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HIGH ROOT BIOMASS FOR CEREAL CROPS INCREASES CARBON SEQUESTRATION IN ORGANIC ARABLE SYSTEMS

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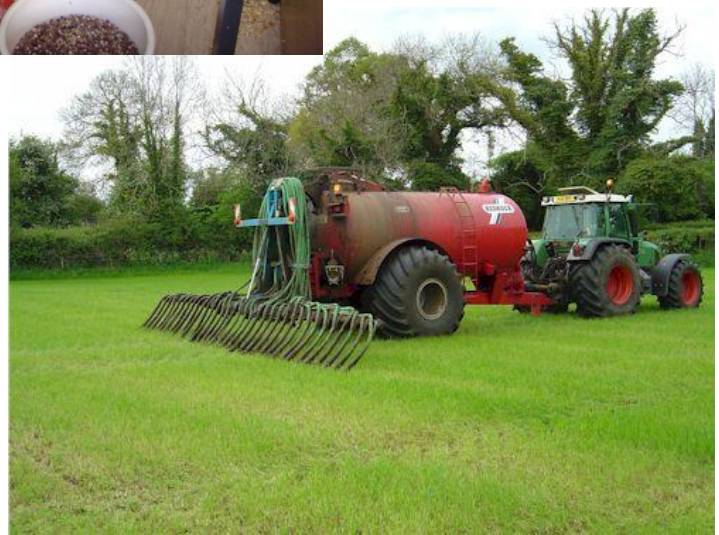
STRUCTURE OF PRESENTATION

- Introduction
- Hypothesis
- Experimental layout and management
- Methodology
- Results
- Conclusions
- Acknowledgements

CARBON SOURCES FOR ARABLE SOILS

- Shoot residues
- Manure
- Root residues?



ROOT C INPUT

- Literature on root C input in agroecosystems limited.
- Root derived C has long residence time in soil
- Knowledge gap leads to increased uncertainity of C sequestration in arable systems
- Root C input estimated using fixed shoot-to-root ratio
- **The question is; does root root C input in organic and inorganic fertilizer-based systems differ?**

HYPOTHESIS

Limited nutrient availability leads to higher macro-root C input in low-input organic compared to high-input inorganic fertilizer-based systems

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CROPPING SYSTEMS (2005-2008)

Inorganic fertilizer-based system C4/+IF/-CC

spring barley → faba bean → potato → winter wheat

Organic system O4/+M/-CC

spring barley → faba bean → potato → winter wheat

Organic system O4/+M/+CC

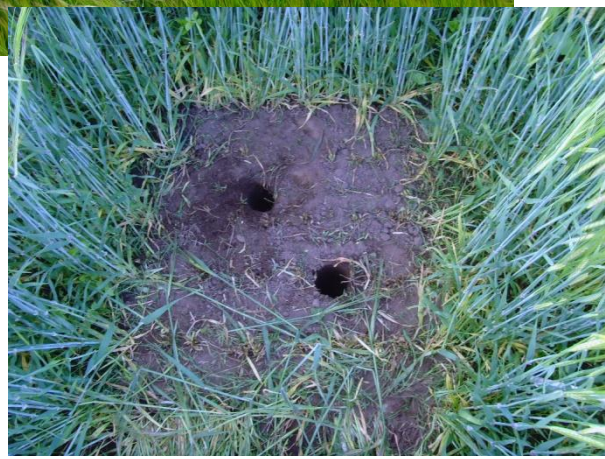
spring barley^{CC} → faba bean^{CC} → potato → winter wheat^{CC}

2007 and 2008:Internal and external N sources (kg N ha^{-1})

2008 crop	system	Catch crops & weeds	Fertilization	Total N input
S. barley	C4/+IF/-CC	14	130	144
	O4/+M/-CC	12	57	69
	O4/+M/+CC	56	57	113
W. wheat				
	C4/+IF/-CC	0	165	165
	O4/+M/-CC	0	108	108
	O4/+M/+CC	0	108	108

METHODOLOGY

- At anthesis (2008), soil cores (ca. 5 cm diam.) from 0-30 cm depth
- Three seperate soil cores taken from both within and between crop rows
- Soil seperated from roots and washed with tap water and collected on a seive (mesh size 0.425 mm)
- Shoot DM biomass and ash-free root DM biomass determined
- Shoot-to-root ratio



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RESULTS

Crop & crop system	Shoot	Root	Shoot-to-root ratio	Grain yield
Winter wheat	___ g DM m^{-2} ____			
C4/+IF/-CC	1121	206	5.4	947[a]
O4/+M/-CC	870	292	3.0	503[b]
O4/+M/+CC	976	250	3.9	631[b]
Spring barley				
C4/+IF/-CC	576[a]	154[a]	3.7[a]	548[a]
O4/+M/-CC	375[b]	201[b]	1.9[b]	329[b]
O4/+M/+CC	565[a]	236[c]	2.4[b]	518[a]

SCENARIO 1

By using the spring barley S/R ratio obtained in the inorganic fertilizer-based system (3.7) to calculate root DM biomass in organic systems, we underestimate root DM biomass

System	Modelled	Measured	difference
	g DM m^{-2}		
O4/+M/-CC	101	201	-100 (50%)
O4/+M/+CC	153	236	-83 (35%)

SCENARIO 2

By using the spring barley S/R ratio in the organic O4/+M/-CC system (1.9) to calculate root DM biomass in the inorganic and the organic fertilizer-based system with catch crops we overestimate root DM biomass

System	Modelled	Measured	difference
	g DM m^{-2}		
C4/+IF/-CC	303	154	+149 (97%)
O4/+M/+CC	297	236	+61 (26%)

CONCLUSIONS

- Cereals in low-input organic systems have higher root DM biomass than those in high-input inorganic fertilizer-based systems
- The high root DM biomass may enhance C sequestration in organic arable systems
- Catch crops led to both high C sequestration and grain yield
- Use of shoot biomass and fixed S/R ratios to estimate root biomass leads to erroneous estimates of root C inputs in organic and inorganic fertilizer-based arable systems

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