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**Soil carbon dynamics following the transition of permanent pasture to cereal cropping: influence of initial soil fertility, lime application and nutrient addition**

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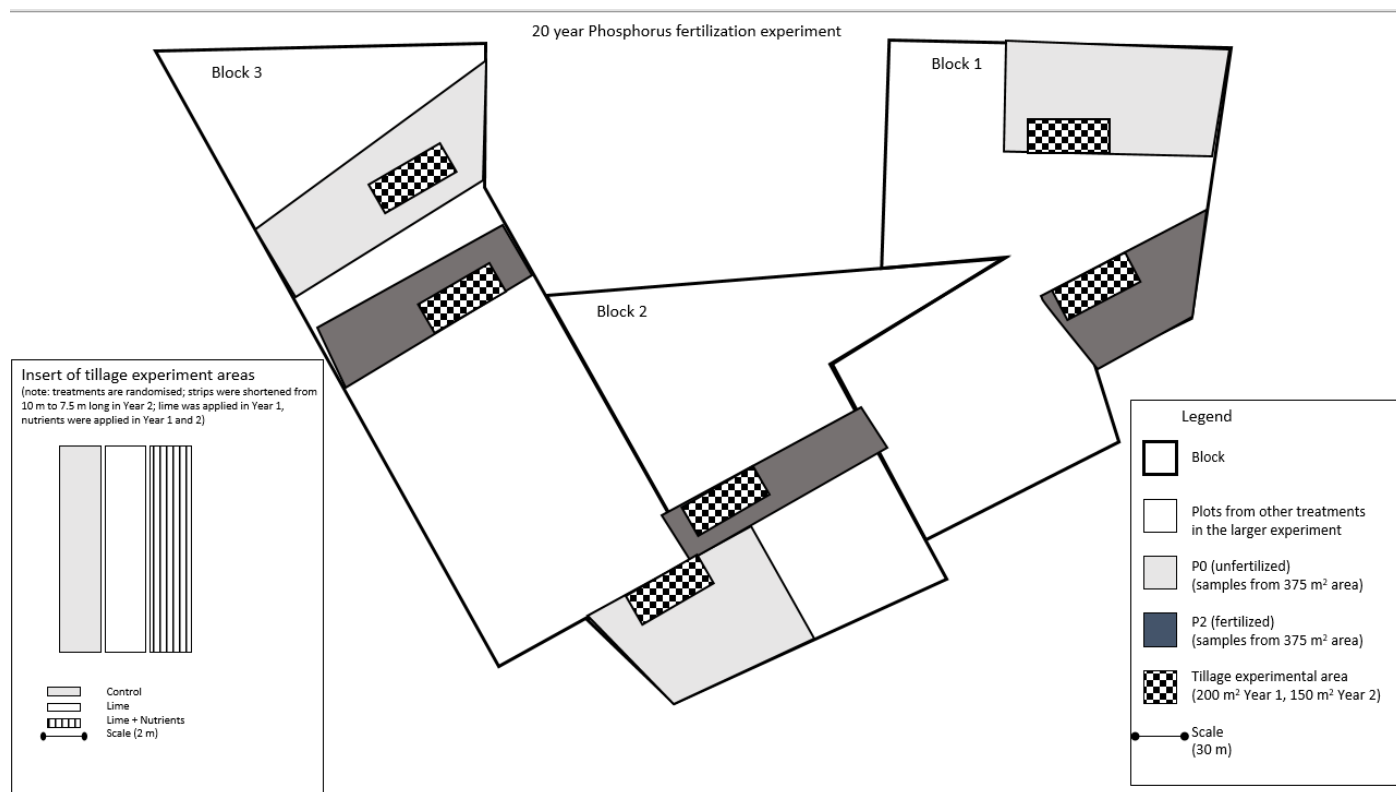
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**Supplementary Table S1. Selected Generalised Linear Mixed Models for analysis of soil parameters in the whole soil and in the <0.4 mm fraction with fixed effects based on Block, Season, Soil Properties.** Fixed effects for all models include fertility (P0 and P2) and soil treatments (control, lime and lime+nutrient) treatments with time including an interaction of fertility and treatment (*Fertility \* Treatment \* Time + (1|Plot) + (1|Time)*). Random effects for all models are based on time and plot number. Values for marginal variance (Marginal R<sup>2</sup>) show the proportion of variance explained by the fixed effects and conditional variance (Conditional R<sup>2</sup>) is the proportion of variance explained by combined fixed and random effects. References to baseline whole soil properties are the March 2017 whole soil properties including the added pasture residue. References to baseline soil properties <0.4 mm are the March 2017 soil properties <0.4 mm. For the block fixed effect, 1 is blocking based on landscape position which was found to be equivalent to blocking based on soil C concentrations. For the season fixed effect, 1 is season based on cumulative rainfall between soil sampling, 2 is season based on Summer, Autumn, Winter and Spring, 3 is season based on thermal time between soil sampling, and 4 is season based on hot or cold temperatures. For the soil properties fixed effect, 1 is soil moisture, 2 is soil pH and 3 is both soil moisture and soil pH. To account for any apparent differences in baseline C content with treatment, we tested the addition of a random effect from treatment (1|treatment) which was not subsequently included in the models due to no significant difference in baseline C, higher AIC from the model and no difference in the marginal or conditional R<sup>2</sup> values.

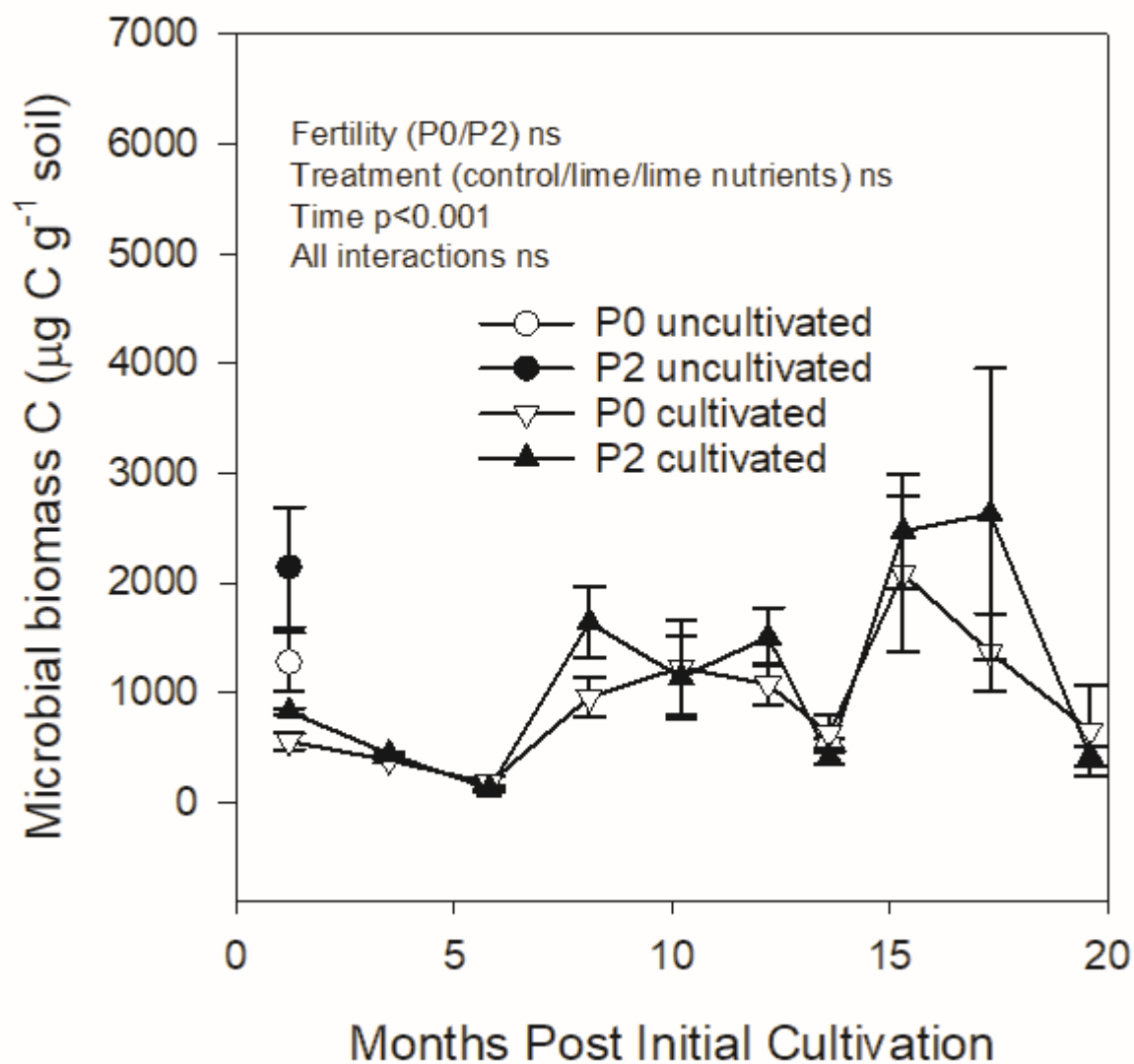
Variable	Block	Season	Soil Properties	Marginal R <sup>2</sup>	Conditional R <sup>2</sup>
<b>Whole soil – first cultivation</b>					
C	1	1	3	61.3 %	70.4 %
C change %	1	1	3	55.0 %	67.0 %
C stocks	1	none	none	38.9 %	70.2 %
N	1	1	1	70.6 %	76.8 %
P	1	3	none	72.7 %	79.9 %
S	1	1	none	25.7 %	39.2 %
<b>Whole soil – second cultivation</b>					
C	1	4	3	73.0 %	77.7 %
C change %	1	4	3	68.1 %	71.5 %
C stocks	1	2	3	64.0 %	79.3 %
N	1	3	2	76.3 %	82.0 %
P	1	none	2	78.6 %	88.1 %
S	1	none	none	57.7 %	85.2 %
<b>Whole soil – entire period</b>					
C:N	1	2	3	38.2 %	76.3 %
C:P	1	1	3	55.5 %	64.4 %
C:S	none	2	2	18.7 %	29.9 %
<b>&lt;0.4 mm fraction – entire period</b>					
C	1	3	2	72.3 %	80.9 %
C change %	1	3	3	65.8 %	76.1 %
C stocks	1	none	none	51.2 %	74.5 %
N	1	none	none	66.6 %	84.6 %
P	1	none	2	77.4 %	85.0 %
S	1	none	none	66.2 %	81.7 %
C:N	none	1	2	29.2 %	82.5 %
C:P	1	none	1	66.0 %	79.8 %
C:S	none	3	none	33.1 %	55.7 %

## Supplementary Materials Figures

**Supplementary Figure S1.** Experimental design showing the three treatments (control, lime, lime+nutrient) superimposed on the replicates of P0 and P2 soils (three replicates). Treatments were randomised for each of the three soil fertility replicates.



**Supplementary Figure S2.** Microbial biomass C in P0 and P2 soils for all cultivated treatments (control, lime, lime+nutrient) across time (0 = March 2017). Soil microbial biomass C in uncultivated soil was measured in adjacent plots in May 2017 as derived from Coonan *et al.*, (2019). Main effects due to fertility, treatment and time are indicated (ns=not significant).



**Supplementary Figure S3.** Physical recovery of plant material in P0 and P2 soils for all cultivated treatments (control, lime, lime+nutrient) across time after the second cultivation with incorporation of 9 Mg ha<sup>-1</sup> triticale residue (March 2018). Main effects due to fertility, treatment and time are indicated (ns=not significant), different lower case letters indicate differences between each time point.

