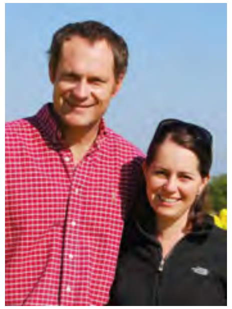
AHDB

Agronomists' Induction: Session 7

Judith Stafford

CEREALS & OILSEEDS

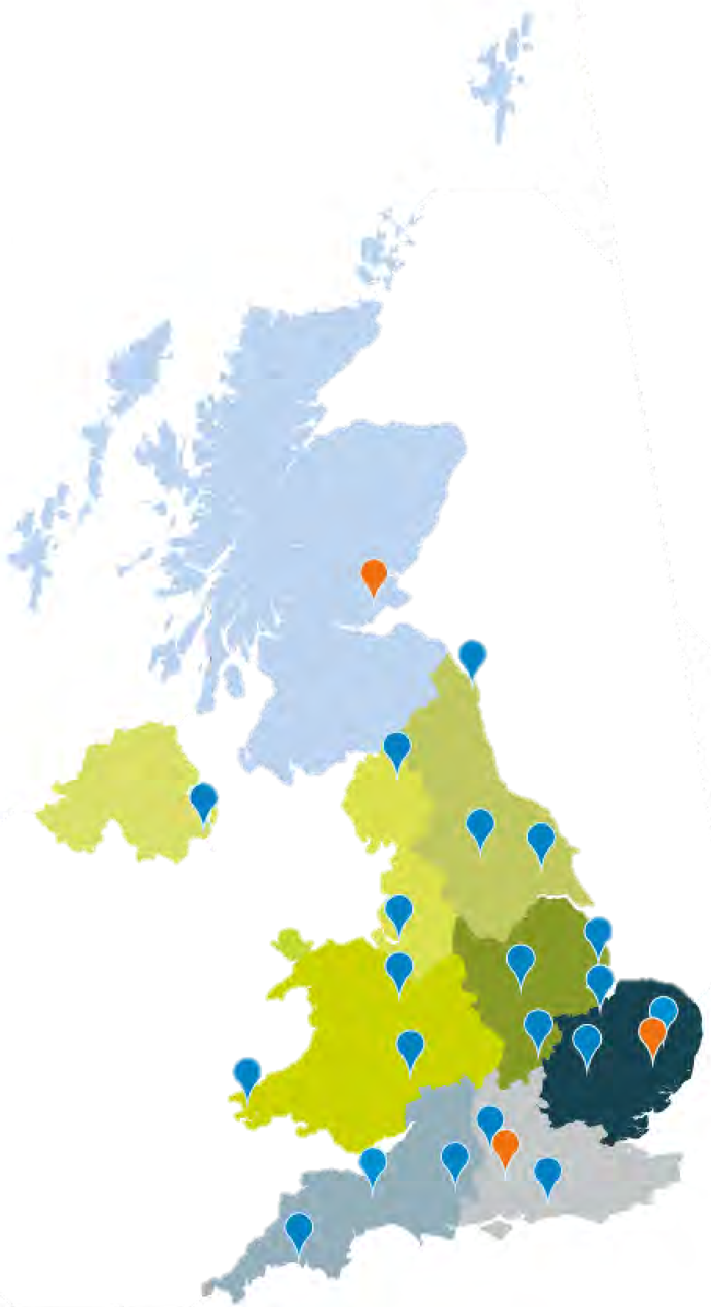
East Midlands



Wainfleet
Gary & Debbie Willoughby

Vale of Belvoir
James & Michael Parker

Northampton
Rick Davies



Agronomists’ Induction: Session 7

Soil health

Amanda Bennett, Resource Management Scientist (Soils), AHDB

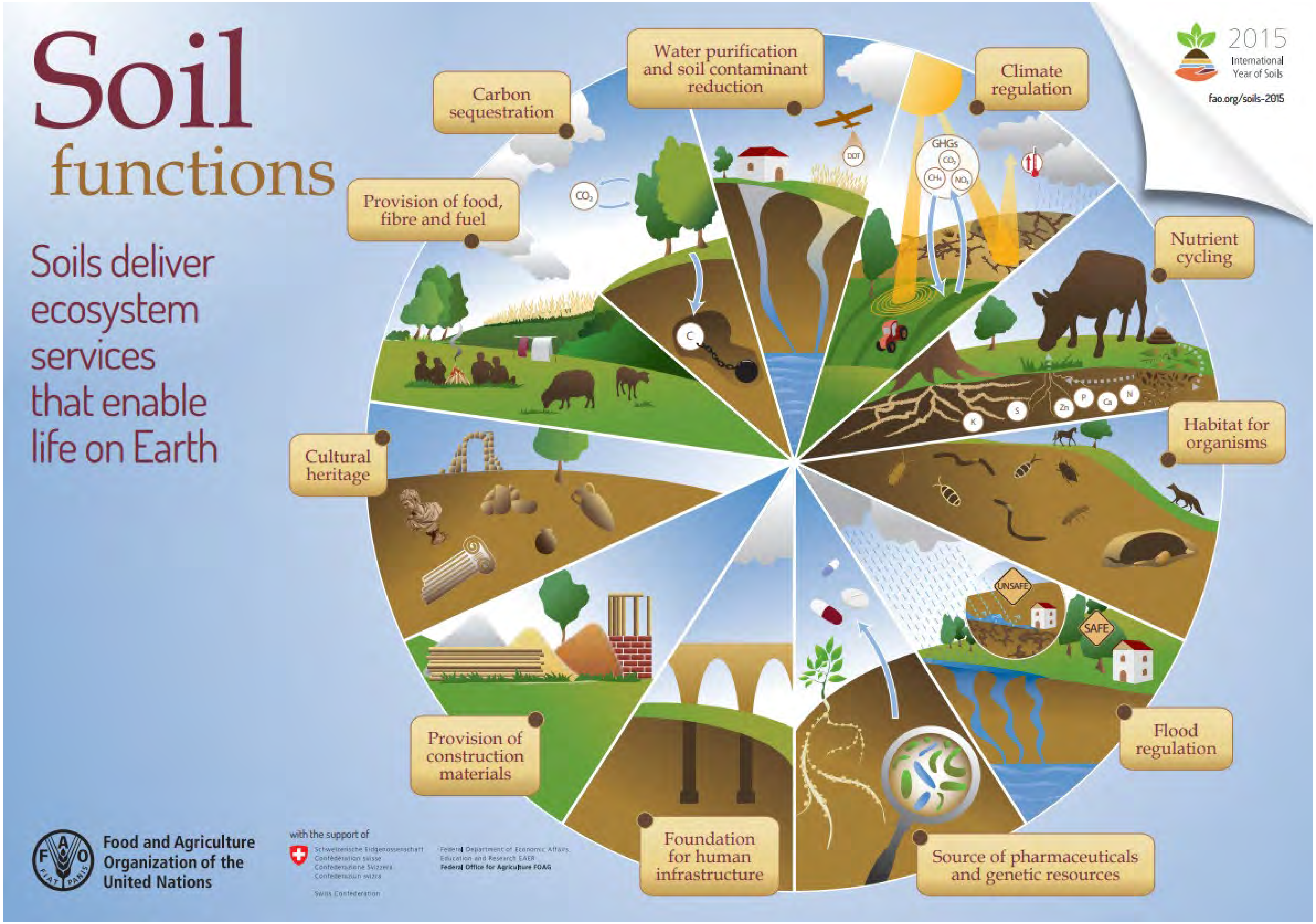
Livestock in the arable rotation

Lizzie Sagoo, Principle soil scientist, ADAS

Soil health

Dr Amanda Bennett, AHDB

amanda.bennett@ahdb.org.uk



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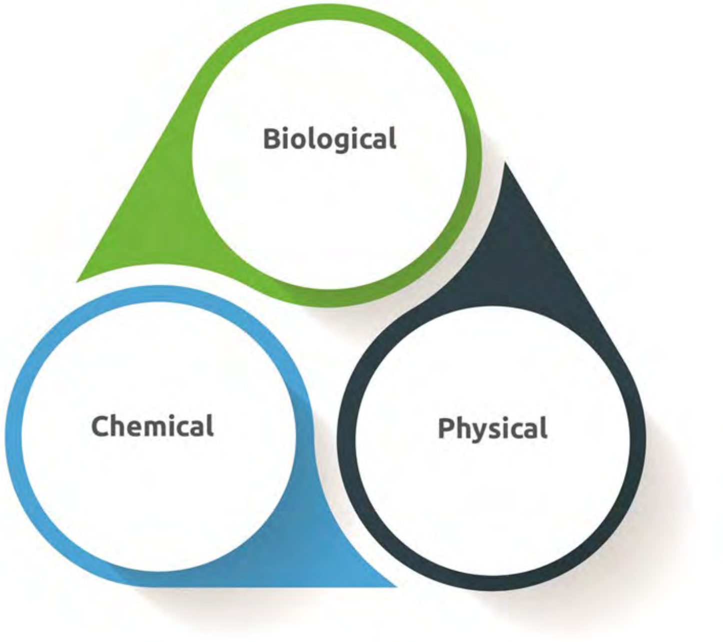
Soil functions (fao.org)

Principles of soil management: Soil health

- *"In a healthy soil, the interactions between* ***chemistry*** *(pH, nutrients and contaminants),* ***physics*** *(soil structure and water balance) and* ***biology*** *(including earthworms, microbes and plant roots) are optimised for the conditions in that place"*



All soils are different






Physical

- Texture
- Structure
- Drainage

Chemical

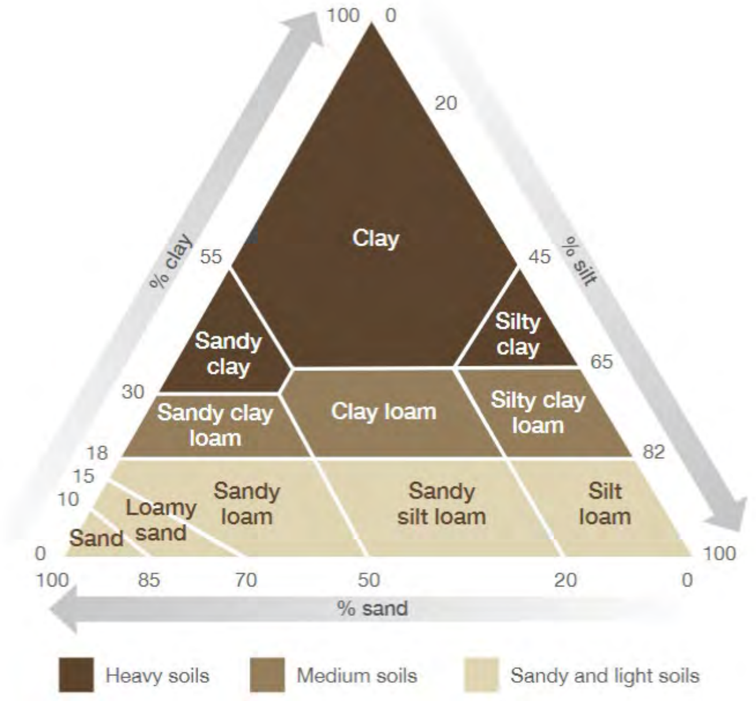
- pH
- N, P, K, Mg
- Minor nutrients

Biological

- Earthworms
- Soil food web
- Microbiology

Physical

- ✓ Know soil textures to understand limits to workability and trafficability
- ✓ Improve soil structure to provide an effective continuous pore space
- ✓ Optimise water balance, through drainage if necessary



www.ahdb.org.uk/greatsoils

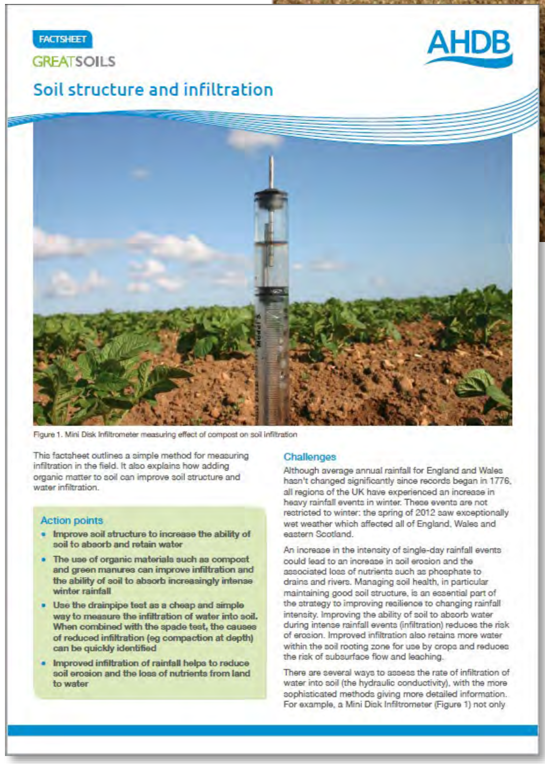


Figure 1. Mini Disk Infiltrometer measuring effect of compost on soil infiltration

This factsheet outlines a simple method for measuring infiltration in the field. It also explains how adding organic matter to soil can improve soil structure and water infiltration.

Action points

- Improve soil structure to increase the ability of soil to absorb and retain water
- The use of organic materials such as compost and green manures can improve infiltration and the ability of soil to absorb increasingly intense winter rainfall
- Use the drainpipe test as a cheap and simple way to measure the infiltration of water into soil. When combined with the spade test, the causes of reduced infiltration (eg compaction at depth) can be quickly identified
- Improved infiltration of rainfall helps to reduce soil erosion and the loss of nutrients from land to water

Challenges

Although average annual rainfall for England and Wales hasn't changed significantly since records began in 1776, all regions of the UK have experienced an increase in heavy rainfall events in winter. These events are not restricted to winter: the spring of 2012 saw exceptionally wet weather which affected all of England, Wales and eastern Scotland.

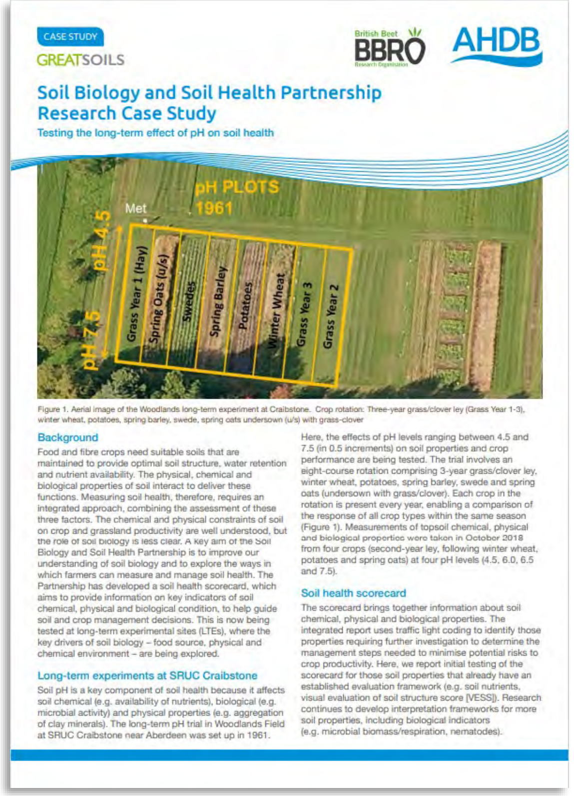
An increase in the intensity of single-day rainfall events could lead to an increase in soil erosion and the associated loss of nutrients such as phosphate to drains and rivers. Managing soil health, in particular maintaining good soil structure, is an essential part of the strategy to improving resilience to changing rainfall intensity. Improving the ability of soil to absorb water during intense rainfall events (infiltration) reduces the risk of erosion. Improved infiltration also retains more water within the soil rooting zone for use by crops and reduces the risk of subsurface flow and leaching.

There are several ways to assess the rate of infiltration of water into soil (the hydraulic conductivity), with the more sophisticated methods giving more detailed information. For example, a Mini Disk Infiltrometer (Figure 1) not only

How to conduct a quick assessment of your soils

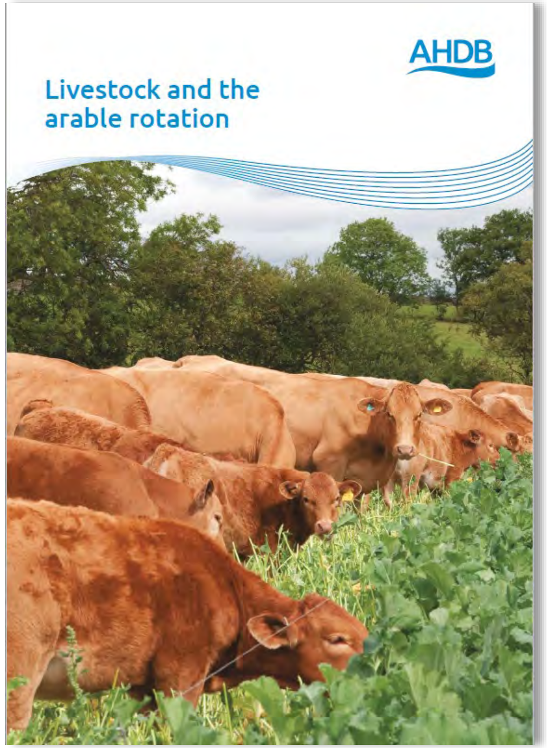
Chemical

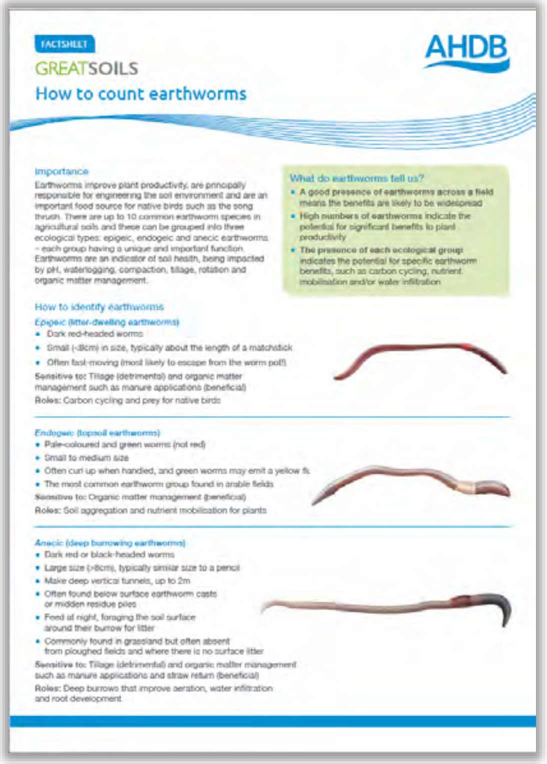
- ✓ Maintain an optimum pH
- ✓ Provide plant nutrients in the right amounts in the right place at the right time



Biological

- ✓ Feed the soil (organisms) regularly with organic matter
- ✓ Move soil only when you have to
- ✓ Diversify crops in space and time





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Home > Knowledge library > Principles of soil health

Principles of soil health

Although soil type cannot be easily changed, knowing which soil type is present helps determine how to manage the soil to optimise its structure, water relations, and nutrient supply.

Soil is an essential natural resource

Healthy, fertile soil is a dynamic living system with physical, chemical and biological properties that promote plant and animal health and maintain environmental quality.

Soil classification (type)

Soils are formed over thousands of years and reflect geology, past climate, vegetation, landscape, human activity, and management.

Find out more about the inherent properties of different soil types

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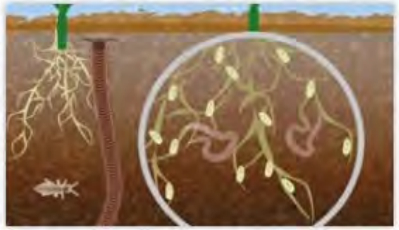
Soil organisms stabilise soil structure

Soil organisms help bind soil into stable aggregates.



The function of soil biology

Soil biology drives soil functions – find out more.

Soil microorganisms – fungi and bacteria

Soil microorganisms play a central role in driving soil processes.

Soil management for horticulture

This soil management guide is a practical manual for growers and agronomists with the primary focus on

Soil macrofauna – earthworms

Earthworms incorporate organic material into the soil and provide

Measuring and Managing Soil Organic Matter

Soil organic matter is the term used

Research Case Study: Testing the effect of organic material additions on soil health

The soil food web and nutrient cycling

Soils contain a very high diversity of organisms. These soil organisms

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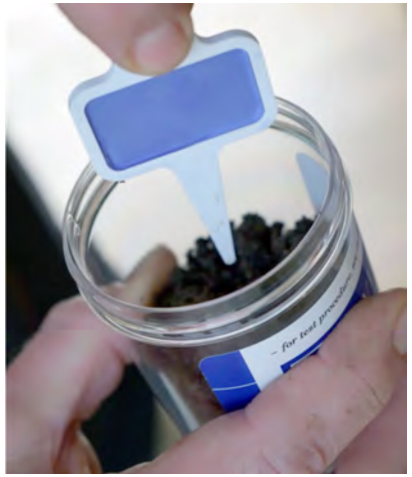
Measuring and monitoring indicators of soil health



Overview

- Approaches to improve soil health:
  - ✓ Increasing organic matter inputs
  - ✓ Increasing crop rotation (length and diversity)
  - ✓ Reducing tillage intensity, where possible

- A soil health review can be used to:
  - highlight areas for investigation
  - measure and monitor improvements over time
  - start conversations about management approaches

Soil Biology and Soil Health Partnership

Soil health scorecards at Harper Adams University

Long-term experiment: Comparison over time on same replicated plots

October 2017 – 2 year Grass/clover ley

Attribute	Control	FYM (23 yrs)	Green compost (13 yrs)
SOM (%LOI)	3.0	4.1	4.0
pH	6.4	7.0	7.0
Ext. P (mg/l)	56	73	60
Ext. K (mg/l)	80	311	187
Ext. Mg (mg/l)	44	87	63
VESS score	2	2	1
Earthworms (No./pit)	11	13	11
PMN (mg/kg)	23	90	43
CO_2-C (mg/kg)	198	228	222

October 2020 – cereal stubbles

Attribute	Control	FYM (25 yrs)	Green compost (15 yrs)
SOM (%LOI)	2.7	3.2	3.4
pH	6.3	6.7	6.7
Ext. P (mg/l)	73	82	72
Ext. K (mg/l)	82	212	144
Ext. Mg (mg/l)	33	69	50
VESS score	3	3	3
Earthworms (No./pit)	1	1	1
PMN (mg/kg)	24	37	37
CO_2-C (mg/kg)	87	111	109

Investigate

Review

Continue rotational monitoring

SOM: soil organic matter (loss on ignition); VESS Visual evaluation of soil structure; PMN: potentially mineralisable nitrogen

GREATSOILS

AHDB

Unearth a wealth of resources on soil management at:

www.ahdb.org.uk/greatsoils

Visit the AHDB knowledge library for further information and access to research reports

www.ahdb.org.uk/knowledge-library

Find out about the Soil Biology and Soil Health Partnership at

www.ahdb.org.uk/soil-biology-and-soil-health-partnership

Livestock in the arable rotation

Integrating beef production into arable systems

Lizzie Sagoo, ADAS Soil Scientist

Grass/herbal leys – benefits for the arable producer

- Diversification
- Improved soil quality
- Weed management
- Profit

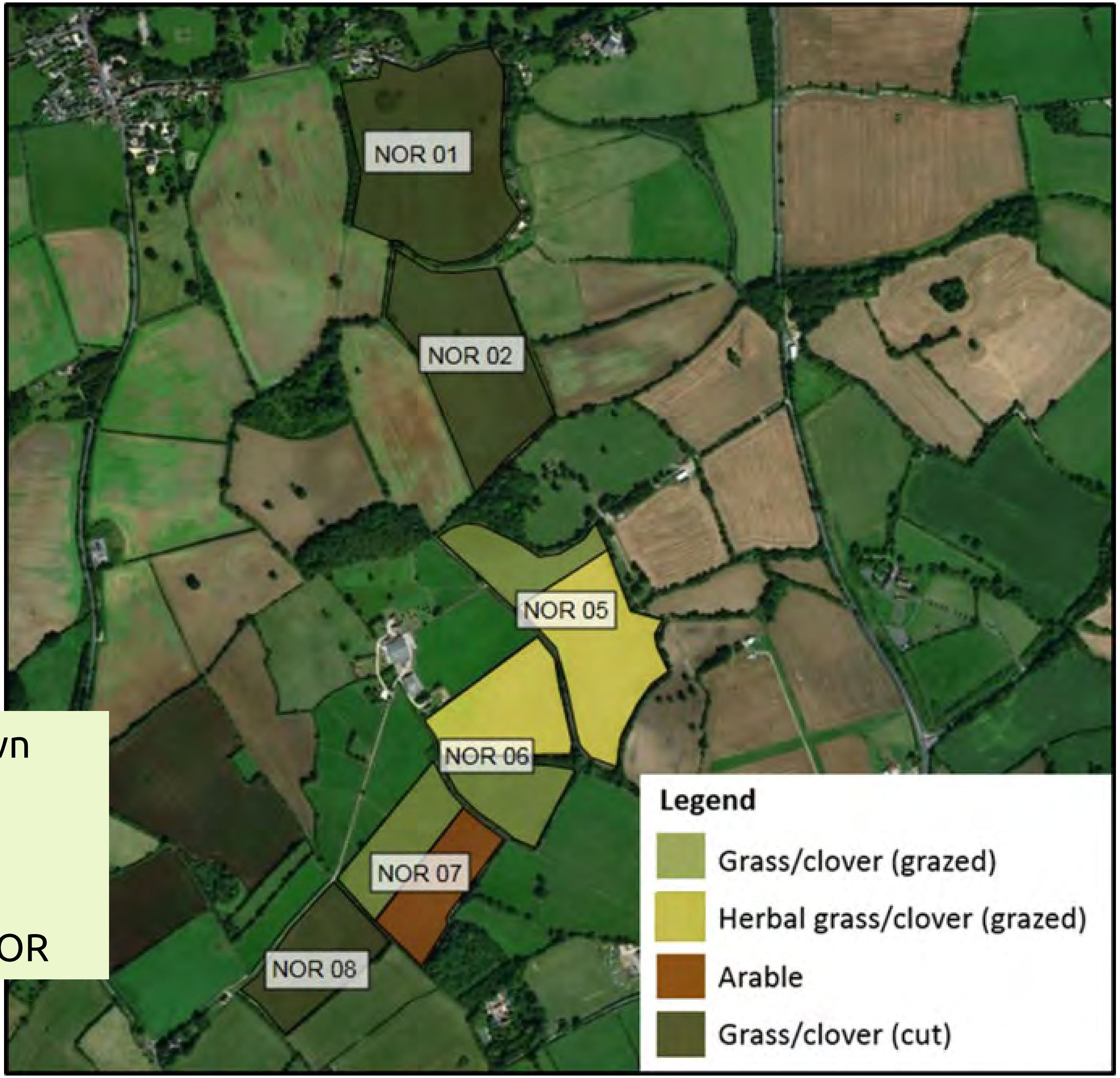
Integrating livestock into arable systems – benefits for the livestock producer

- Potential to start or expand production
- Reduced cost of production
- Need to link to arable farmers

Integrating beef production into arable systems

- AHDB Beef & Lamb project (2016-2022)
- **Aim**: Investigate the practical, economic, environmental & agronomic implications of integrating beef enterprises into arable systems
- Norwood Farm, Somerset

Norwood Farm Somerset

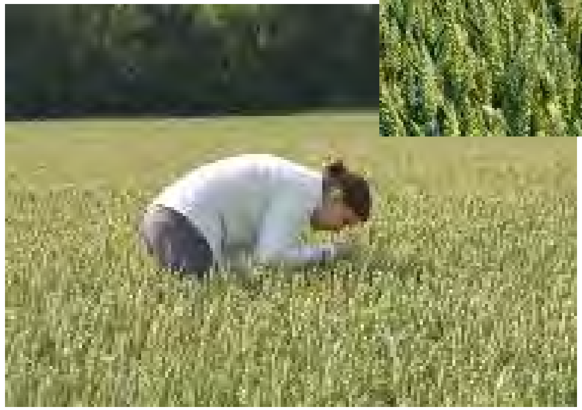


Autumn 2017 – grass sown
2018 – 1st yr grazing
2019 – 2nd yr grazing
2020 – 3rd yr grazing
2021 – Arable, cereals (NOR 07)

Norwood Farm - measurements

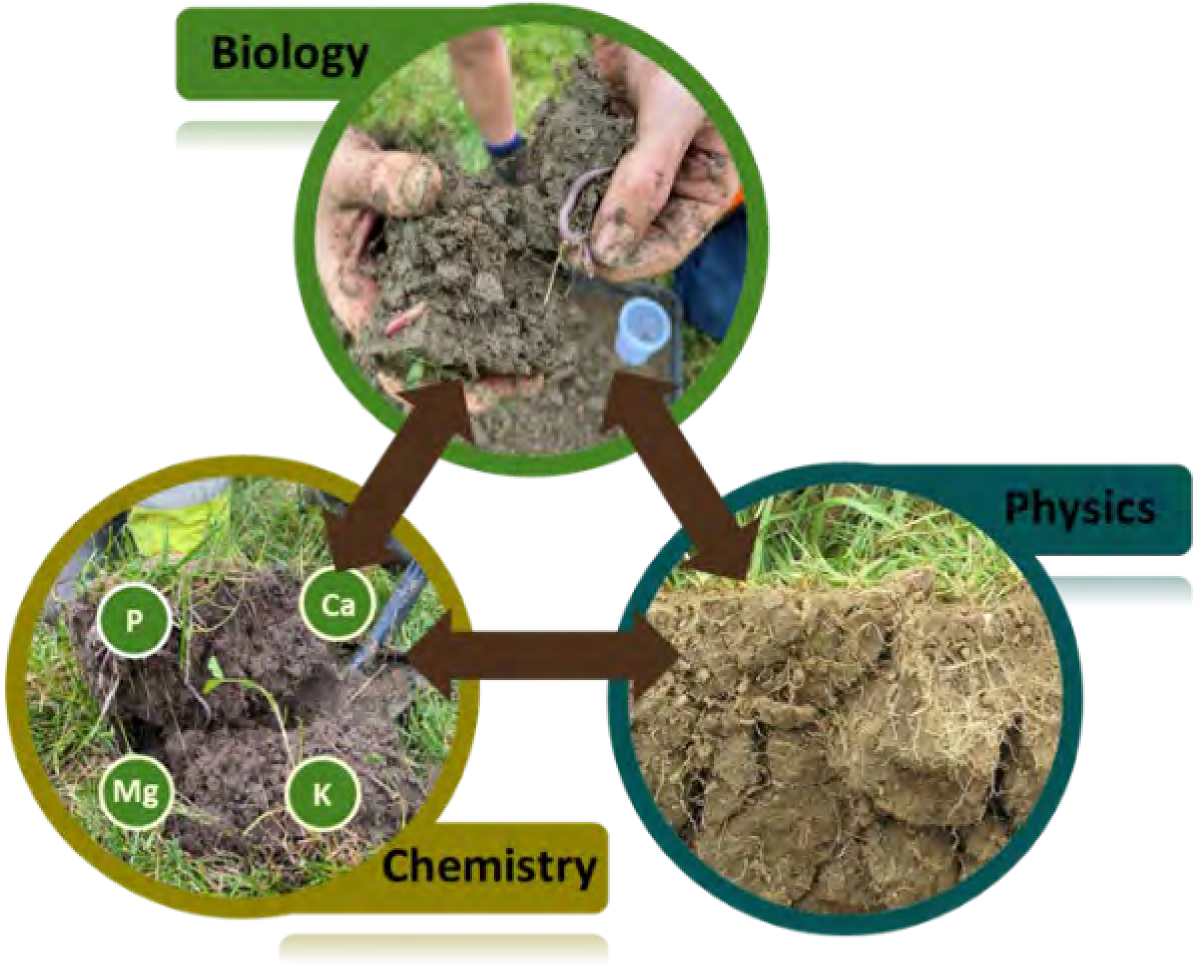
- Effect of grass/herbal ley on
  - Soil quality
  - Blackgrass
  - Yields of the following arable crop
- Forage quality & livestock performance
- Economics



Impact on soil quality

- Assess soil health
  - 6 fields at Norwood Farm
  - Baseline measurements in autumn 2017
  - Repeat measurements in autumn 2020
- Quantify the impact of grass and herbal leys on soil quality
  - Change between 2017 and 2020 measurements



Soil organic matter

- Measured by loss on ignition
- Average increase 0.3 percentage points between 2017 and 2020 (*P*<0.05)
- Equivalent to an increase of 6 t/ha organic matter in the top 15 cm layer of soil

Leys – taking land out of cultivation

Grazing animals – manure inputs

Soil biological health - earthworms

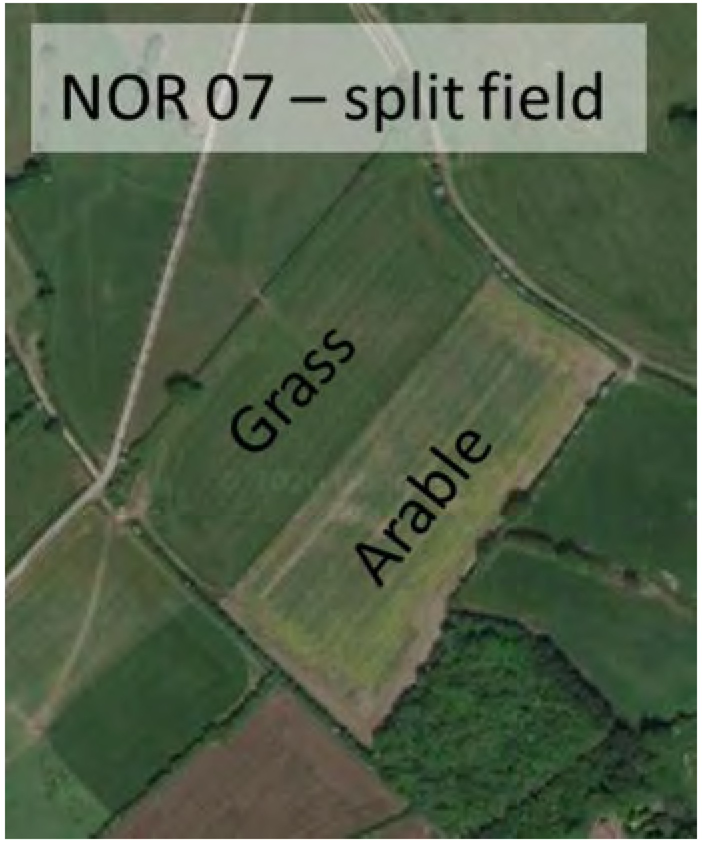
- Earthworm numbers increased by a mean of 60% in grass fields between 2017 and 2020

Field		Worms (number/m²)	
		2017	2020
NOR07	Arable	209	154
NOR07	Grass/clover	139	169
NOR06	Grass/clover	95	332
NOR06	Herbal	139	228
NOR05	Grass/clover	222	215
NOR05	Herbal	197	323

What is the benefit to the following arable crop?

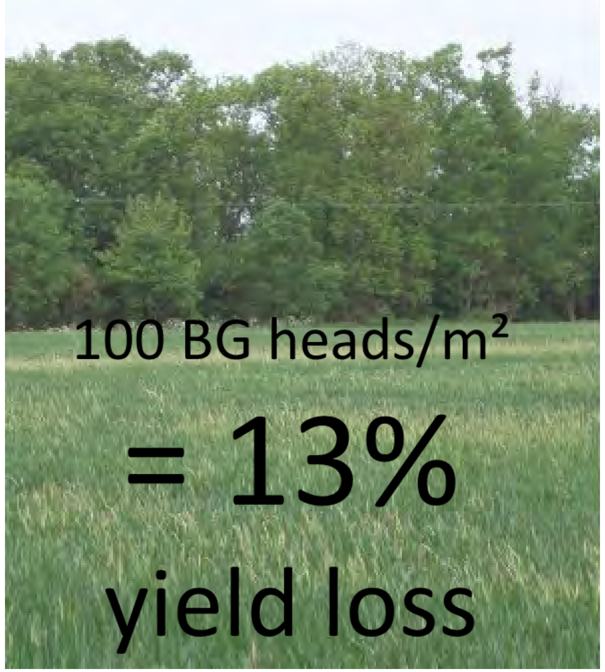
- NOR 07 field was split grass/clover and arable in autumn 2017
- Impact on blackgrass and 2021 barley crop

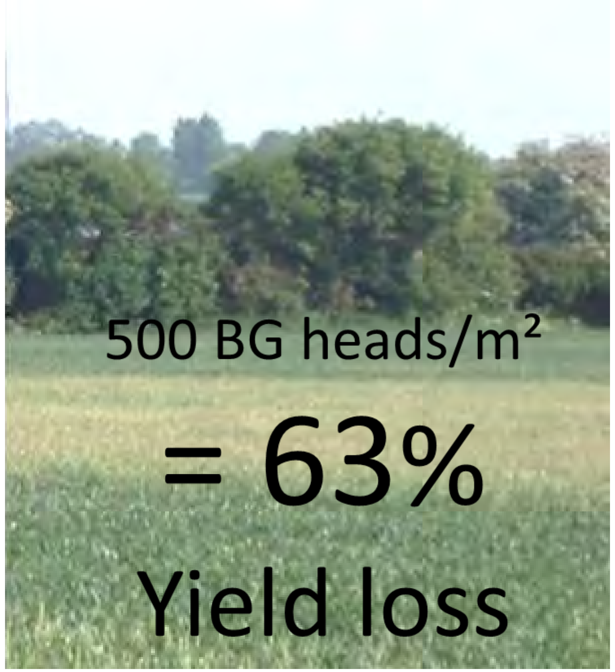
2017	Winter wheat	
2018	Grass/clover	Winter oilseed rape
2019	Grass/clover	Winter triticale
2020	Grass/clover	Wild bird mix
2021	Spring barley	



Using leys to manage weeds in the rotation

- Why do we need to manage weeds?
  - Herbicide resistance
  - Loss of actives
  - Yield loss
- Breaking the weed seed cycle
  - Seed return
  - Seed back





What is the benefit to the following arable crop?

- Blackgrass

2017	Winter wheat 57.5 heads/m²	Winter wheat 52.5 heads/m²
2018	Grass/clover	Winter oilseed rape
2019	Grass/clover	Winter triticale
2020	Grass/clover	Wild bird mix
2021	Spring barley 0.16 heads/m²	Spring barley 1.30 heads/m²

- Impact on spring barley yields
  - Yields were 0.7 t/ha higher following grass/clover

Do the economics stack up?

Full cost benefit analysis of cattle in the rotation at Norwood

List of costs considered in the setting up of the ley and rearing the cattle

Set-up costs	Cattle production costs
Establishment of the ley	**Variable costs**
Tillage (e.g. discing, drilling, rolling)	Additional forage or supplementary concentrates
Inputs (e.g. seeds, sprays, fertiliser)	Fertilisers or sprays
Infrastructure costs	Vet and medicines charges
Fencing posts	**Overheads**
Fencing wire	Labour
Electric fencing equipment	Machinery/vehicles
Water troughs and pipes	Electricity
Handling system	Water
Labour	

Set-up costs at Norwood Farm

Ley establishment	Grass/clover ley £/ha	Grass/herbal ley £/ha	
Subsoiling, power harrowing + drilling and rolling	113	113	All associated costs included – e.g. fuel, labour and depreciation
Seeds	178	205	Price at time
Total	**291**	**318**	

Infrastructure	Grass/clover ley £/ha	Grass/herbal ley £/ha	
Fencing, gates water troughs, pipes, cattle crush	603	603	Materials only
Labour	417	417	All infrastructure labour
Total	**1,020**	**1,020**	

Total set-up cost	**165**	**174**	**£/year of ley (inc. depreciation of materials)**

Cattle rearing/production costs at Norwood

Variable costs	Grass/clover ley £/ha	Grass/herbal ley £/ha	
Supplementary feed, fertiliser and sprays	171	145	Only the grass/clover group received some additional silage
Vet and med	16.6	16.6	3 insecticide treatments
Total	**187.6**	**161.6**	

Overheads	Grass/clover ley £/ha	Grass/herbal ley £/ha	
Labour - cattle	150	150	Cattle management
Fertiliser spreading	15	15	Cost of the machinery and labour
Electricity, fuel and water	46	46	Mains water
Total	**211**	**211**	

Total rearing costs	**93**	**87**	**£/head**

Estimated margin for Norwood Farm

	Grass/clover ley	Grass/herbal ley
Cattle output - Valuation change	*Output per head* *£184** Output per ha £791/ha	*Output per head* *£191** Output per ha £821/ha
Set-up costs - Ley and infrastructure costs	£165/ha	£174/ha
Rearing costs - Cattle production	£399/ha	£373/ha
Margin - Before rent and finance	**£227/ha**	**£274/ha**

** Weight gained x £1.80 per kg*

Margin comparisons
Net margin before rent and finance

Grazing leys

- Grass/clover ley
  - £227/ha
- Grass/herbal ley
  - £274/ha

Crops

Winter wheat	£567/ha
Winter barley	£222/ha
Spring oats	£198/ha
Spring barley	£180/ha
Winter oilseed rape	£101/ha
Winter beans	£27/ha
Spring linseed	£-293/ha

Source: AHDB Farmbench, South West farms on clay loam and silty clay loam soils
– 3 year average 2018 -2020
– Before rent and finance

Take home messages

- Grass and herbal leys & grazing livestock in the rotation
  - Soil quality benefits
  - Help control blackgrass
  - Diversified rotation
  - Impact on farm profitability
  - AHDB ‘Mix and match’ cost benefit calculator

  ahdb.org.uk/beef-in-the-arable-rotation-mix-and-match-calculator

Thank you

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@Lizzie Sagoo

Day 2 Workshop – 12:25

- Red Group – Seminar 2
- Green Group – Emperor Suite
- Blue Group – Seminar 1