The Use of Composts in Agriculture

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Warwick HRI

Project outline

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Warwick HRI

Staff at Warwick HRI

- Mary Dimambro
- Robert Lillywhite
- Clive Rahn
- Mary Turner

Programme

- Project outline
- Chemical characterisation of composts
- Field trial results
- Summary




EU landfill Directive (1999/31/EC)

BMW sent to landfill in the UK must be reduced to:

- 75% of the amount produced in 1995 by 2010
- 50% of the amount produced in 1995 by 2013
- 35% of the amount produced in 1995 by 2020

Since 50%+ of municipal solid waste is biodegradable, that means finding alternative routes of disposal for:

- between 4.9 & 7.7 Mt by 2010
- between 10.6 & 15.5 Mt by 2020

Waste in the UK

- Municipal solid waste = MSW
- Biodegradable municipal waste = BMW
  - Green waste
  - Food waste
  - Paper & cardboard

Composting in the UK

- 2003/04: 2 Mt BMW composted
  - 84% green waste
  - Composting of kitchen and other municipal wastes is in its infancy
- Area of up to 500,000 ha would be required to spread 15 Mt compost (rate: 250 kg N / ha)

Discussion of compost characteristics

Mary Dimambro




Talk summary

- The composts
- Compost analysis
- Results
- Summary

Sourcing the composts

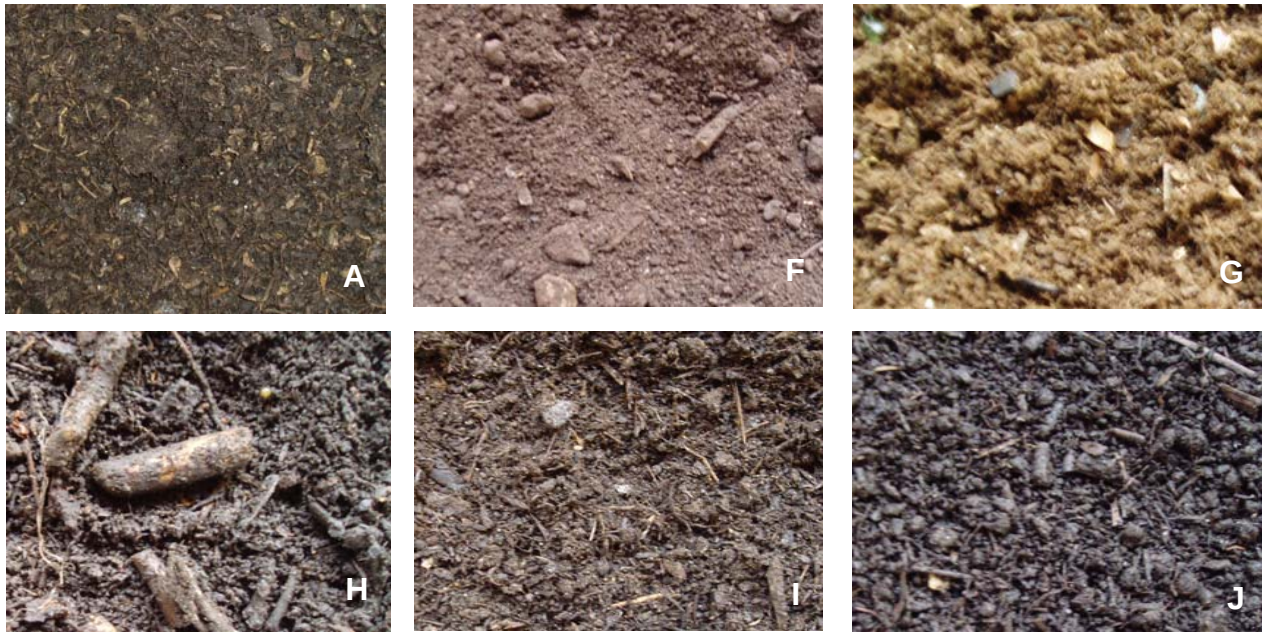
- UK composters contacted
- At least 15 companies compost BMW
  - Source segregated
  - Mixed MSW
- 12 composts obtained





The composts

- 12 used for initial characterisation
- 5 selected for the field trial



The composts

Feedstock	A	B	C	D	E	F	G	H	I	J	K	L
Green waste	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Straw					✓							
Fruit waste		✓			✓	✓						
Vegetable waste		✓		✓	✓	✓						
Potato waste								✓				
Milk waste			✓									
Paper	✓									✓		
Cardboard	✓				✓	✓			✓	✓		
Kitchen waste	✓									✓		✓
Catering waste										✓		
Pet food waste											✓	
Manure								✓				
Mixed MSW							✓					✓
System	VE	VE	OW	VE	OW	OW	VE	OW	VE	VE	VE	VE

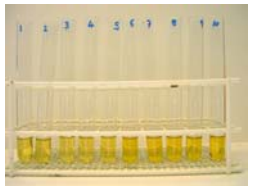
VE=In Vessel, OW=Open Windrow

Compost analysis

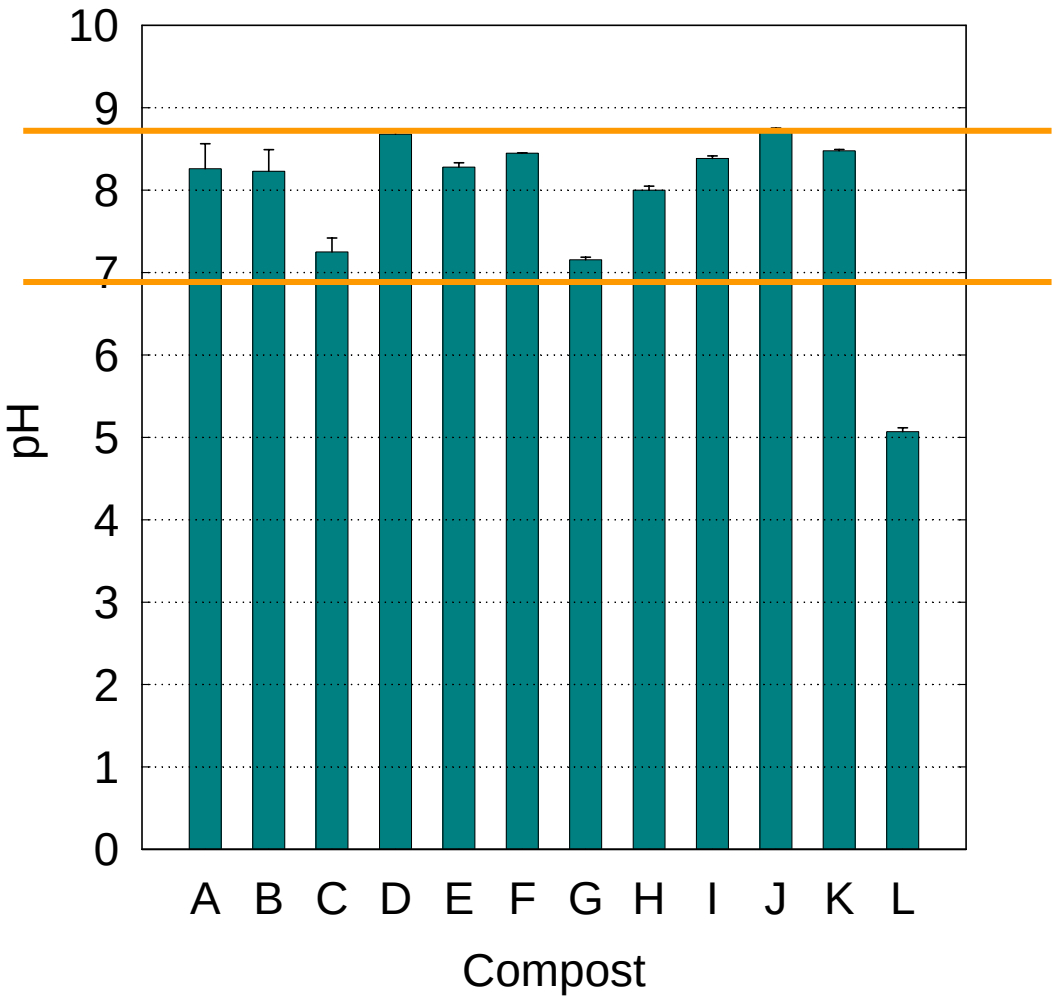
- British Standard methods for soil improvers and growing media
- Recommended by BSI PAS 100
- Performed at
  - Warwick HRI
  - Direct Laboratories, Wolverhampton

Compost analysis

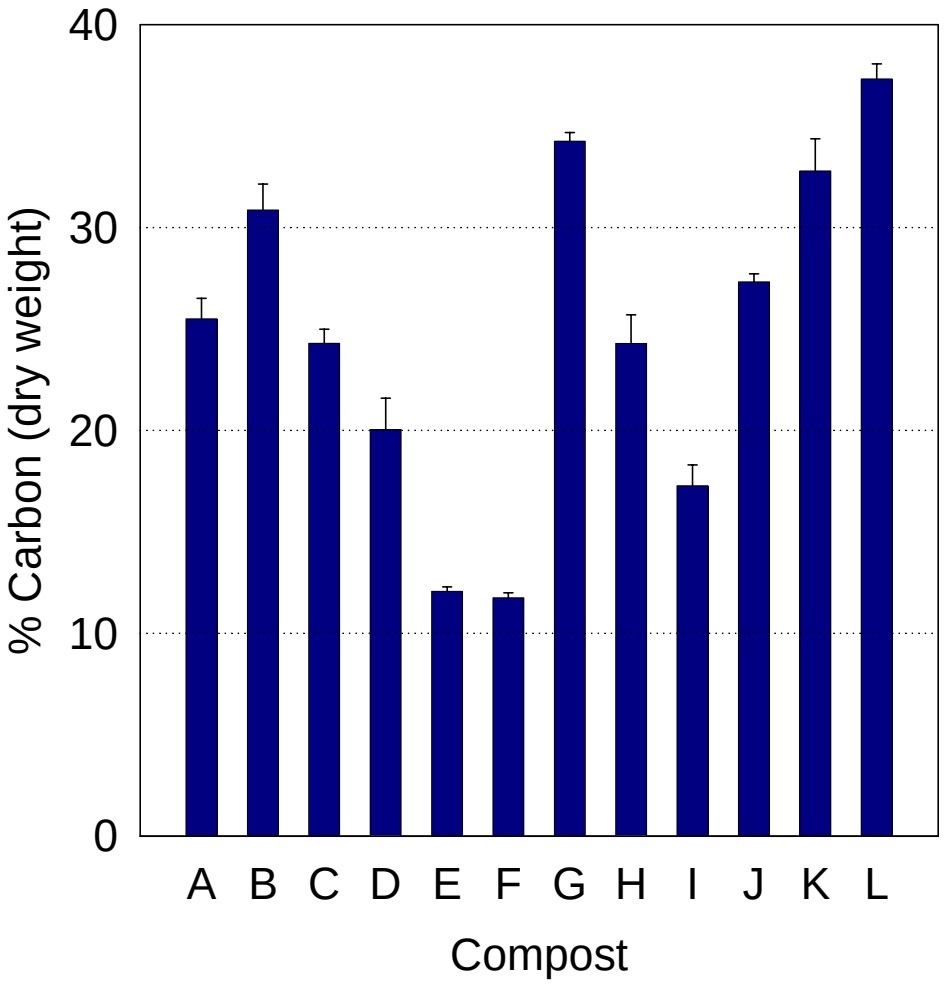
- Characterisation:
  - Moisture content, bulk density, pH, conductivity, organic matter, nutrients
- Proximate analysis:
  - Water soluble carbohydrates, cellulose, lignin, ash
- Heavy metals
- Total coliforms, *E. coli*, *Salmonella*
- Bioassay



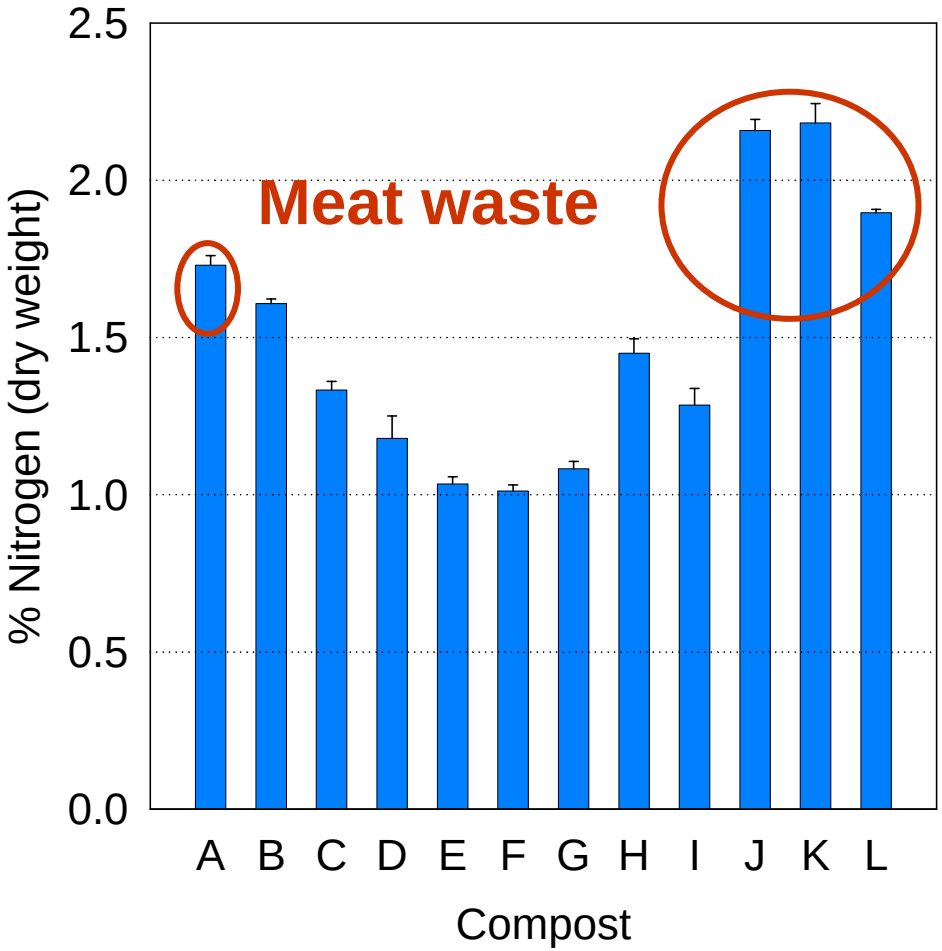
Results: pH



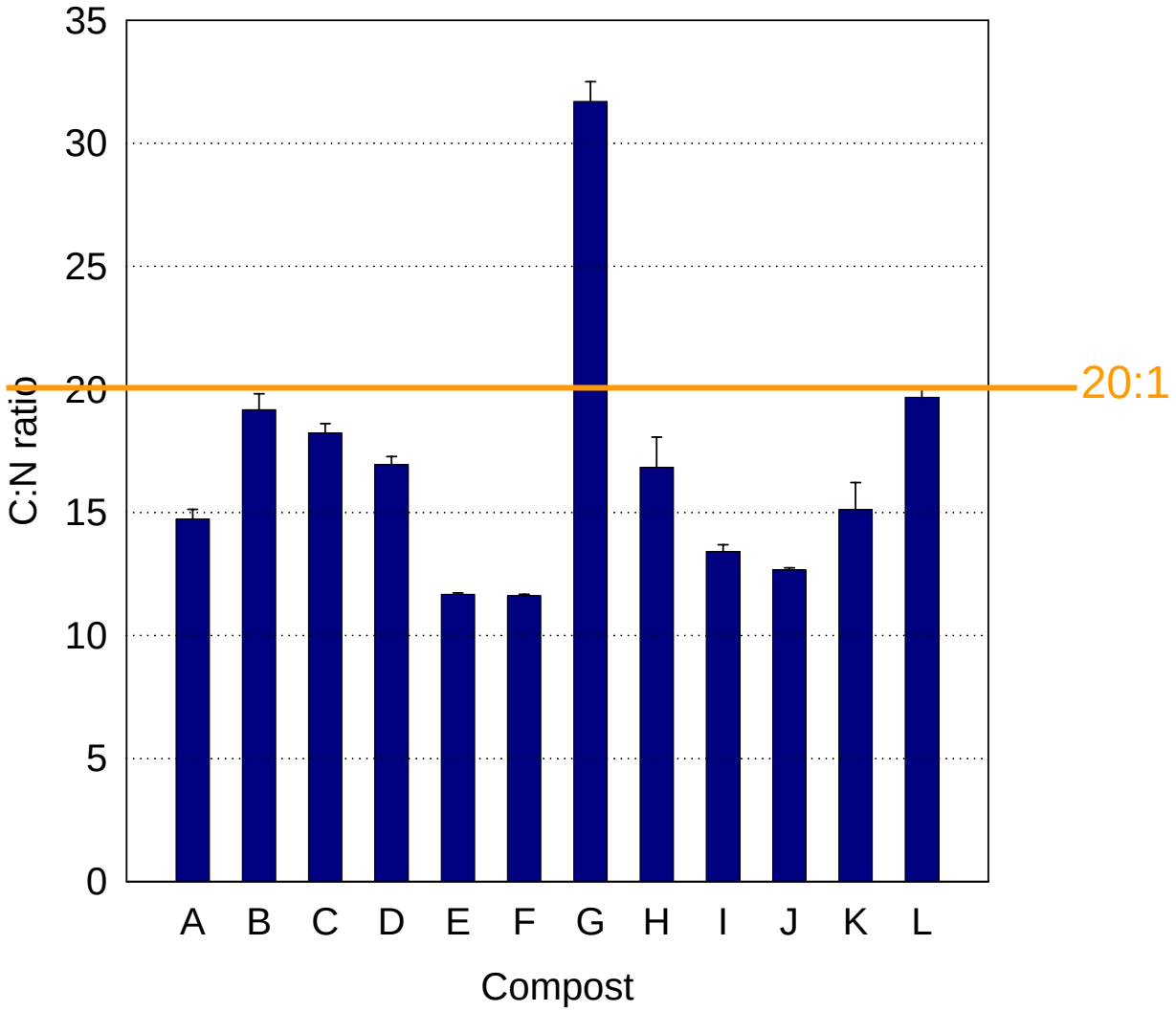
Results: Carbon



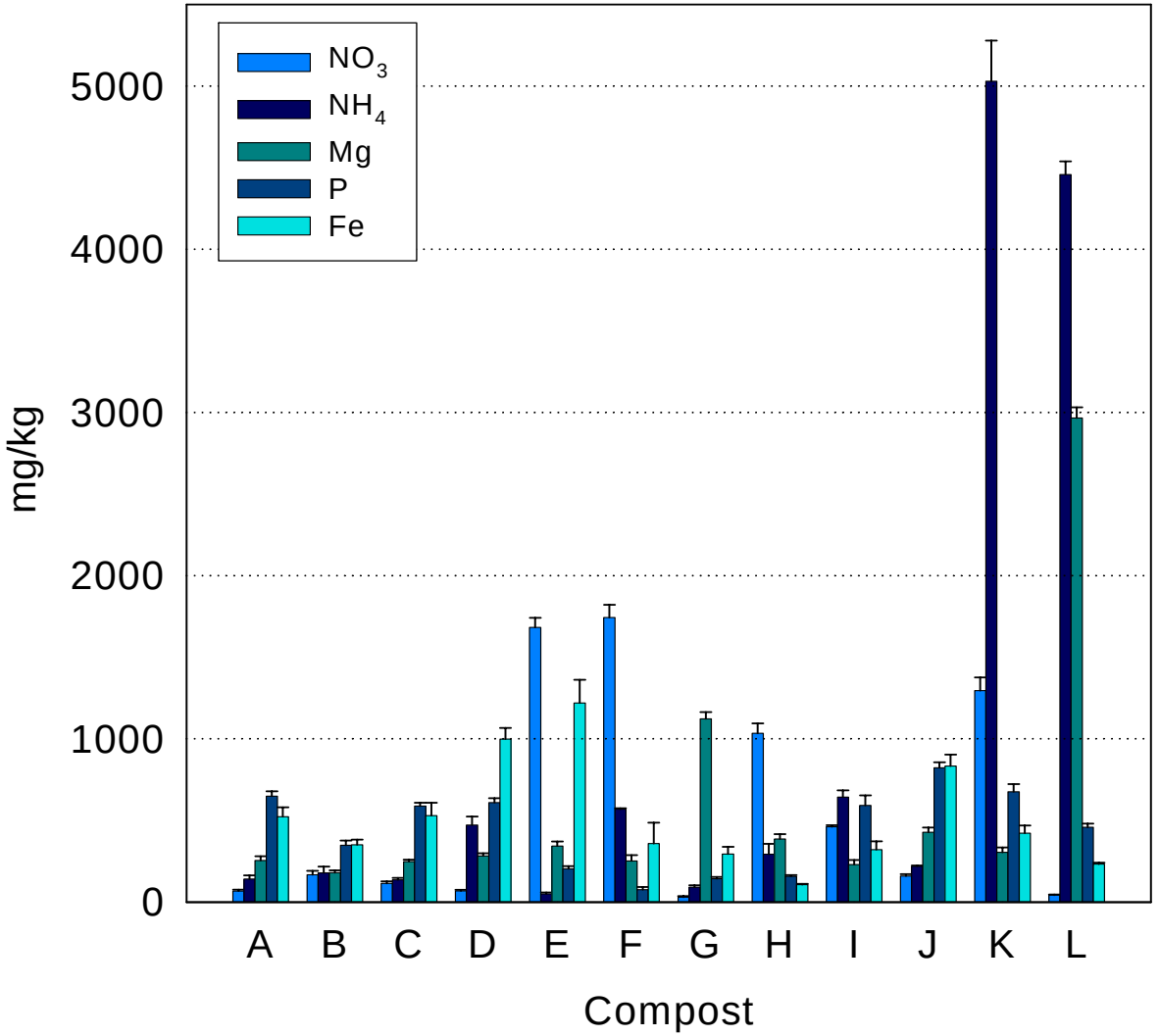
Results: Nitrogen



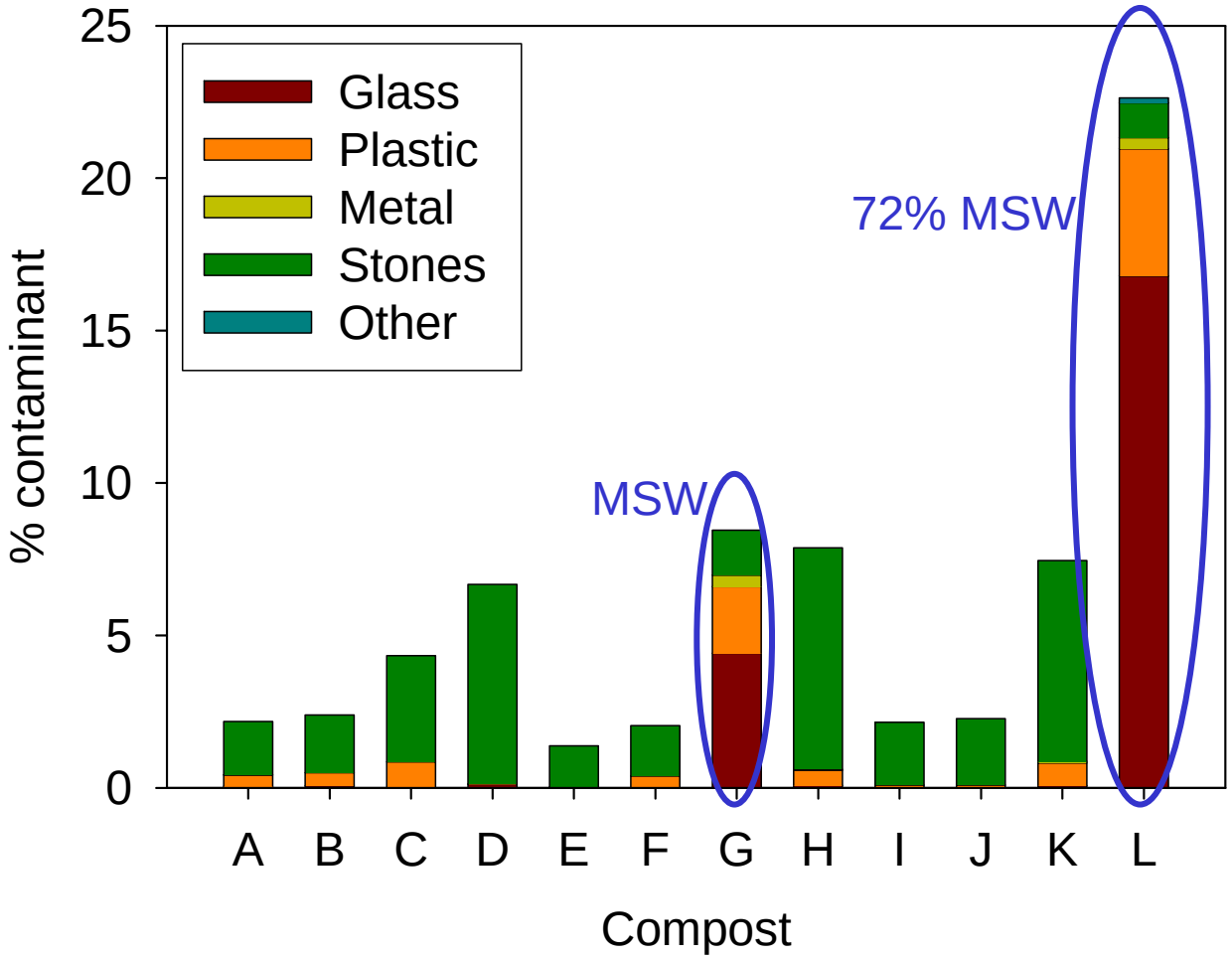
Results: C:N ratio



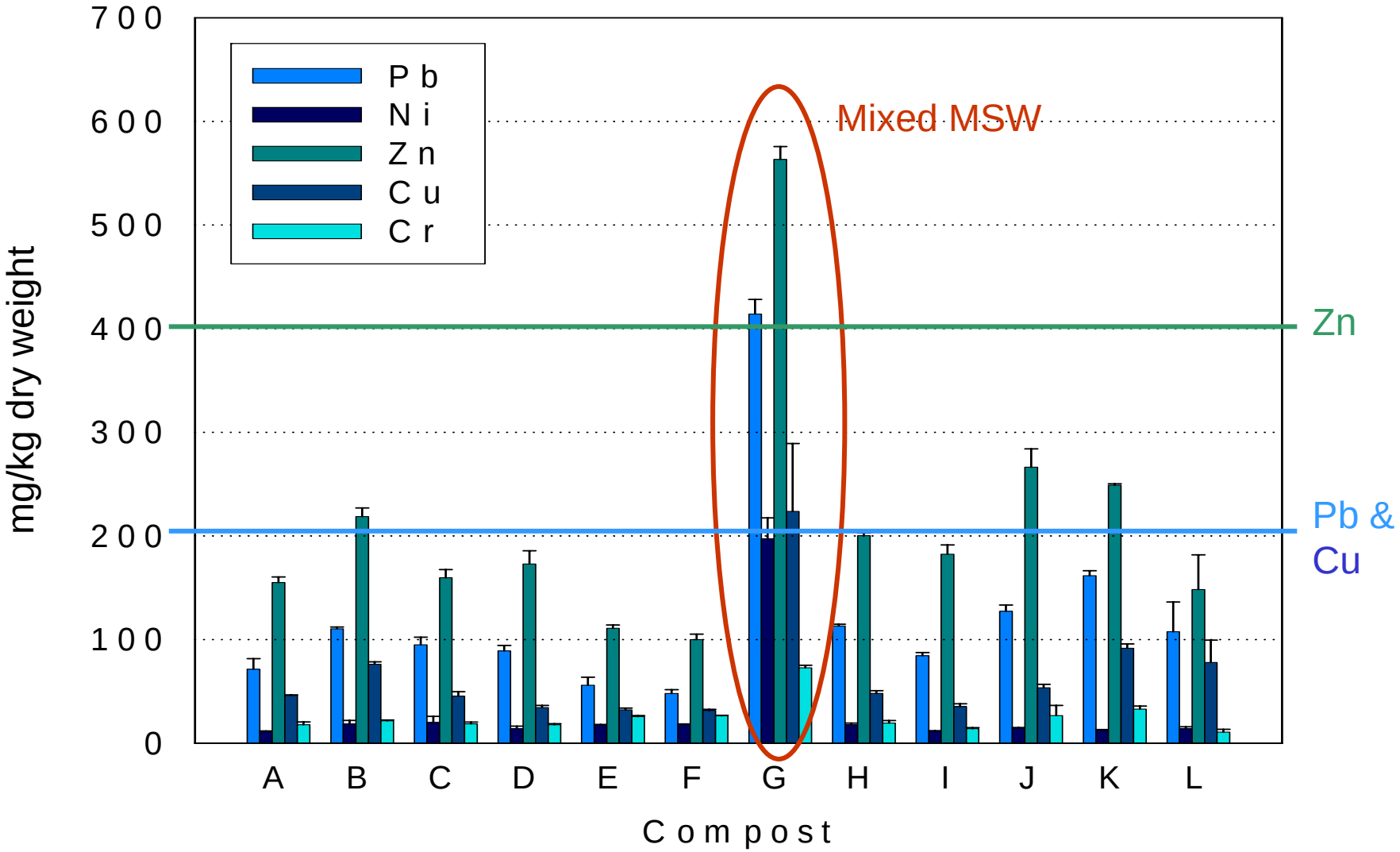
Results: Nutrients



Results: Contaminants



Results: Heavy Metals



Methods: Germination Test

Composts used

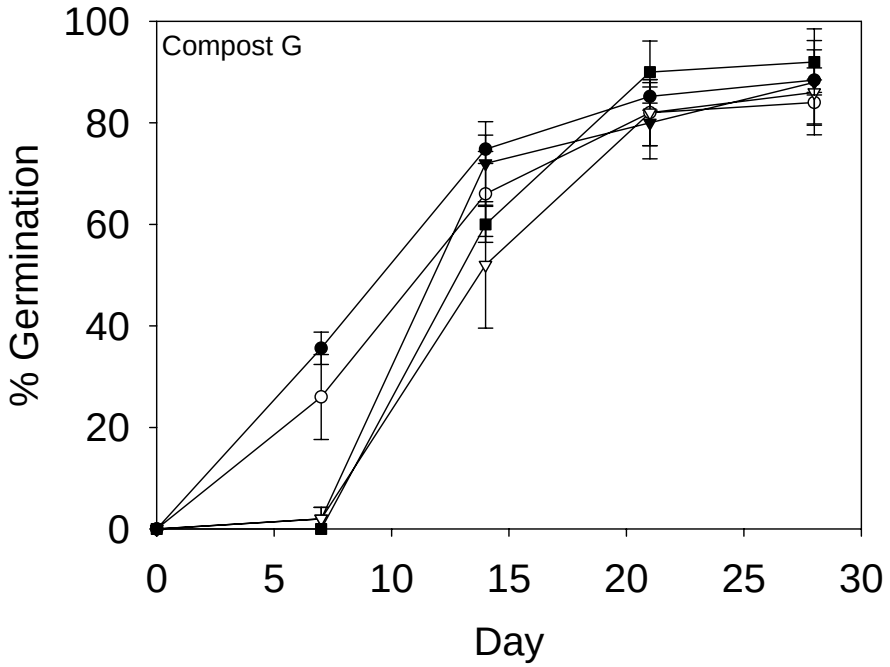
	Feedstock
A	Green & kitchen waste, paper, cardboard
B	Green waste, fruit & vegetable waste
F	Green waste, fruit & vegetable waste, cardboard
G	MSW
J	Green & kitchen waste, paper, cardboard, catering waste

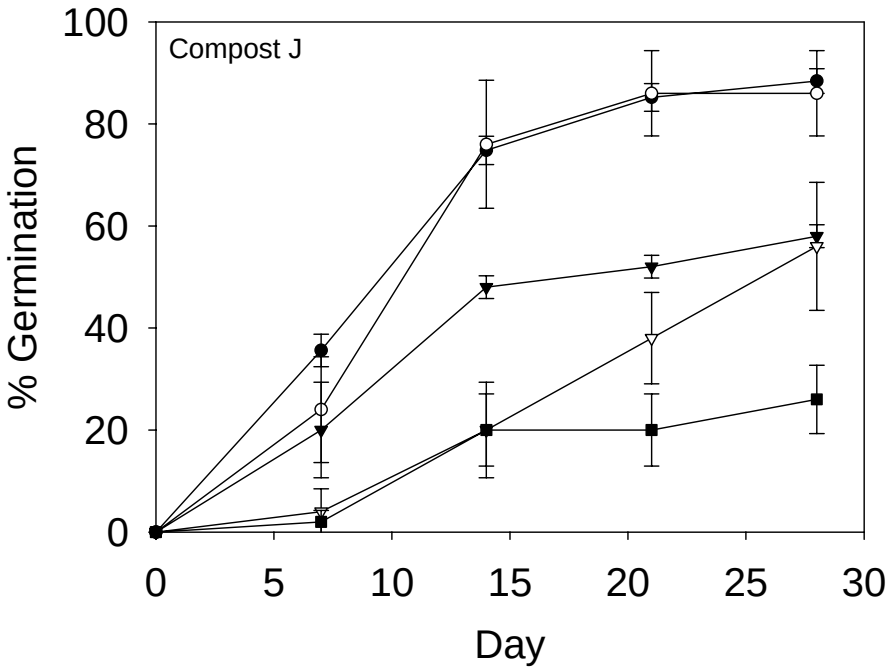
Methods: Germination Test

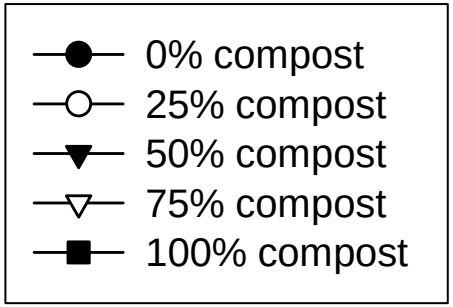
Compost	Peat
0%	100%
25%	75%
50%	50%
75%	25%
100%	0%

Day 14

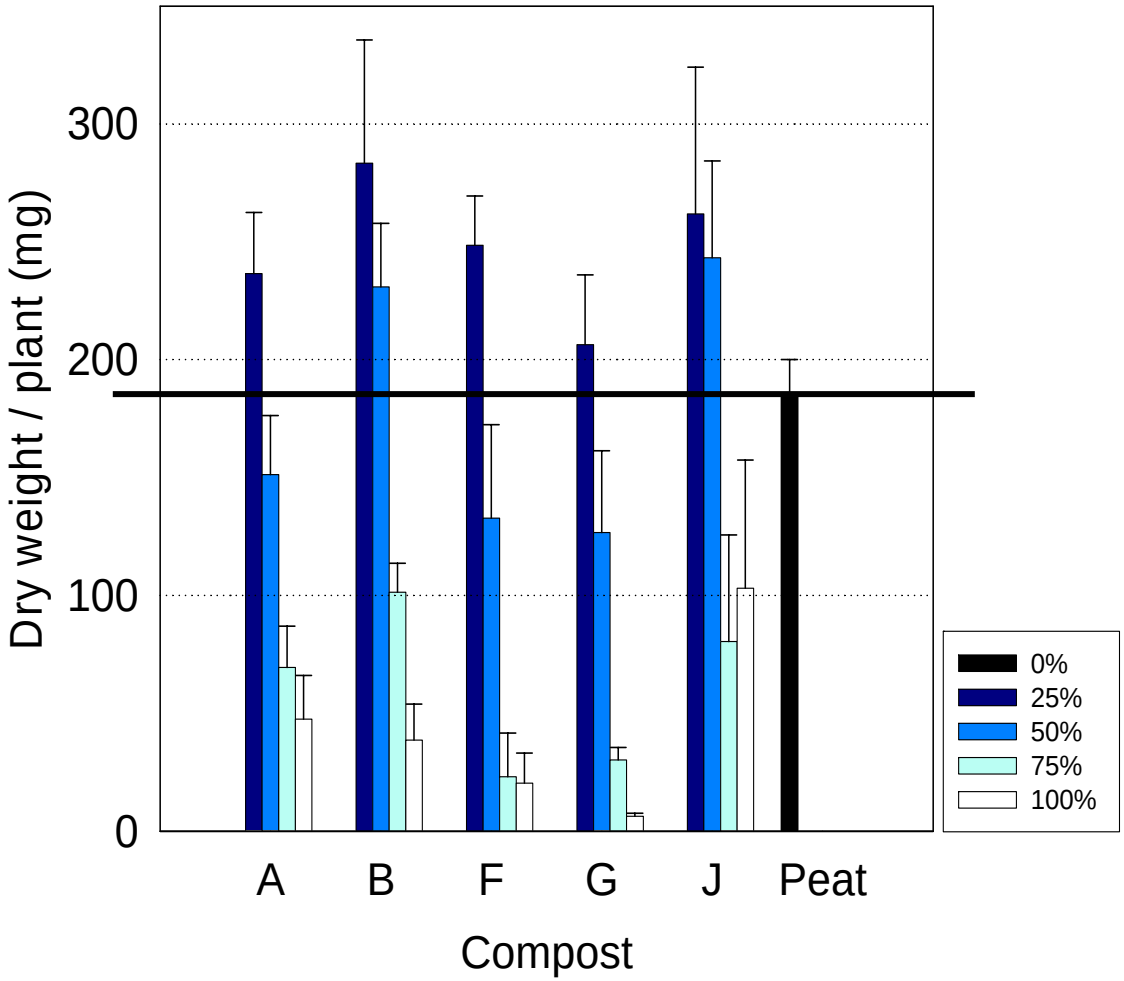
Results: Germination







Results: tomato yield



Bioassay summary

- 25% compost:
  - does not inhibit germination
  - does not reduce plant growth

- 100% compost:
  - reduces germination
  - reduces growth

Compost summary

- 100% MSW compost
  - High physical contaminants (glass, plastic)
  - High C:N ratio
  - High heavy metals (some exceed PAS 100)

Compost summary

- Source segregated composts
  - Generally within or close to PAS 100 limits
  - Low physical contaminants (mostly stones)
  - Low heavy metals
  - Range of nutrient concentrations

Compost analysis

- More details in the technical report

The field trial

Rob Lillywhite




Breakdown of presentation

- **Composts used**
- **Field trial design**
- **Data collection**
- **Results**
- **Discussion**




Composts used

	Feedstock	System	End use
A	Green & kitchen waste, paper, cardboard	In-vessel	Agricultural land, reclamation, landfill cover
B	50% green waste, 50% fruit & vegetable waste	VCU	Soil conditioner
F	30-40% green waste, 60-70% fruit & vegetable waste, cardboard	Windrow	Landscaping, agricultural land
G	MSW	In-vessel	Landfill cover
J	Green & kitchen waste, paper, cardboard, catering waste	In-vessel	Soil conditioner

Field trial design

5 composts (A, B, F, G & J) x

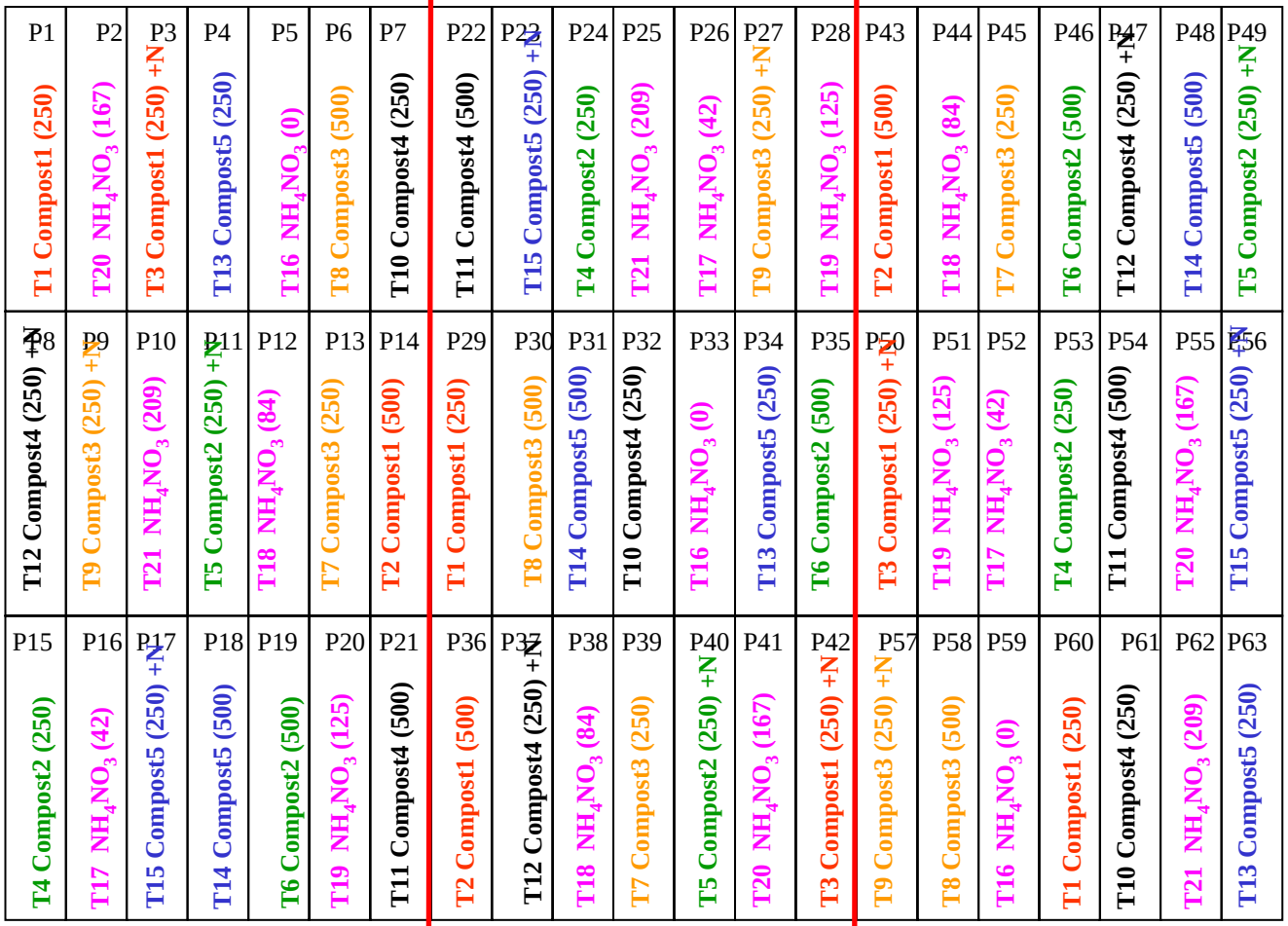
3 treatments (250, 500 & 250+125 kg/ha N) +

6 fertiliser (0, 42, 84, 125, 167 & 250 kg/ha N) x

3 replicates = 63 plots




Field trial design



WARWICK

Compost incorporation

Compost	%N	Amount (t/ha) to give 250 kg/ha N	Amount (t/ha) to give 500 kg/ha N
A	1.73	26.3	53.7
B	1.61	40.9	81.8
F	1.01	31.0	62.3
G	1.08	33.8	67.6
J	2.16	24.9	49.8




Data collection

Barley

- **Above ground yield – day 50**
- **Grain yield - final harvest**

Soil

- **Pre-drilling**
- **Pre-top dressing**
- **Post-harvest**

Field trial

Location: Warwick HRI, Wellesbourne

Crop: Spring barley, variety Optic

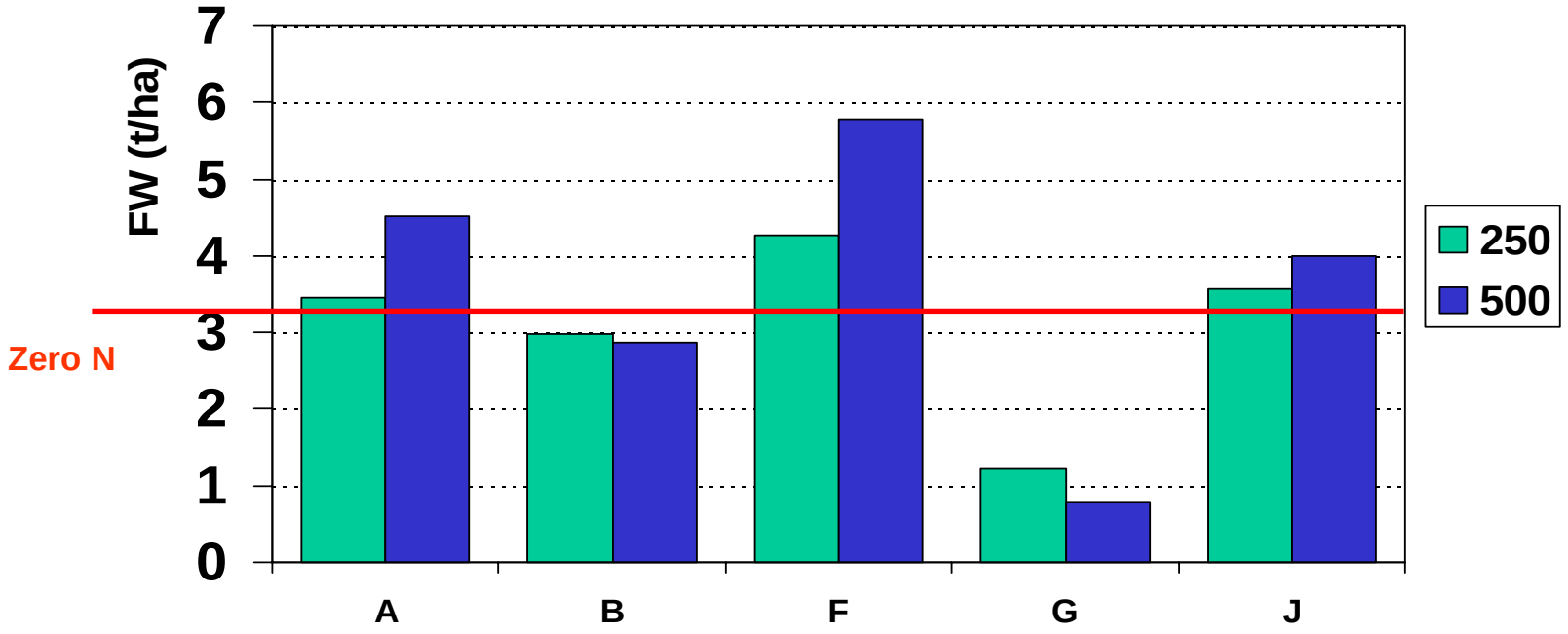
Composts incorporated: 14th March 2005

Drilled: 15th March 2005

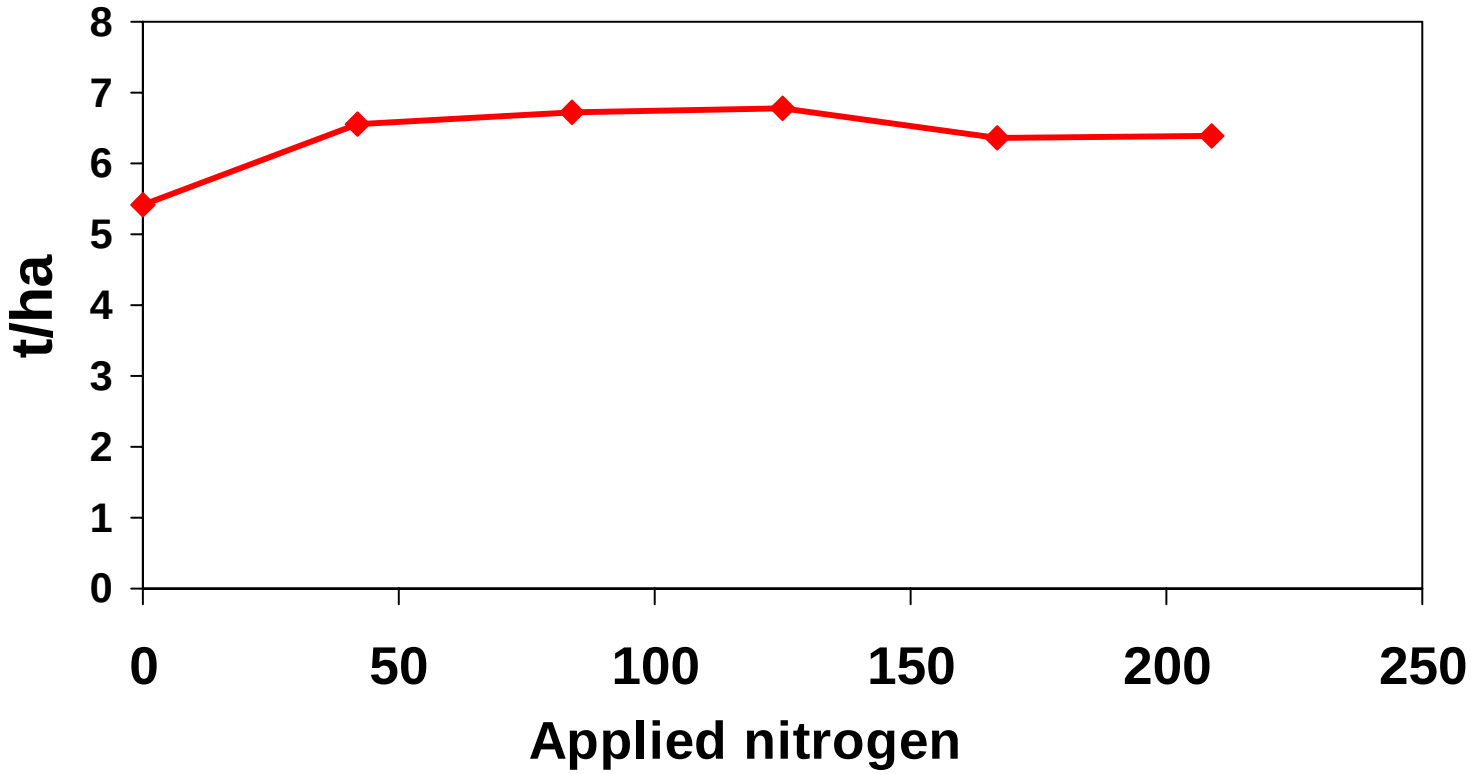
Harvested: 4th August 2005



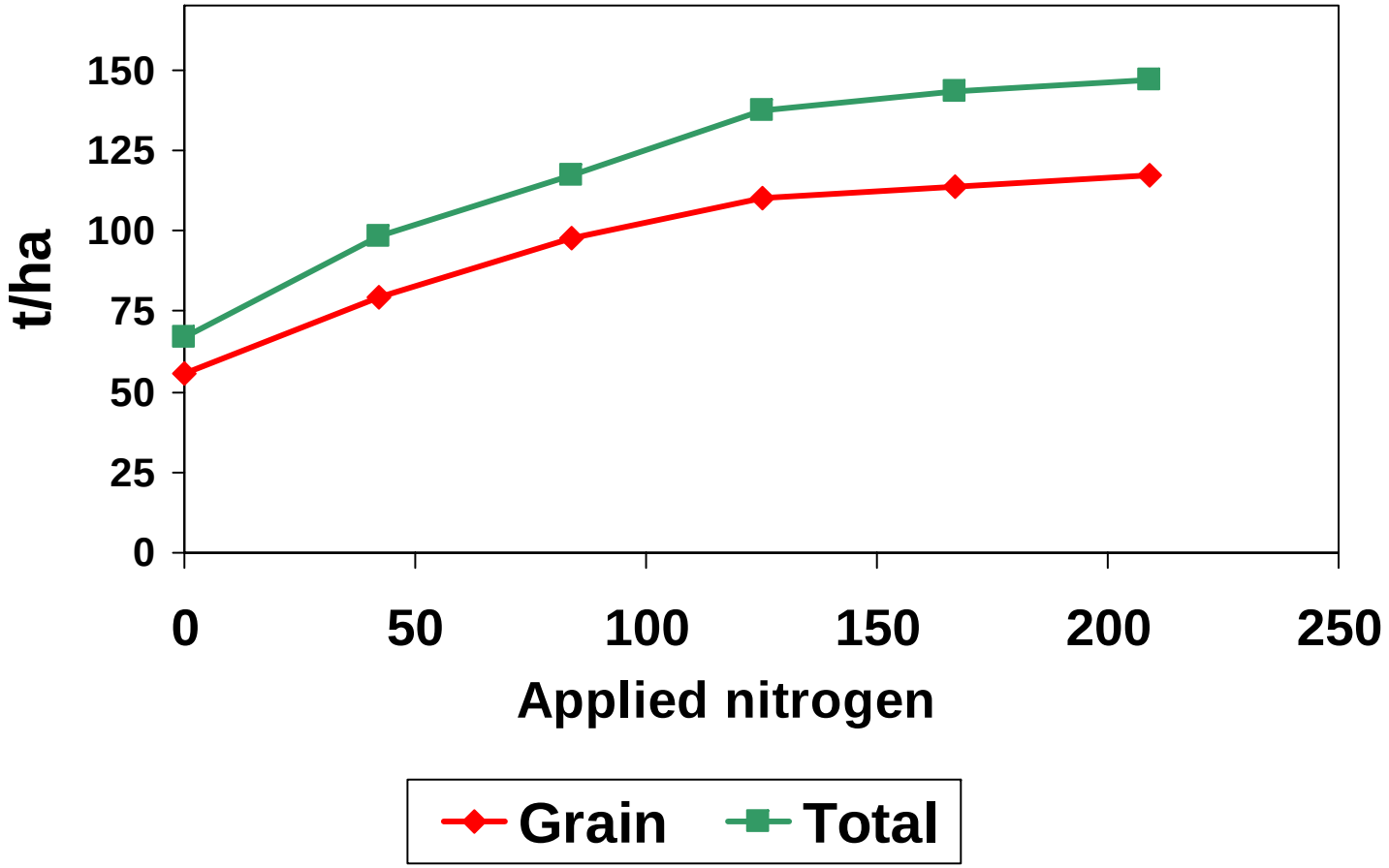

Yield pre top dressing



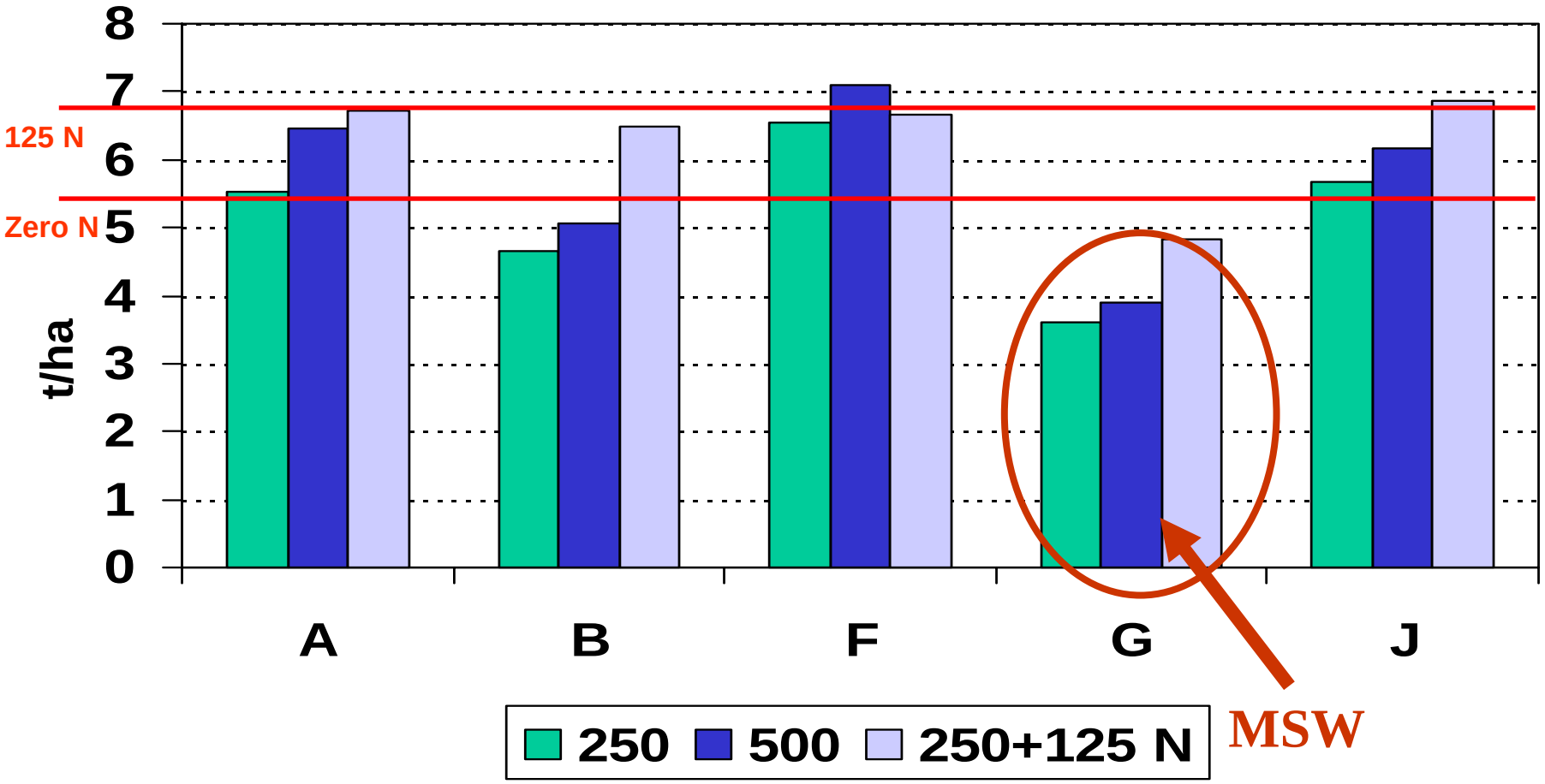
Grain yield at harvest



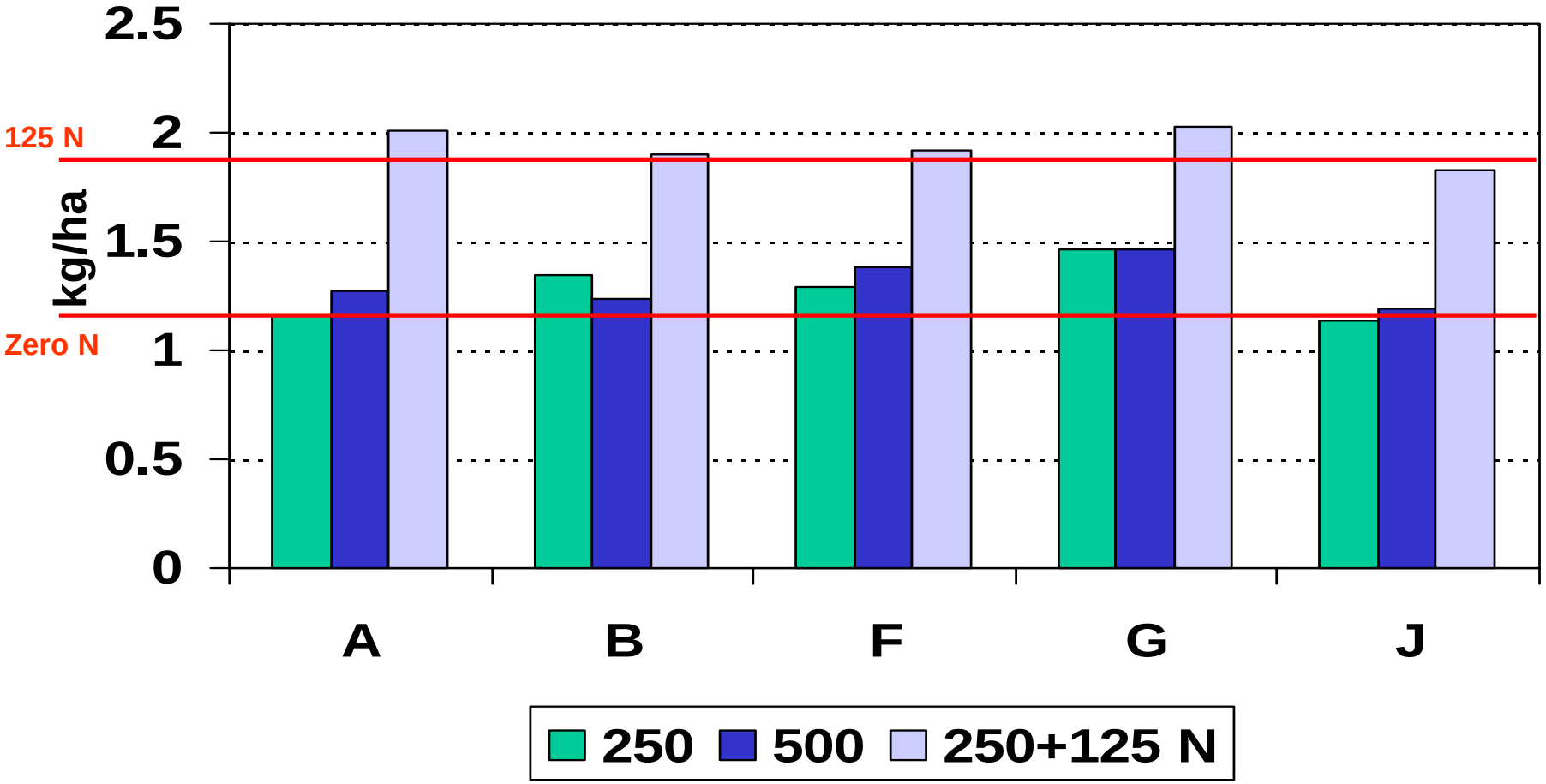
N uptake at harvest



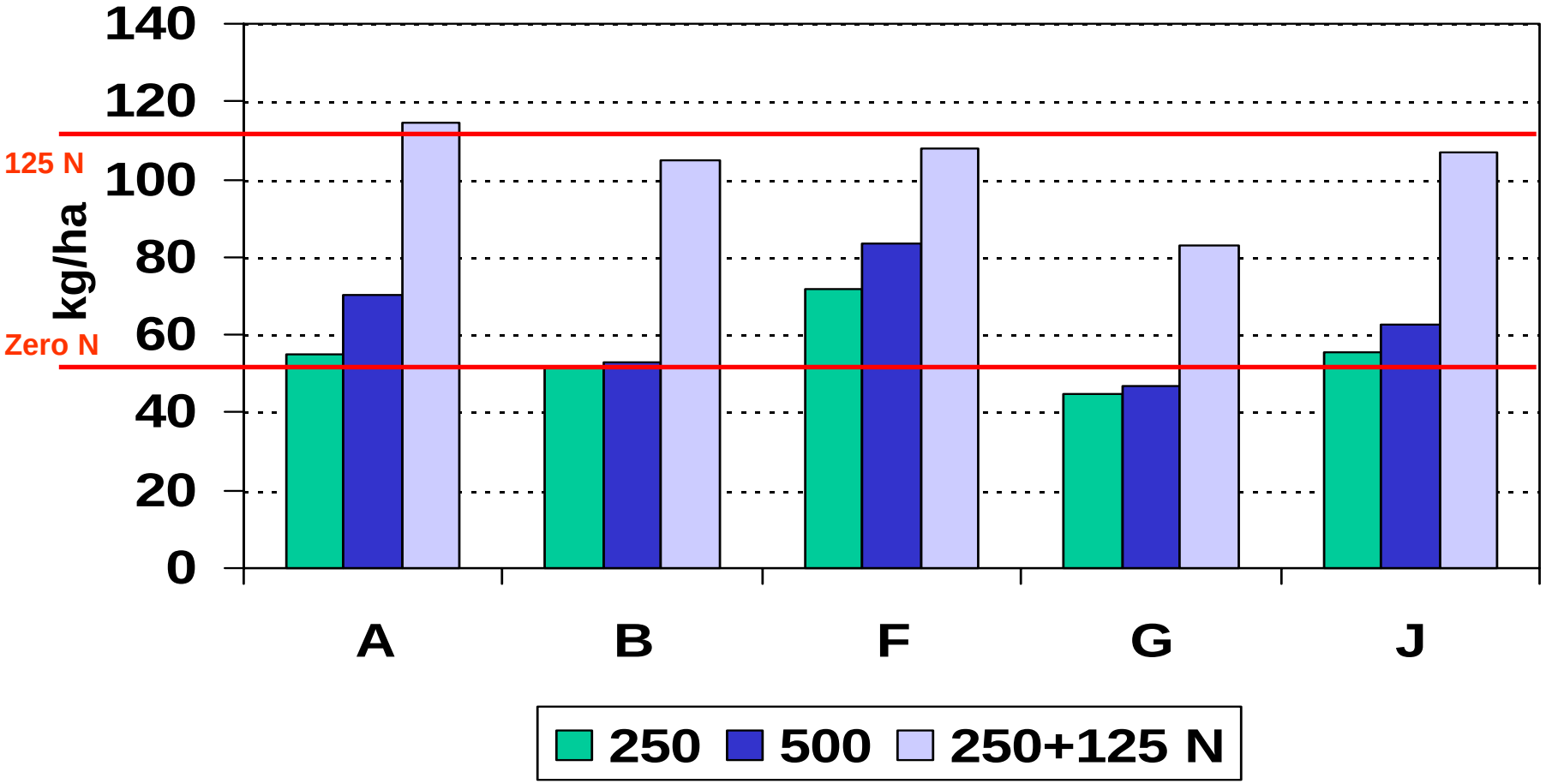
Grain yield at harvest



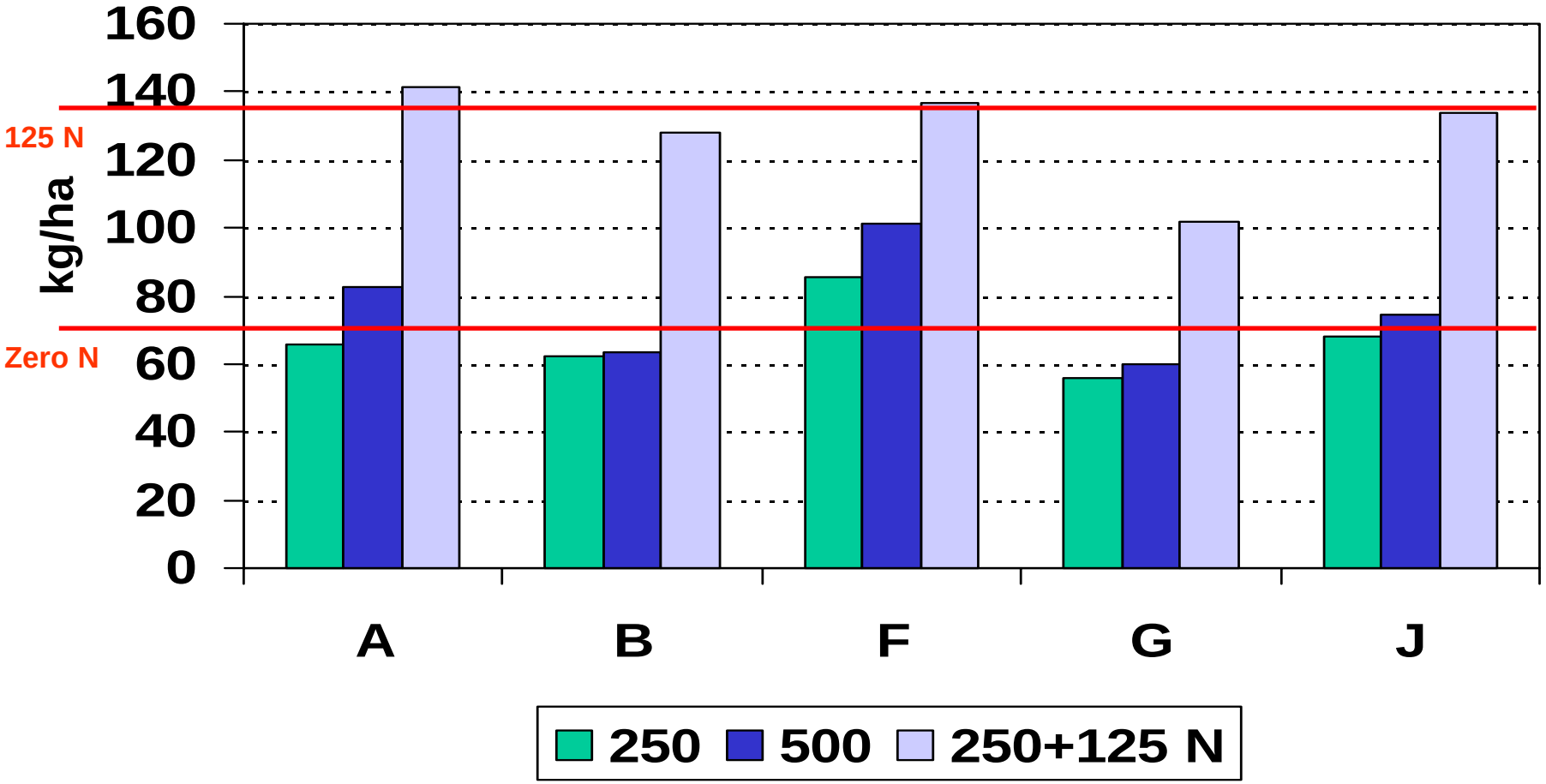
Grain %N at harvest



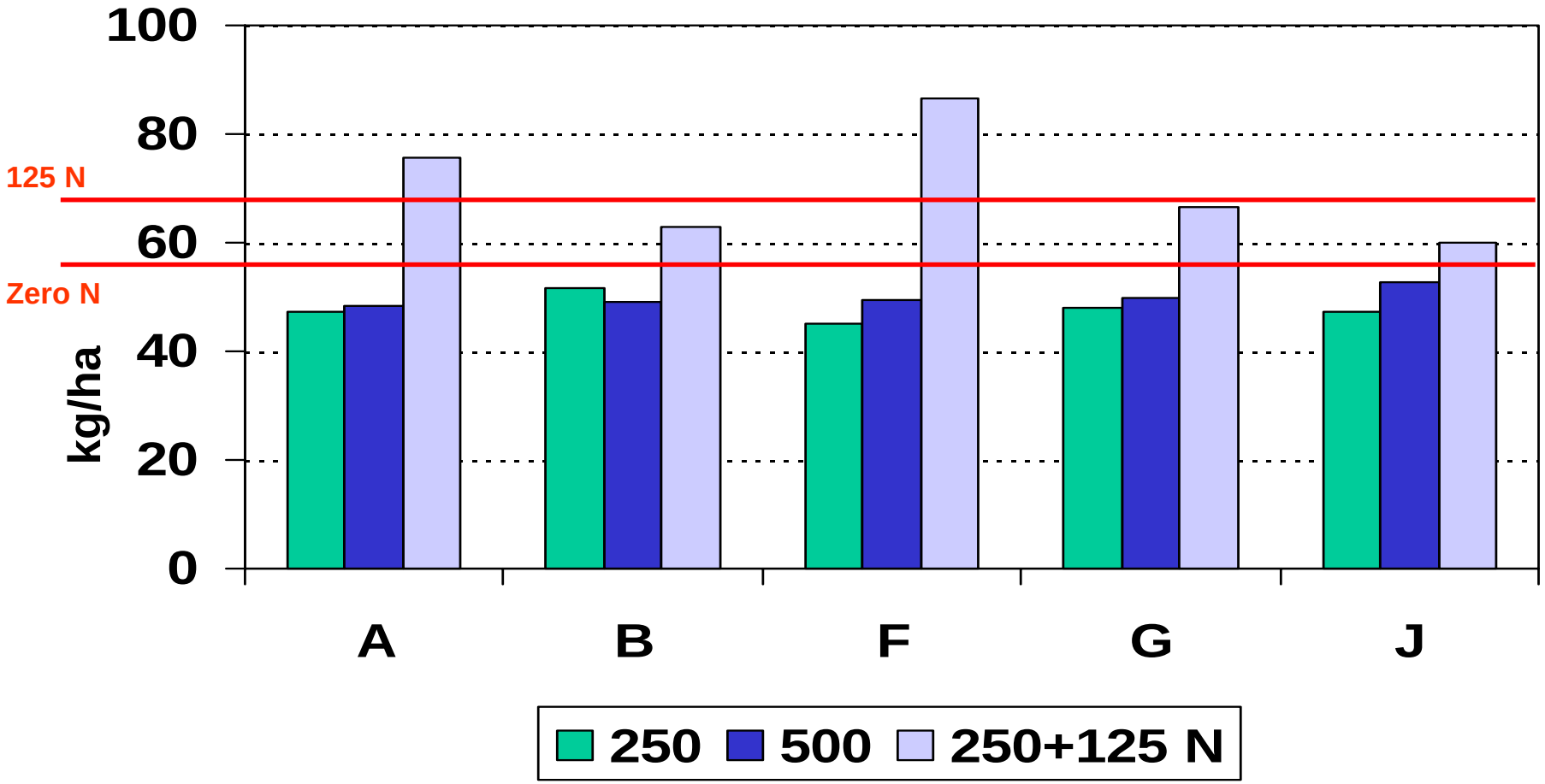
Grain N uptake at harvest



Total N uptake at harvest



Soil min N (0-60 cm) at harvest



Heavy metal content of grain

The barley grain was analysed for:

- **chromium**
- **copper**
- **lead**
- **nickel**
- **zinc**

Application of compost G resulted in a slight increase in copper content and a significant increase in levels of zinc.

Heavy metal content of soil

Soils were analysed on 3 occasions for:

- **chromium**
- **copper**
- **lead**
- **nickel**
- **zinc**

Application of compost G resulted in a slight but not significant increase in levels of lead, nickel and zinc.

What does it all mean?

Composts A, F and J are suitable for application to agricultural land without adverse effects.

Compost F is the only compost with nitrogen fertilising value in the first year of incorporation.

Due to higher levels of heavy metals and sodium, compost G cannot be recommended for application to agricultural land.

Summary

Mary Dimambro




Compost summary

- **All composts contain**
  - **Organic matter**
  - **Nitrogen**
  - **Essential nutrients**

Compost summary

- **Source segregated composts**
  - **Low physical contaminants**
  - **Low heavy metals**
  - **Range of nutrient concentrations**

Compost summary

- **100% MSW compost**
  - **High physical contaminants (glass, plastic)**
  - **High heavy metals**
  - **Range of nutrients**

Field trial summary

- **No significant fertilising effect was obvious in the first year of compost incorporation**
- **Composts A, F, and J**
  - **containing mainly plant and food waste**
  - **no adverse effects**
  - **showed agricultural benefit**

Field trial summary

- **Compost B**
  - **slightly reduced establishment and yield**
  - **higher levels of lead and zinc**
- **Compost G**
  - **adversely affected plant establishment and yield**
  - **higher levels of all heavy metals**

Recommendations

- **Source segregated composts**
  - **Low heavy metals**
  - **Can be of agricultural benefit**
- **Compost + fertiliser best combination**

- **Mixed waste composts not recommended**

Technical report

- **Available soon as a pdf**
- **Please ensure we have your email address**

Acknowledgements

- Onyx Environmental Trust
- DEFRA
- The compost suppliers
- Direct Laboratories
- Warwick HRI Analytical Laboratory