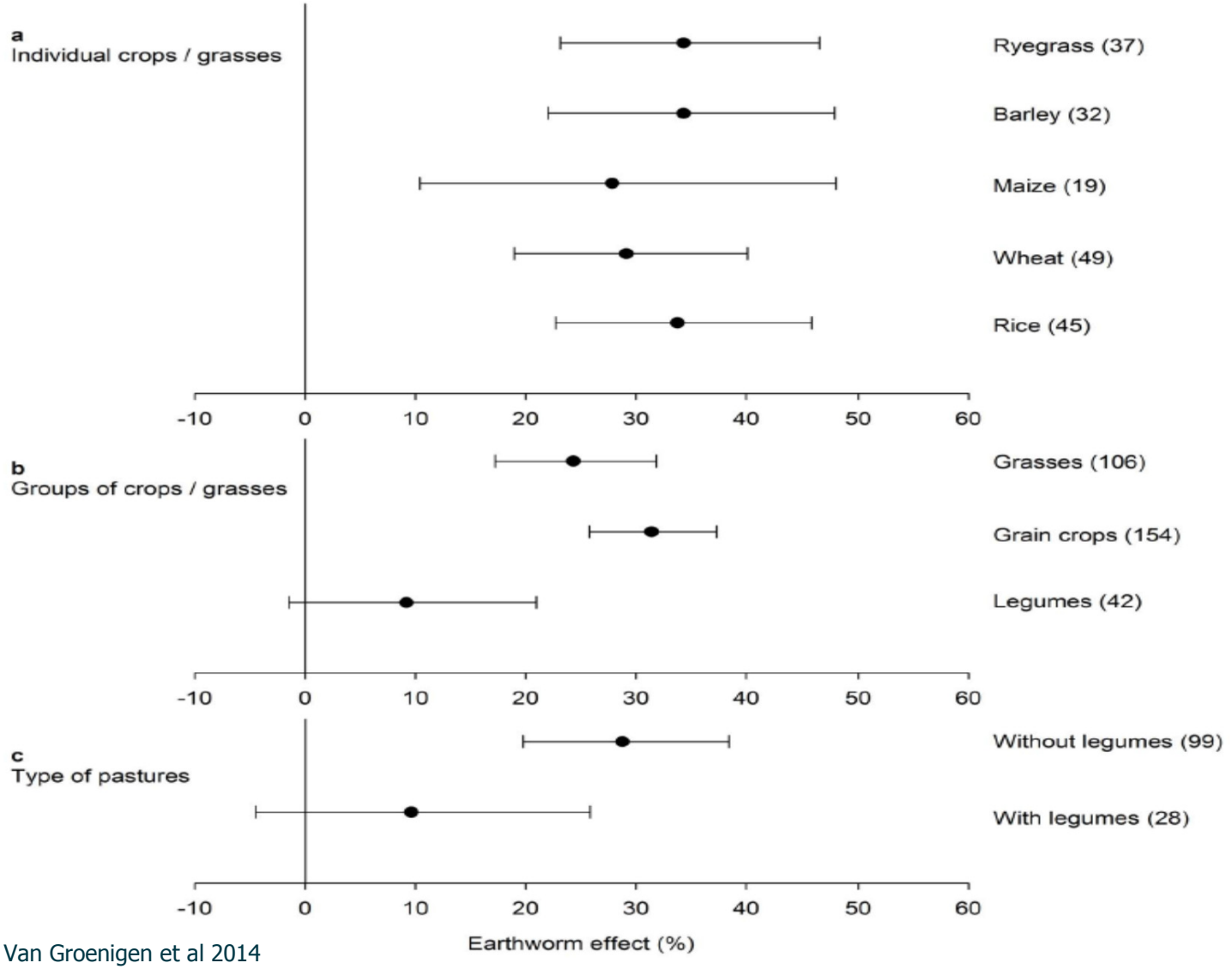
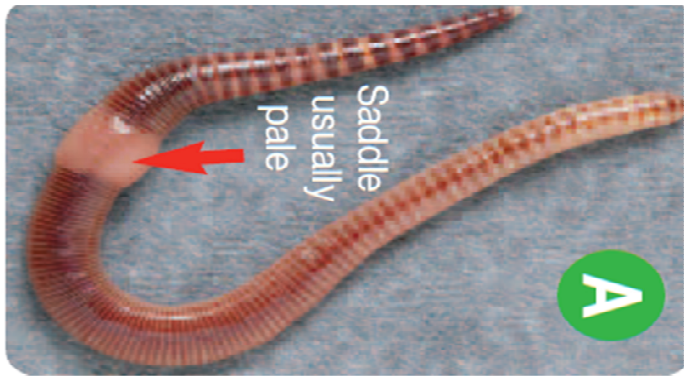
Positive effects of earthworms on yield



Van Groenigen et al 2014

Earthworm types

- Red worms – vertical burrowers and surface living
- Pale (+green) worms – soil feeding
- Stripy worms – compost worms



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Potential for Controlled Traffic Farming (CTF) in Grassland

Paul Hargreaves
(SRUC Crichton Dairy Centre)

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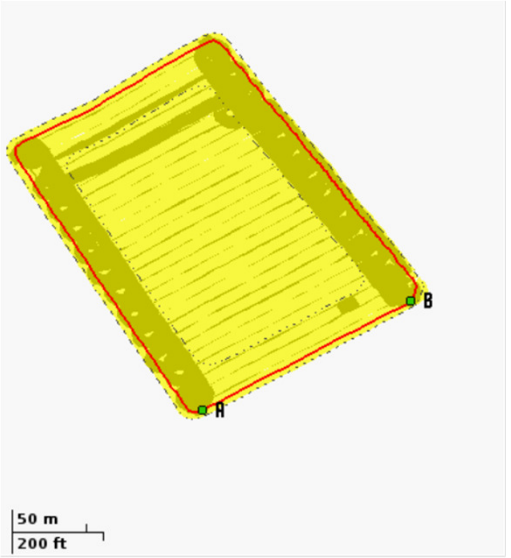
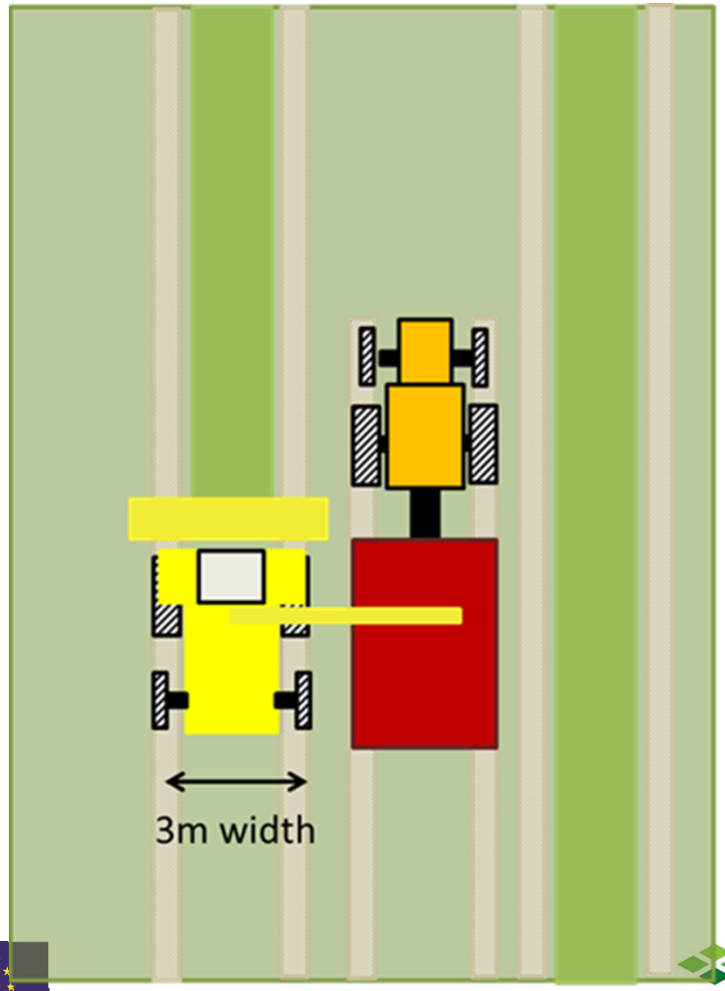
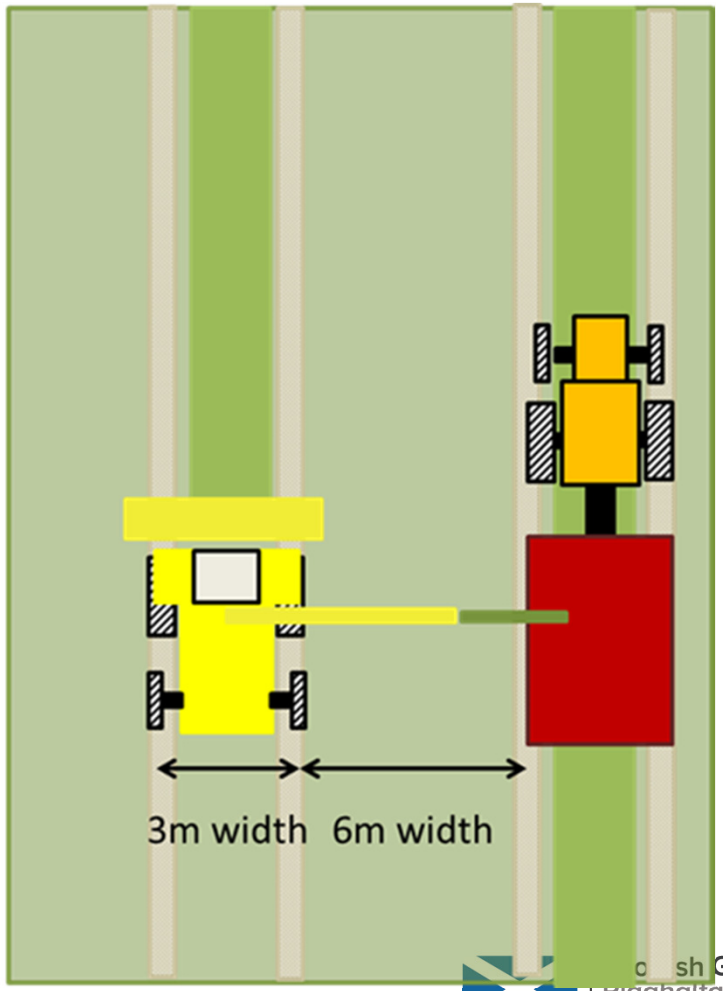
Experimental Work



- An 8 ha perennial ryegrass field at SW Scotland split into two
- Two traffic management treatments: normal (N) and CTF
- 3-cut silage system
- 9 m triple gang mower (9 m working width)

Controlled Traffic Farming – Working widths





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Results of Experimental Work

Silage Cut	Normal Traffic	Controlled Traffic	Difference (t DM ha^{-1})	P-value
1st Cut (t DM ha^{-1})	5.28	5.43	0.15	0.27
2nd Cut (t DM ha^{-1})	3.58	3.88	0.30	0.72
3rd Cut (t DM ha^{-1})	2.34	2.84	0.50	**<0.01**
2nd + 3rd Cut	5.92	6.72	0.80	**<0.05**
Total silage	11.29	12.15	0.96	

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Developments in measuring soil quality

- More background information – AHDB

GREATSOILS

- Thresholds and database – BBSRC-SARIC

- Putting it together – RESAS

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Why measure soil quality?

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- Think of it in terms of:

- An MOT for your soil Or A check up at the doctors
- Working towards
  (i) rolling out soil quality testing
  (ii) ‘what if’ model for knowledge exchange

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First questions

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- What is the state of my soil?
- Depends on
  - Soil type
  - What you do with it
- How do I tell?
  - Need indicators as can't measure everything

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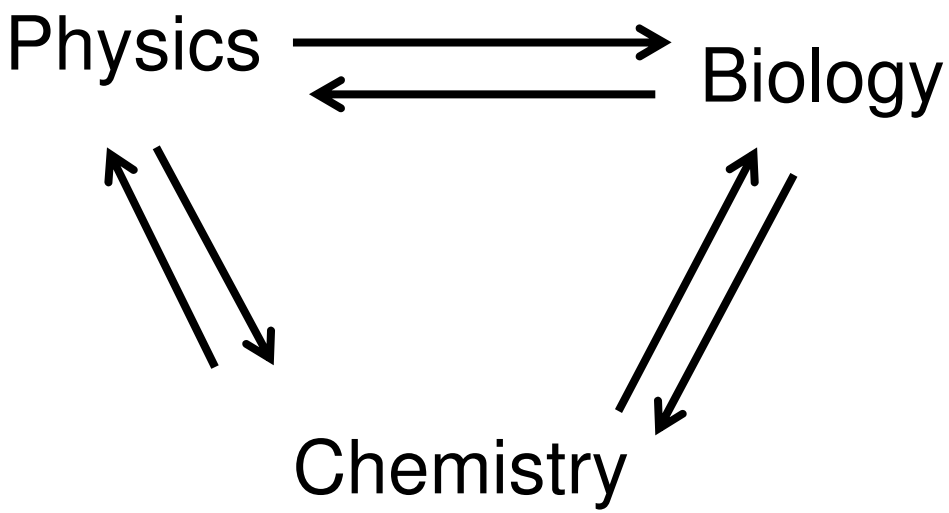
Components of soil quality



Current soil reports
pH
Routine nutrients

Components of soil quality

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Physics ⇄ Biology

Physics ⇄ Chemistry

Biology ⇄ Chemistry

Current soil reports
pH
Routine nutrients

Putting it all together will need a different approach to sample collection – linking physical observation and soil samples sent for testing

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Rolling out soil quality testing
Scorecard threshold values

Based on proposals for soilquality.org.uk (based on the Australian model - http://www.soilquality.org.au/) to enable utilisation of a wider database for benchmarking and ultimately advice.

The traffic light sytem represents:

RED (High risk, need to investigate urgently)
AMBER (Moderate risk, need to investigate further)
GREEN (Low risk, continue to monitor)

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Potential scorecard...

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ACME SOIL ANALYSIS COMPANY

Report for Mr A. Farmer
(who has a grassland field that needs some lime, has had a fair bit of P added and is compacted)

pH	
P	
K	
Mg	
Potentially Mineralisable Nitrogen	
Loss on Ignition	
VESS	
Earthworms	
DNA measures	

Would be followed with links to or hard copy of background information on the parameters measured, especiallyif red or amber.

Backed up by details...

Scotland – Extractable P (Modified Morgan's)

Bar chart classes	Traffic light colour	Description of this class (e.g. toxic)
0-1.7		VL – risk to production
1.8-4.4		L – potential risk to production
4.5-9.4		M-
9.5-13.4		M+
13.5-30.0		H – potential risk to environment
> 30.0		VH – risk to environment

Links to information sheets, websites, apps.

Hardcopy options

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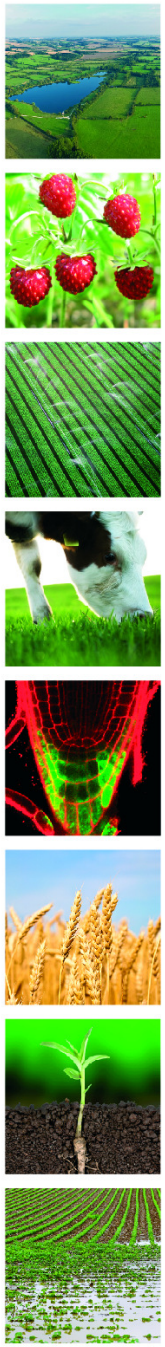
SARIC • SUSTAINABLE AGRICULTURE RESEARCH & INNOVATION CLUB



Making more of the results

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soilquality.org.uk

Potential for benchmarking

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- As in the current SRUC ‘AGREcalc’ where you can see your carbon footprint in relation to others
- You will be able to see how your soils perform against comparable soils and over time
- Benchmarking will improve the more data is entered

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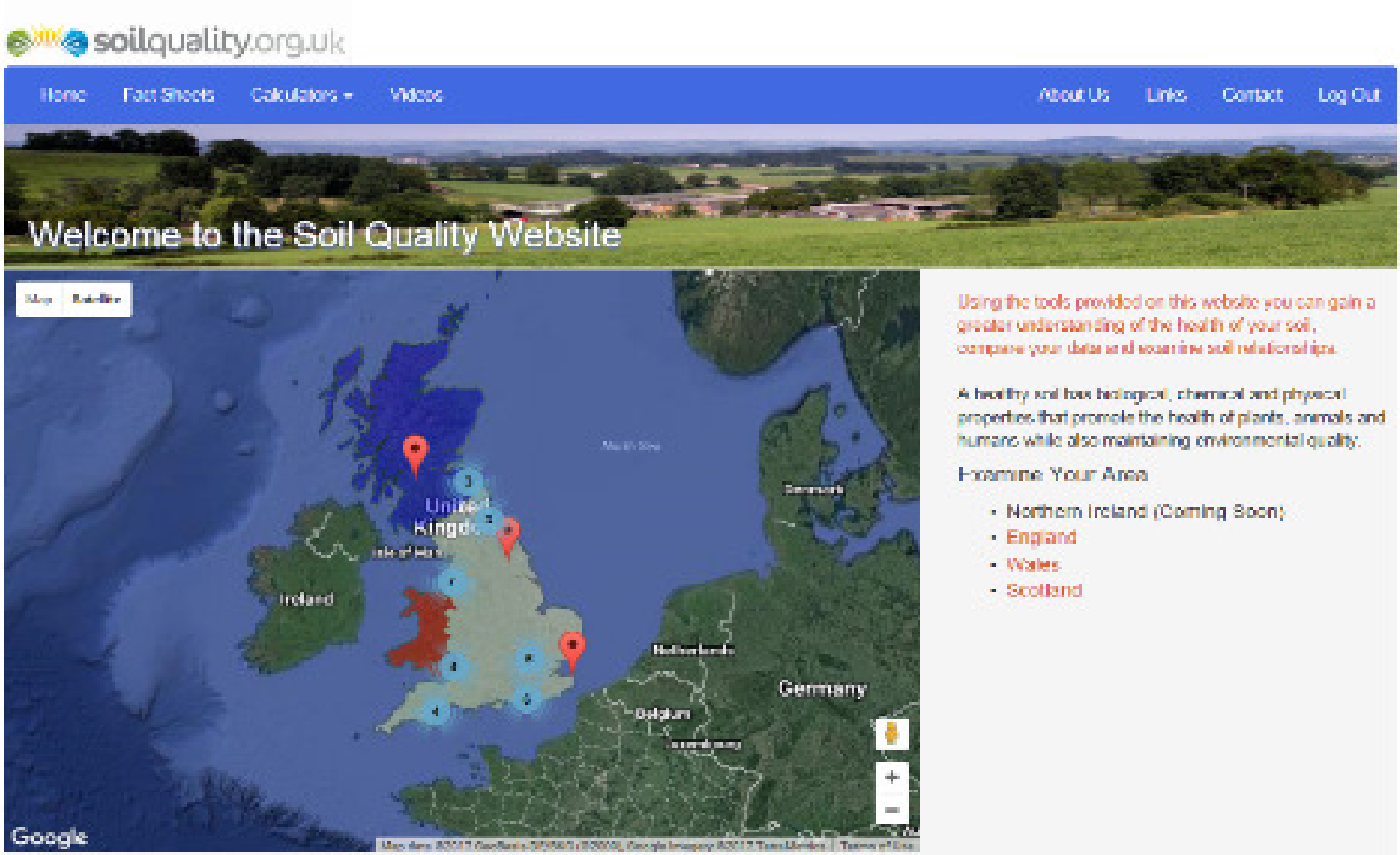


Newcastle University

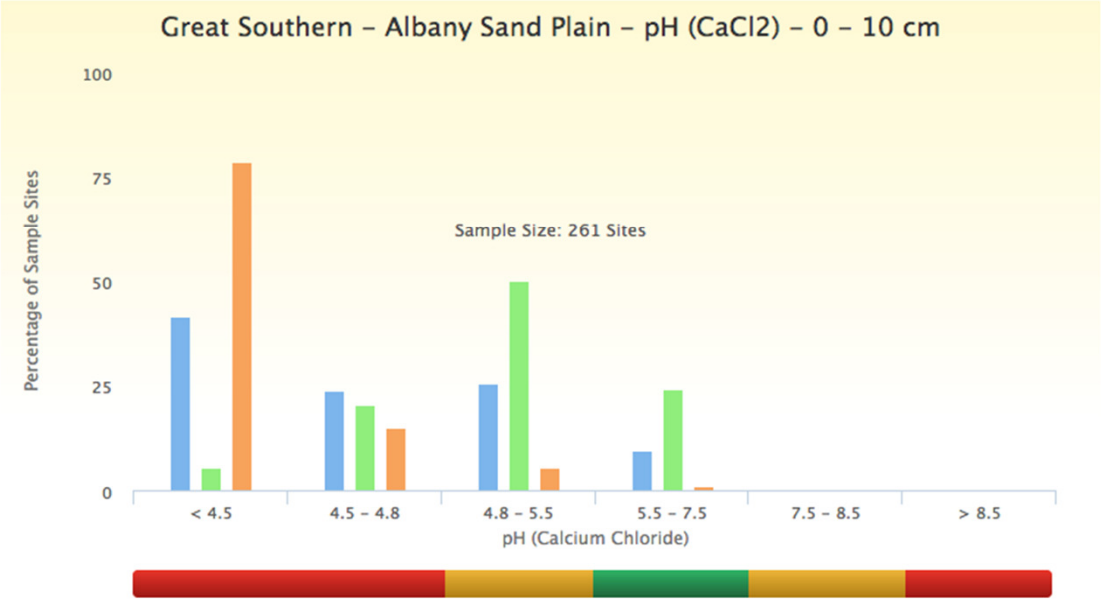
SRUC

SAC Consulting ADAS

Game & Wildlife Conservation Trust

BGS

Great Southern Albany Sand Plain - pH ($CaCl_2$) - 0 - 10 cm



Year	Soil Texture	Rainfall	Management Group	Land Use	Sample Size
All	All	All	Albany Sand Plain	All	261
All	All	All	Albany Sand Plain	Cropped	51
All	All	All	Albany Sand Plain	Permanent Pasture	106

Graph Additional DataSets

Year All

Soil Texture All

Rainfall ✓ All
Cropped
Permanent Pasture
Crop + Pasture
Bushland

Management Group

Land use All

Choose a Soil Quality indicator from one of the three tabs below to examine grouped data.

Biological

Chemical

pH ($CaCl_2$)
- 0 - 10 cm
- 10 - 20 cm
- 20 - 30 cm

Water Repellency
- 0 - 10 cm
- 10 - 20 cm
- 20 - 30 cm

Electrical Conductivity (ECe)
- 0 - 10 cm
- 10 - 20 cm
- 20 - 30 cm

Nitrogen Stock
- 0 - 30 cm

Cation Exchange Capacity
- 0 - 10cm

Physical

Fact Sheets related to pH ($CaCl_2$) - 0 - 10 cm

- Making Sense of Chemical Indicators
- Managing Soil Acidity - WA
- Soil Acidity

soilquality.org.au

Home | Fact Sheets | Calculators | Videos | About Us | Links | Contact

Cradle Coast Compare Your Data

Australia / Tasmania / Cradle Coast

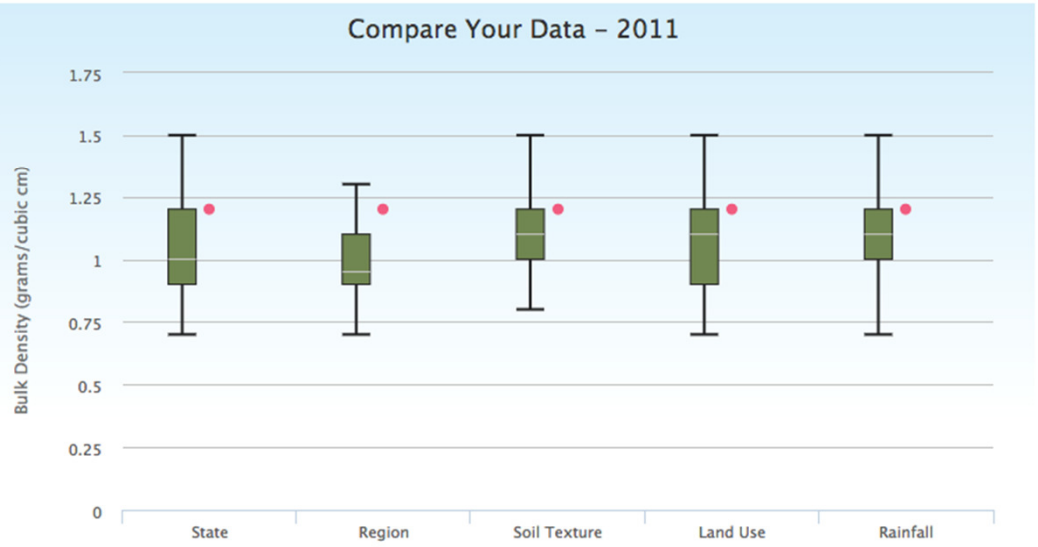
Overview | Examine | **Compare** | Relate

Site Report - Bulk Density - 0 - 10 cm

Return to Site Report

State
Tasmania
Region
Cradle Coast
Paddock ID
TAS0164

Management Group
Unavailable
Soil Texture
Loam
Land Use
Crop + Pasture
Rainfall
< 800mm



How To Compare Data

The circle on the graph represents your value from soil test results. This sits next to a plot showing the entire spread of that groups' data. The line in the centre is the average value of the all the data, and the box surrounding represents the middle 50% of the sample sites in this dataset. The upper and lower "tails" reflect the range for the top and bottom 25% of the sample sites in this data set.

Choose a Soil Quality indicator from one of the three tabs below to compare grouped data.

Biological

Chemical

Physical

Clay Content
- 0 - 10 cm

Bulk Density
- 0 - 10 cm
- 10 - 20 cm
- 20 - 30 cm

Gravel Content
- 0 - 10 cm
- 10 - 20 cm
- 20 - 30 cm

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Questions

- Would that be useful?
- Would the ability to relate values regionally and/or over time be useful?

Why measure soil quality?

FARM ADVISORY SERVICE

- Think of it in terms of:

- An MOT for your soil Or A check up at the doctors
- Working towards
  (i) rolling out soil quality testing
  (ii) ‘what if’ model for knowledge exchange

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‘what if’ model for knowledge exchange

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- To get across the interactions that go towards soil quality
- To present some basic scenarios for management change
- Lead you to other sources of information

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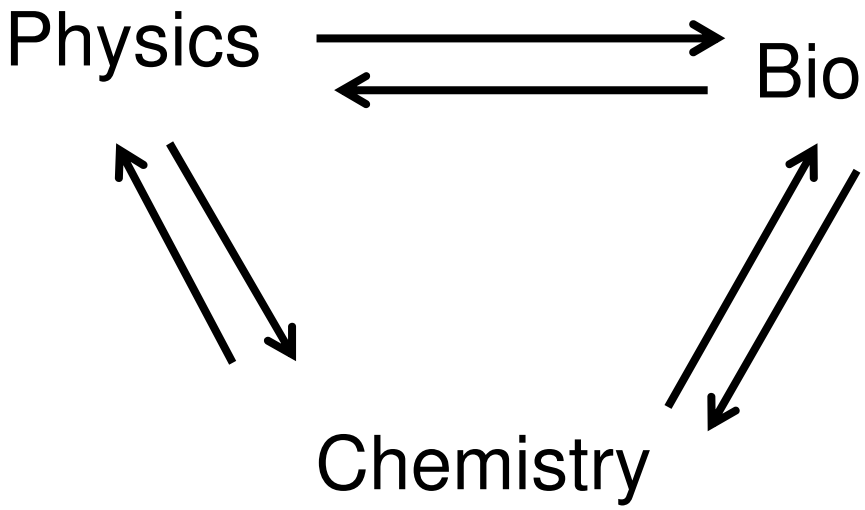
Interactions within soil quality



No perfect solution
Just different solutions
With varying outcomes

Too much
Loss of £
Pollution

Just right
Good for £

Too little
Loss of £

‘Goldilocks’ scenario

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Background information – effects of general management options

DRIVER				Reduced Tillage
EFFECTS	Biology	+ve	Earthworms	+
			Microbial biomass	+
			Enzyme activity	+
			Biodiversity	+
			Natural enemies	+
		-ve	Slugs	+
			Weeds	+
			Diseases	+
	Chemistry	+ve	Soil Organic Matter	+
		-ve	Nutrient Loss	-
			Herbicide Use	+
			Pesticide Loss	
			Nutrient Immobilisation	
	Physics		Soil Structure	+/-
			Trafficiability	+
			Water infiltration	+
	Margin		Yield	-
			Short Term	-
			Long Term	+

Similar tables for:
No-till
Cover crops
High N amendment
High C amendment

Knowledge introduction – visual tool

- Rationale was to visualise those complex interactions
- To give rapid overview of the general responses to expect

Knowledge introduction – visual tool

I'd like to know about the effects of changing management to.....

Effect on Soil Quality Variables

For the Management and Conditions of:
Cover Crop
and the soil:
Sandy
the climate:
Warm Wet
the cropping:
Arable-combinable

Key to Outcomes
Positive
Negative

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Question

- Would that be useful as a way to think about soil quality?

Thank You

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Visual Evaluation of Soil Structure

Soil structure affects root penetration, water availability to plants and soil aeration. This simple, quick test assesses soil structure based on the appearance and feel of a block of soil dug out with a spade.
The scale of the test ranges from Sq1, good structure, to Sq5, poor structure.

Equipment:
Garden spade approx. 20 cm wide, 22-25 cm long.
Optional: light-coloured plastic sheet, sack or tray ~50 x 80 cm, small knife, digital camera.

When to sample:
Any time of year, but preferably when the soil is moist. If the soil is too dry or too wet it is difficult to obtain a representative sample.
Roots are best seen in an established crop or for some months after harvest.

Where to sample:
Select an area of uniform crop or soil colour or an area where you suspect there may be a problem. Within this area, plan a grid to look
at the soil at 10, preferably more, spots. On small experimental plots, it may be necessary to restrict the number to 3 or 5 per plot.

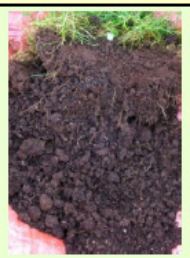
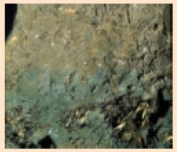
Bruce Ball, SRUC (bruce.ball@sruc.ac.uk),
Rachel Guimarães, University of Maringá, Brazil (rachellocks@gmail.com),
Tom Batey, Independent Consultant (2033@tombatey.f2s.com) and
Lars Munkholm, University of Aarhus, Denmark (Lars.Munkholm@agrsci.dk)

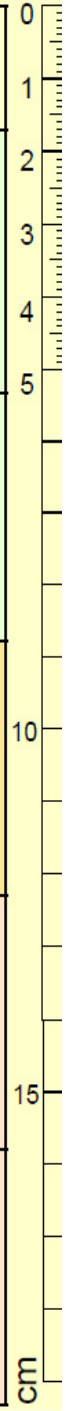
Method of assessment:

Step	Option	Procedure
Block extraction and examination		
1. Extract soil block	Loose soil	Remove a block of soil ~15 cm thick directly to the full depth of the spade and place spade plus soil onto the sheet, tray or the ground
	Firm soil	Dig out a hole slightly wider and deeper than the spade leaving one side of the hole undisturbed. On the undisturbed side, cut down each side of the block with the spade and remove the block as above.
2. Examine soil block	Uniform structure	Remove any compacted soil or debris from around the block
	Two or more horizontal layers of differing structure	Estimate the depth of each layer and prepare to assign scores to each separately.
Block break-up		
3. Break up block (take a photograph - optional)		Measure block length and look for layers. Gently manipulate the block using both hands to reveal any cohesive layers or clumps of aggregates. If possible separate the soil into natural aggregates and man-made clods. Clods are large, hard, cohesive and rounded aggregates.
4. Break up of major aggregates to confirm score		Break larger pieces apart and fragment it until a piece of aggregate of 1.5 - 2.0 cm. Look to their shape, porosity, roots and easily of break up. Clods can be broken into non-porous aggregates with angular corners and are indicative of poor structure and higher score.
Soil scoring		
5. Assign score		Match the soil to the pictures category by category to determine which fits best.
6. Confirm score from:		Factors increasing score:
	Block extraction	Difficulty in extracting the soil block
	Aggregate shape and size	Larger, more angular, less porous, presence of large worm holes
	Roots	Clustering, thickening and deflections
	Anaerobism	Pockets or layers of grey soil, smelling of sulphur and presence of ferrous ions
	Aggregate fragmentaion	Break up larger aggregates ~ 1.5 – 2.0 cm of diameter fragments to reveal their type
7.Calculate block scores for two or more layers of differing structure		Multiply the score of each layer by its thickness and divide the product by the overall depth, e.g. for a 25 cm block with 10 cm depth of loose soil (Sq1) over a more compact (Sq3) layer at 10-25 cm depth, the block score is (1 x 10)/25 + (3 x 15)/25 = Sq 2.2.

Scoring: Scores may fit between Sq categories if they have the properties of both.
Scores of 1-3 are usually acceptable whereas scores of 4 or 5 require a change of management.

16 Oct 2012

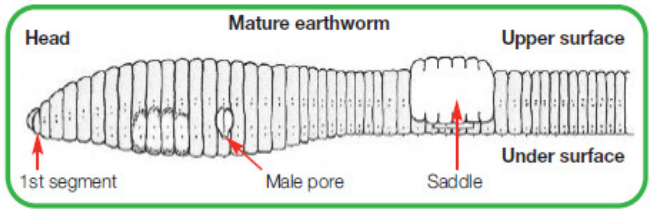
Structure quality	Size and appearance of aggregates	Visible porosity and Roots	Appearance after break-up: various soils	Appearance after break-up: same soil different tillage	Distinguishing feature	Appearance and description of natural or reduced fragment of ~ 1.5 cm diameter
Sq1 Friable Aggregates readily crumble with fingers	Mostly < 6 mm after crumbling	Highly porous Roots throughout the soil			 Fine aggregates	 The action of breaking the block is enough to reveal them. Large aggregates are composed of smaller ones, held by roots.
Sq2 Intact Aggregates easy to break with one hand	A mixture of porous, rounded aggregates from 2mm - 7 cm. No clods present	Most aggregates are porous Roots throughout the soil			 High aggregate porosity	 Aggregates when obtained are rounded, very fragile, crumble very easily and are highly porous.
Sq3 Firm Most aggregates break with one hand	A mixture of porous aggregates from 2mm -10 cm; less than 30% are <1 cm. Some angular, non-porous aggregates (clods) may be present	Macropores and cracks present. Porosity and roots both within aggregates.			 Low aggregate porosity	 Aggregate fragments are fairly easy to obtain. They have few visible pores and are rounded. Roots usually grow through the aggregates.
Sq4 Compact Requires considerable effort to break aggregates with one hand	Mostly large > 10 cm and sub-angular non-porous; horizontal/platy also possible; less than 30% are <7 cm	Few macropores and cracks All roots are clustered in macropores and around aggregates			 Distinct macropores	 Aggregate fragments are easy to obtain when soil is wet, in cube shapes which are very sharp-edged and show cracks internally.
Sq5 Very compact Difficult to break up	Mostly large > 10 cm, very few < 7 cm, angular and non-porous	Very low porosity. Macropores may be present. May contain anaerobic zones. Few roots, if any, and restricted to cracks			 Grey-blue colour	 Aggregate fragments are easy to obtain when soil is wet, although considerable force may be needed. No pores or cracks are visible usually.



Key to common British earthworms of amenity grasslands

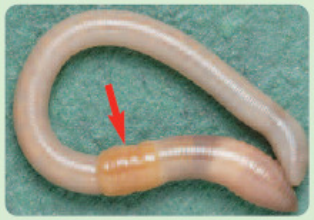
By David T. Jones *and* Chris N. Lowe

There are 26 British species of earthworm. This guide covers the seven most common species that occur in grass lawns and playing fields. It does not include the red stripy earthworms that occur in compost heaps, other species that occur in gardens, or woodland species.



Start here

Is it more than 2cm long, **AND** does it have a clearly developed saddle?



The saddle is usually a different colour to the rest of the body, and slightly wider

NO → It is not a mature earthworm - you can't identify it with this guide. At least 50% of the earthworms you find will be immatures.

YES → Is the body from the first segment to the saddle partly or entirely pale in colour (whitish, pink, grey or greenish)? It may have some reddish or dark segments

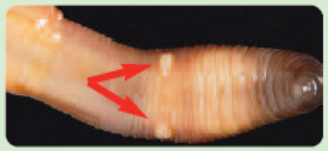
NO → It may be a species not on this guide

YES → **Turn over**

NO → Is the upper surface of the body, from the first segment to the saddle, entirely dark in colour (dark red, purplish red or chestnut brown)?

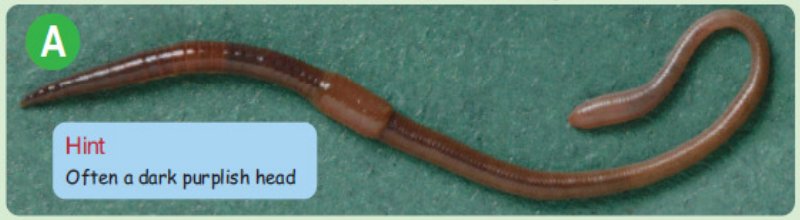
YES → Is the earthworm longer than 8cm when **NOT** moving?

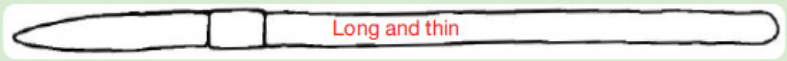
YES → Are the male pores visible?

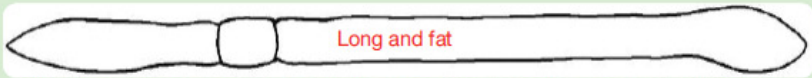


YES → Is the body: **A Long and relatively thin** or **B Long and relatively fat**?

Black-headed worm *Aporrectodea longa*

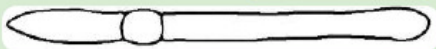






Lob worm *Lumbricus terrestris*

NO → **Redhead worm** *Lumbricus rubellus*



Hint
Line drawings show typical sizes of the adult worm

Key to soil texture start here


a


b


c


d

Put some soil about the same volume as an egg in the palm of your hand. Add drops of water and work the soil with your fingers to break down any lumps. Add sufficient water until the soil is evenly moist and feels like putty. a

Squeeze the soil in your palm. Can you form it into a ball? b

YES

NO

Can you pinch the ball to make a flat ribbon of about 3mm thickness? c

YES

NO

Now feed the ribbon through your hand so that it supports its own weight. d

Is the soil 'ribbon' less than 2.5cm long before it breaks?

YES

NO

Is the soil 'ribbon' between 2.5cm and 5cm long before it breaks?

YES

NO

Is the soil 'ribbon' longer than 5cm before it breaks?

YES

Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?

Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?

Take a pinch of soil and add water to make it very wet. Rub it between your fingers. How gritty does the soil feel?

Very gritty	In between	Very smooth	Very gritty	In between	Very smooth	Very gritty	In between	Very smooth
c Sandy loam	d Silty loam	e Loam	f Sandy clay loam	g Silty clay loam	h Clay loam	i Sandy clay	j Silty clay	k Clay

a Sand

b Loamy sand

Safe fieldwork

We don't advise you to work on your own. Make sure that you know what to do in an emergency. Take a responsible friend who can help if things go wrong. Ensure that you have permission from the landowner to dig holes on their land. Wear plastic gloves and wash your hands before eating. Cover any open wounds before starting the activity.

FSC Designed by FSC Publications
www.field-studies-council.org

OPAL EXPLORE NATURE

Open Air Laboratories (OPAL) is a new partnership initiative which is encouraging people to spend more time outside understanding the world around them. OPAL wants to get everybody involved in exploring, studying but most of all enjoying their local environment. OPAL will be running a programme of events and activities until the end of 2012. To find out more about events in your region please visit the website:

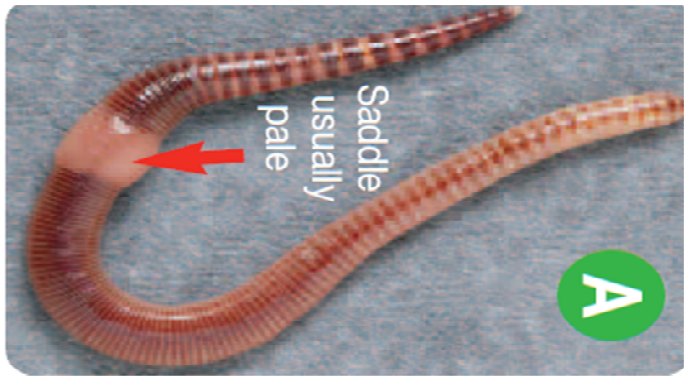
www.OPALexplorenature.org

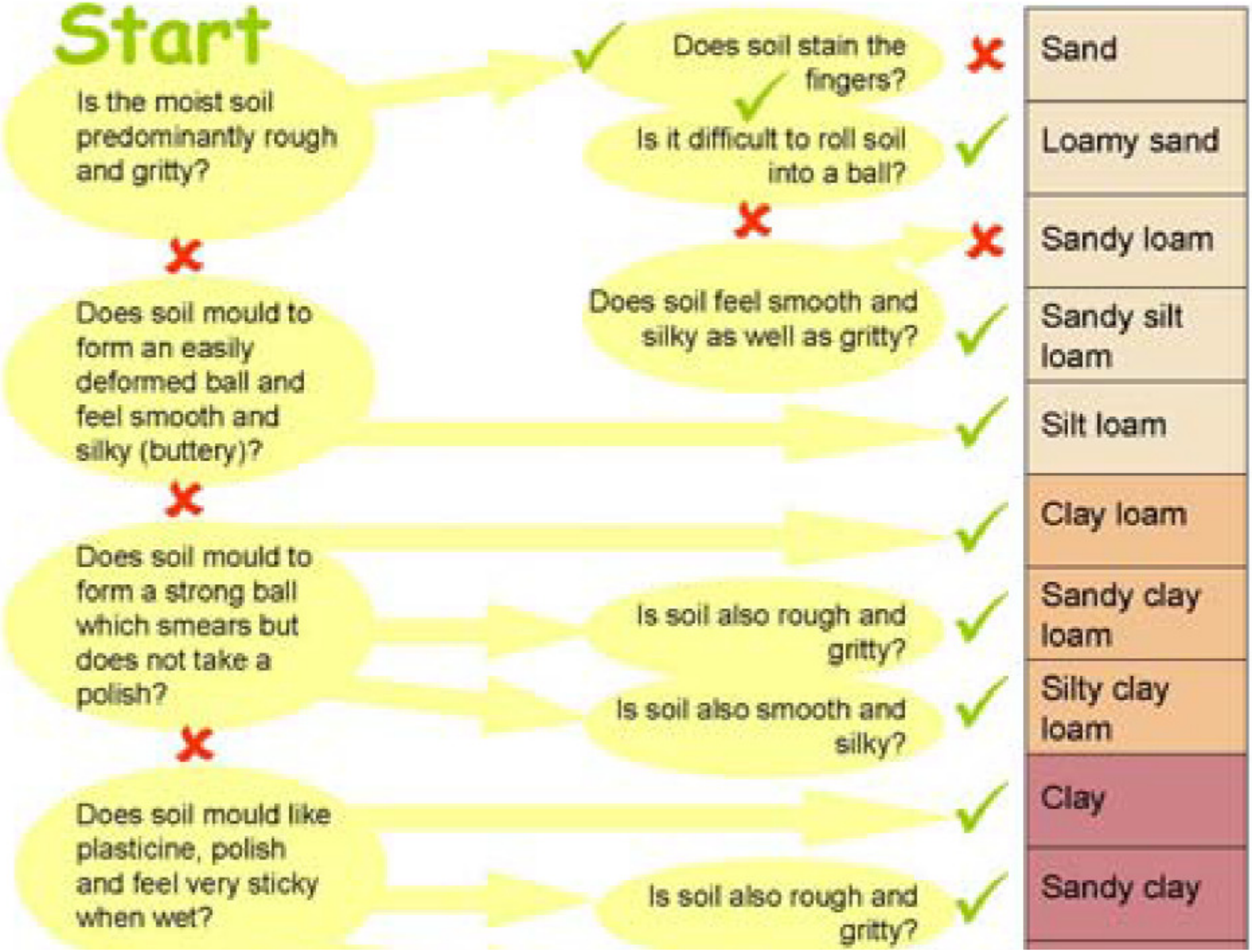
LOTTERY FUNDED

Photographs by: Martin Head[1], Simon Norman[4], Louise Parker[4]. Text by: Martin Head[1], Nick Voulvoulis[1], James Bone[1], Laura Edwards[1], Elizabeth Stevens[1], Declan Barraclough[3], Tatiana Boucard[3], David Jones[2], Paul Eggleton[2], Stephen Brooks[2], Simon Norman[4], Louise Parker[4], Rebecca Farley[4], Mark Dowding[4], Linda Davies[1], Cardina Biscariou[1]. [1] Imperial College London. [2] Natural History Museum. [3] Environment Agency. [4] Field Studies Council.

Earthworm types

- Red worms – vertical burrowers and surface living
- Pale (+green) worms – soil feeding
- Stripy worms – compost worms




Start
Is the moist soil predominantly rough and gritty?
Does soil stain the fingers?
Is it difficult to roll soil into a ball?
Does soil feel smooth and silky as well as gritty?
Does soil mould to form an easily deformed ball and feel smooth and silky (buttery)?
Does soil mould to form a strong ball which smears but does not take a polish?
Is soil also rough and gritty?
Is soil also smooth and silky?
Does soil mould like plasticine, polish and feel very sticky when wet?
Is soil also rough and gritty?
Sand
Loamy sand
Sandy loam
Sandy silt loam
Silt loam
Clay loam
Sandy clay loam
Silty clay loam
Clay
Sandy clay

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