

ECSM 2019

Recovered phosphorous fertiliser and the effects on residual soil P indices compared to commercial P fertiliser

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Outline of Presentation

- Background
- The phosphorous issue
- The Irish Waste Water phosphorous recovery potential
- Quality assessment
- Field trial methodology
- Results
- Conclusions



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(1) <https://www.taurus.ag/importance-of-phosphorus-to-crops/>

Background

- Phosphorous (P) is a naturally occurring mineral found in all living organisms and is vital to sustain life.
- P is a growth limiting nutrient
- Artificial P fertiliser is manufactured from finite P rich rock (phosphate rock).
- Mineral P fertiliser is vital to sustain modern farming practices.
- P is vital for food production, to feed the growing global population.
- The North Western region of Europe (NWE), does not have an indigenous supply of phosphorous.



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Peak P

- P-Rock is finite.
- The largest reserves of P-Rock are found in Morocco
- Reserves are located in geopolitically sensitive areas
- Many reserves are unobtainable or contaminated.



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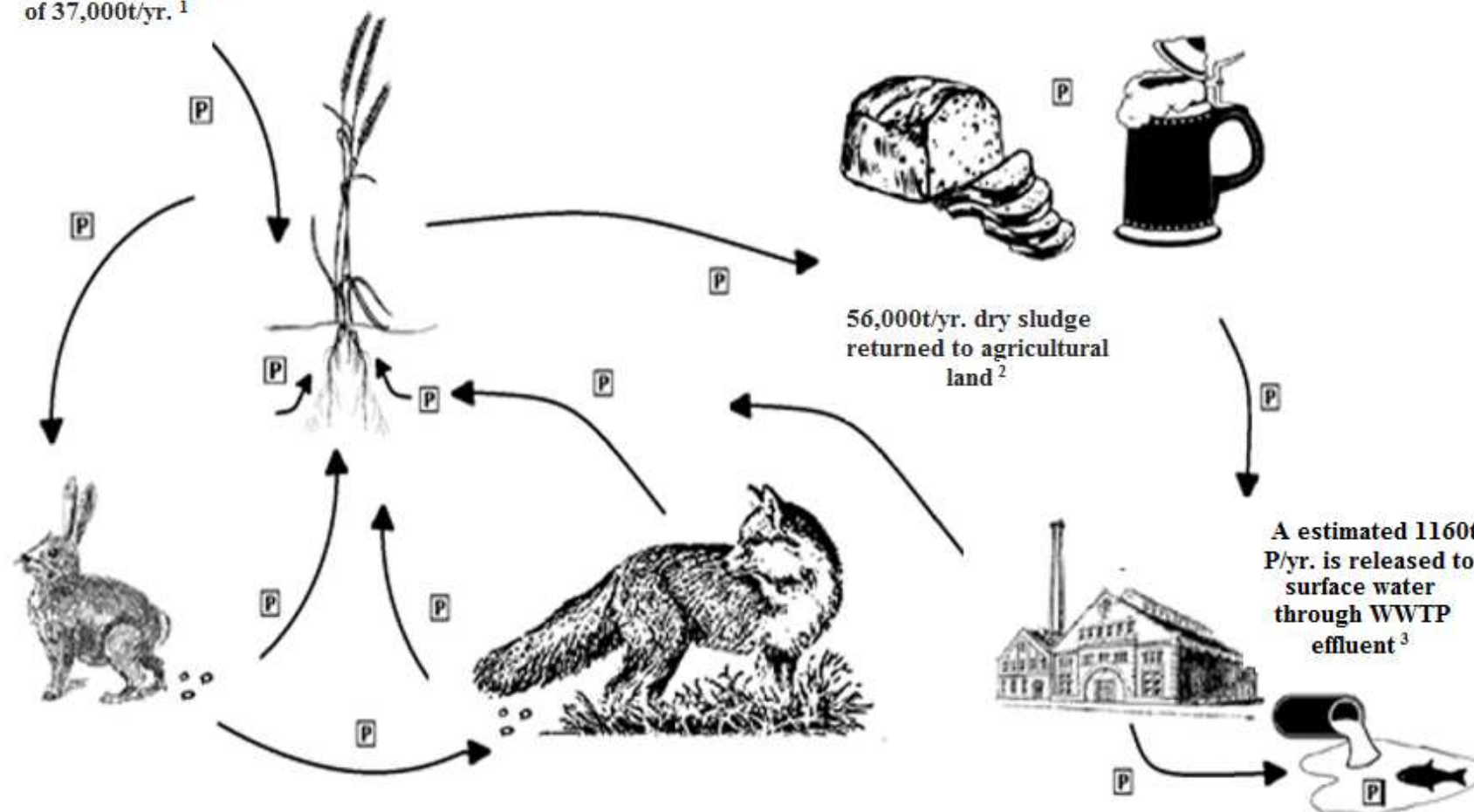
(2)

(1) <https://inhabitat.com/>

(2) <https://permaculturenews.org/2009/01/14/phosphorus-matters/>

The simplified modern Irish P-Cycle

P-fertilisers input
of 37,000t/yr.¹



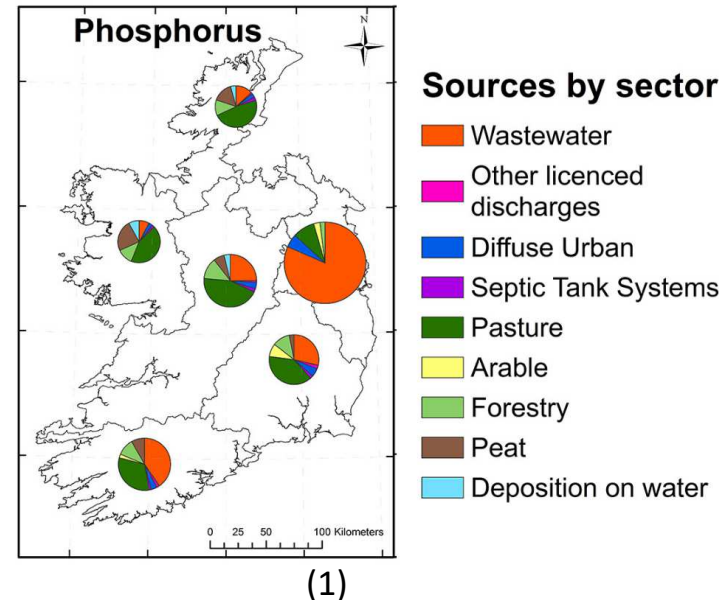
1. Dillon, et al. Teagasc National Farm Survey FERTILISER USE SURVEY 2005-2015. Teagasc 2018

2. Irish Water, National Wastewater Sludge Management Plan, Irish Water 2016

3. Mockler, et al. Sources of nitrogen and phosphorus emissions to Irish rivers and coastal waters: Estimates from a nutrient load apportionment framework, Science of The Total Environment, Volumes 601–602, 1 December 2017, Pages 326-339

Environmental Effects

- Effluent discharged from municipal WWTP contains varying levels of dissolved phosphorous which contribute to eutrophication of receiving water bodies
- It is estimated that 113,000 t/y of phosphorous (26% of NWE P requirements) is produced by waste water in NWE every year (Interreg, 2016).

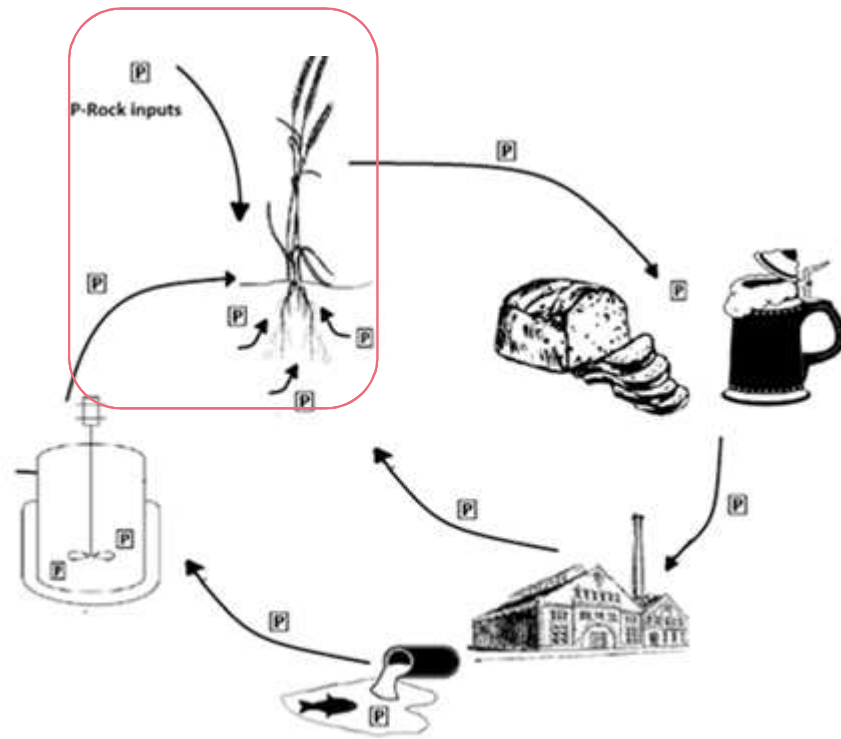


(1).Mockler, et al. Sources of nitrogen and phosphorus emissions to Irish rivers and coastal waters: Estimates from a nutrient load apportionment framework, Science of The Total Environment, Volumes 601–602, 1 December 2017, Pages 326-339

Research Aims



Closing The Modern P-Cycle



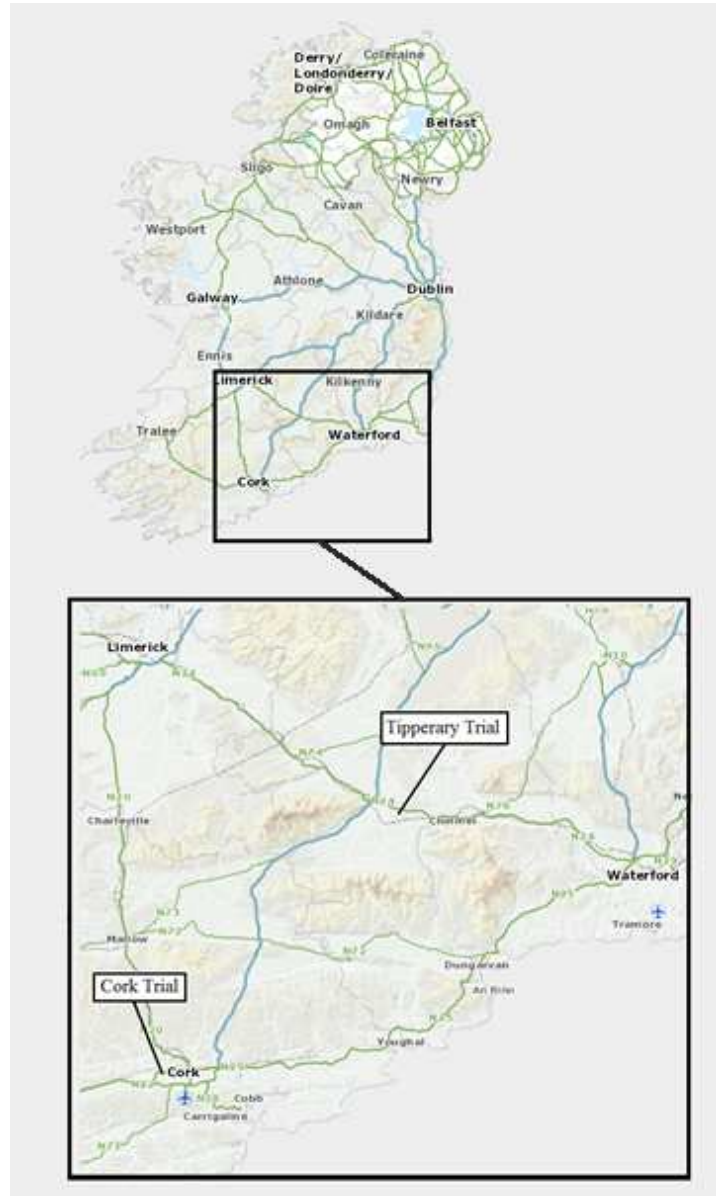
Review of Study

- Establish a trial protocol to test recovered products
- Analyse P availability and performance of recovered P products in comparison with commercial P fertilisers
- Establish and review added benefits of recovered products.

Field Trials

Trial Establishment

- Two trial locations (Tipperary and Cork)
- Trials commenced in March 2018
- Based on a three cut grass silage system
- The trial comprises 12no, 10m² test plots, each plot is surrounded by a 630mm sampling belt;
- Testing Crystal Green Struvite (low solubility Eco P)
- From the soil tests it was determined that 494kg/ha of 24-2.5-10 (NPK) (12.5kg.P/ha) is required to produce a sustainable silage crop and to maintain soil nutrient levels



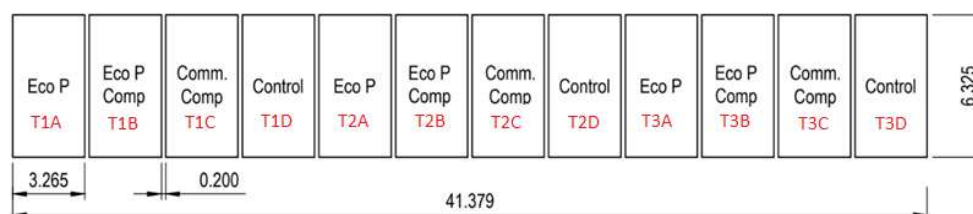
Trial Layout

Trial measurements

- Weekly DM/yield
- Three grass silage cuts were measured
- Before and after soil sampling.



Eco P Grass Trial plot layout



No 1 = Eco P only;

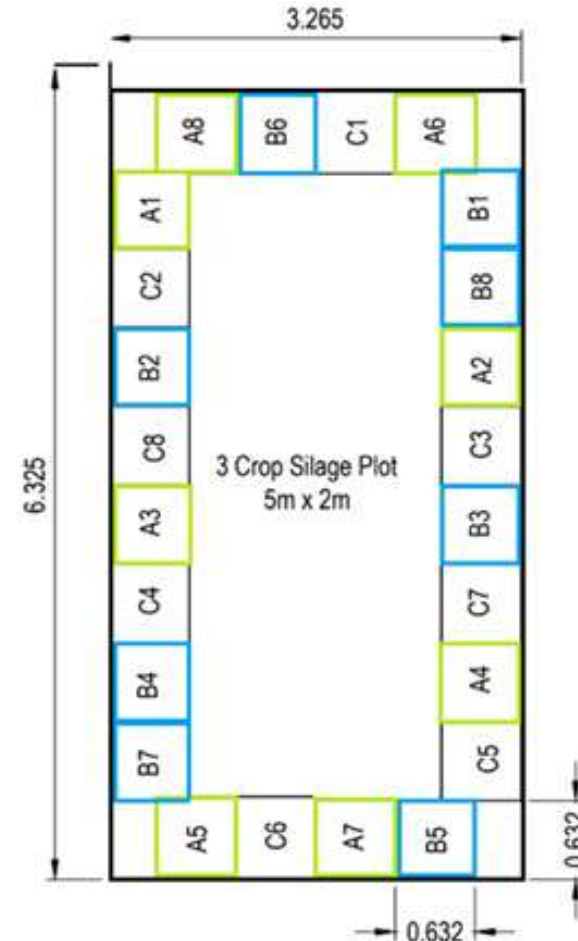
No 2 = Eco P compound fertilizer;

No 3 = Commercial compound fertilizer;

No 4 = Control (no fertilization).

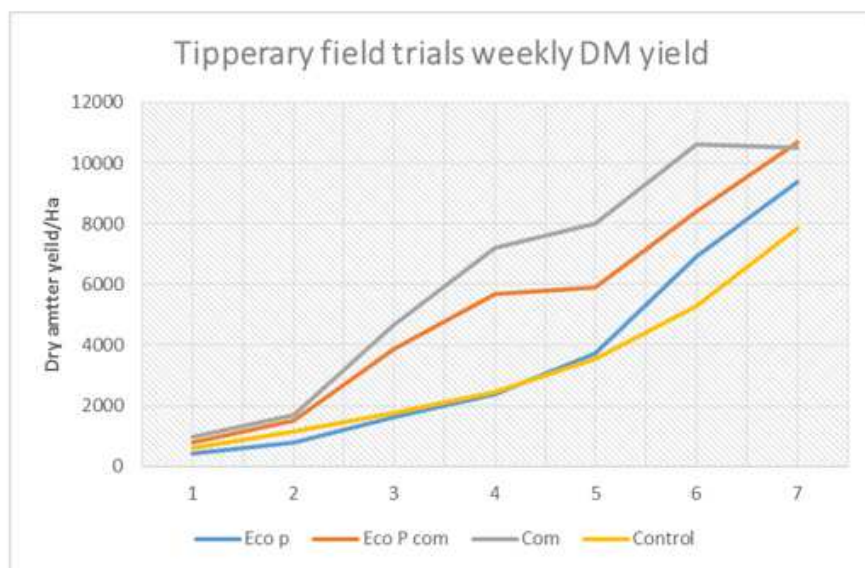
Grass Sampling

- The weekly grass dry matter (DM) yield is measured, using the shears and quadrant method
- Weekly quadrant is cut from the outside sampling belt of the plot.

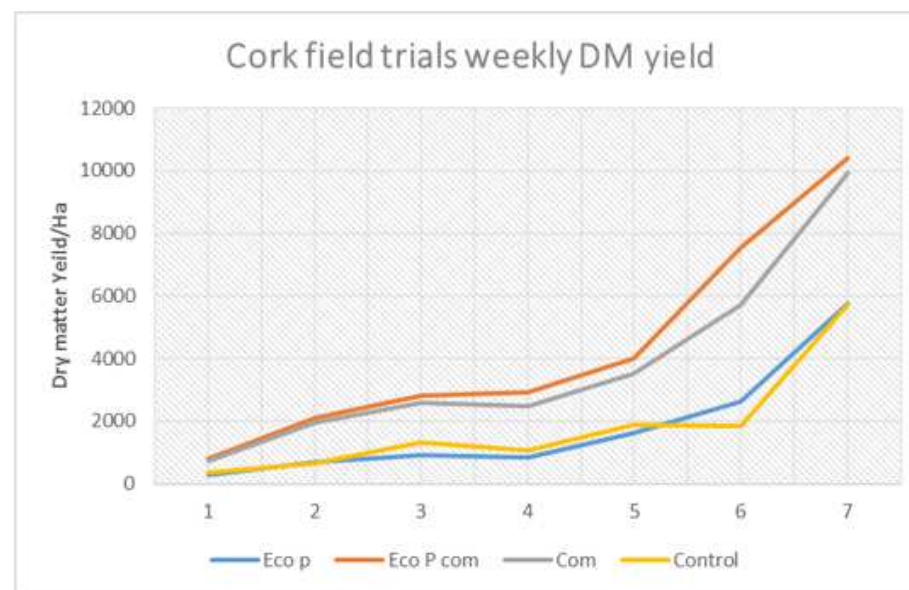


Weekly Measurement Results

Tipperary



Cork

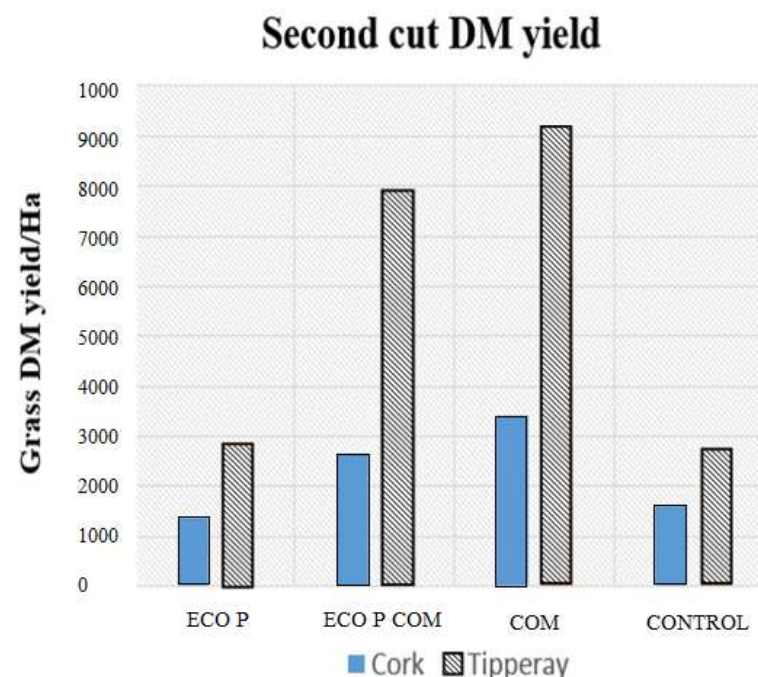
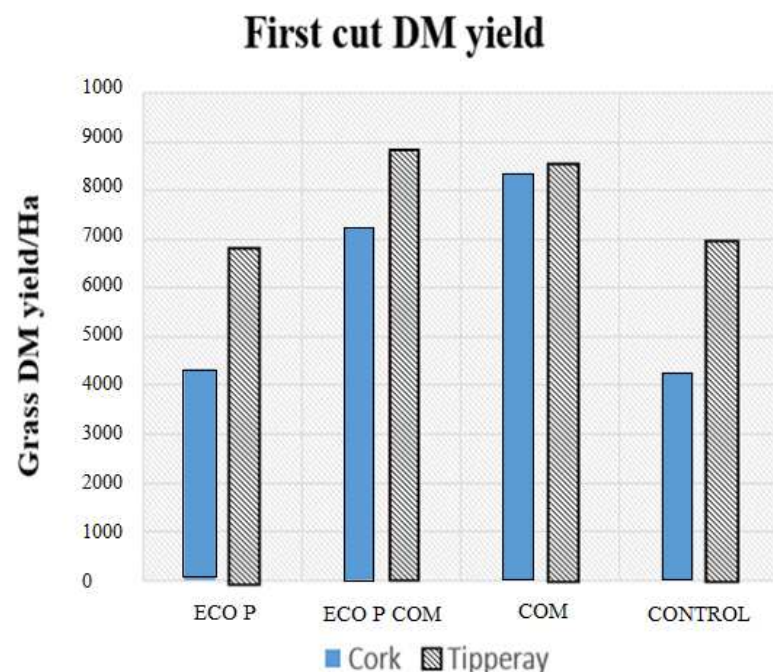


Silage Cut Measurements

- The internal growth plots were cut with a reciprocating mower
- Grass was collected and weighed
- A grass sample from each plot was taken and the grass dry matter content was determined
- The dry matter yield per hectare was then established
- The results are compared with cuts of silage taken from the four plots in triplicate (Crop DM yield/ha).



Grass Crop Cuts Results

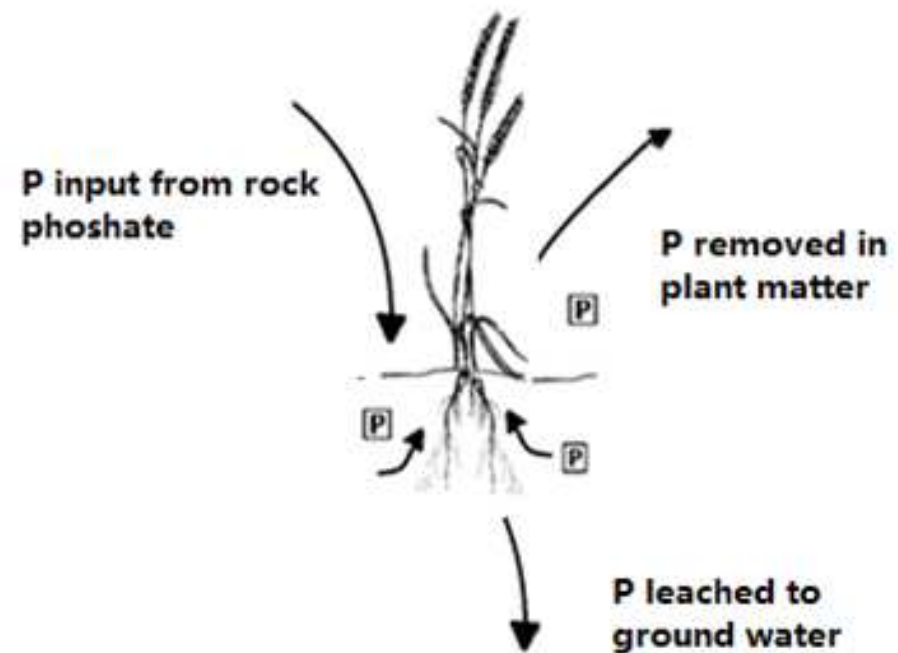


- First grass cut taken on the 20th of June 2018
- Tipperary trial location out-performed the Cork trial location
- Similar results for Eco P and the control.

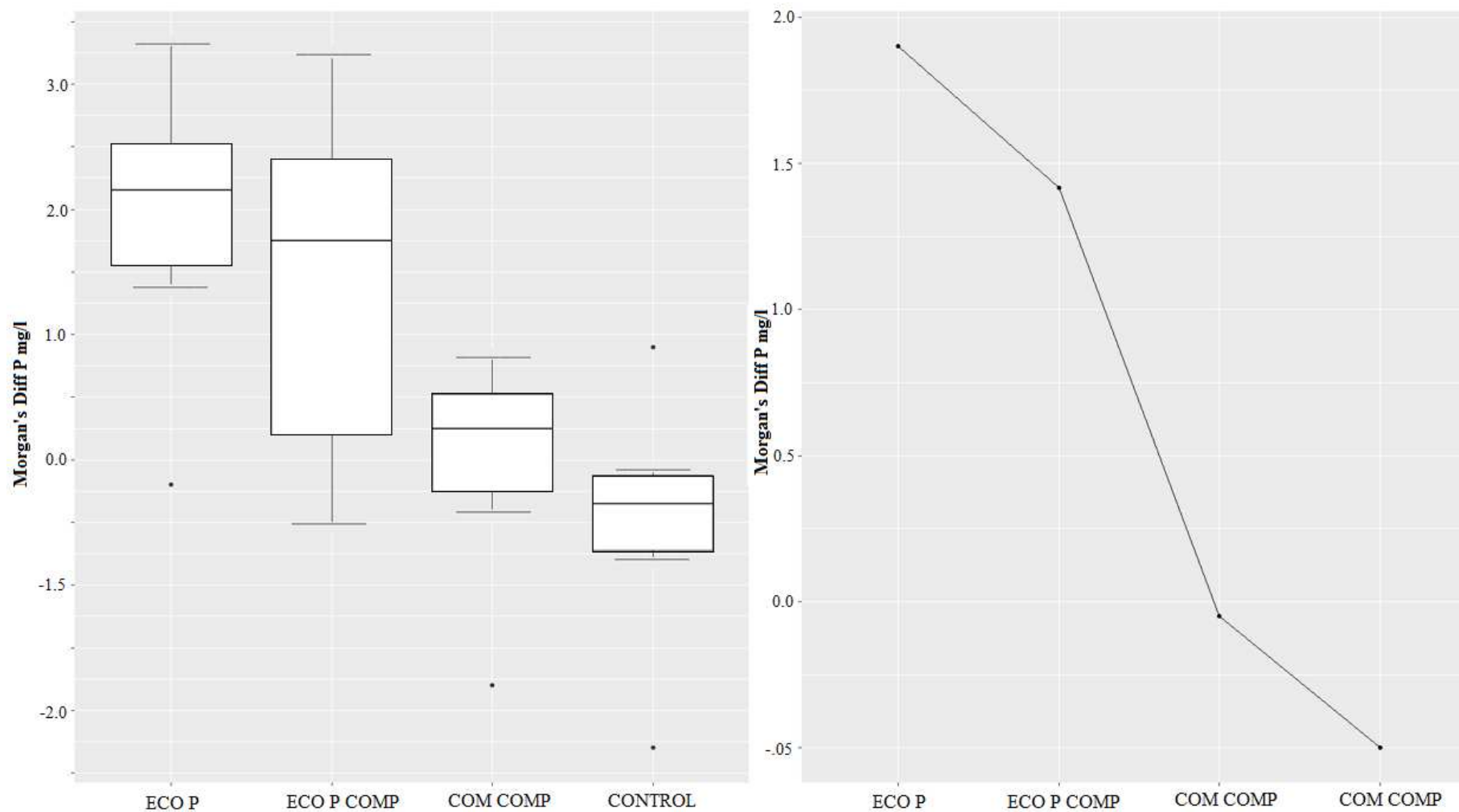
- Second cut taken on the 15th of August 2018 and the third cut 8 weeks later
- Drought severely affected trial growth
- Second cut produced a fraction of the first cut.¹⁴

Residual Soil P Build Up

- The soil samples were analysed to determine the Morgan's extractable P concentration (mg/l) of the soil.
- The differential P index are determined by subtraction the before and after soil P results
- From this the P balance can be determined
- There is a mean residual difference of 1.46mg/l between Eco P compound and the commercial compound.

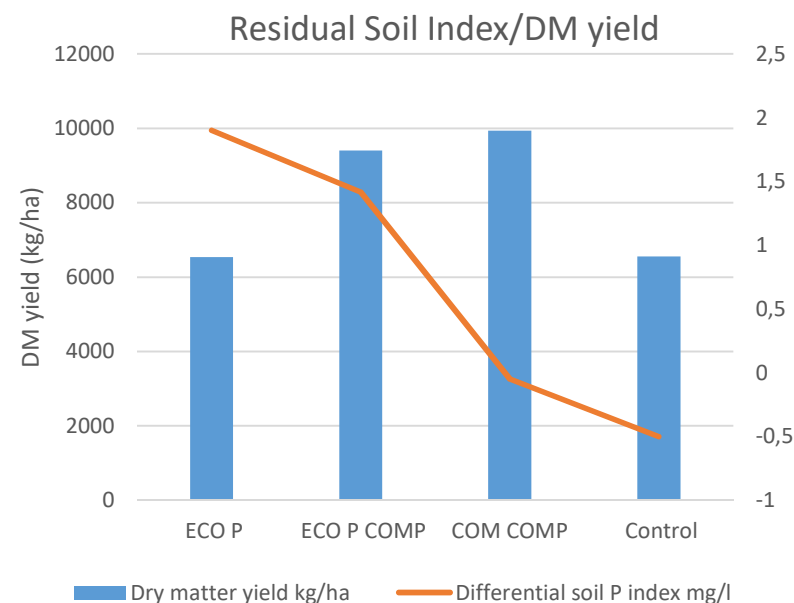


Residual Soil P Build Up Results



Combined Yield and Soil P Analysis

- The differential crop yield and soil P indices were analysed in R, using ANOVA at a significance level $P \leq .05$
- The differential soil P index between the Control and both Eco-P test cases is statistically significant
- The commercial compound” produced 9.9tDM/ha compared to the Eco P compound test case, which produced statistically insignificant difference of 9.4tDM/ha
- There was a statistically significant difference between the control test case which produced 6.5tDM/ha and the compound test cases



Hochberg Pairwise T-Test			
Control	A ECO P	B ECO P COMP	C COM COMP
Mean Difference (mg/l)	2.4	1.916	0.45
Level of significance	0.0024	0.012	0.5231

Conclusions

- Overall the results from this study clearly show that recovered Eco P (Struvite) fertiliser produced a sustainable yield of 9.4t.DM/ha, compared with commercial phosphorous fertiliser and there is no statistically significant difference.
- There was a statistically significant increase in soil P index of 1.4mg/l when using Eco P in comparison with TSP and the control.
- The Eco P test case produced a sustainable crop of grass while maintaining soil P indices, suggesting that the low solubility of EcoP fertiliser prevents P losses



Conclusions

- Eco P fertiliser provides added efficiencies of building soil P indices while producing a sustainable crop of grass dry matter and reducing soil P leaching.
- The results overall are considered to be important and merit further investigation through further field work.
- These properties increase the competitiveness of Eco P incentivising the recovery and reuse of P from municipal waste water streams providing the North Western region of Europe with an indigenous supply of P with the potential to sustain modern farming practices, while closing the modern P-cycle.

Questions?