Stranraer Soil Nutrient Network

FARM ADVISORY SERVICE

Green Valley Golf Academy
Thursday 15th November 2018

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Agenda

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- The Story so Far
- Soil Sampling and Lime
- Worm Workforce
- Trace Elements for Animals and Plants
- Potash
- Nutrient Budgets
- Close

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THE STORY SO FAR…

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The Story so Far…

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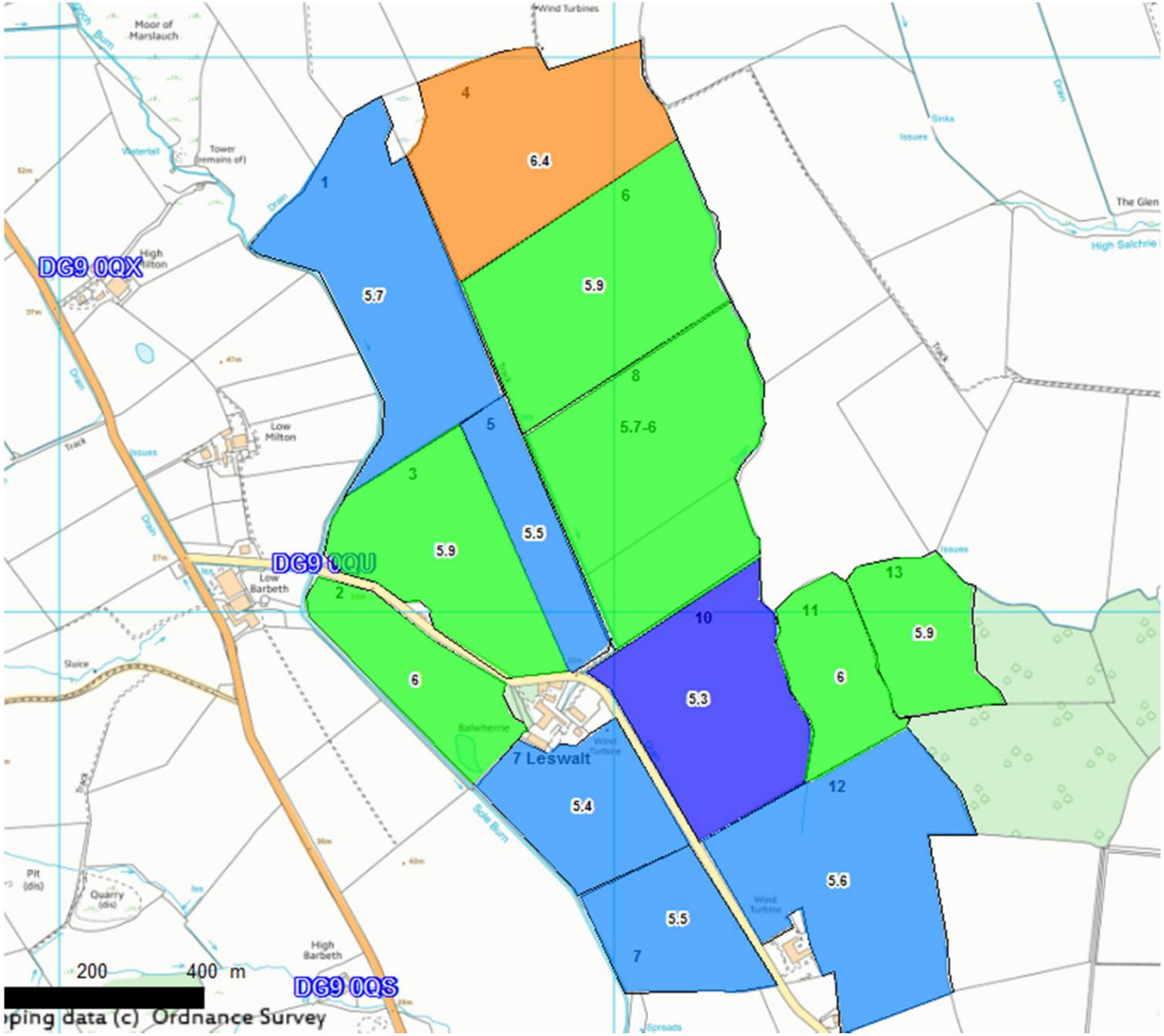

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pH Map

Soil pH

- <5.4
- 5.4 - 5.6
- 5.7 - 6.2
- 6.3 - 6.5
- >6.5

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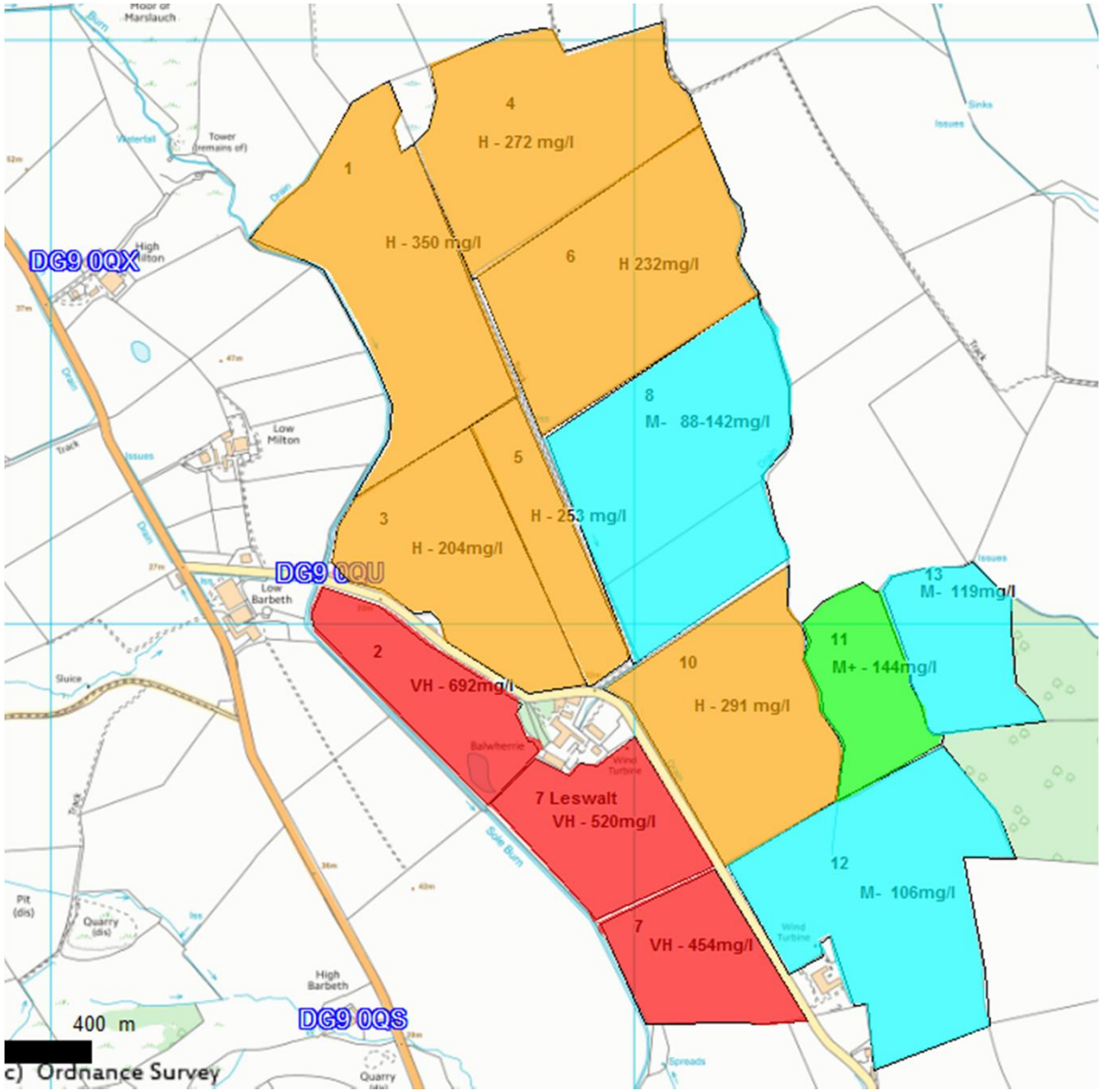

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K Map

Potassium Status

- VH
- H
- M+
- M-
- L
- VL

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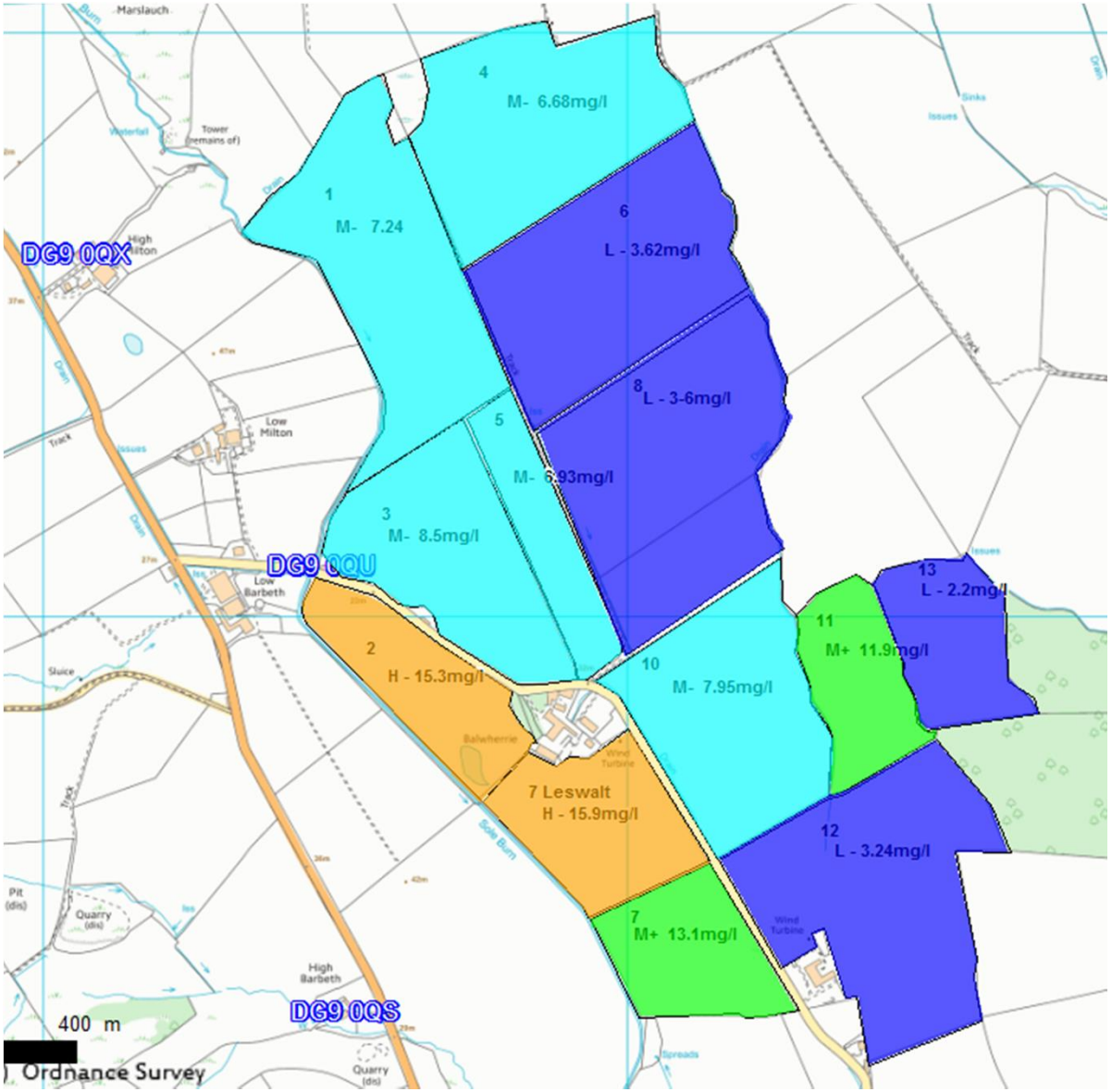

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P Map

Phosphorus Status

- VH
- H
- M+
- M-
- L
- VL

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SOIL SAMPLING

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Soil Sampling

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- Why ?
- Measures the plant available nutrients in the soil
- Gives you information to manage deficits and surpluses in soil nutrients
- Measures the acidity of the soil - Ph will dictate what is actually available to the plant
- Corrections of low ph and nutrient deficits will improve the productivity of your crop and save you money!

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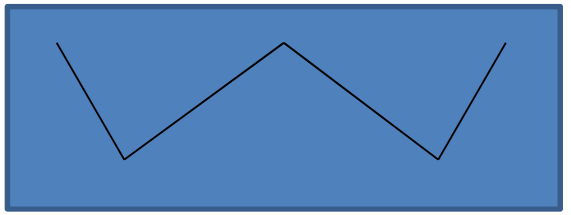
How to sample

- Twist a gouge or pot corer down to 7.5cm
- Walk the field in a ‘W’.



- Avoid gateways, feed areas or former muck-heap sites
- Collect 25 plugs of soil in a clean bucket
- Seal a well-mixed sub sample in a plastic bag or box and label
- Send to an accredited soil testing laboratory (either direct to the laboratory or via a local co-op, fertiliser merchant or independent company)

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Value for Money

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Basic Soil Report

Soil Report

INTERIM REPORT

UKAS TESTING 7624

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Balwherrie Farm
Leswalt

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DG9 0QU

Farm Sampled:	
Your reference:	S58629
Last Crop:	Grass - silage
Next Crop:	Grass - silage
Soil Type:	Mineral

Sample ID :	7 Leswalt
Lab sample no:	18009886
Case no:	ASD-2018-5503
Date received:	18/09/2018
Date reported:	27/09/2018

Determination	Result	Units	Status
pH	5.4		
Lime req (Arable)	6.4	t/ha	
Lime req (Grass)	3.9	t/ha	
Extractable Phosphorus	15.9	mg/l	High
Extractable Potassium	520.0	mg/l	V High
Extractable Magnesium	162.0	mg/l	Mod
Extractable Calcium	870	mg/l	
Extractable Sodium	34.60	mg/l	

Broad Spectrum Soil Report

Soil Report

INTERIM REPORT

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Balwherrie Farm
Leswalt

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Farm Sampled:	
Your reference:	S58629
Last Crop:	Grass - grazing
Next Crop:	Fodder rape
Soil Type:	Mineral

Sample ID :	4
Lab sample no:	18009879
Case no:	ASD-2018-5503
Date received:	18/09/2018
Date reported:	27/09/2018

Determination	Result	Units	Status
pH	6.4		
Lime req (Arable)	0.0	t/ha	
Lime req (Grass)	0.0	t/ha	
Extractable Phosphorus	6.68	mg/l	M(-)
Extractable Potassium	272.0	mg/l	High
Extractable Magnesium	125.0	mg/l	Mod
Extractable Calcium	1900	mg/l	
Extractable Sodium	54.30	mg/l	
Extractable Sulphur	19	mg/l	High
Extractable Copper	1.45	mg/l	Low
* Extractable Manganese	13	mg/l	Mod
Extractable Boron	0.71	mg/l	Mod
Extractable Zinc	1.7	mg/l	Mod
Organic Matter (LOI)		%	
* Cation Exchange Capacity		% by Wt	

Small Print

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- Avoid sampling when soil is waterlogged….or too dry!
- Sample amalgamated fields separately
- Sample problem areas or known soil types separately
- Try to sample atleast 2 months after slurry/manure/fertiliser or lime applications
- Sample atleast every 4 years
- For fields underperforming start with a soil sample
- Try to sample the year before sowing a crop to allow time to correct any deficits

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THE FIRST PRIORITY

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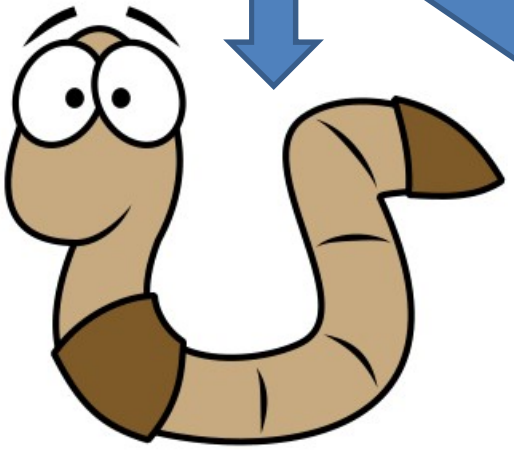
pH



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Why Do We Need to Lime?

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- Leaching
- Crop Uptake
- Impact of Ammonium Nitrate Fertiliser
- Acid Rain

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How Much Lime?

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Eg Silage Land

Acidic effect of Fertiliser	175kg
Crop Removal 1st cut	80kg
Crop Removal 2nd cut	45kg
Leaching/Drainage	100-250kg
	400- 550kg /Ac/Yr

So 2 ton /Acre every 5 years to standstill !!!

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Why Do We Need to Lime?

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% Nutrient Availability at different pH

	N	P	K
pH 5 (very strong acidic)	53%	34%	52%
pH 5.5 (strong acidic)	77%	48%	77%
pH 6.0 (medium acidic)	89%	52%	100%

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At What Cost?

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Ph	Utilisation % Nitrogen	Cost of Poor Utilisation	Cost - 4 cwt bags/ac applied per year	Cost – 7 cwt bags/ac applied per year	Cost of Lime/ac applied
5	53	£6	£24	£42	£132
5.5	77	£4	£16	£28	£66
6	89	£1.50	£6	£10.50	£33

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Soil Quality: Soil Indicators

Dr. Paul Hargreaves
SRUC Dairy Research and Innovation Centre

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Soil – air, water, minerals

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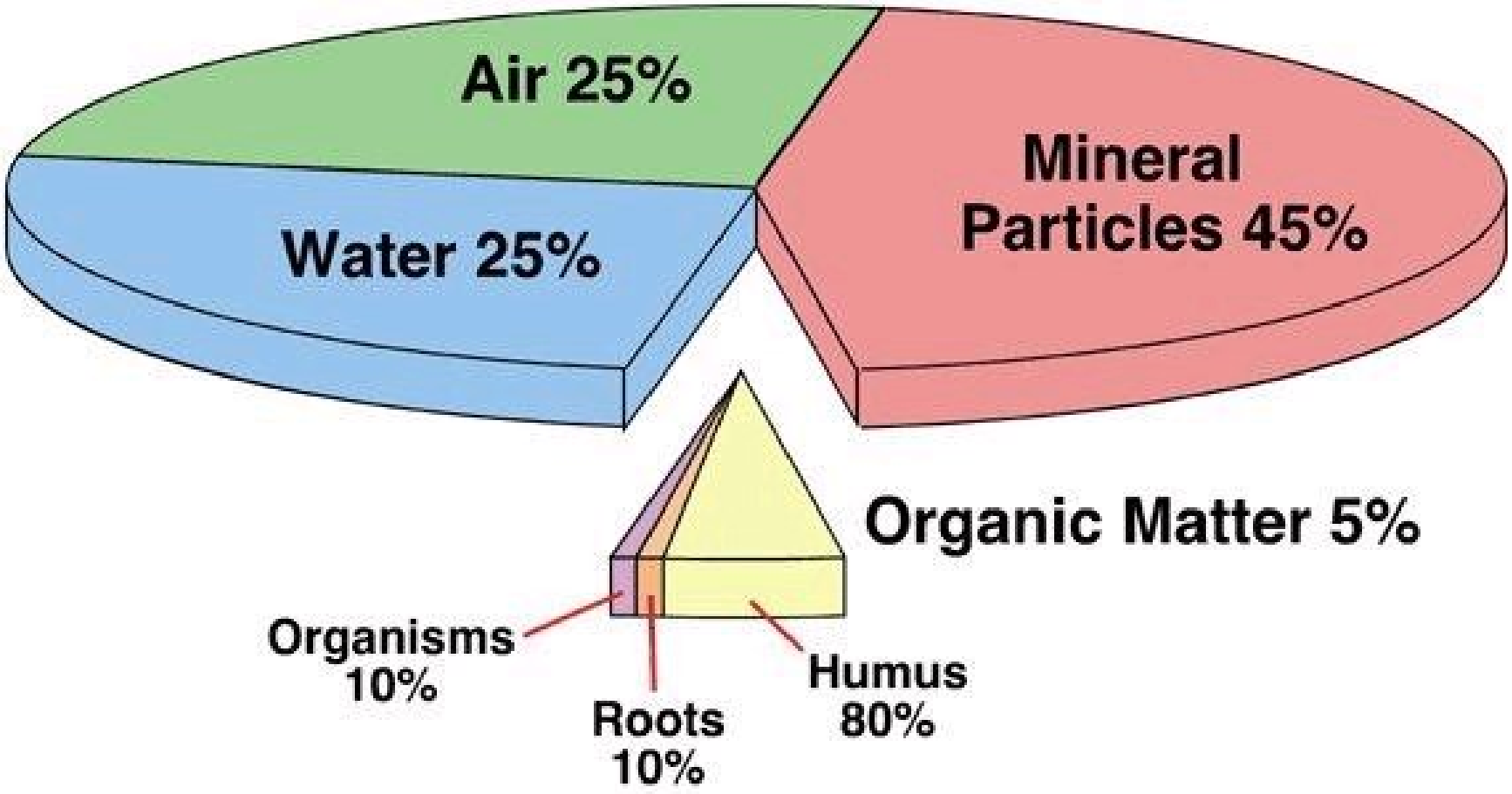

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Soil functions

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Support hooves and wheels

Reduce gas losses, N_2O, N_2, NH_3 and CH_4

Recycle nutrients in wastes

Store water and plant nutrients – minimise runoff, sediment and fertiliser losses

Prevent NO_3 and pesticide leaching losses

Good soil function increases profitability and conserves the environment

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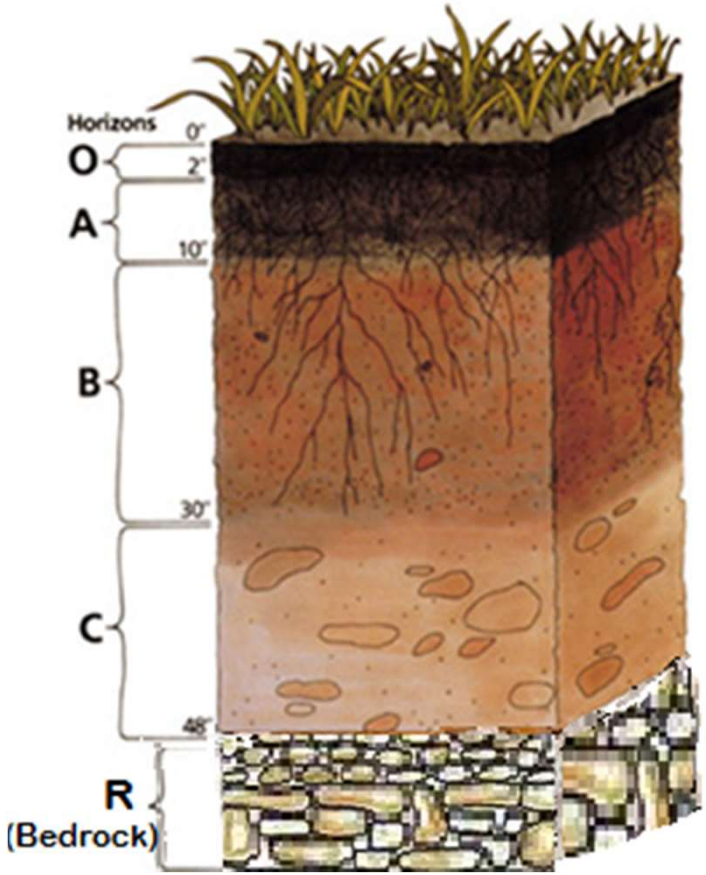
Soil Profile



'O' horizon – Organic horizon, generally dead plant material. Can be missing - deeper in forest soils.

'A' horizon – Top-soil, usually contains most organic material and has the greater mass of roots – most biological activity, with greater soil structure

'B' horizon – Sub-soil, can be several metres thick, usually of a greater density than the top soil, less organic material, greater mineral content. Lighter in colour.

'C' horizon – Parent material, generally undefined layer containing more minerals, can be from the underlying rock material or bedrock, but not always the case.

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Soil Structure

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Structure is the how the particles bind together to form aggregates that allows:

- roots to anchor the plant
- water to drain through pores and cracks
- water retention
- air to roots for favourable gas exchange
- mineralisation of nutrients and release to crop roots
- biodiversity of microbes

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Organic Matter

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- Soil plays a major role in the global carbon cycle, with the global soil carbon pool estimated at 2500 gigatons, 3.3 times the size of the atmospheric pool and 4.5 times the biotic pool.
- Organic material in the soil comes from the breakdown of plant and animal material.
- Depending on their chemical structure, decomposition is rapid for sugars, starches and proteins (days), slow for cellulose, fats, waxes and resins (months) or very slow for lignin (years).
- 35-80 % of the non-living part of organic matter is humus

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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

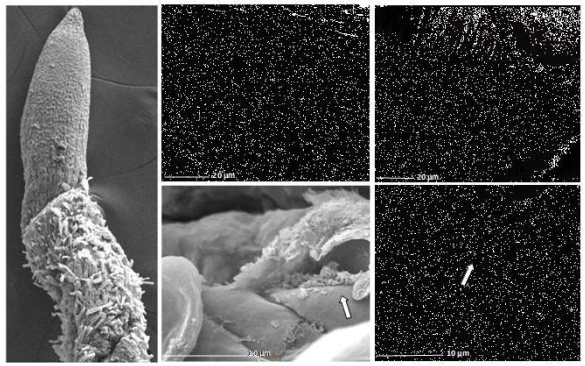
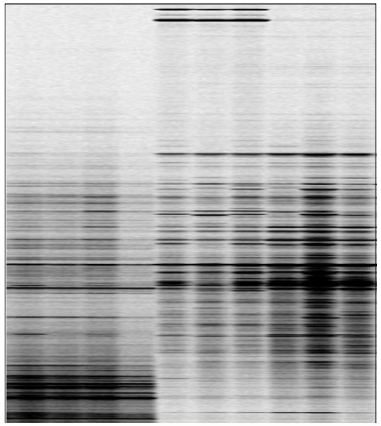


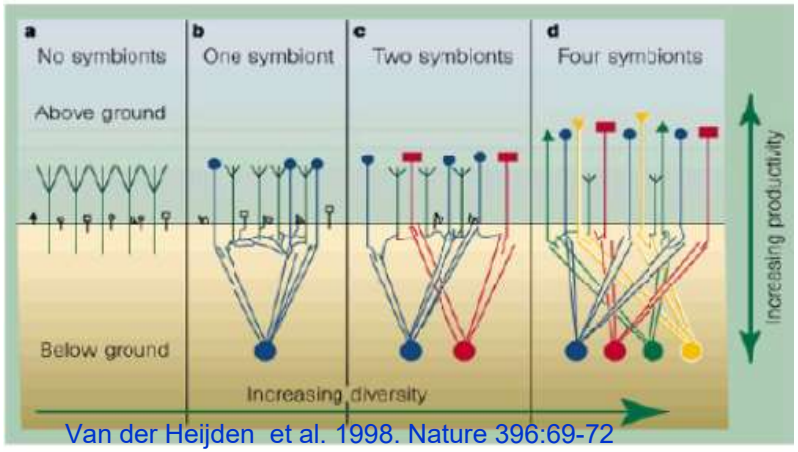
Photo : L. Avoscan & A. Viollet



- Fantastic diversity
  - Until recently: only access to culturable microorganisms
  - Methodological progresses
    ⇨possibility to extract DNA from soils

    ↳ 10^4 – 10^6 bacterial genotypes / g soil

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



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

What lives in the soil?

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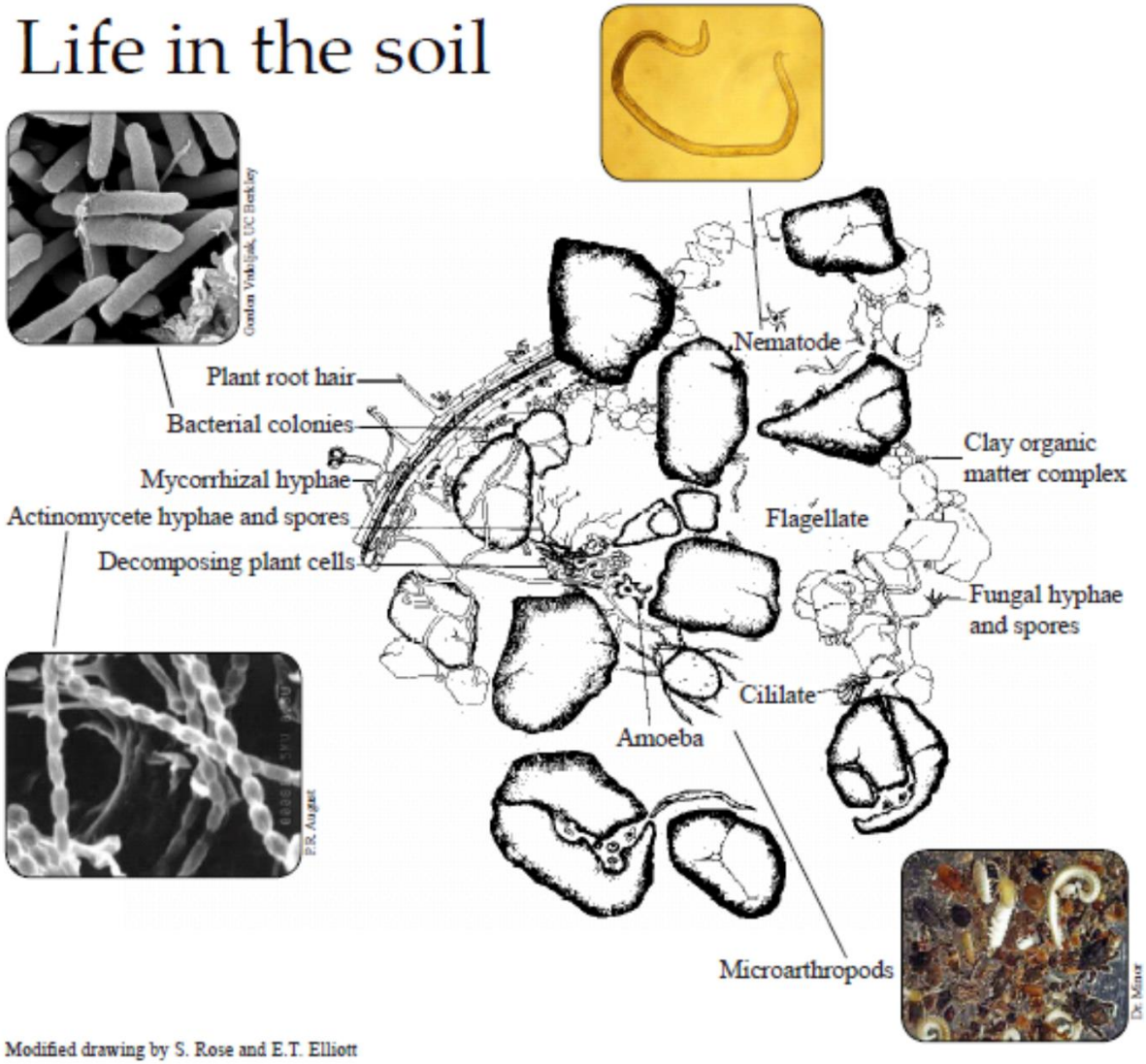

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Soil Biota

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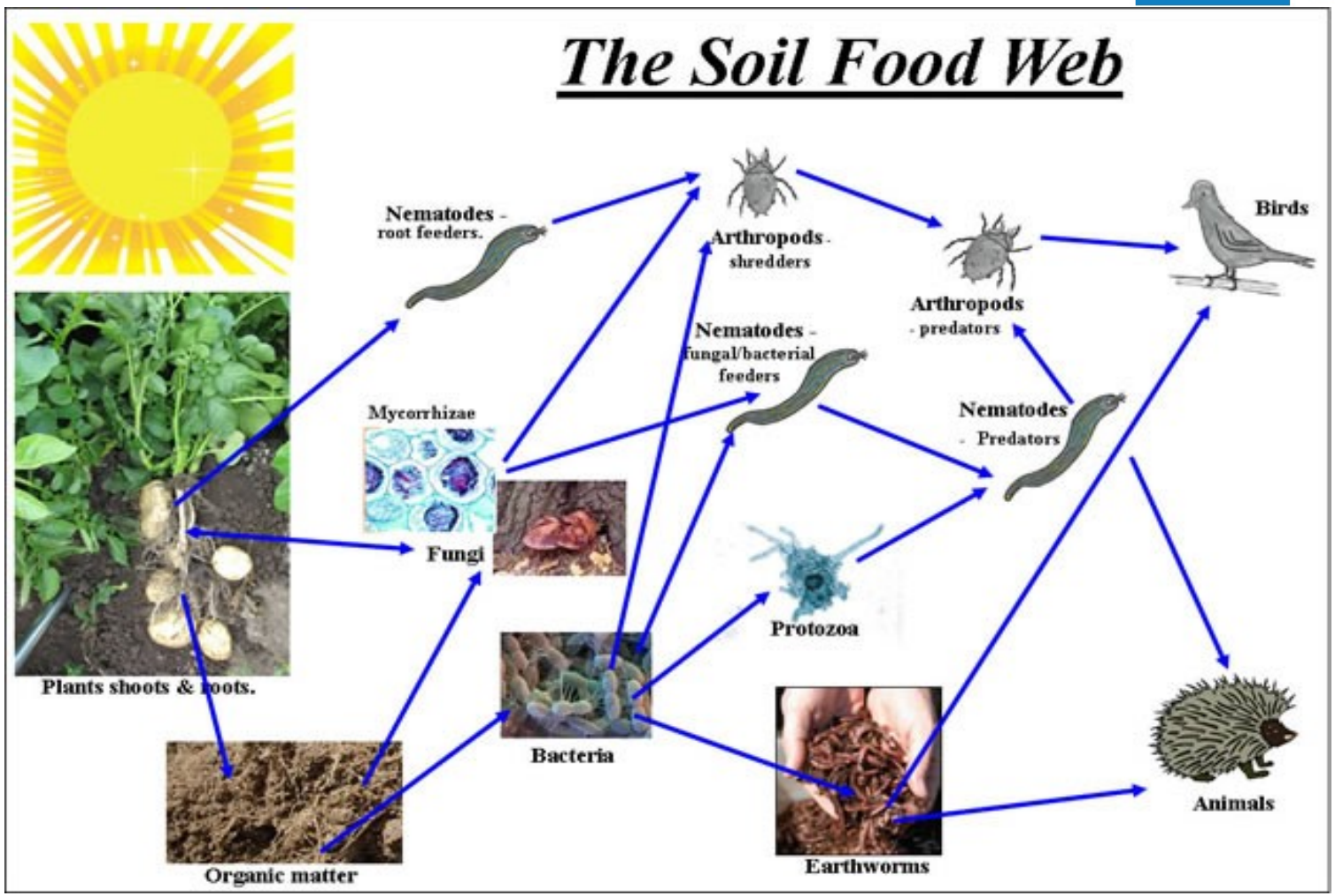

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Earthworms

Can be very good indicator of soil quality as:

- they do not move very far (10 metres)
- can live for up to 10 years
- exposed to soil changes – pH, waterlogging, compaction, organic matter

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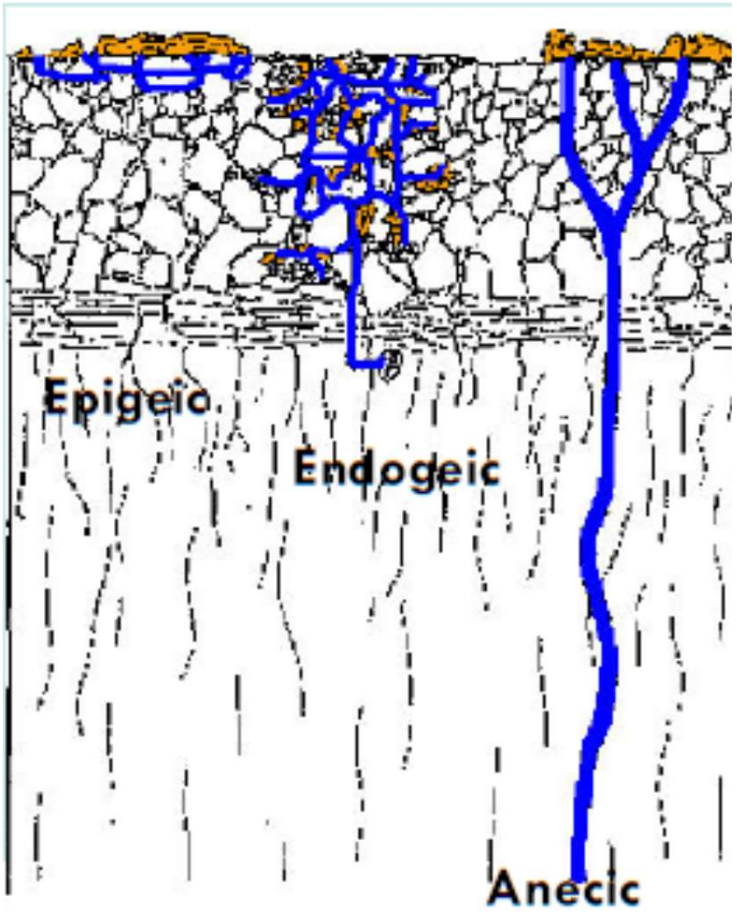
Earthworms



Modified from Fraser and Boag 1998

Three main types:

Litter Feeders (Epigeic) – found close to the soil surface or in the litter layer

Shallow Burrowers (Endogeic) – found in extensive borrows close to the soil surface and feed on organic material

Deep Burrowers (Anecic) – more vertical borrows and mix mineral soil with organic material from the surface

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Soil Pores

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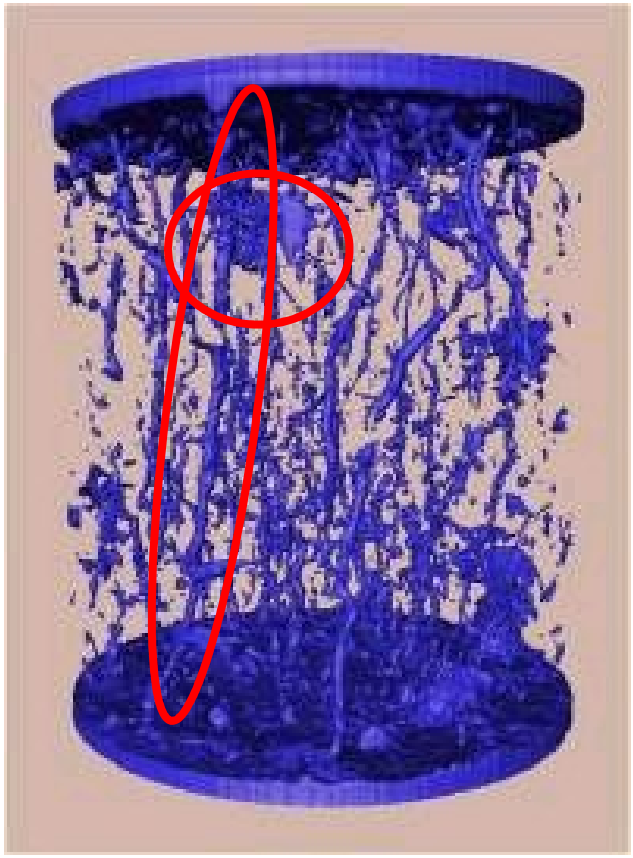
Dye labelling



Computer-aided tomography

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Aggregates Sizes

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Soil After Compaction Treatments

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Earthworms and Compaction

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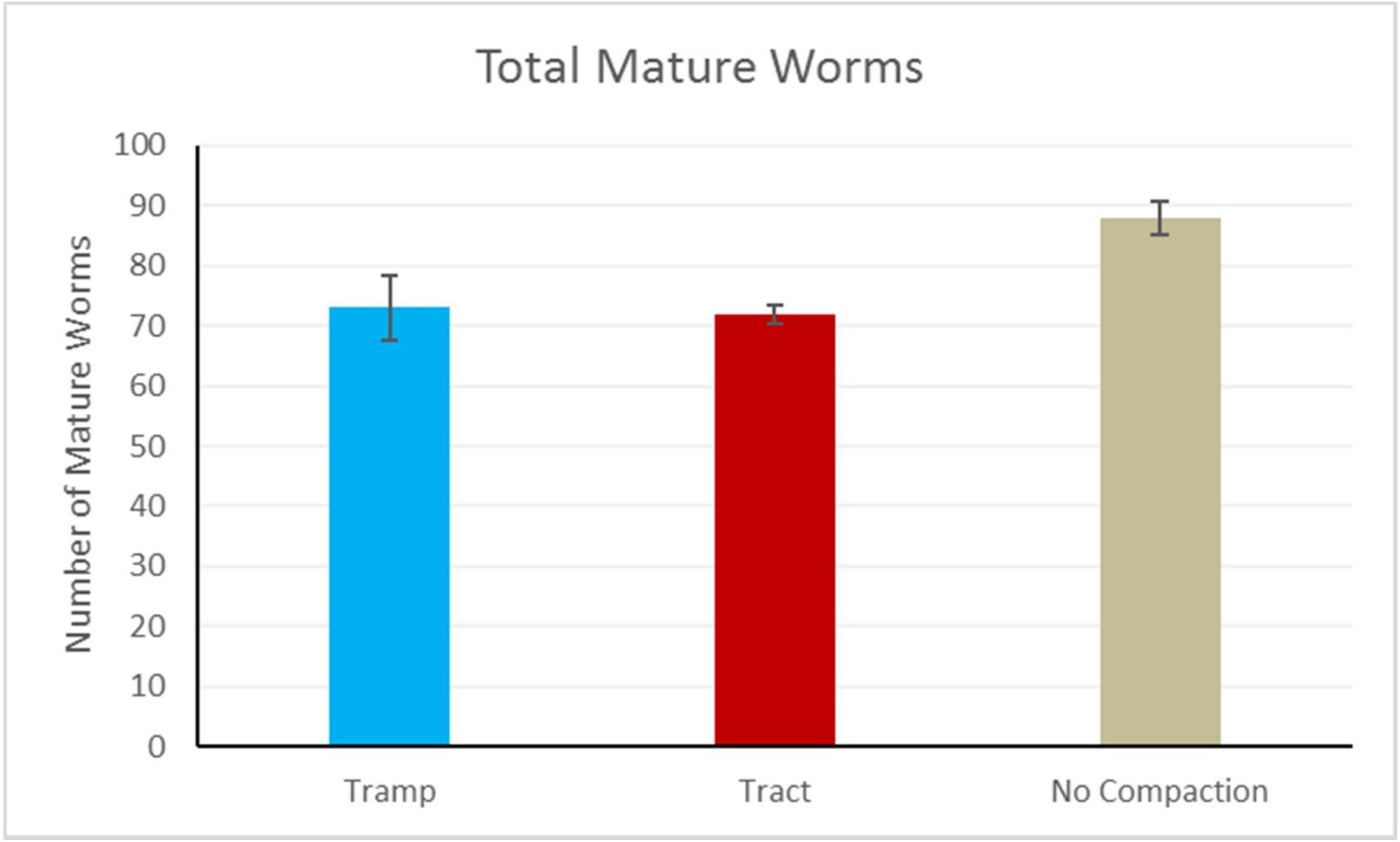

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Earthworms and Compaction

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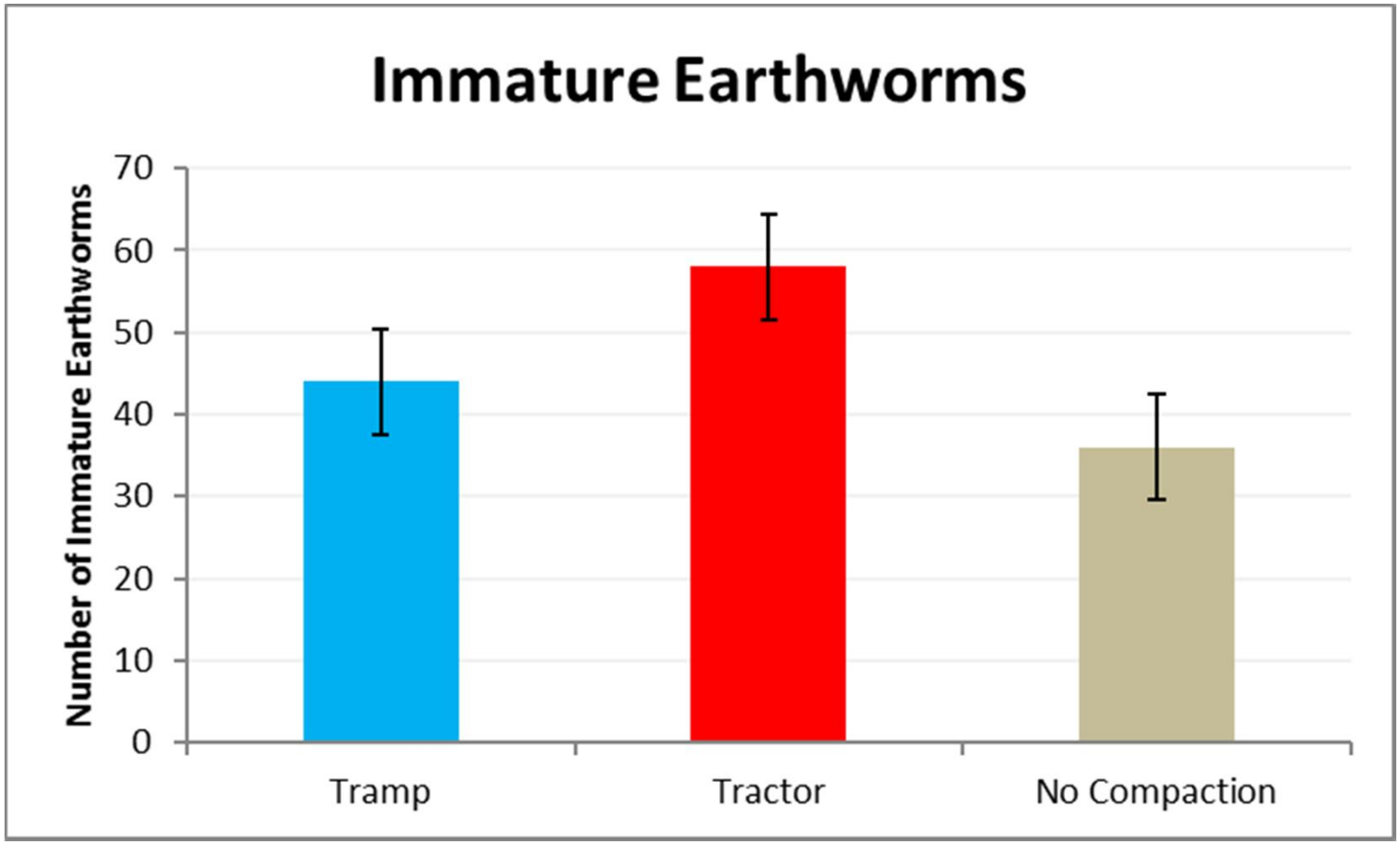

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Earthworm Identification I

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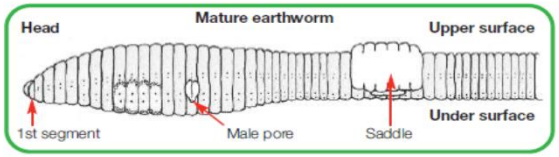
Key to common British earthworms of amenity grasslands

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 upper surface of the body, from the first segment to the saddle, entirely dark in colour (dark red, purplish red or chestnut brown)?

NO → It may be a species not on this guide

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

YES → **Turn over**

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

YES → Are the male pores visible?

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

Hint: Line drawings show typical sizes of the adult worm

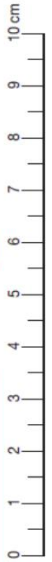
NO → Is the body: A **Long and relatively thin** or B **Long and relatively fat**?

Black-headed worm *Aporrectodea longa*

Long and thin

Long and fat

Lob worm *Lumbricus terrestris*



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Earthworm Identification II

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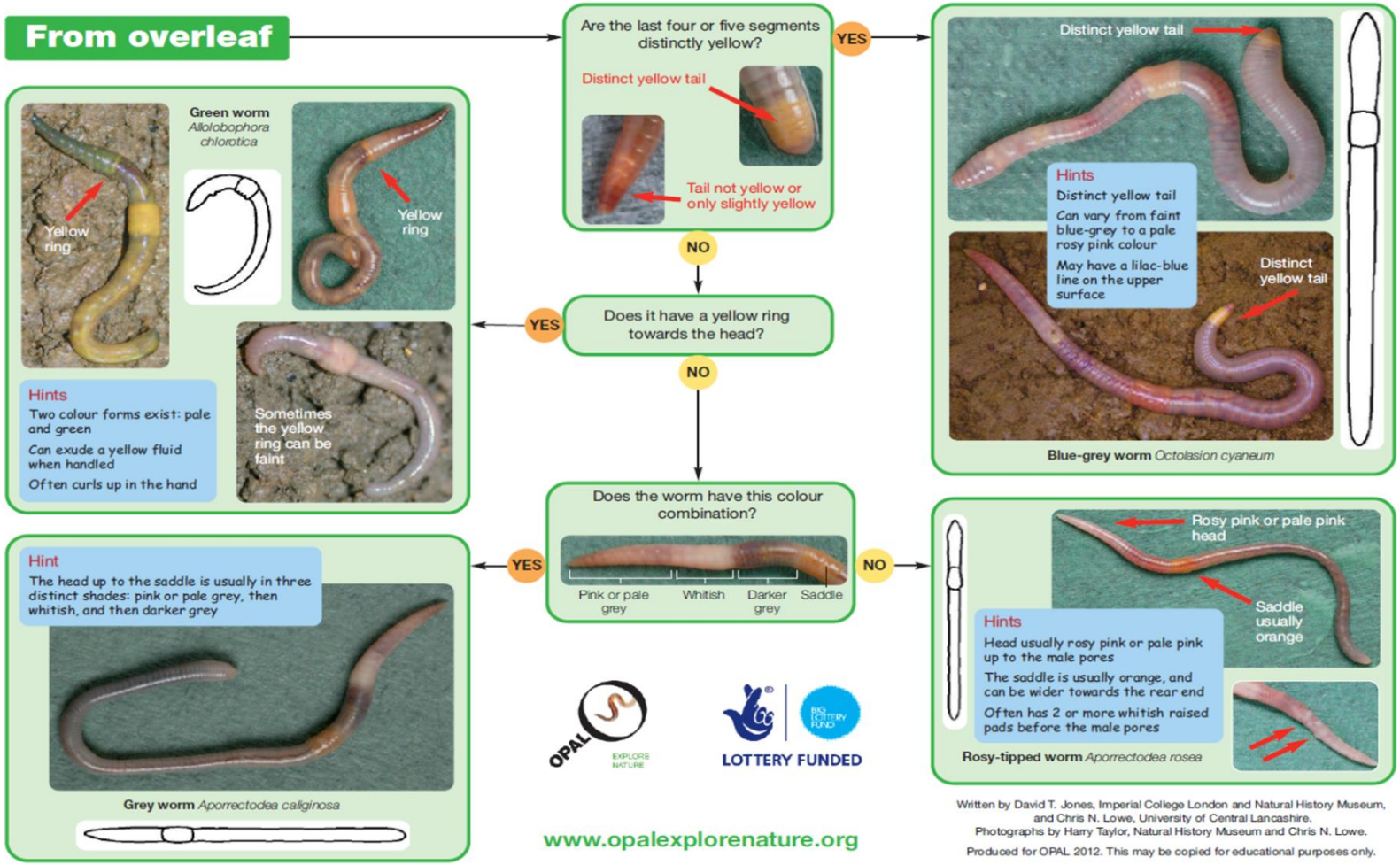

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Written by David T. Jones, Imperial College London and Natural History Museum, and Chris N. Lowe, University of Central Lancashire.
Photographs by Harry Taylor, Natural History Museum and Chris N. Lowe.

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Earthworms and Compaction

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Worm Numbers

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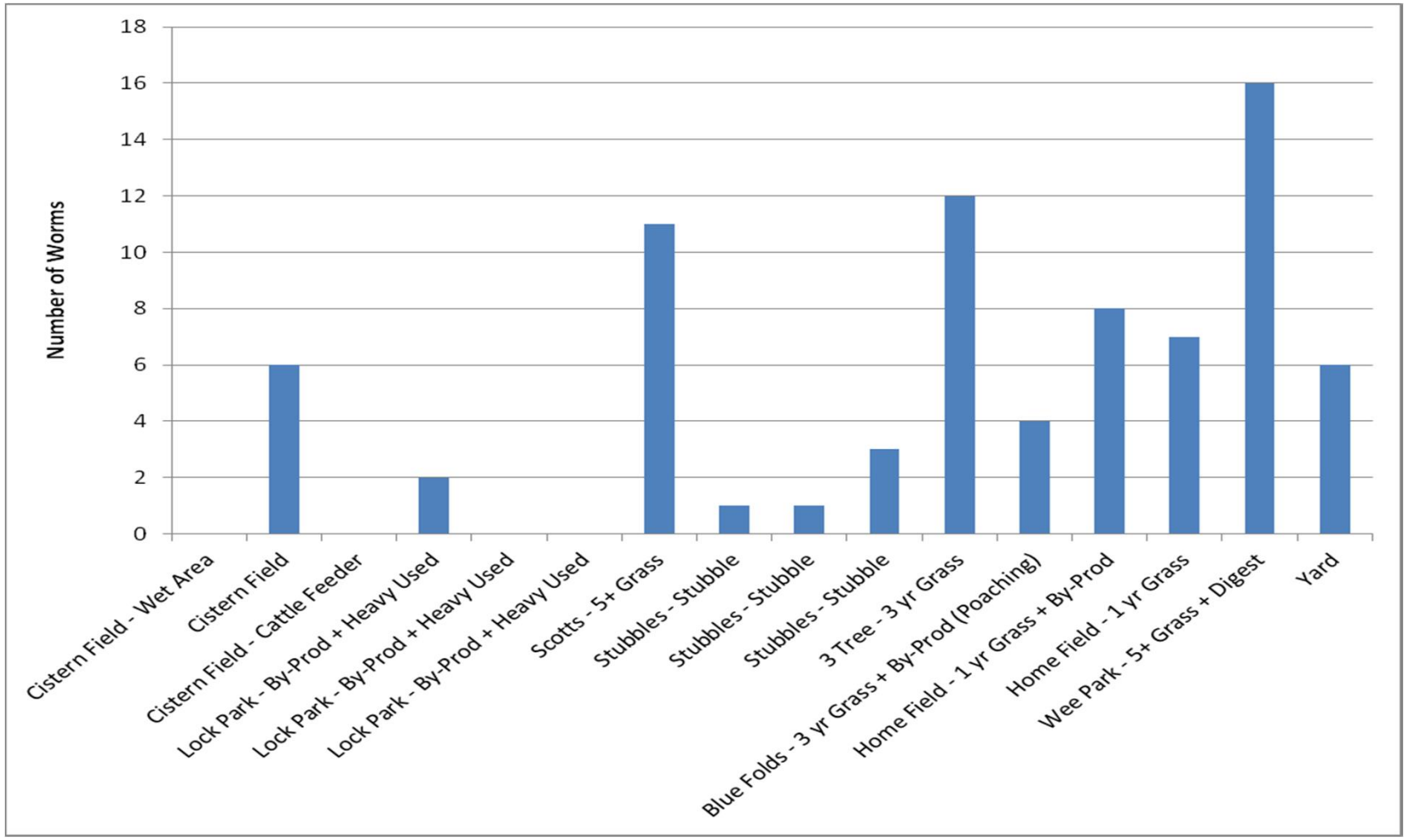

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Other Methods

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Background - Soil Compaction

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Soil Compaction Problem

- Severe or poor soil condition in 8 - 12% of grasslands*
- If moderate fields included then over 70%*
- Reduced pore space/increased water filled pore space
- Reduced oxygen diffusion
- Microbial activity decreases

* Newell-Price et al., (2013). Soil & Tillage Research, 127

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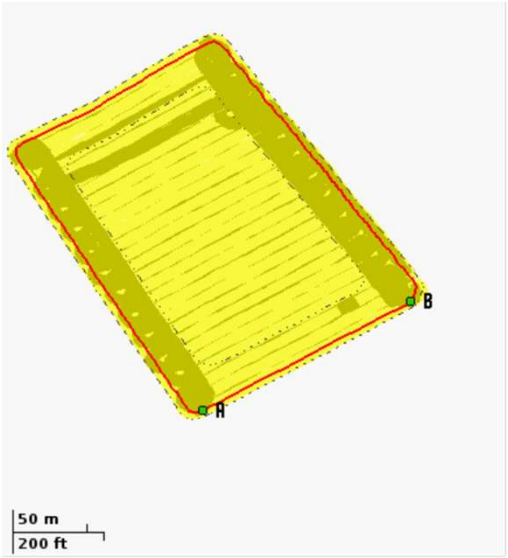
Experimental Work



- 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)

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Controlled Traffic Farming – Working widths

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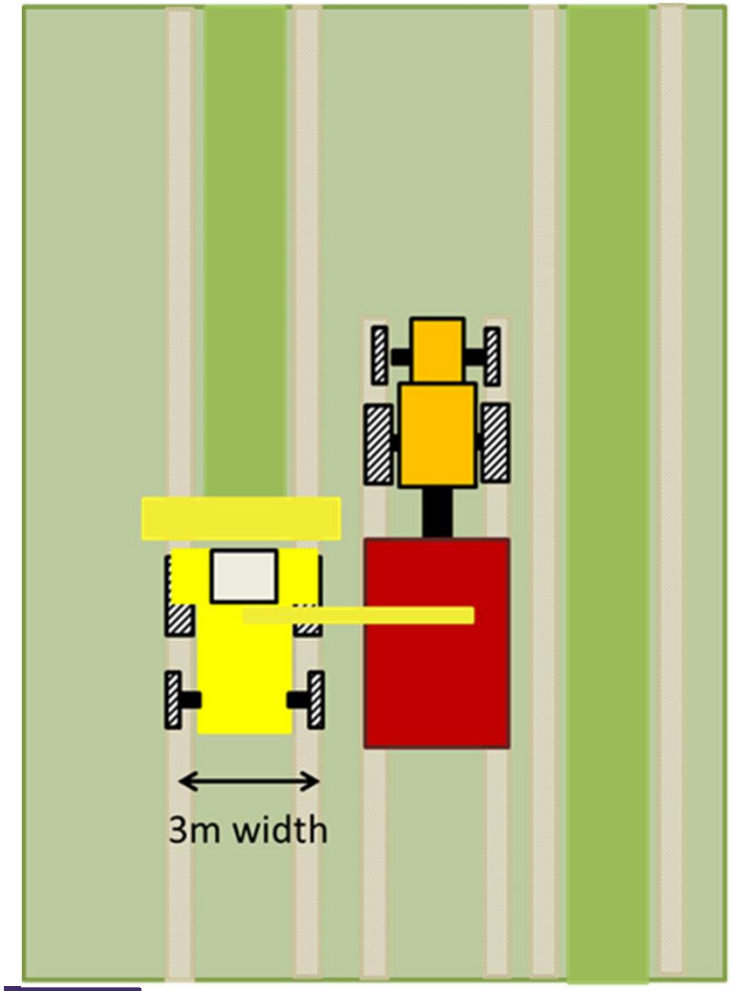

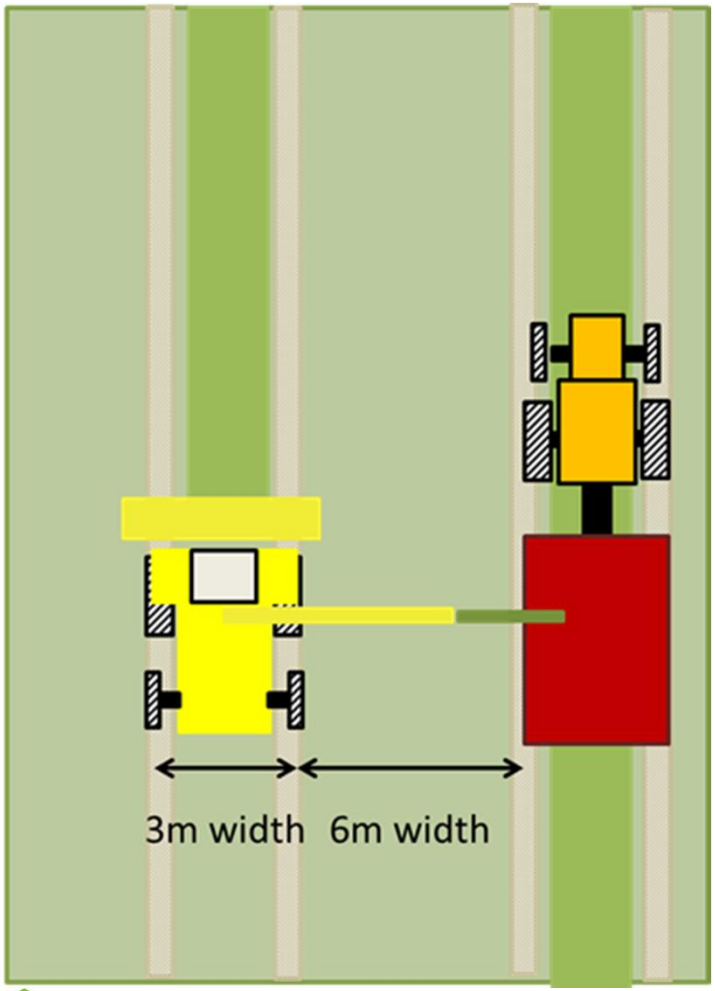

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Results of Experimental Work

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Measurement	Normal Traffic	Controlled Traffic
Bulk Density (g cm^3)	1.02	0.99
VESS	1.93	1.84
pH	6.5	6.4
P (Index)	2	2
K (index)	2-	2-

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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Cost of guidance equipment

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Investment	Equipment	Repeatable positioning	Capital Cost	RTK Annual Fee	Total Annual Cost***
Level 1	Low accuracy* Manual steering	No	£1,500	–	£468
Level 2	Low accuracy* Assisted steering	No	£5,000	–	£1325
Level 3	High accuracy** Assisted Steering	Yes	£10,000	£500	£3050
Level 4	High accuracy** Integrated steering	Yes	£15,000	£500	£4275

* (+/-150–200 mm) These will result in an increase in trafficked area due to their inaccuracy and non-repeatable positioning

** (+/-20 mm) Real Time Kinematic (RTK)

*** The total annual cost includes interest rates (4.5%), depreciation (15%), maintenance (5%) and training (£100 year^{-1}) (Nix, 2015)

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Cost benefits of CTF

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Assumptions

- The average DM yield for 2 and 3 ‘cut’ managed grassland harvest systems in the UK is 12 t ha^{-1} and 16.6 t ha^{-1} respectively
- The crop has a value of £72 t^{-1}
- Normal traffic management covers 80% of the field area
- The use of CTF increases forage yields by an average of 13%

Benefits

Trafficked area %	Yield increase ha^{-1} 2-cut		Yield increase ha^{-1} 3-cut	
45	0.53 t	£38	0.73 t	£53
15	1.00 t	£72	1.36 t	£98

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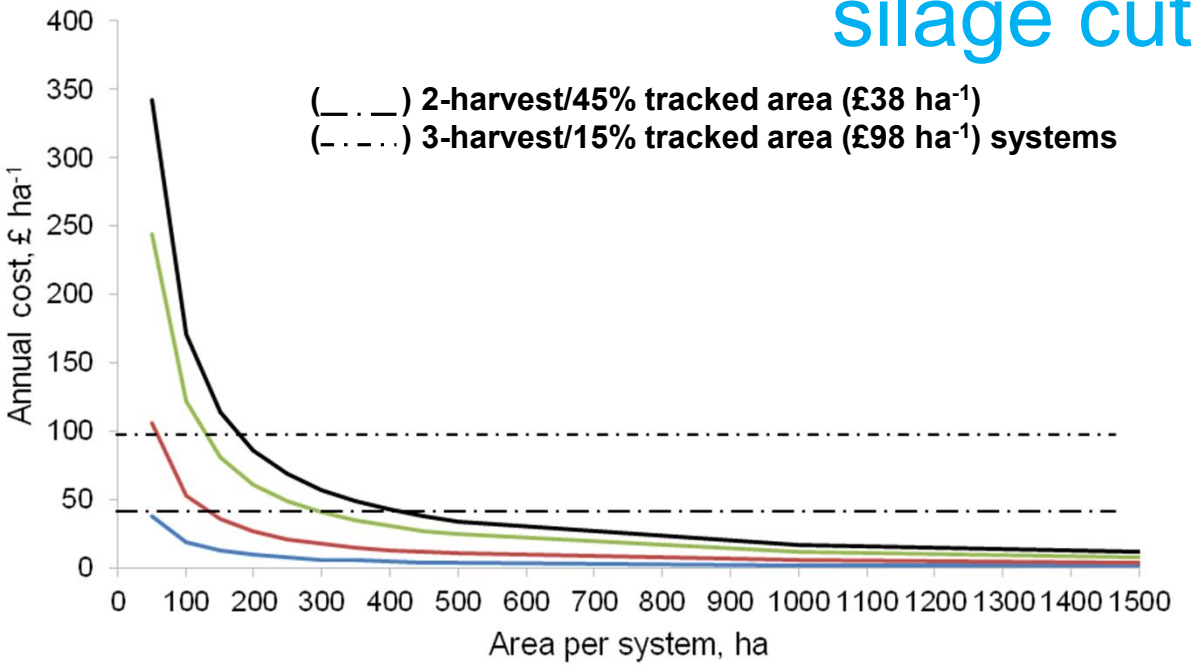
Break even for different numbers of silage cuts



Level 1
Level 2
Level 3
Level 4

Assuming additional costs are for vehicle guidance:

- A break-even area of 175 ha for a 15% trafficked area and 3 cuts year^{-1} with four high accuracy (RTK)-integrated steering systems
- A break-even area of 50 ha for a 45% trafficked area and 2 cuts year^{-1}, for four low accuracy-manually steered systems

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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
  - rolling out soil quality testing

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First Questions

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- What is the state of my soil?
- Depends on
  - Soil type
  - What you want to do with it

- How do I tell?
  - Need indicators as can't measure everything

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Components of soil quality

Phy ology

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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Practical considerations

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Selected soil health measurements:

Routine analysis (P, K, Mg, Ca, pH)
LOI
VESS
Earthworms
PMN

Why?

Combines physics, chemistry and biology
Lab set-up
Turn around time

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Potential scorecard...

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NAME		ASD-2018-4897					
CUSTOMER							
TEXT_ID							
Field Name		West		Mid		East	
FID							
Potentially Mineralisable N		30		30		36.4	mg/kg
Organic Matter (LOI)		5.39		5.38		5.74	%
pH		5.6		5.8		6.3	
Extractable Phosphorus		5.13		13.5		27.9	mg/L
Extractable Potassium		390		321		305	mg/L
Extractable Magnesium		113		118		170	mg/L
Extractable Calcium		1500		1400		2000	mg/L
Extractable Sodium		14.5		11.6		13.1	mg/L
mean VESS		2.7		1.7		2	
Mean worms		2.3		1.7		1	
Lime req (Grass)	tonne/Hectare	4.7		3.7		0	
Lime req (Arable)	tonne/Hectare	2.7		0		0	

Soil texture = sandy loam

Soil health recommendation

Soil structure (VESS) low in the West field
Adding OM and upping pH should alieviate this
Depending on OM source consider extra N to account for immobilisation
Worm numbers would benefit from OM and reduced tillage

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Potential for benchmarking

- 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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Benchmarking Results

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soilquality.org.au

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

Cradle Coast Compare Your Data

Australia / Tasmania / Cradle Coast

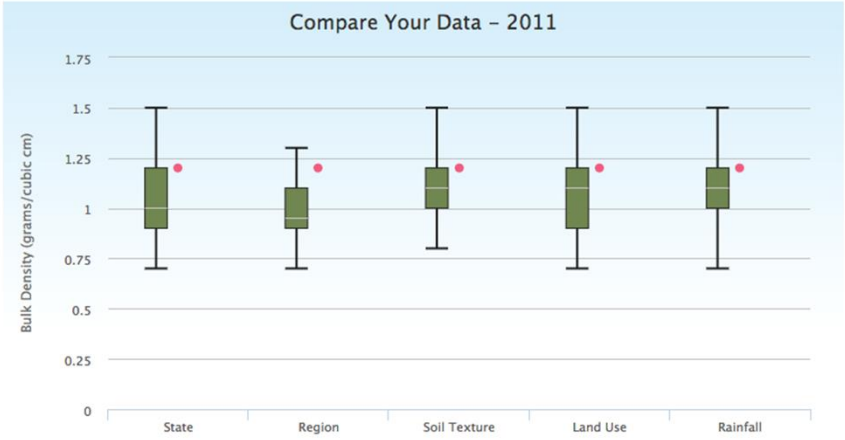
Overview | Examine | Compare | Relate

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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Summary

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- Living soil is important for crop yield and quality
- Can be an indicator of soil health
- Compaction is important as it reduces yields
- Soil health monitoring is a combination of methods
- Benchmarking indicates the health of a soil compared to other fields in the area

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Thank you

Any Questions?

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TRACE ELEMENTS FOR PLANTS AND ANIMALS

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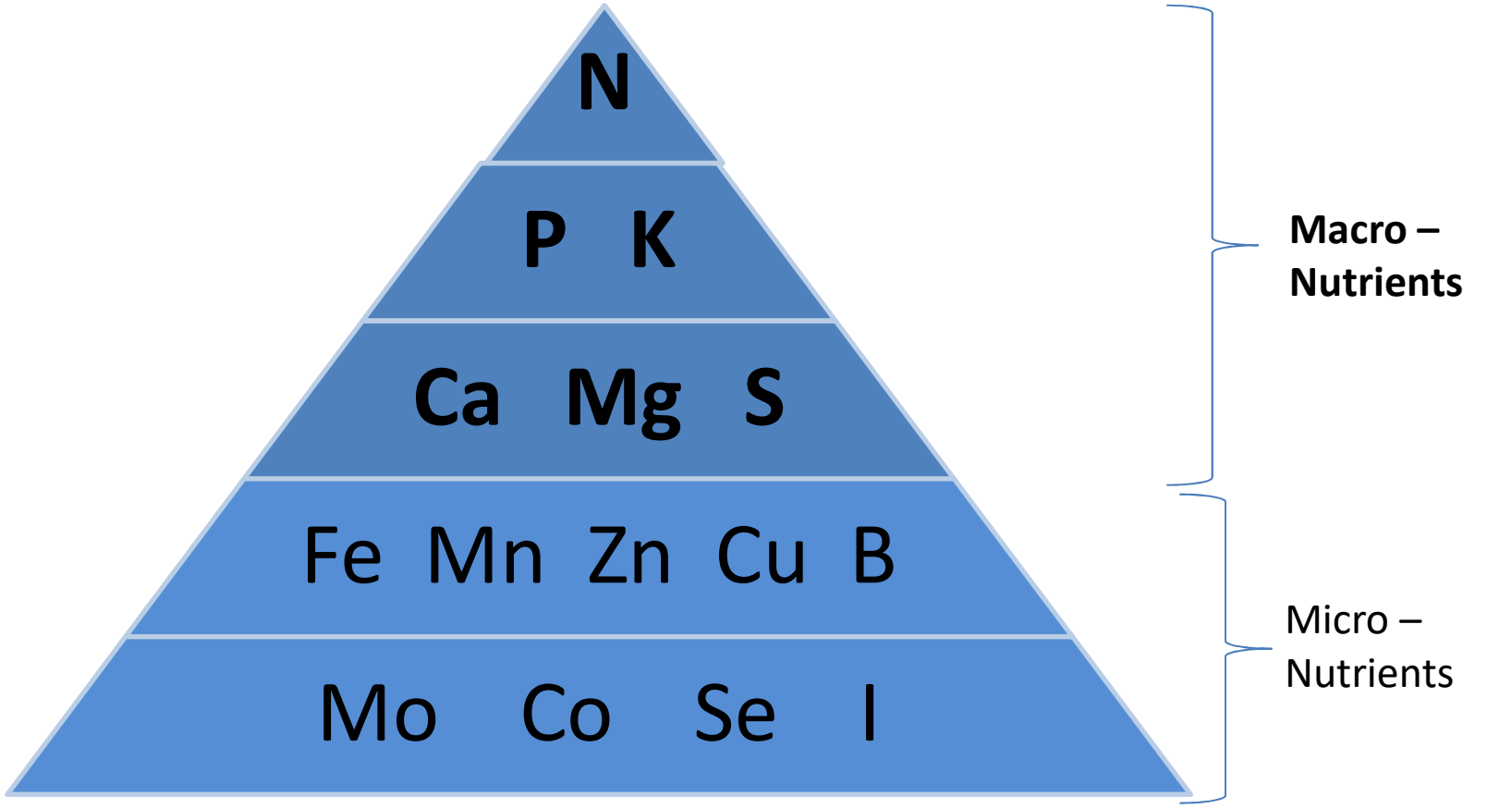

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- Nitrogen is found in all amino acids, proteins and enzymes
- Life does not exist without Nitrogen!

- Phosphate
  - Essential for ATP
  - Part of DNA/RNA
  - Required for new roots

- Potassium
  - Regulates pressure and water flow in plants
  - Moves photosynthates across plant
  - Structure & Immunity

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- Calcium
  - Strength
  - Soil structure
  - Soil microbes – nutrient recycling
- Magnesium
  - Photosynthesis
  - Mobilisation of Phosphate
  - Animal health issues
- Sulphur
  - N efficiency
  - Enzymes and Vitamins

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Fe Mn Zn Cu B

- Iron
  - Oxygen Transportation
  - Chlorophyll
- Manganese
  - Growth
  - Immune Response
  - Photosynthesis
- Boron
  - Seed & cell wall formation
  - Calcium Mobility
- Zinc
  - Balanced excess K
  - Palatability
- Copper
  - Reproduction
  - Immune Response

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Mo Co Se I

- Selenium
  - N fixation in Legumes
  - Palatability
- Cobalt
  - Growth
  - Immune Response
- Molybdenum
  - N formation
  - Reduces Copper absorption
- Iodine
  - Thyroid Hormone Synthesis
  - Fertility

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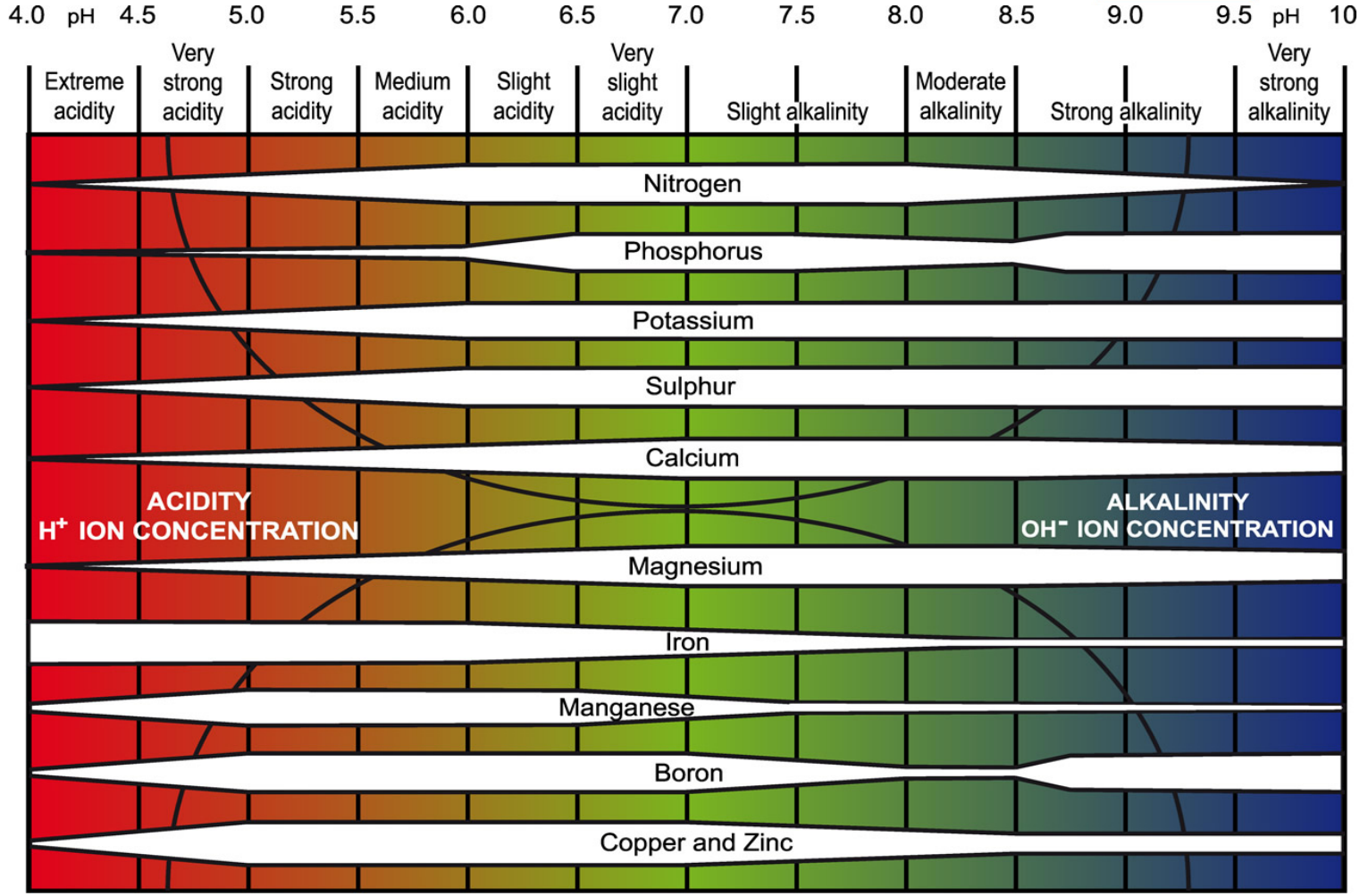

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POTASH

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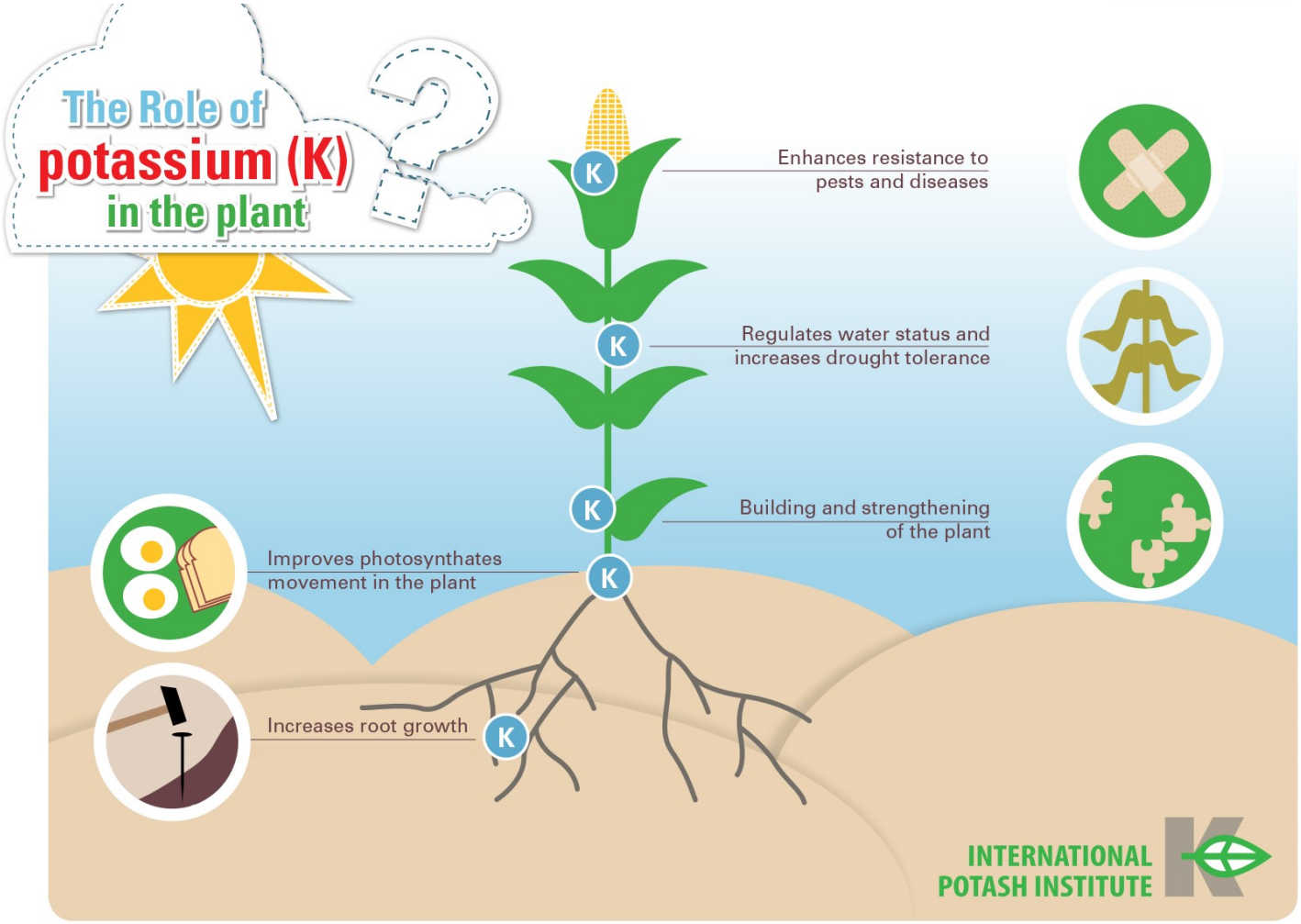

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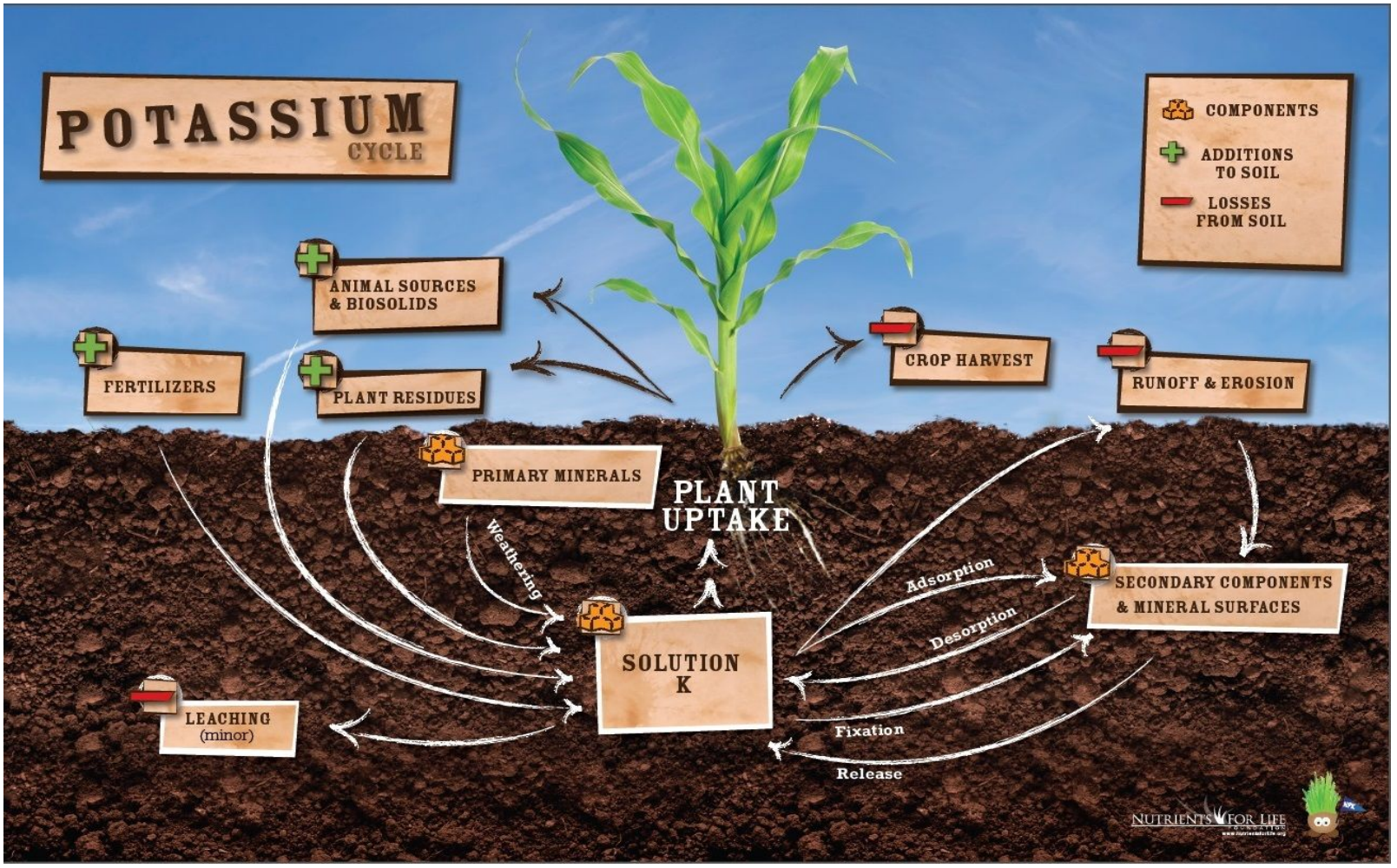
POTASSIUM
CYCLE
COMPONENTS
ADDITIONS TO SOIL
LOSSES FROM SOIL
ANIMAL SOURCES & BIOSOLIDS
FERTILIZERS
PLANT RESIDUES
CROP HARVEST
RUNOFF & EROSION
PRIMARY MINERALS
PLANT UPTAKE
Weathering
Adsorption
Desorption
SECONDARY COMPONENTS & MINERAL SURFACES
SOLUTION K
LEACHING (minor)
Fixation
Release
NUTRIENTS FOR LIFE

Potassium in the Soil

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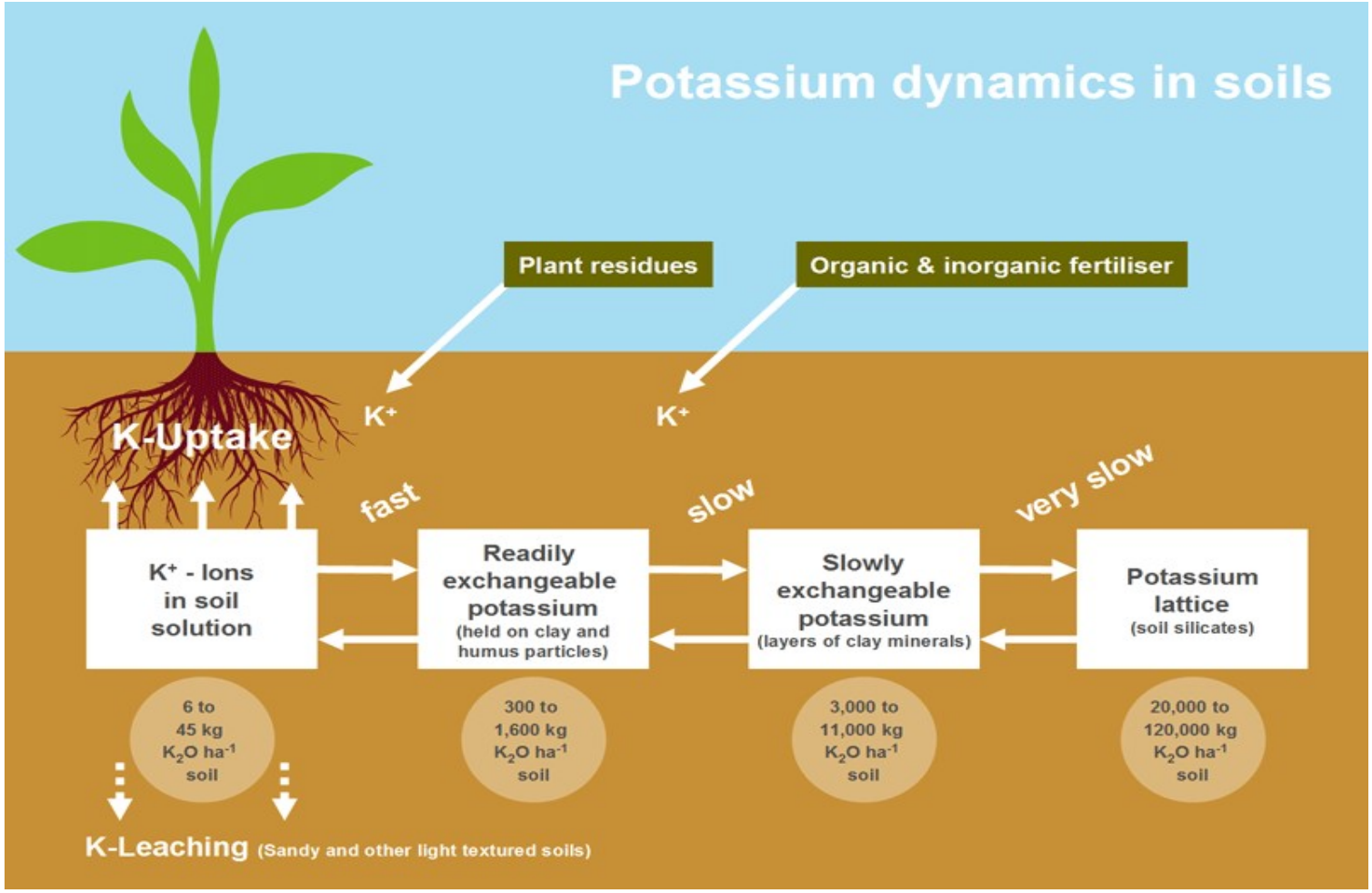

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Sources of Potash

Potassium Sources - Slurry/FYM

- Muriate of Potash (60%)
- Fibrephos (0-16-16)
- Potassium Nitrate (13-0-45)
- Sylvinite (16% K20 + 32% Na20
- Sulphate of Potash (50%)

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Potash and Nitrogen

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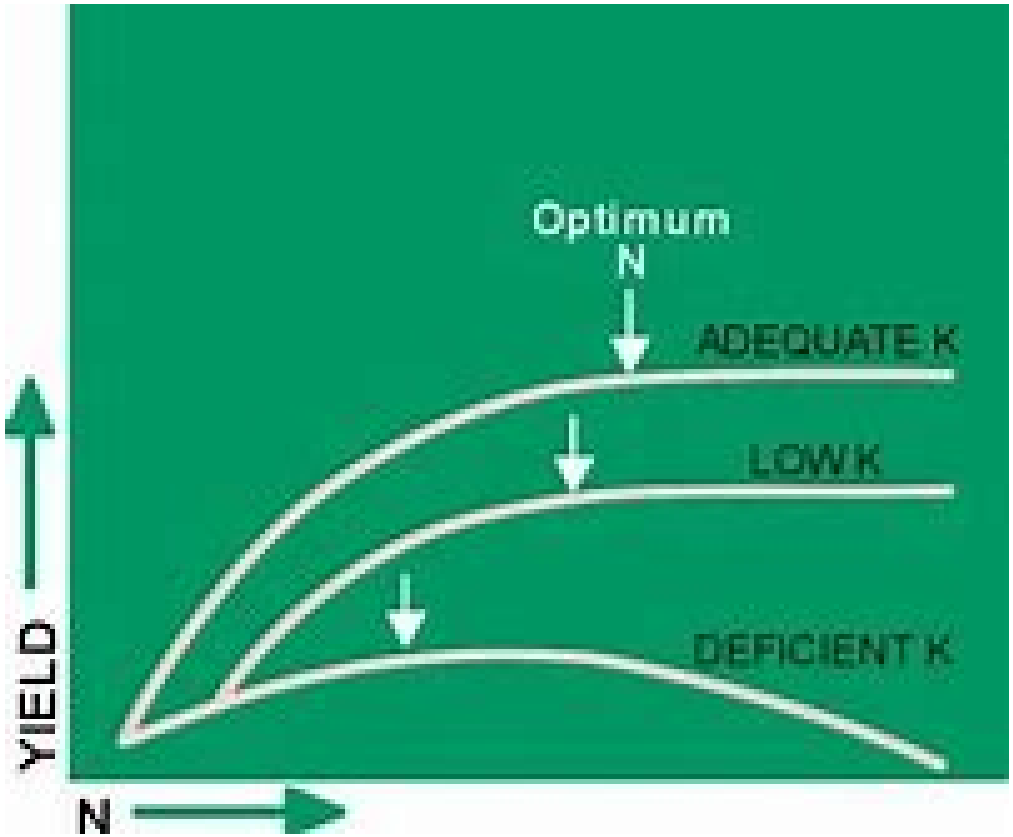

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Distribution of K20 Uptake

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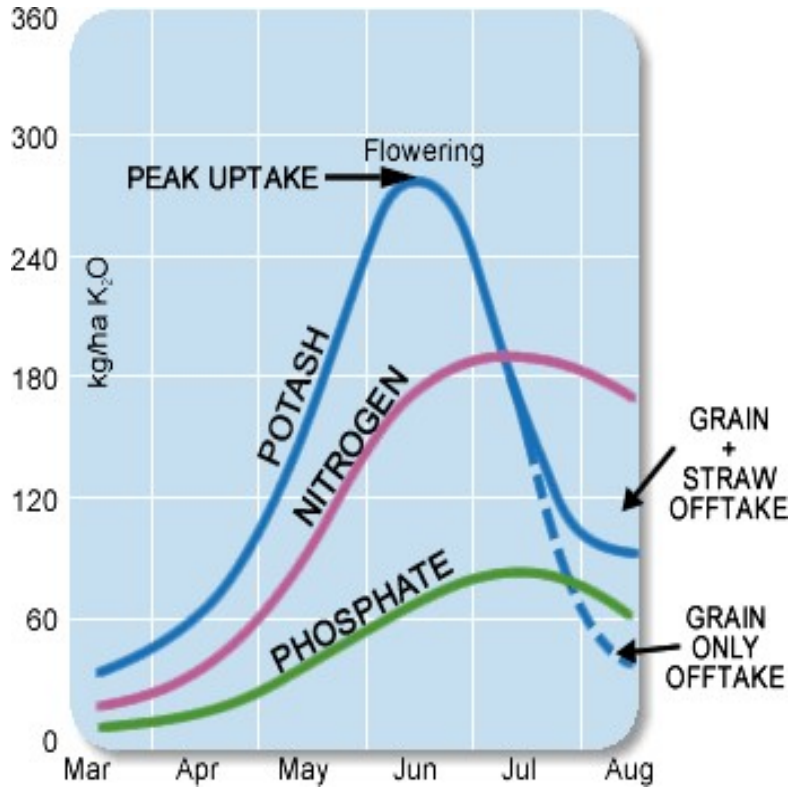
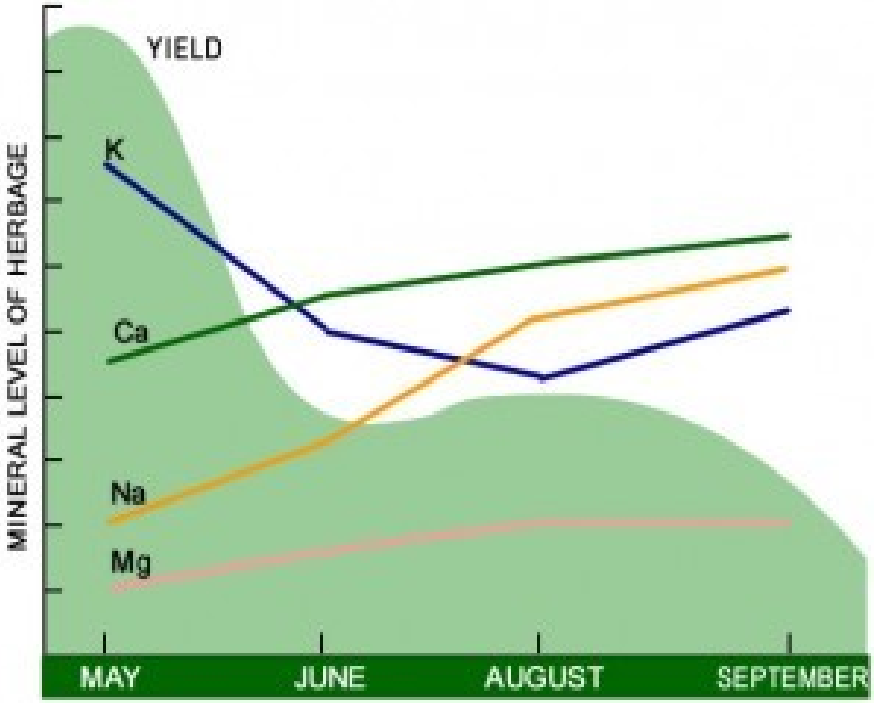
Winter Wheat 8t/ha



Grass Sward



Images from www.pda.org.uk

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Symptoms of K Deficiency

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NUTRIENT PLANS

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What is a Nutrient Plan?

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Why Do A Nutrient Budget?

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£ /Ton	2017	2018	2019	Unit Cost
34.5% N	£200	£230	£280+	81p
MOP 60%	£270	£275	£280	47p
TSP 46%	£280	£315	£354	77p

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Why Do A Nutrient Budget?

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	2017	2018	2019
Impact 200 Acre Farm 70t/Year		+£2100	+£3500
Dairy	-	0.24ppl	0.40ppl
Beef	-	4p/kg	+7p/kg

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What Difference Does DM Make?

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DM %	N (units/1000gal)	P (units/1000gal)	K (units/1000gal)
5%	5	4	28
4%	4	3	23
3%	3	2	17

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What Difference Does Timing Make?

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	N (units/1000gal)	P (units/1000gal)	K (units/1000gal)
Spring	5	4	28
Summer	2	4	28
Winter	1	4	25

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What Difference Does Application Method Make?

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	N(units/1000gal)	P(units/1000gal)	K (units/1000gal)
Spring Splashplate	5	4	28
Spring Trailing Shoe/Dribble Bar	7	4	28
Summer Splashplate	2	4	28
Summer Trailing Shoe/Dribble Bar	5	4	28

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What Difference Does Application Method Make?

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	N (units/1000gal)	P (units/1000gal)	K (units/1000gal)	££££
Splashplate	20	16	112	£10/1000gal
Trailing Shoe/Dribble Bar	28	16	112	£11/1000gal

Diff. ¼ cwt N/Acre. £3.50/acre

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Slurry Comparison

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Source	DM	N (units/1000gal)	P (units/1000gal)	K (units/1000gal)
Teagasc	5%	5	4	28
Wigtownshire	6.4%	8	5	27
SAC	6%	7	5.5	20
RB209	6%	7	5.5	21
Balwherrie	7.66%	5	4	23

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Nutrient Plan

UKAS TESTING
7624

W S AGNEW & SON
Balwherrie Farm
Leswalt

STRANRAER
DG9 0QU

SAC COMMERCIAL LTD

Farm Sampled:	
Your reference:	S58629
Last Crop:	Grass - silage
Next Crop:	Grass - silage
Soil Type:	Mineral

Sample ID :	12
Lab sample no:	18009887
Case no:	ASD-2018-5503
Date received:	18/09/2018
Date reported:	27/09/2018

Determination	Result	Units	Status
pH	5.6		
Lime req (Arable)	5.4	t/ha	
Lime req (Grass)	2.7	t/ha	
Extractable Phosphorus	3.24	mg/l	Low
Extractable Potassium	106.0	mg/l	M(-)
Extractable Magnesium	43.10	mg/l	Low
Extractable Calcium	1300	mg/l	
Extractable Sodium	22.10	mg/l	

- 2 cuts silage
  - P = L
  - K = M-
- pH 5.6
- Slurry applied @ 2000gal/acre

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Nutrient Plan

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CLIENT:	W&S Agnew, Balwherrie Farm				**DATE:**		04/10/2018		
Field Name:		12	**Total Area:**	14.78	**Harvest Year:**		2019		
Last Soil Analysis Date:	27/09/2018								
Ph	5.6	mg/l							
Phosphate	L	3.24			**P20 Policy:**	Build up	Run Down	Maintenance	
Potash	M-	106			**K20 Policy:**	Build Up	Run Down	Maintenance	
Magnesium	L	43.1							
Calcium		1300							
Last Limed									
Last Year Crop 2018	Grass Silage x 3								
This Year Crop 2019	Grass Silage x 2								
RECOMMENDATION:									
	Amount (kg/ha)				Application Rate (kg/ha or gal/ha) / acre		Fertiliser Grade	Total Product Required kg	Fertiliser Applied & Date
	N	**P**	**K**	**SO3**	m3/ha	gal/ac			
Nutrient Required	210	95	220	50-80					
Nutrient Supplied from Manures	10	8	46		17	1600	5.4.23		
Fertiliser Applications:									
1st Application								0	
1st Cut	114	20	64	35	500	(4cwt/ac)	23.4.13+7 so3	7390	
2nd Cut	85	15	48	26	370	(3cwt/ac)	23.4.13+7 so3	5469	
Grazing Aftermath								0	
Total	**209**	**43**	**158**	**61**					
Total Nutrient Supplied	-1	-52	-62	-19					
Additional Straights		46			100		0.46.0	1478	
Total	209	43	158	61					

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Nutrient Plans

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- Soil Sample
- Slurry/Dung Sample
- Take note of yield – no of trailers & stock grazing
- Take note of what is actually applied!
- Use SAC/RB209 for recommendations
- Call the Stranraer Office!

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If You Only Remember 3 Things…….

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- Your soil is ALIVE – don't squash it, drown it or starve it of Oxygen and food!
- Buying Lime is the best money you will spend
- Sampling soil, forage and animals will help you farm Smarter!

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Thank You

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