

Nitrogen cycling differences associated with grassland sward composition reveal promising N loss mitigation strategies at key times of the year

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Overview

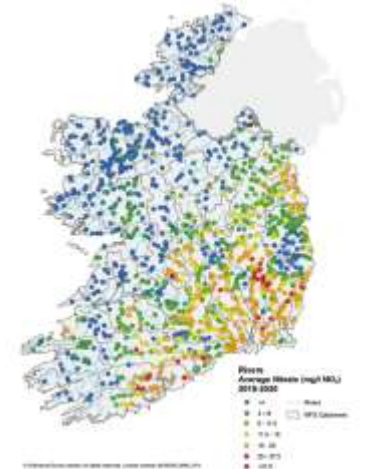
- Background
- Experimental Design
- Materials & Methods
- Results
- Conclusions
- Further Research



Background



- Challenging Policy Objectives
 - Increase agricultural output
 - Reduce GHG + Better water quality + Enhance biodiversity
- Nitrogen loss from agriculture to environment
 - N_2O emissions
 - NO_3^- leaching
- Better understanding of soil N cycle
 - Improve management advice
 - Implement better environmental practices



Sources: DAFM; EPA; Gov. of Ireland

Experimental Design

Monitoring Lysimeter:

- Soil Moisture (%)
- Soil Temperature (°C)

Rainfall Gauge

Soil Type: Luvisol
Soil Texture: Silty Clay Loam
(Poorly Drained)

- Static Chamber N_2O Sampling

- Herbage DM Yields & N uptake

4 Treatments × 6 Replicates
Completely Randomised Design

- Leachate Collection

H₁: Cumulative and seasonal N losses (N_2O and leached N) would be lower from T2, T3 and T4 than T1; possibly linked to specific differences in soil N cycling

Materials & Methods



- N_2O Concentration: $t(0)$, $t(30)$, $t(60)$
- $F_{(daily)} = (\Delta C / \Delta t) \times ((M \times P) / (R \times T)) \times (V / A)$



- $$\delta^{15}N^x_{(soil)} = (\delta^{15}N^x_{(soil)} \times N_2O_{(sample)} - \delta^{15}N^x_{(air)} \times N_2O_{(air)}) \div (N_2O_{(sample)} - N_2O_{(air)})$$

- $SP = \delta^{15}N^{\alpha} - \delta^{15}N^{\beta}$

$^{15}/^{14}N$ - $^{15}/^{14}N$ -O

- $F_N = SP_X - SP_D / SP_N - SP_D$; $F_D = 1 - F_N$

Bracken et al., 2021. Development and verification of a novel isotopic N_2O measurement technique for discrete static chamber samples using Cavity Ring Down Spectroscopy. Rapid Communications in Mass Spectrometry. 35, e9049. <https://doi.org/10.1002/rcm.9049>.

Bracken et al., 2021. Source partitioning using N_2O isotopomers and soil WFPS to establish dominant N_2O production pathways from different pasture sward compositions. Science of The Total Environment, 781, 146515. <https://doi.org/10.1016/j.scitotenv.2021.146515>

Results

- Temporal data
- N₂O emissions & intensity
- Seasonal N losses
- ¹⁵N₂O source partitioning

***Figures
temporarily
withheld whilst
under review***

Conclusions

- MSS are a less intensive & more sustainable system
- N losses linked to chemical fertiliser application
 - Fertiliser N offset with BNF may not reduce cumulative N losses proportionately
- Less synthetic fertiliser in Spring minimises N loss
- Ribwort plantain associated with lower F_N
- Limitations: Short-term, Small Scale, Single Soil Type

Further Research



FaSTEN Project P.I.:
Dr D. Wall

Thank You

- Field & lab technicians
- PhD supervisors
- Research collaborators
- Funding bodies



Any Questions

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