

Soil nitrogen mineralisation, microbial community, and enzymatic activity are impacted by soil type and nutrient management

Sorcha Kelly

Supervised by : Fiona Brennan, David Wall, Eric Paterson, Roy Neilson,
Florence Abram



@SorchaRKelly2



NUI Galway
OÉ Gaillimh



The James
Hutton
Institute



Soil Organic Matter

- SOM is a mixture of complex organic compounds.
- It is important for:
 - ❖ Store of nutrients
 - ❖ Maintaining soil structure
 - ❖ Water retention capacity
 - ❖ Maintaining biological productivity
- Mineralisation is the decomposition of SOM releasing nutrients
- Potential amount of N mineralisation occurring in a soil is essential to determine more specific fertiliser plans
 - For a similar yield outcome, different soils will need different quantities of N fertiliser top-up



Research Questions

- How do soil type and treatment effect
 - Potential N mineralisation
 - Enzymatic activity
 - Microbial community structure

Site	pH	SOM (g/kg)	N mineralisation potential (NH ₄ /kg)
Moorepark 1 (MP1)	6	83	161.4
Moorepark 4 (MP4)	5.5	81	151.1
Johnstown Castle (JC2)	5.7	92	260.6
Grange (GR1)	6	104	335.8















Solarium Pot Experiment Facility at Johnstown castle. Long term trial. Established more than 5 years. Grass used is *L. perenne*

Treatments applied to soils (pots)

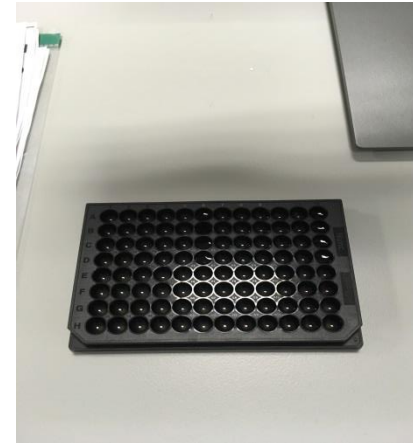
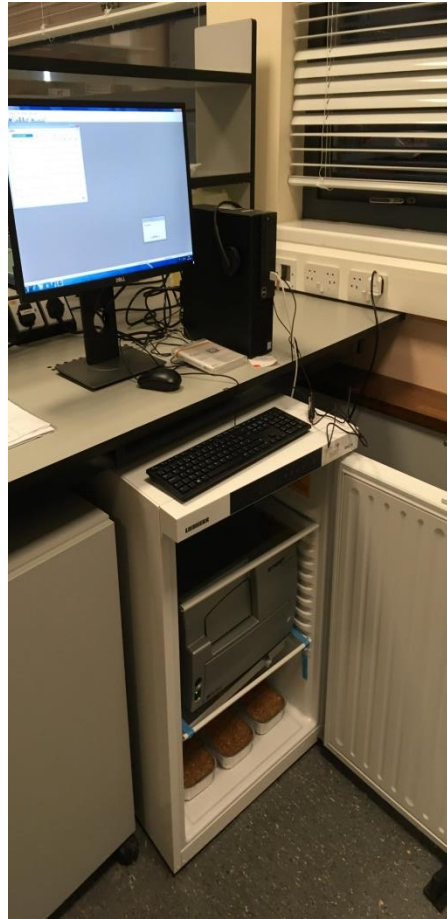
- Control
- Lime (5t/ha equivalent)
- Chemical P (40kg/ha) + Lime
- Organic P (20kg/ha) + Lime

Hypotheses

	Potential N Mineralisation	Enzyme Activity	Microbial Community
Lime			
Chemical P			
Organic P			
Soil Type			

Methods

- Enzyme Assay
- Seven day anaerobic incubation
- 16S and ITS sequencing
- Microbial biomass C, N, P
- Chemical soil test for pH, C, N, P, K, S

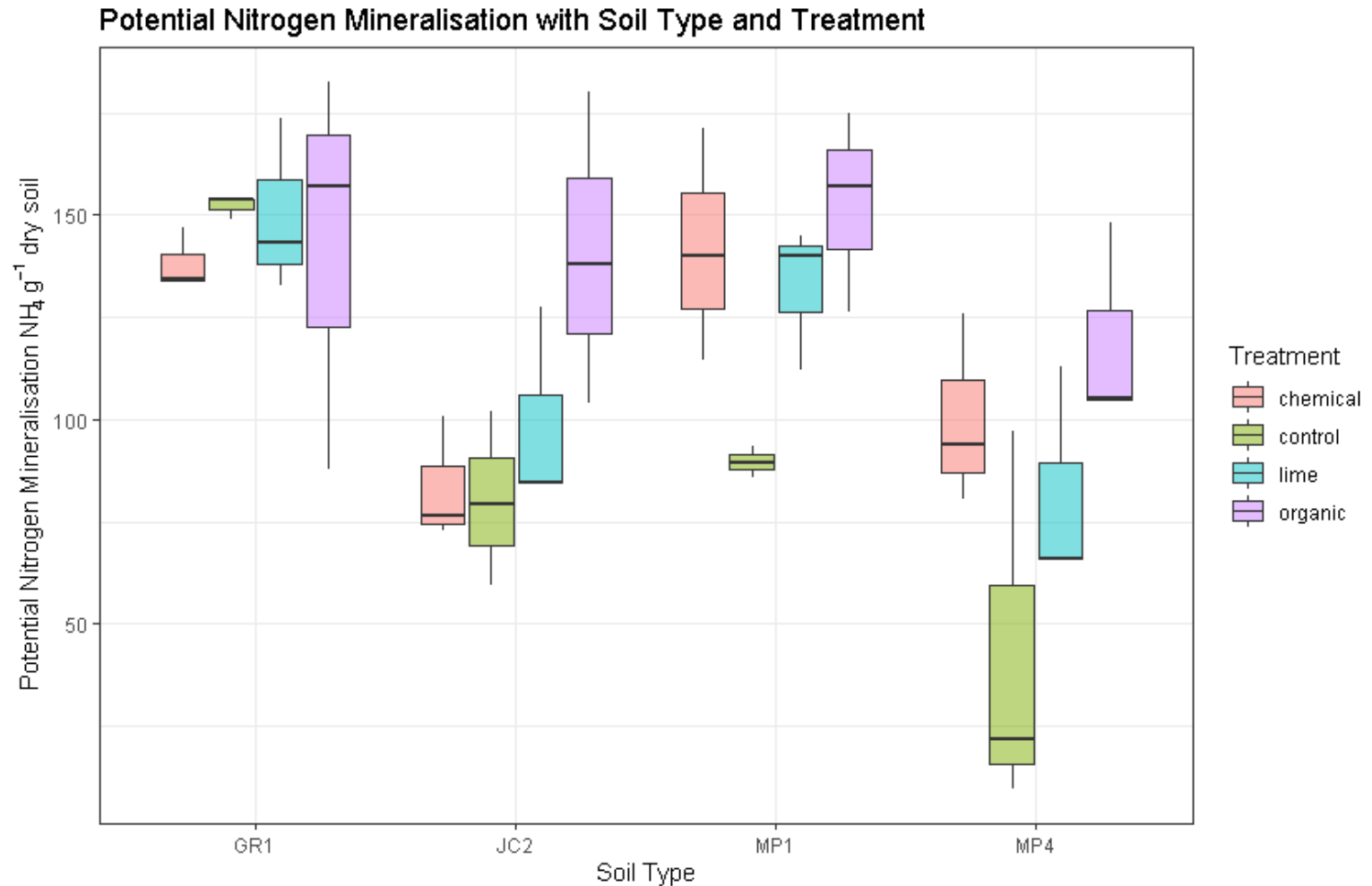


Methods - Enzymes

	Enzyme	Substrate	Function
C	β -1,4-glucosidase (B-GLU)	4-MUB- β -D-glucopyranoside	Hydrolyses cellobiose to glucose
	α -1, 4-glucosidase (A- GLU)	4-MUB- α -D-glucopyranoside	Degrades starch and releases glucose
C & N	β -N-acetyl-glucosaminidase (NAG)	4-MUB-N-acetyl- β -D-glucosaminide	Breaks down chitin
N	Lucine aminopeptidase (AMI)	L-leucine-7-amido-4-methylcoumarin hydrochloride	Breaks down proteins
	Arylamidase (NAP)	L-leucine- β -naphthylamide hydrochloride	Breaks down peptides
P	Phosphatase (P)	4-Methylumbelliferyl-phosphate	Hydrolyses ester phosphate bonds releasing phosphate.

The affect of treatment and soil type on potential N mineralisation

- Significant effect of soil type ($p < 0.01$) and trt ($p < 0.05$)
- High OM soil (*GR1*) no treatment effect
- Highest organic P treatment



The affect of treatment and soil type on potential N mineralisation

	pH	OM	Total C	N	P	K	Morgan PM	KM
Potential Mineralisation	+	+	+	+	+	NS	+	NS

p<0.05 *

p<0.01**

The affect of treatment and soil type on enzyme activity

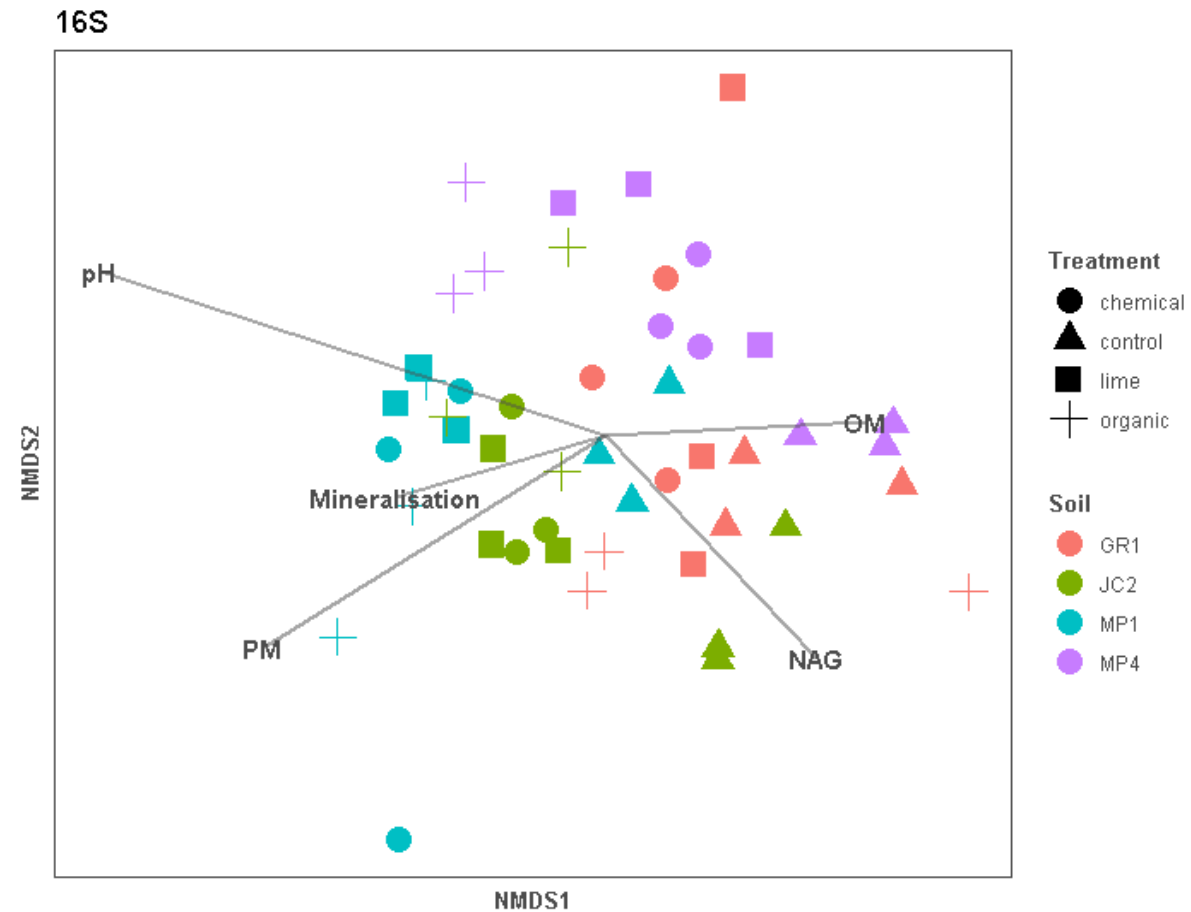
		Potential N Mineralisation
C	A-Glu	NS
	B-Glu	NS
C & N	NAG	NS
N	NAP	+*
	AMI	+*
P	P	NS

p<0.05 *
p<0.01**

There was no significant effect of soil type or treatment on enzyme activity

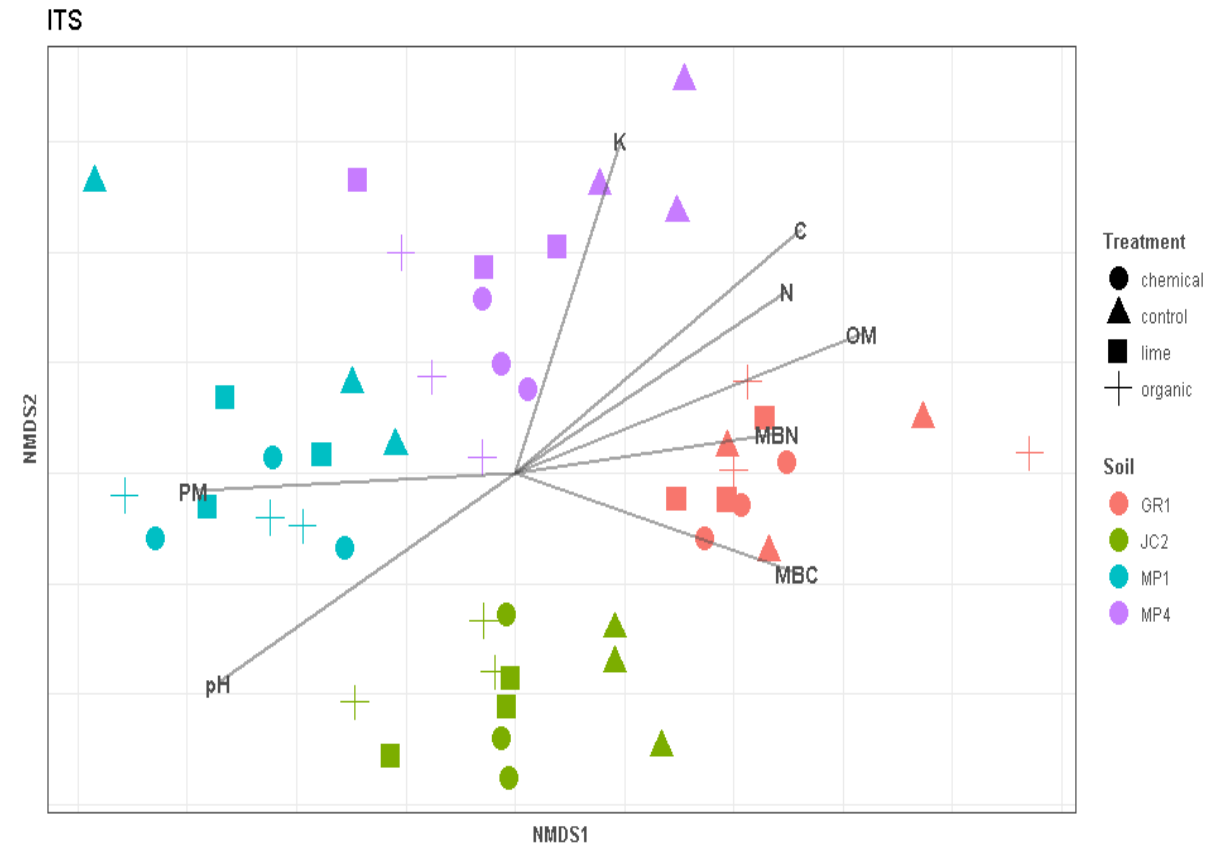
The affect of treatment and soil type on bacterial community structure

- Significant effect of soil type ($p < 0.01$) and trt ($p < 0.01$)
- GR1 soil no effect of treatment.
- 72 significantly different genera between the soil types



The affect of treatment and soil type on fungal community structure

- Significant effect of soil type ($p < 0.01$) and trt ($p < 0.01$)
- 35 significantly different genera between the soil types



Conclusion



- N mineralisation potential is significantly effected by soil type and treatment
- P availability and soil pH effects soil N mineralisation potential
- Enzymatic activity was not significantly effected by treatment or soil type
- Bacterial and Fungal community structure were significantly effected by soil type and treatment