

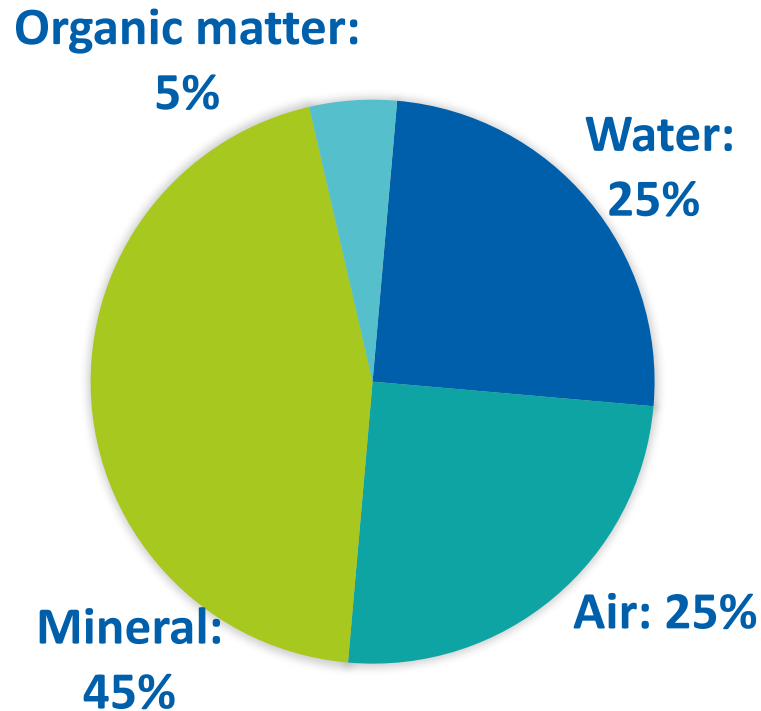
Contaminated Land and Groundwater: Resources Past and Future  
University of Manchester 26 July 2018



# Soil Organic Matter Management

John Williams  
ADAS Soil Scientist

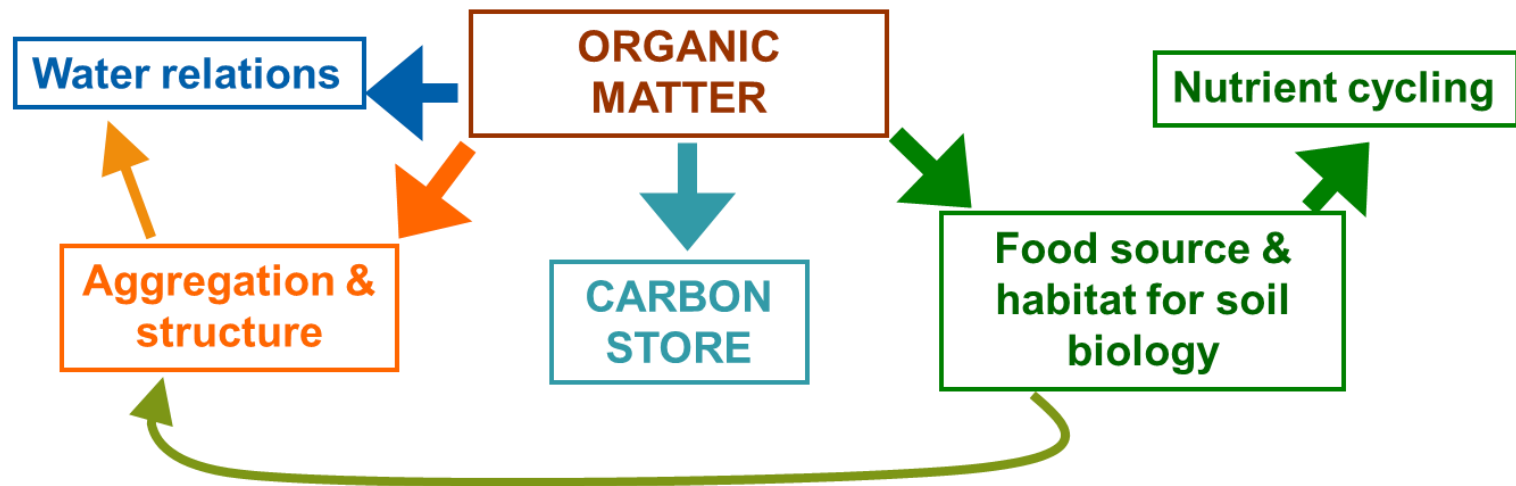
# What does soil comprise?



**Organic matter:** The *carbon* containing material in the soil that is derived from living organisms (e.g. plants, fauna and manure).

# Soil organic matter (SOM)

- A key indicator; SOM decline a major 'threat'
- The majority of soil functions are driven by biological processes, underpinned by SOM decomposition
- The 'major currency' in soil systems



SOM measurements – an overall indicator of soil quality

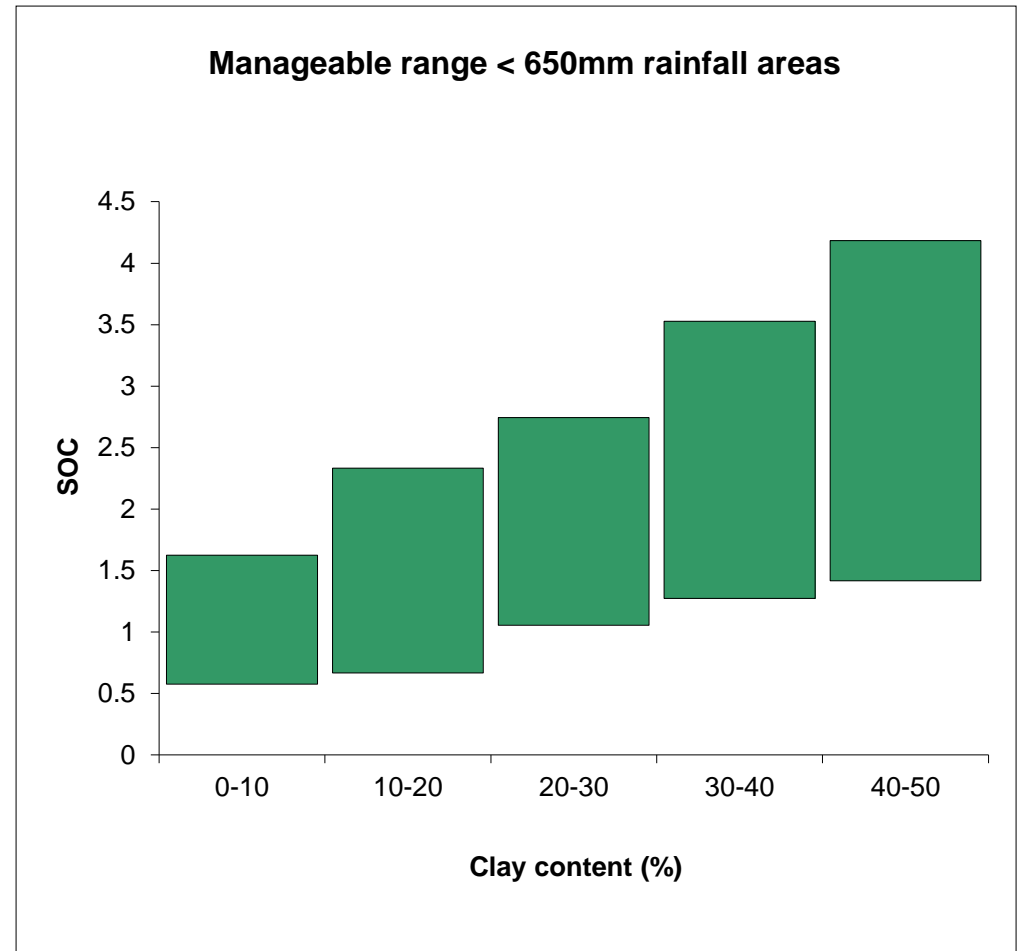
# Benefits of organic matter

- Improved soil structure and workability
- Increased water holding capacity and infiltration
- Increased biological activity
- Improved retention and turnover of nutrients
- Greater resilience to dry weather conditions



# 'Typical' organic matter levels in soils

- There is no easily defined 'critical level' of SOM below which soil functions become impaired
- Approximate guide: 2% SOC (~4% SOM)



Source: Verheijen et al., 2005



# Measuring the impacts of management on SOM....

- A needle in a haystack?

Landuse change:  
-1.7 - + 1.4 t/ha/yr



Change cultivation practices:  
-1.7 - +0.7 t/ha/yr



Apply organic materials:  
0.5 - 2.5 t/ha/yr

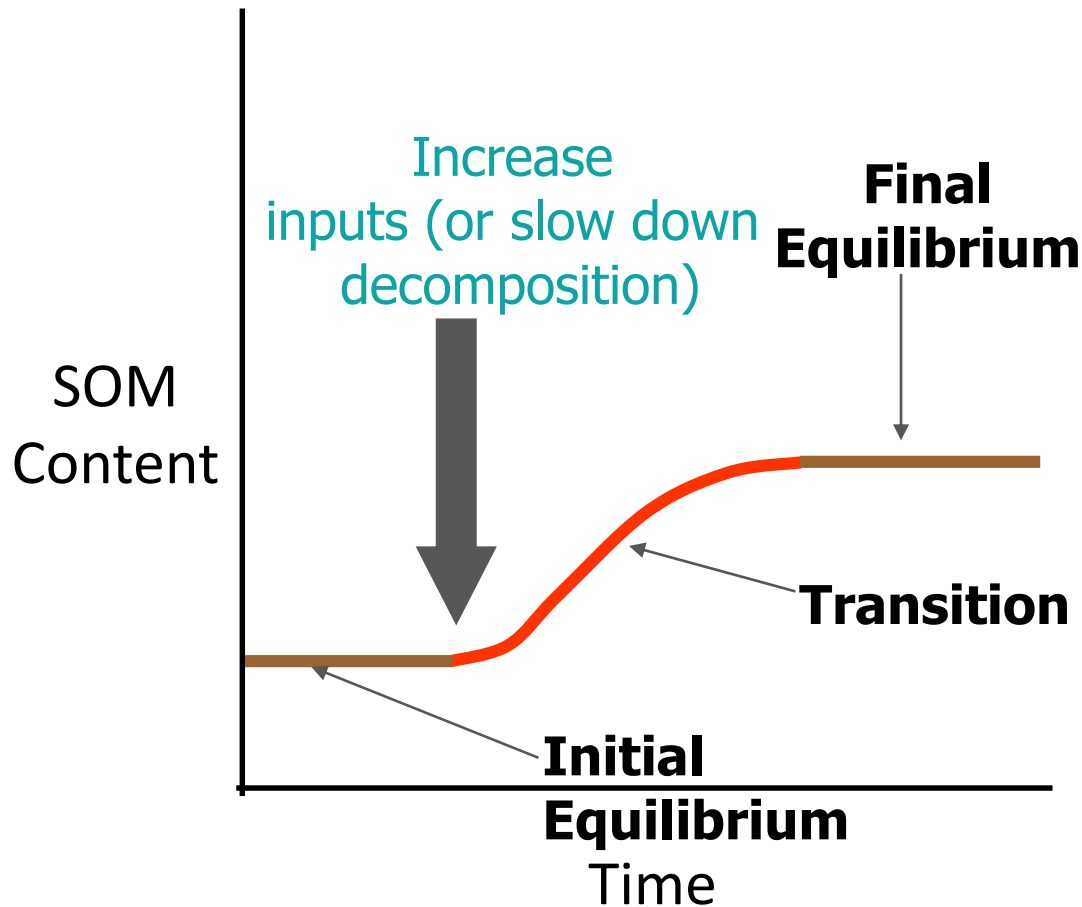


Grow higher yielding  
crops: 0.17 - 0.34 t/ha/yr



*Data from Dawson & Smith, 2006*

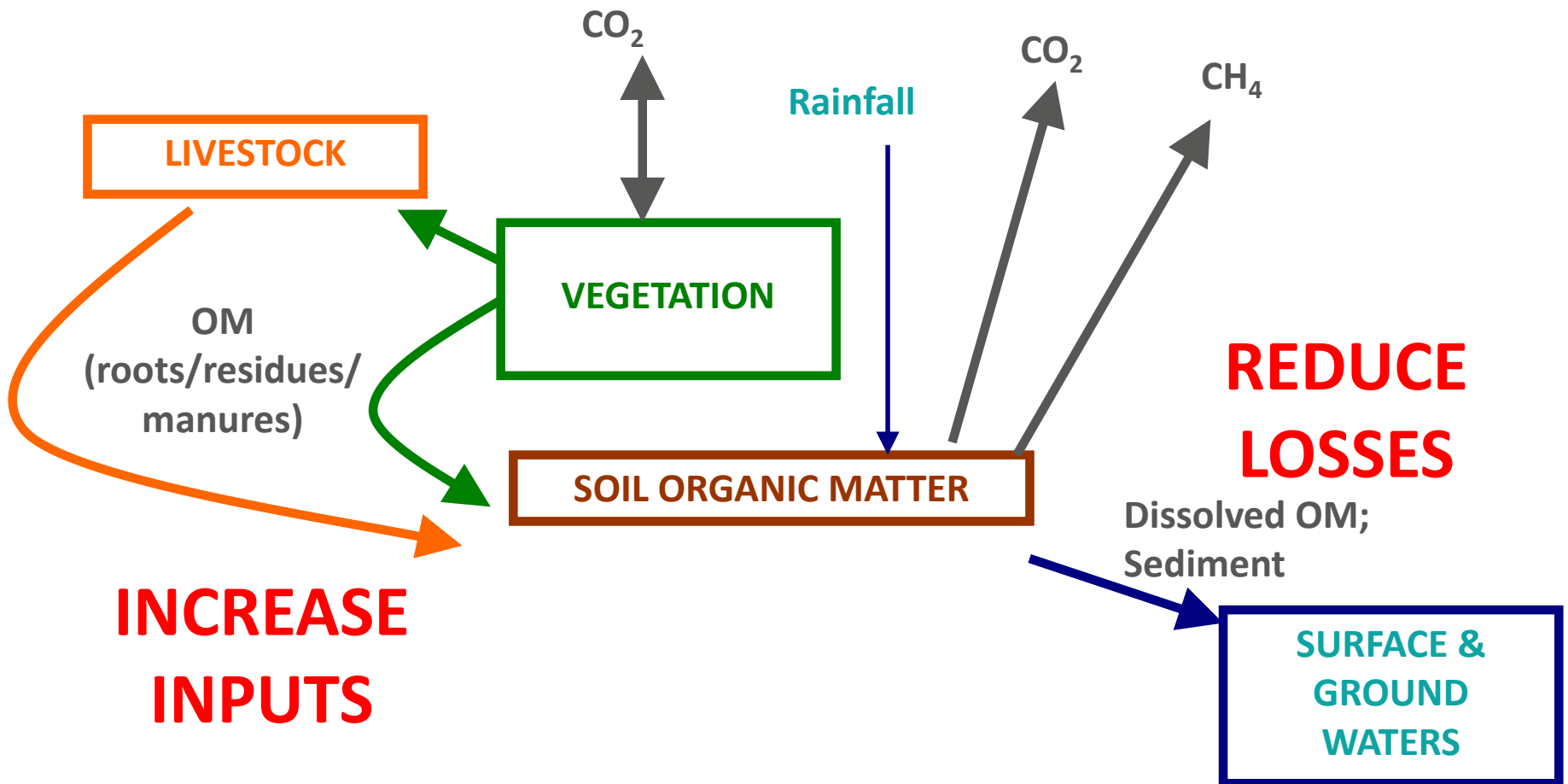
# SOM accumulation rates change over time



- Annual rate of increase declines as a new equilibrium is reached
- SOM will not accumulate indefinitely

# What can we do to maintain/increase SOM?

Simple soil organic matter budget



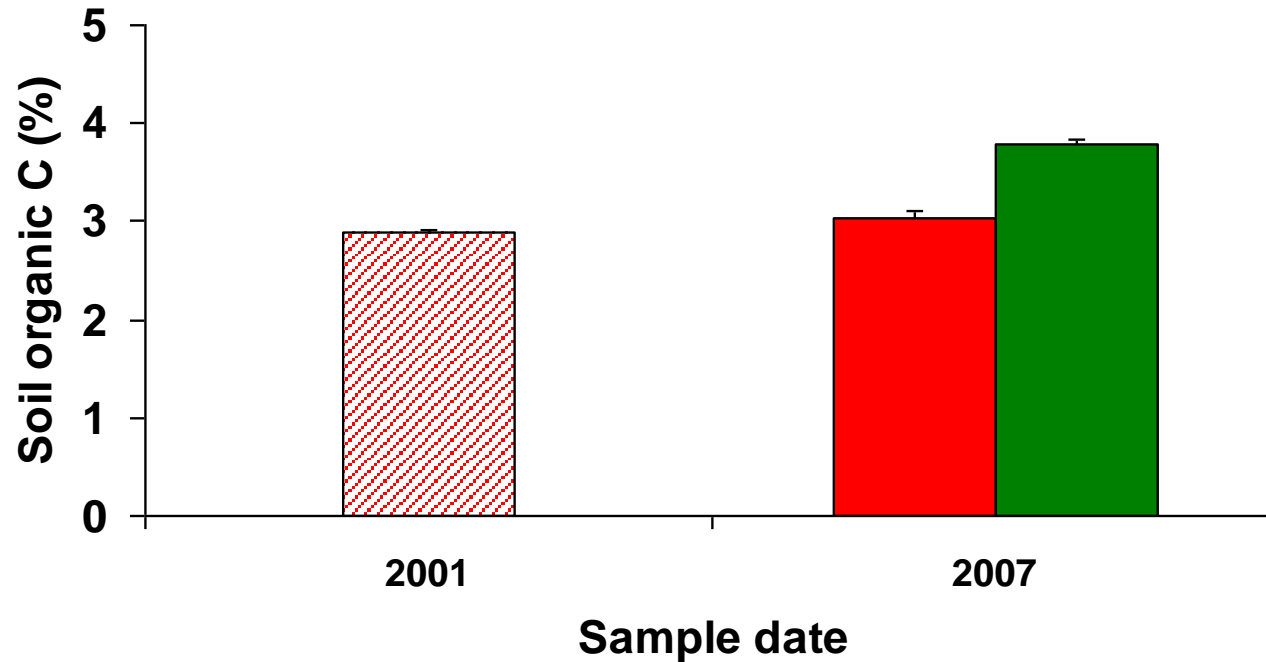


# What can we do to maintain/increase SOM?

## Croplands:

1. Convert to permanent grassland
  2. Introduce rotational grass
  3. Use cover crops/green manures; incorporate residues
  4. Apply organic materials
- 

# Introducing grass into the rotation: Increase in SOC following arable reversion to ungrazed grassland



- ▨ Initial sample (autumn 2001)
- Arable (autumn 2007)
- Arable reversion grassland (autumn 2007)

**24% increase in SOC after 6 years of arable reversion  
to grassland (heavy clay soil)**

# Cover crops

- Provide over-winter cover (minimise erosion, weeds, nitrate leaching)
- Increase N retention – provide nutrients to next crop (if a legume will fix atmospheric N)
- Potential benefits for soil structure, water holding & porosity
- Limited evidence of SOM benefit *per se*.



# Organic manures - a good source of organic matter

Organic material	Dry Matter	Application rate (t/ha) NVZ 250kg N/ha	Organic matter applied (t/ha)
Cattle FYM	25%	42	5.5
Broiler litter	60%	8	2.5
Green Compost	60%	33	4.5
Green/Food Compost	60%	22	5.0



# Long-term sites measuring the impact of organic material additions



## Terrington (Norfolk)

Silty clay loam (28% cl); arable rotation

Treatments:

Pig FYM & Slurry	20 years (1993)
Green compost	9 years (2005)
Green/food compost	3 years (2010)
Food-based digestate	3 years (2010)

## Harper Adams (Shropshire)

Sandy loam (12% cl) arable rotation

Treatments:

Cattle FYM & Slurry	20 years (1993)
Green compost	9 years (2005)
Green/food compost	3 years (2010)
Food-based digestate	7 years (2006)

All materials applied at equivalent to 250 kg N/ha & 'balanced' with fertiliser N

Part of the Wrap/Defra DC-Agri experimental programme

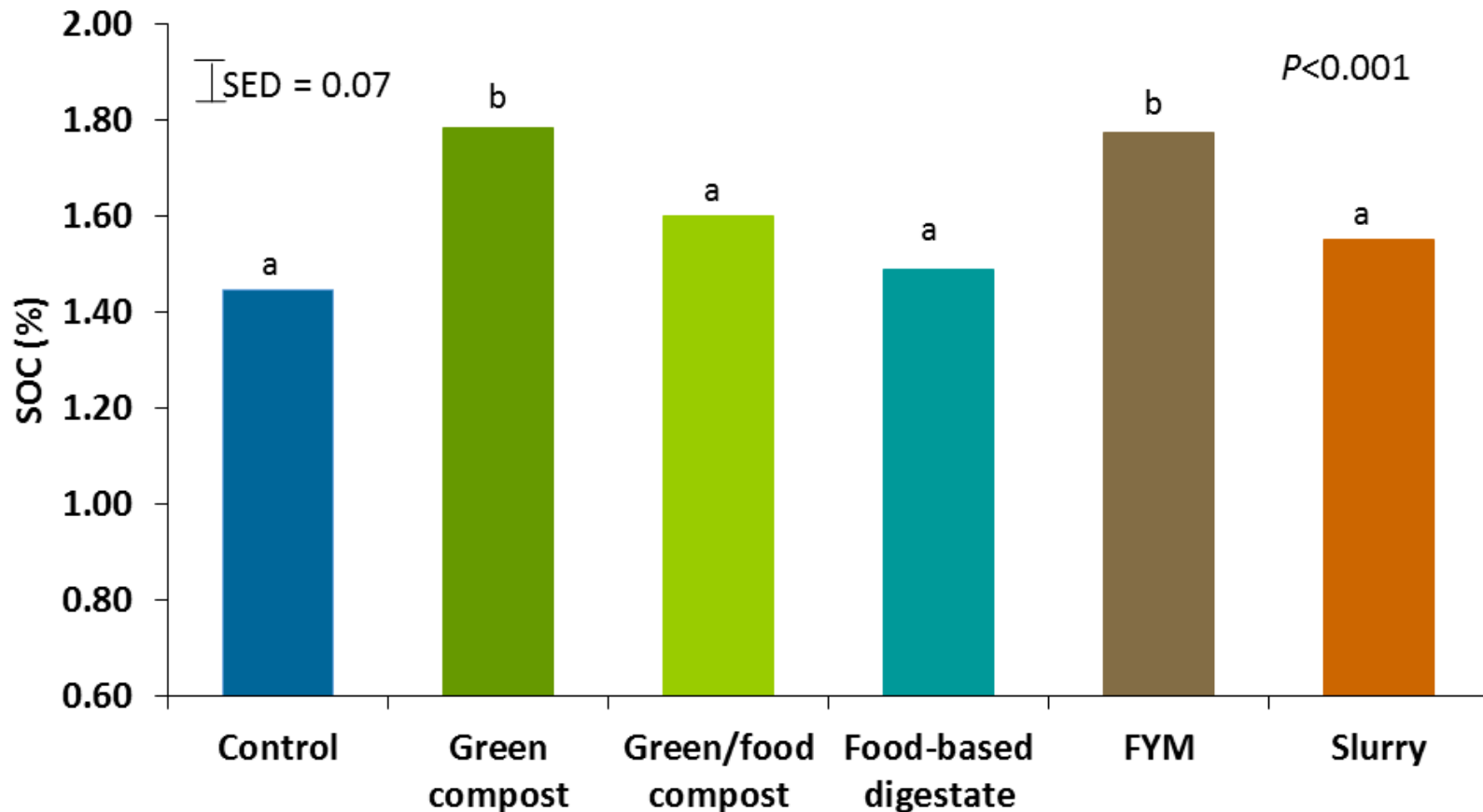
# Total organic matter loadings (t/ha) up to spring 2013

Treatment	Harper Adams	Terrington
FYM (20 yrs)	105	81
Livestock slurry (20 yrs)	45	18
Green compost (9 yrs)	49	47
Green/food compost (3 yrs)	9	13
Food-based digestate (3-7 yrs)	5	2



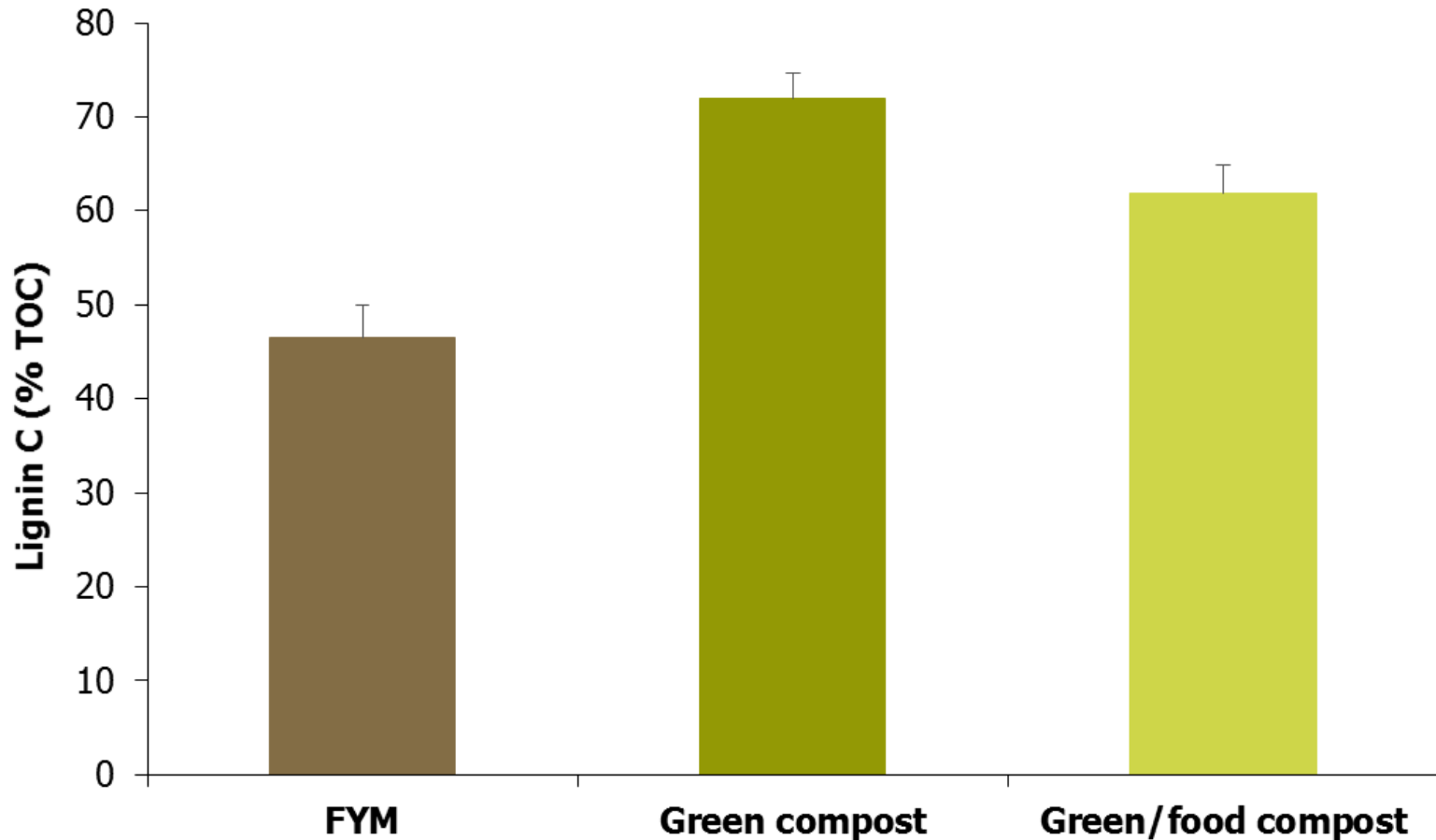
# Topsoil organic C (spring 2013)

*Cross-site analysis*

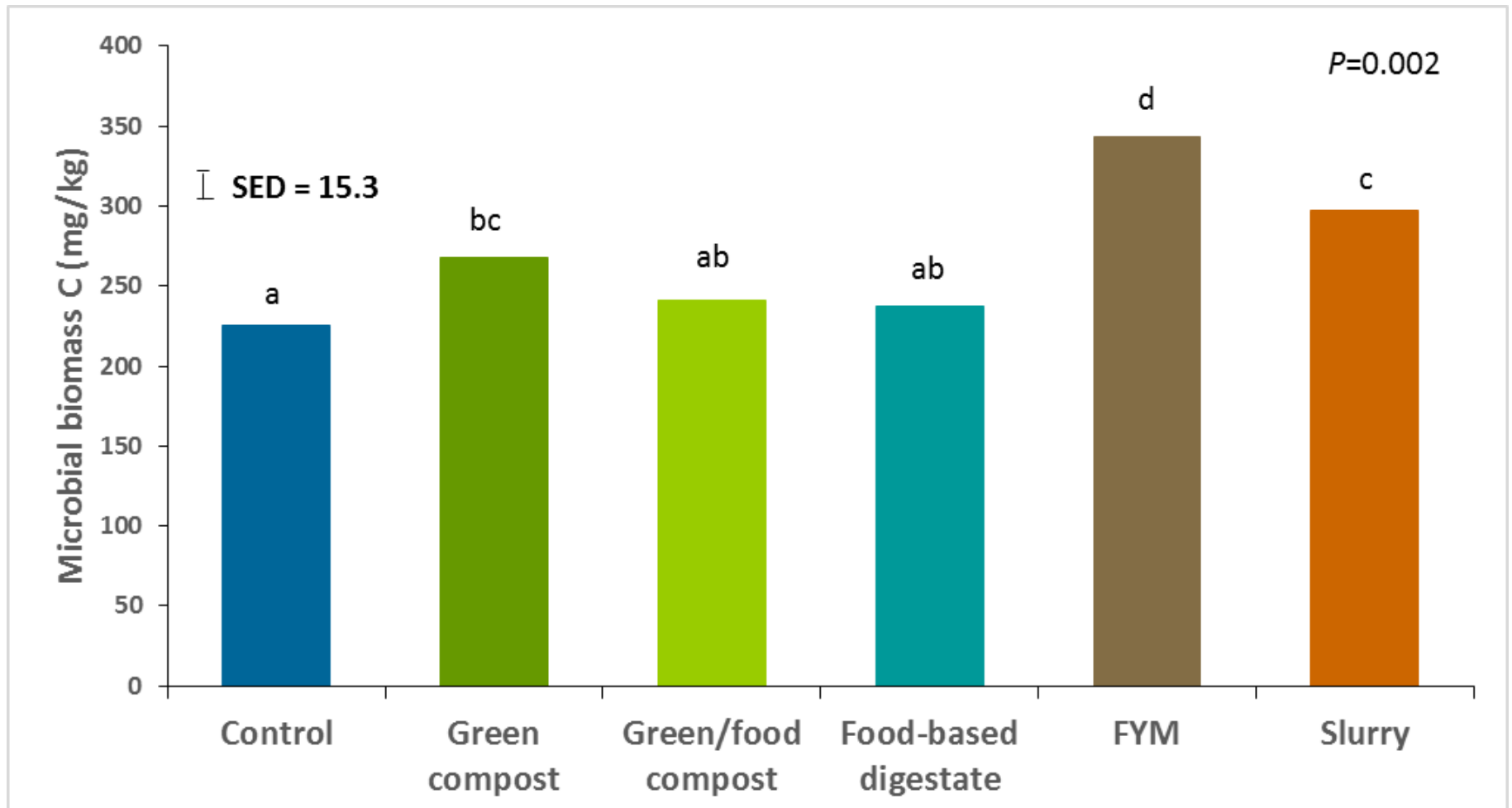


*c.*25% increase in SOM following 20 yrs FYM (*c.*100t OM input)  
& 9 yrs green compost (*c.*50 t OM input)

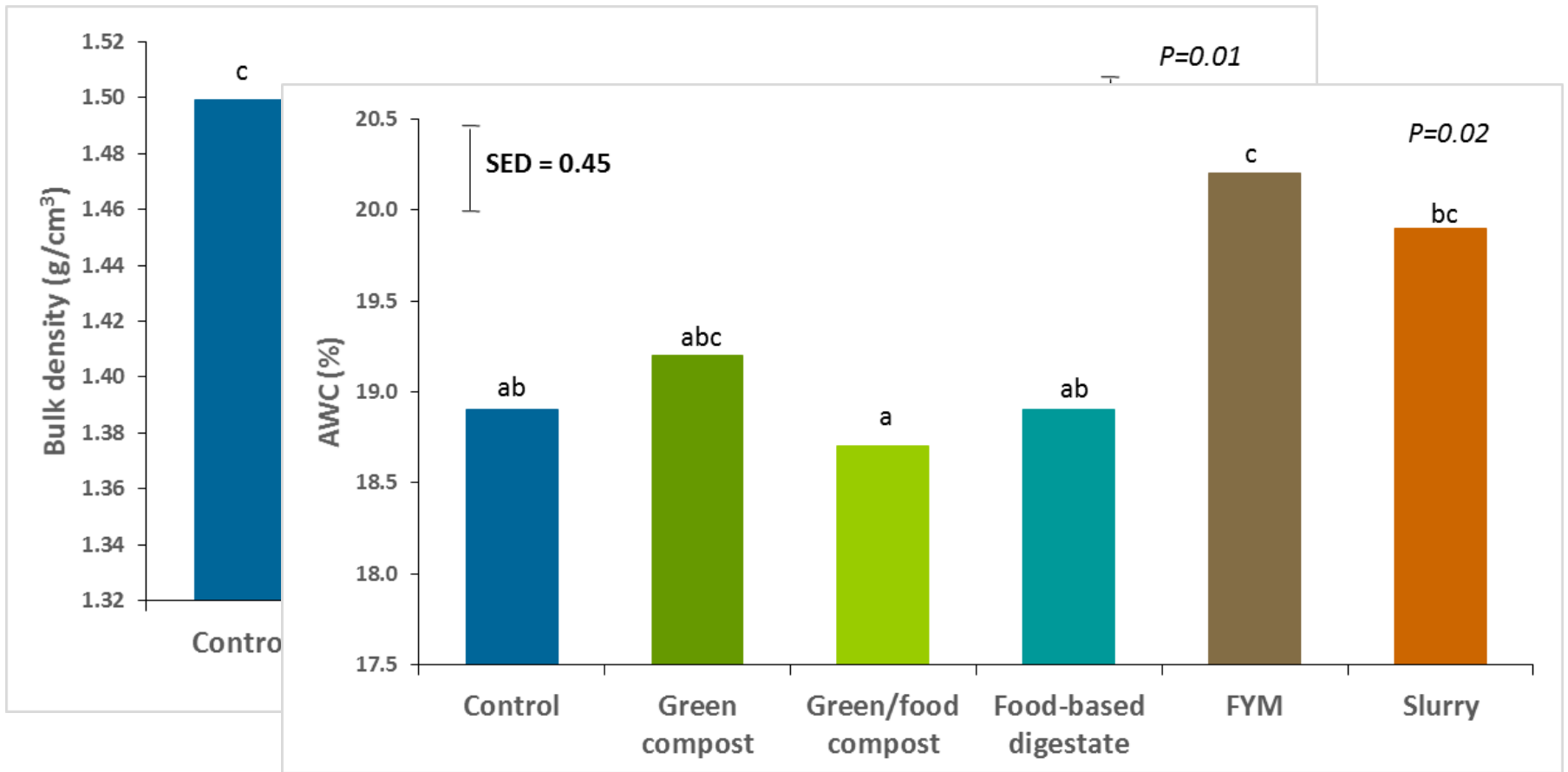
# Compost supplies stable (lignin-based) organic matter



# Soil biological properties



# Soil physical properties



Improvements in soil physical condition greater on the FYM & slurry treatments

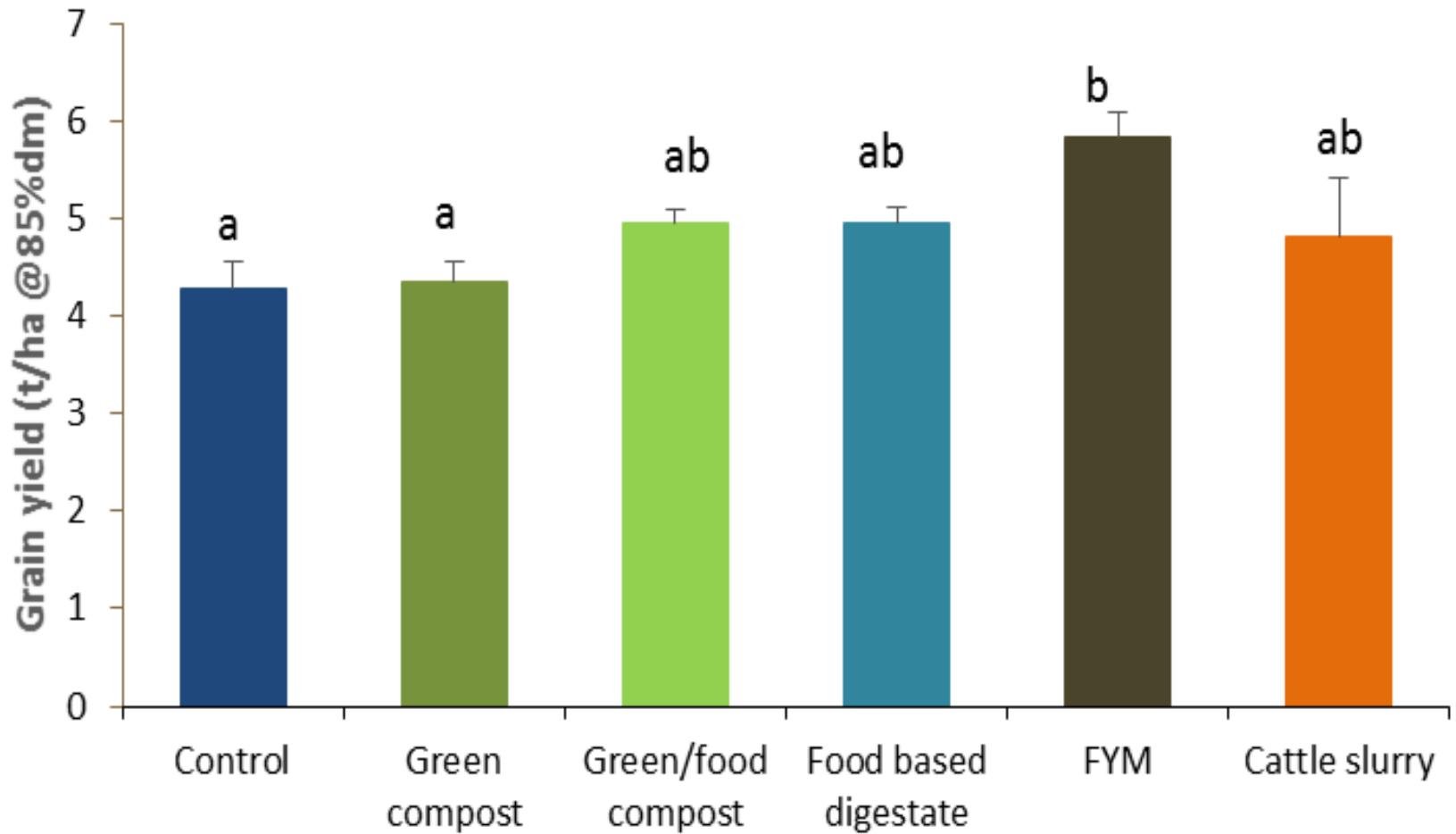
# Quantity & Quality matter

- **Decomposable OM (FYM):** Higher turnover rates, lower retention; More needed over a longer timescale; BUT supports higher biomass and has greater impact on soil physical functioning
- **Resistant OM (Compost):** lower turnover rates, higher retention, greater impact on bulk soil OM (& CEC) over shorter timescale; does improve soil biological and physical functioning, but to a lesser degree.

# Impact on crop yields

Winter wheat grain yield at Harper Adams (2013)

$P=0.05$





# Conclusions

- Soil biology & SOM (as food source) underpins soil function & managing soil health is largely about managing SOM
- Changing land use (e.g. arable to grassland) will increase soil organic matter levels but takes time
- Organic manures are a valuable source of organic matter and nutrients, which lead to improvements in soil health and crop yields, but not all materials are the same.
- It is important to consider the wider implications of practices which improve SOM, to minimize environmental impacts.



Thank you

Questions?

[John.Williams@adas.co.uk](mailto:John.Williams@adas.co.uk)

