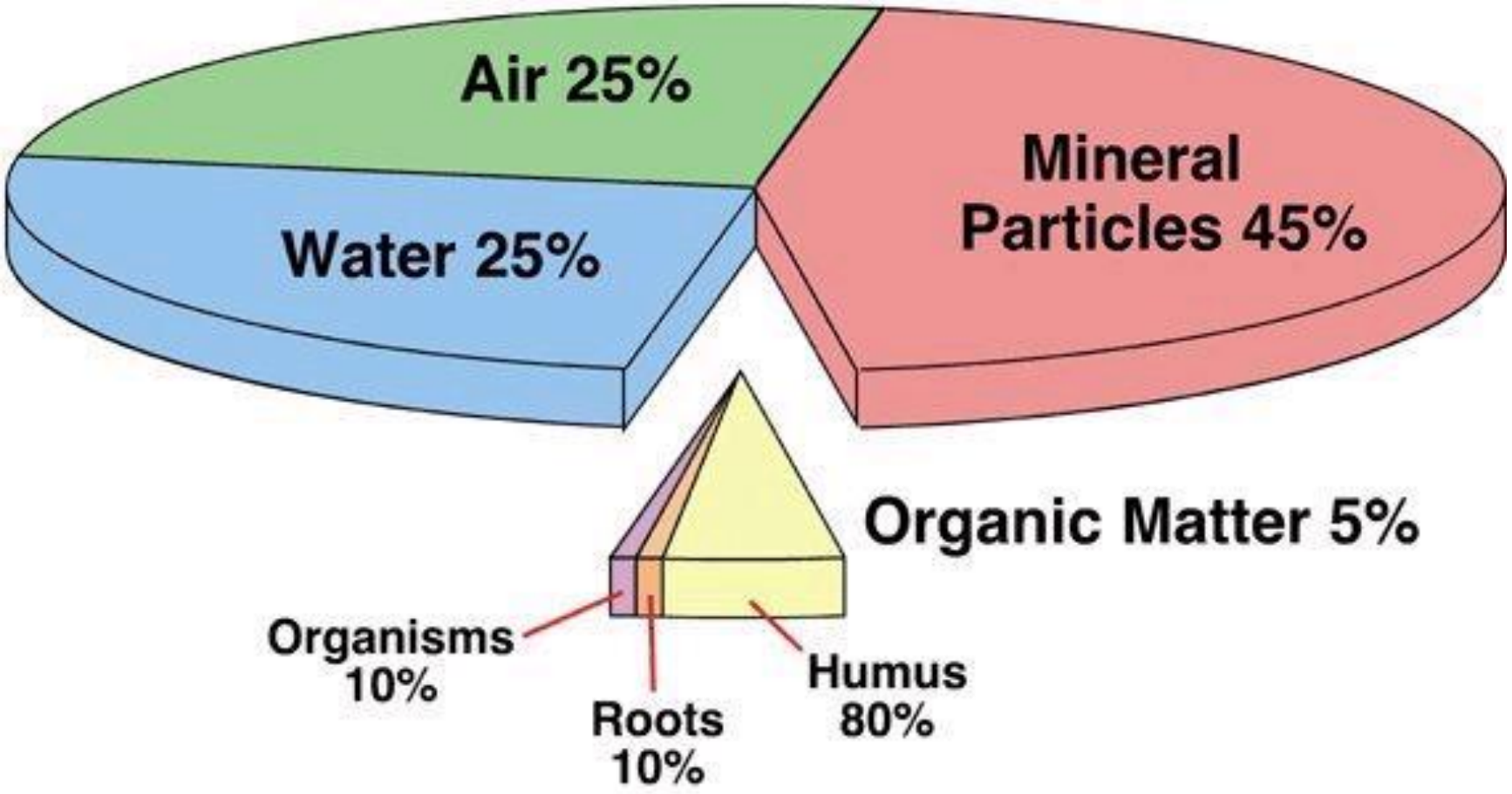
Soil Health:
What are the benefits?

Dr. Paul Hargreaves, Dr. Joanna Cloy
and Prof. Bob Rees

SRUC

Soil – air, water, minerals



Soil functions

Reduce gas losses, N_2O, N_2, NH_3 and CH_4

Supports roots and plants

Recycle nutrients in wastes

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

Prevent NO_3 and pesticide leaching losses

Good soil function sustains growth and conserves the environment

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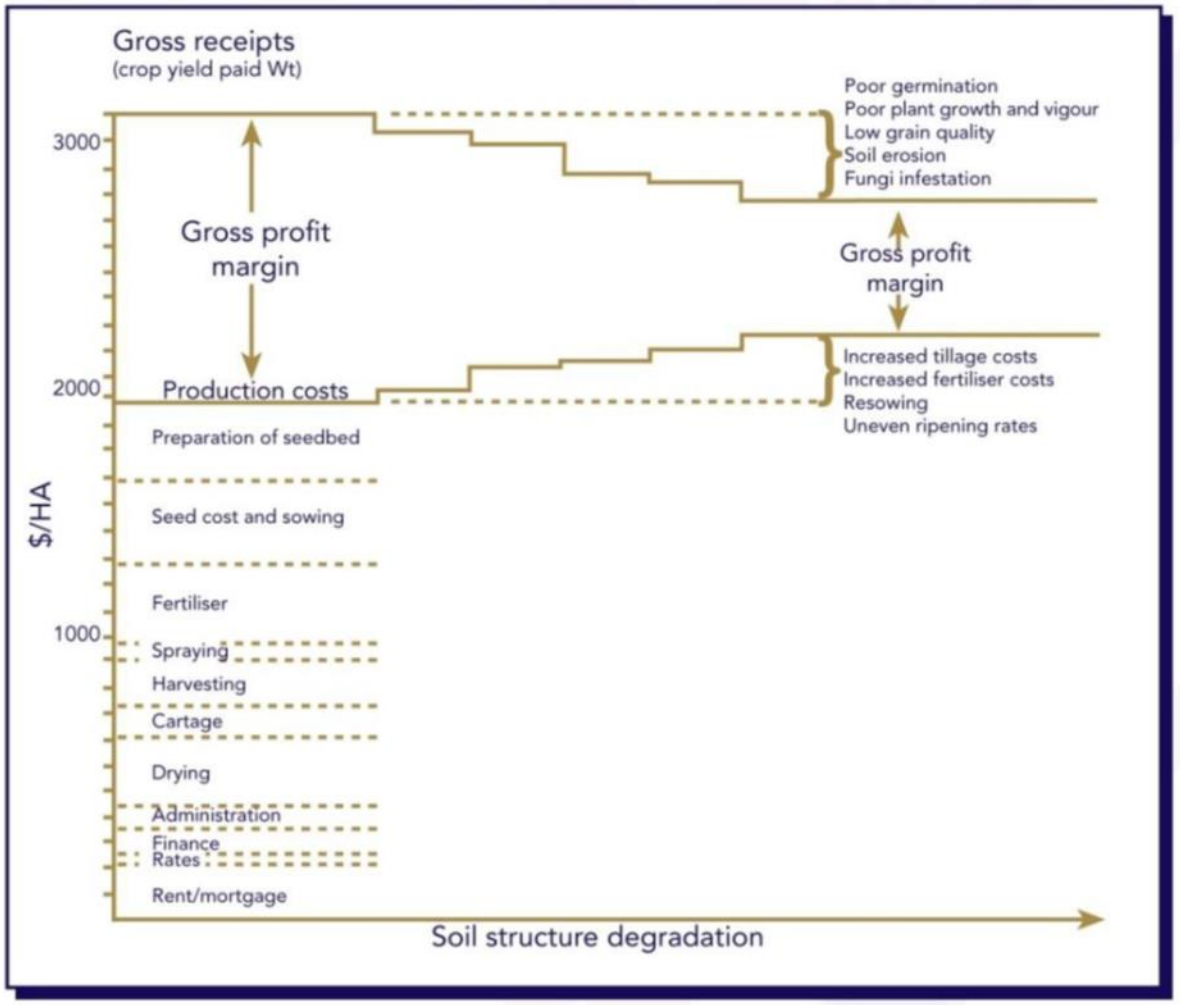
Reductions to Margins



Production costs ($/ha) and narrowing profit margin associated with increasing soil structure degradation.

(G. Shepherd, Bioagrinomics, New Zealand)

Know Your Soil

Biological

Feed the soil regularly through plants and OM inputs

Move soil only when you have to

Diversify plants in space and time

KNOW YOUR SOILS; principles to improve soil health

Chemical

Maintain optimum pH

Provide plant nutrients – right amounts in the right place at the right time

Physical

Texture and limits to workability, trafficability

Optimise water balance through drainage

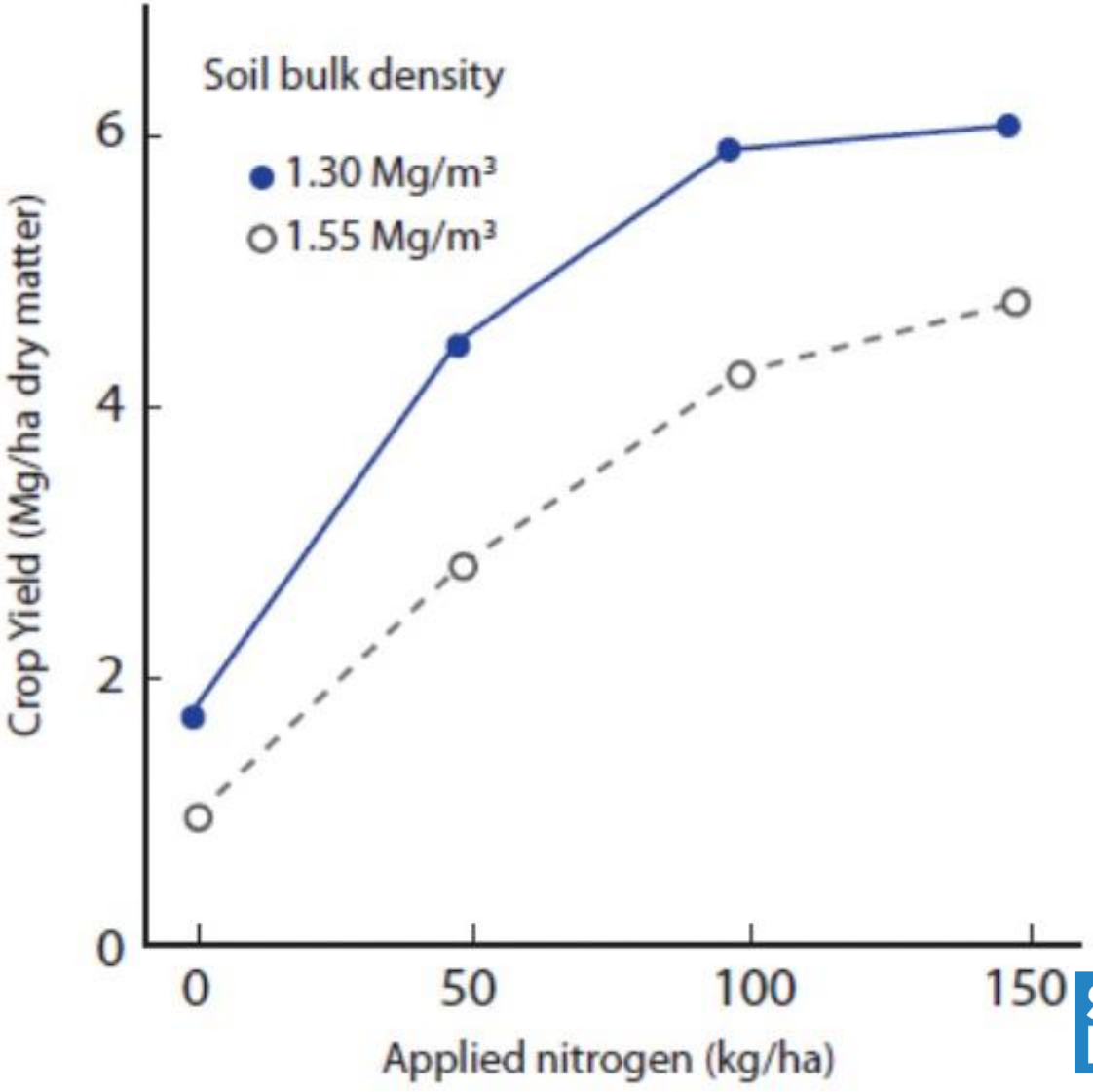
Soil structure

Soil Structure

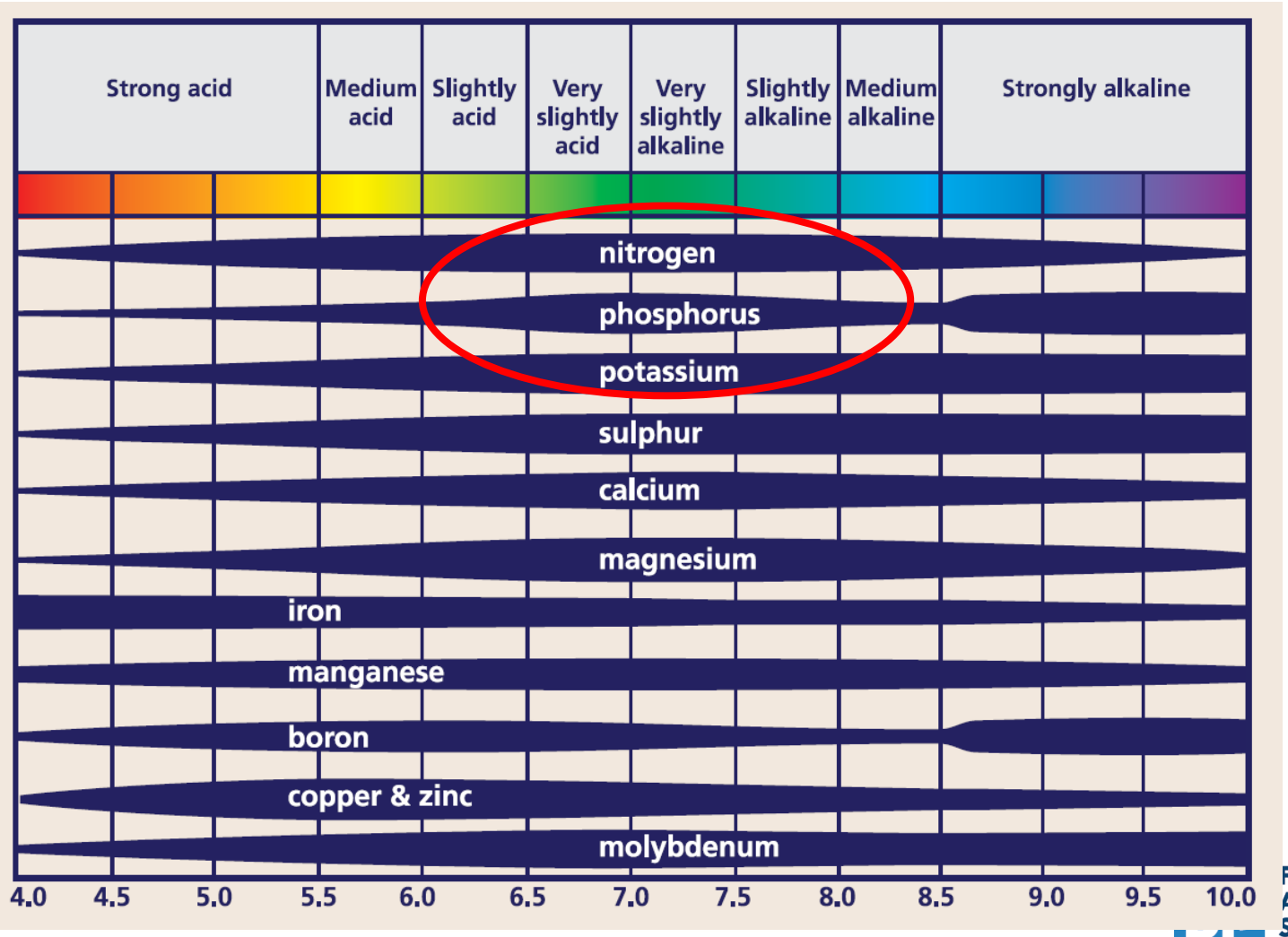
Structure is the how the particles bind together to form aggregates that allows:

- 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 plant roots
- biodiversity of microbes

Compaction and Nitrogen Use



Soil pH Availability and Nutrients



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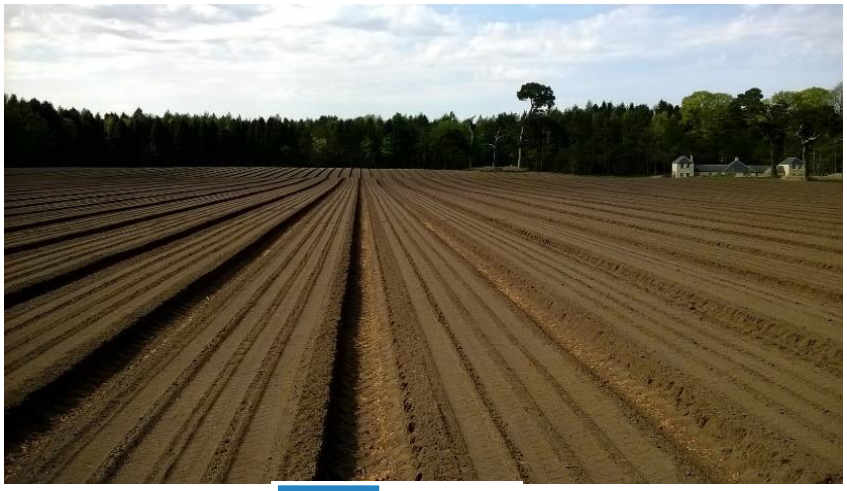
Organic Matter

- Soil plays a major role in the global carbon cycle
- 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 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

Soil health: organic matter

- Organic matter contains carbon and helps maintain carbon in the soil
- Scottish agricultural soils have typical organic matter contents of 5 to 10%
- Soil organic matter increases soil stability, drainage, fertility and encourages biodiversity
- Organic matter is lost as a result of continued cultivation
- Need to replace organic matter that is lost



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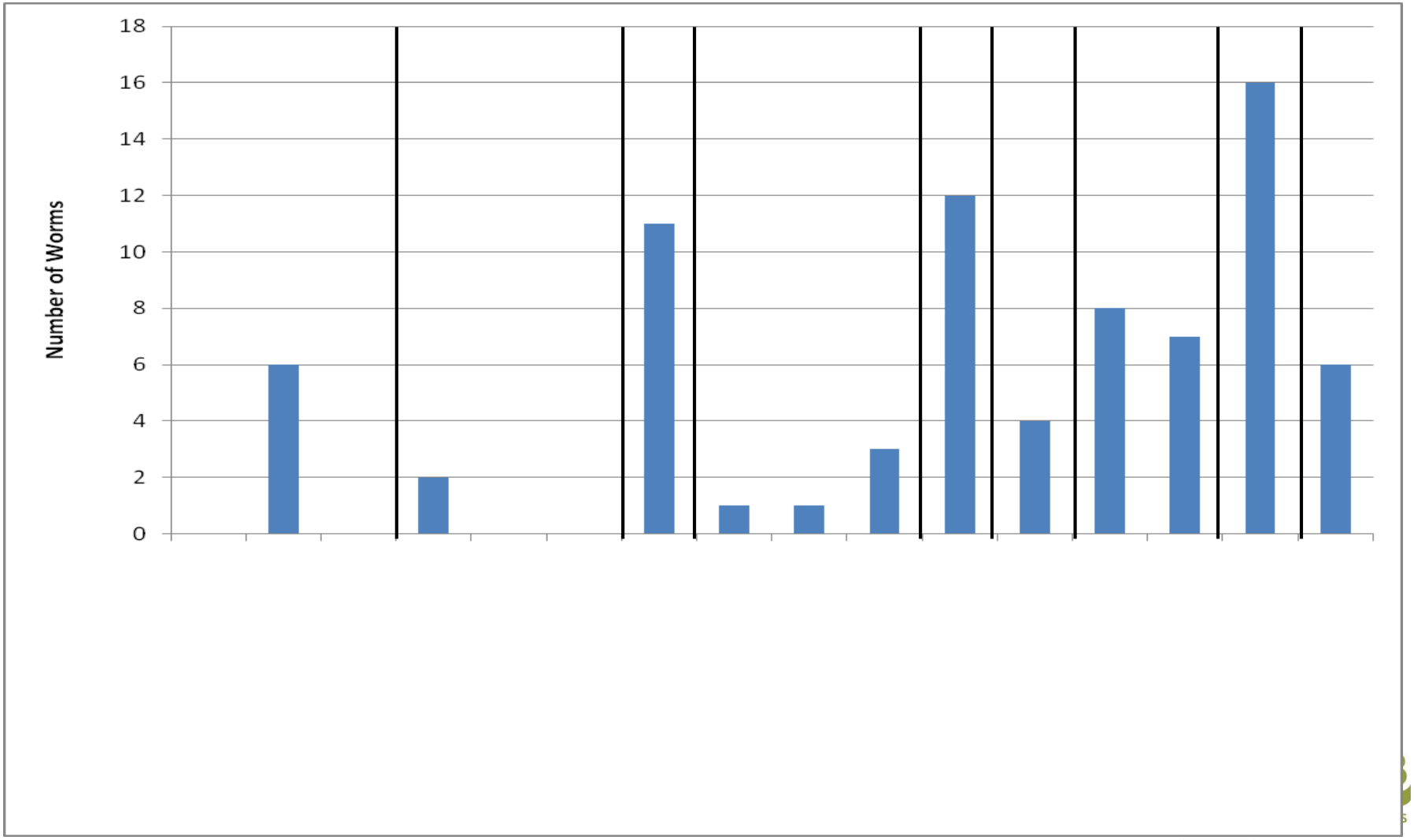
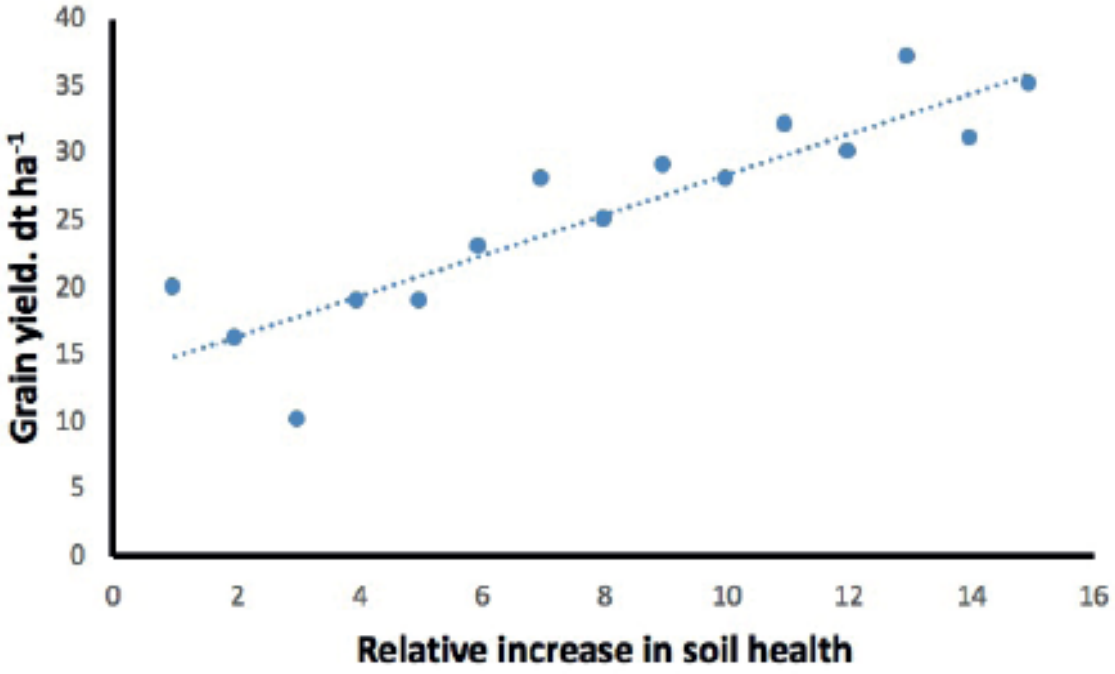
Tillage and Earthworms

- Reduced tillage increases earthworm numbers
- The deeper burrowing worms show greater significant increase from reduced tillage
- Greater increases in number where soil had been under no-tillage for longer (over 5 years)
- Deeper burrowing worms more responsive to no and reduced tillage

Farm Earthworm Numbers



Soil Quality and Yields



Yield of small grain cereals in relation to soil health from a series of trials at 50 locations across Eastern and Central Europe (redrawn from Mueller et al., 2018)

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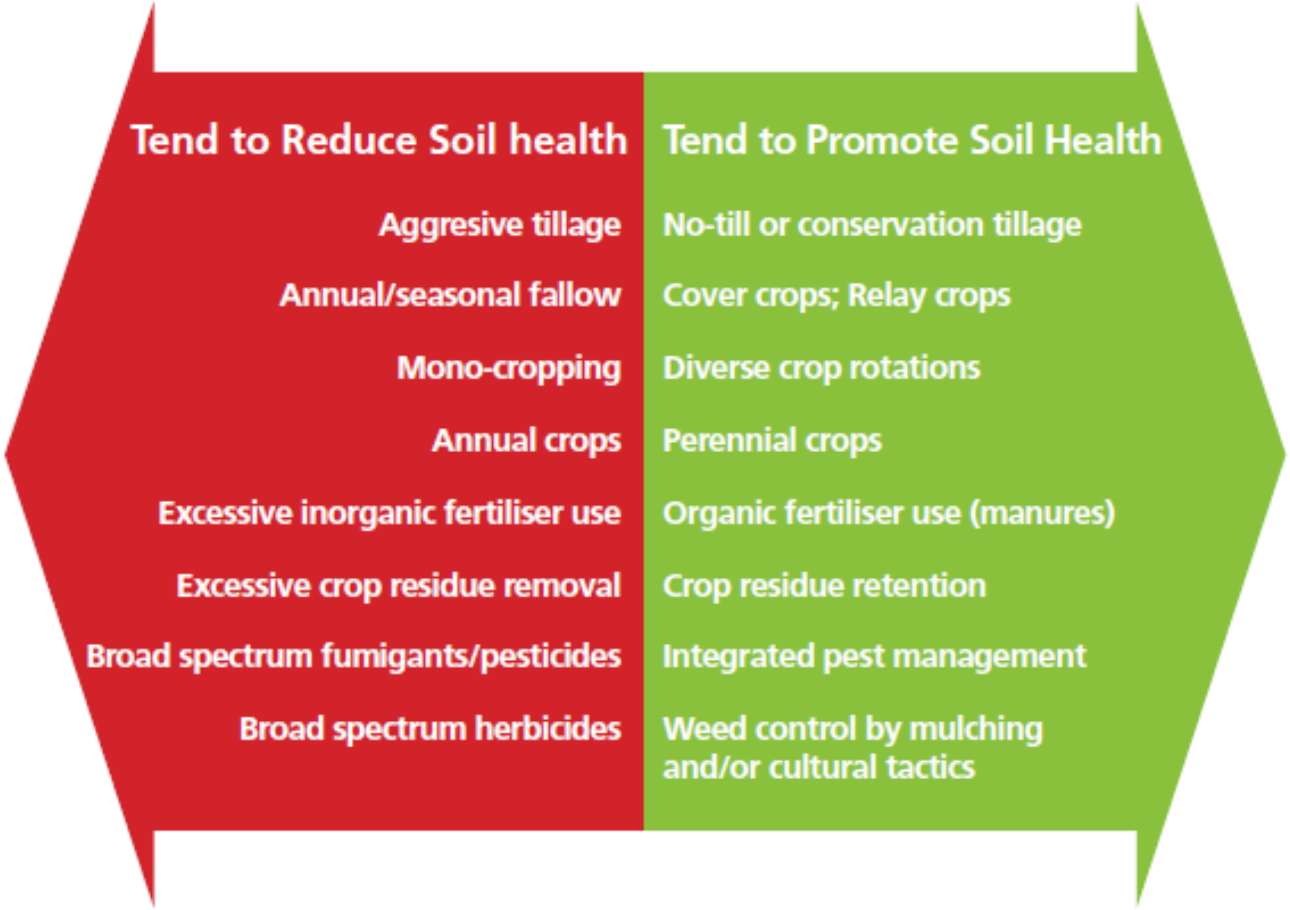
Questions

- 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

Management practices that reduce or improve soil health



No 'one size fits all' due to varying soil type, agricultural system and climate

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Minimum and Reduced Tillage

- Generally non-inversion tillage
  - Retains more organic material close to the surface
  - More nutrients close to the surface
  - Less fuel use, less labour costs
  - Can see reduced yield
  - Need to think about varieties with greater rooting
  - Control of compaction?
  - Cover crops to help with soil health and structure

Cover Crops

- Mainly sown between cash crops
- Protects soil that would be left bare over winter
- Helps retain soil organic material
- Can improve soil structure
- Reduce fertiliser costs

Summary

- Know your soil – use a spade
- Need to understand physics, chemistry and biology
- Soil health monitoring is a combination of methods
- Organic matter is important for soil structure and stability
- Living soil is important for growth and quality
- Consider mitigation measures
- Measure, Monitor, Manage

INSPIRE Innovate INTEGRATE

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National Advice Hub
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W: www.fas.scot

The Scottish Government
Riaghaltas na h-Alba

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AHDB

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

Thank you

Assessing Soil

- Smell
- Colour
- Ease of break up of the soil
- Larger soil aggregates
- Shaper points to soil aggregates

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 changes in the soil – pH, tillage, waterlogging, compaction, organic matter

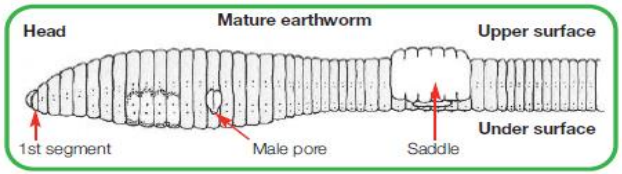
Earthworm Identification I

OPAL EXPLORE NATURE

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

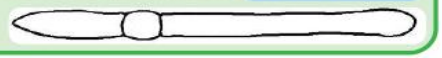
YES → **Turn over**

NO → 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 → Is the earthworm longer than 8cm when **NOT** moving?

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

Hint: Sometimes slightly flattens its tail into a paddle shape



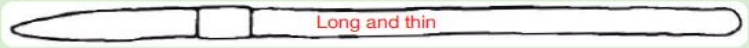
Hint: Line drawings show typical sizes of the adult worm

YES → Are the male pores visible?

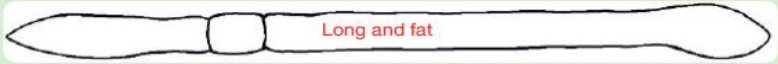
Black-headed worm *Aporrectodea longa*

A

Hint: Often a dark purplish head



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



B

Hint: A stout worm, often as thick as a pencil

Hint: Sometimes flattens its tail into a wide paddle shape

Lob worm *Lumbricus terrestris*

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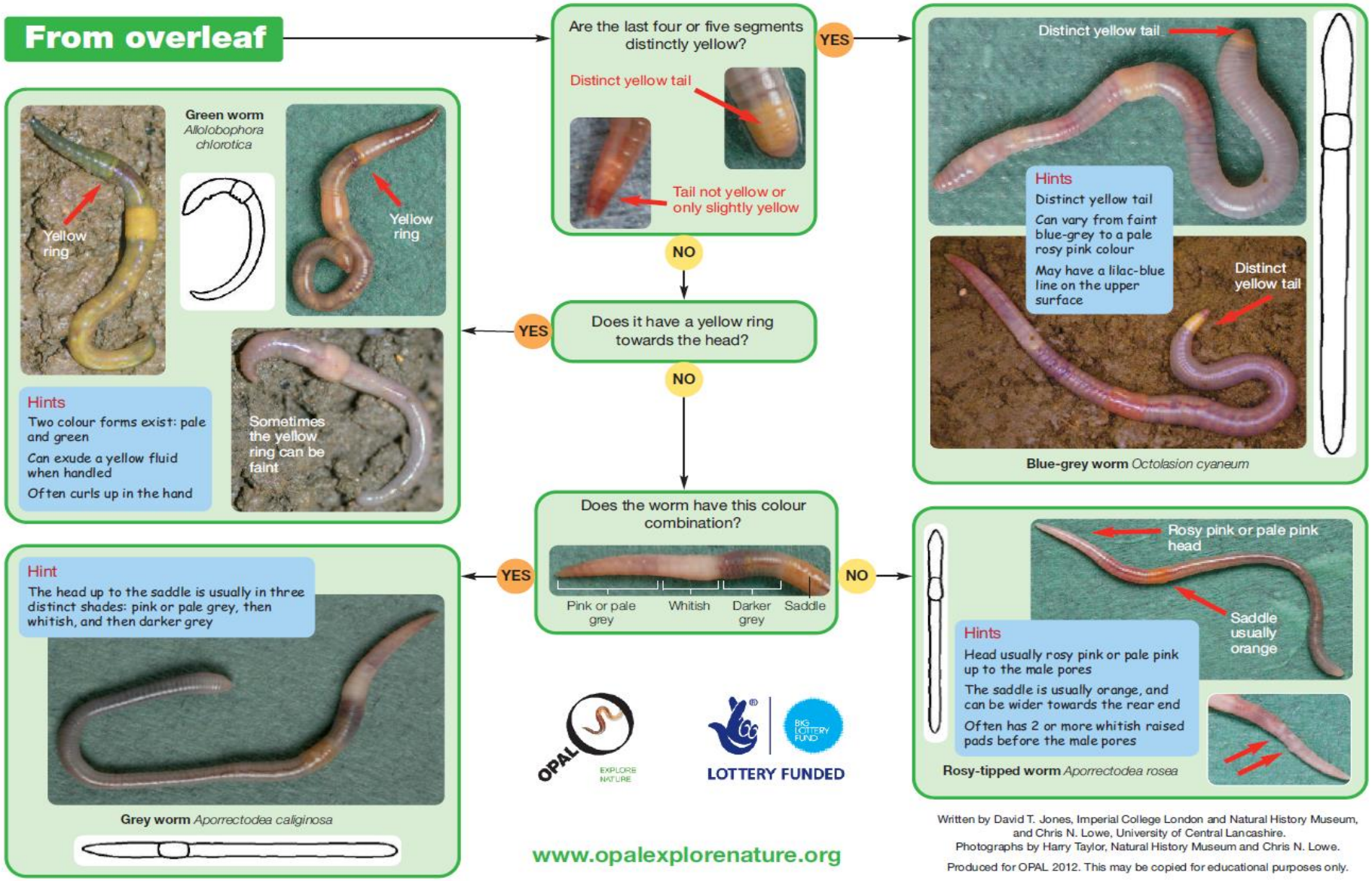
Earthworm Identification II



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.