# Can soil Nitrogen tests accurately predict N mineralisation in grassland soils?

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## 1. Introduction

• Current Irish grassland N fertiliser recommendations are based on production intensity & crop demand and are **not soil specific**, as they fail to account for variability in soil N mineralisation.

• Biological N tests, i.e. anaerobic incubations are reliable predictors of potential N mineralisation ($N_o$) in soils; but are time consuming (i.e. 7 to 210 days) (Keeney,1982).

• Chemical N tests, are rapid (i.e. 1-3 days); but their reliability in predicting $N_o$ has been variable in previous studies.

• **These tests have never been investigated for Irish grassland soils**.

## 2. Objectives

1. To evaluate the ability of soil N tests to predict the soil N mineralisation capacity for a range of grassland soils.
2. To differentiate Irish grassland soils according to their ability to supply mineralised N as a basis for new N fertiliser recommendations.

## 3. Methodology

• 37 soil samples collected from grassland sites across Ireland to a depth of 10cm. (35 mineral soils & 2 organic soils).

• Soils were analysed for multiple parameters e.g. P, K, Mg, S, Na, soil organic matter (SOM), total C:N, textual class etc.

• 6 rapid soil N tests were evaluated in this study and compared to a 7-day anaerobic incubation soil test (AI-7) which can reliably predict soil N mineralisation potential (Table 1).

• Statistical analyses using linear and stepwise regression procedures was preformed using SAS.JMP version 9.

Table 1. The soil base N tests evaluated for their ability to predict soil N mineralization potential.

| No | Soil N Test type |
|----|------------------|
| 1 | 2$M$ KCl extraction |
| 2 | Hot 2$M$ KCl extraction |
| 3 | Mild Acid-Oxidation; 0.05$M$ KMnO$_4$+ 0.5$M$ H$_2$SO$_4$ extraction  + distillation |
| 4 | UV absorbance @ 260nm of 1$M$ KCl extraction |
| 5 | UV absorbance @ 210nm of 1$M$ KCl extraction with NO$_3$ removed |
| 6 | Illinois Soil N Test (ISNT); diffusion with 2$M$ NaOH |
| 7 | 7 day anaerobic incubation (AI-7) @ 40°C-2$M$  KCl extraction |

## 4. Results

• SOM% ranged from 6 to 27% for 37 grassland soils.

• Mineralised N (AI-7) ranged from 92.17 (loamy sand) to 403.31 (loam) mg NH$_4^+$-N kg$^{-1}$ for the 35 mineral soils (Fig 1).

• ISNT had the strongest relationship with AI-7 ($R^2$=0.69) (Fig 2), followed by UV 260nm ($R^2$= 0.38), UV 210nm ($R^2$= 0.31) & hot 2$M$ KCl ($R^2$=0.24) (n=35).

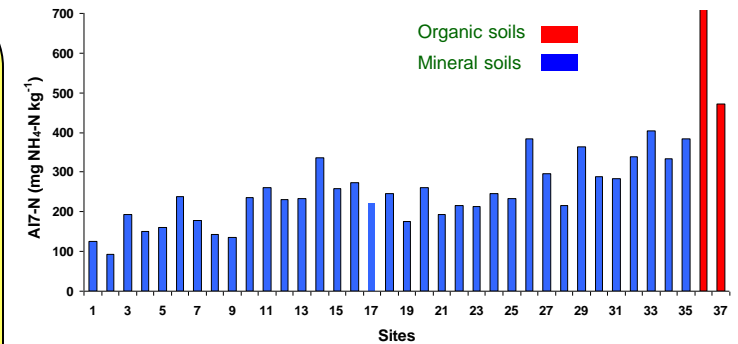• The acid oxidation and 2$M$ KCl had no relationship with AI-7.



Fig 1. Range of mineralised N from 35 mineral & 2 organic soils measured using the AI-7 test.
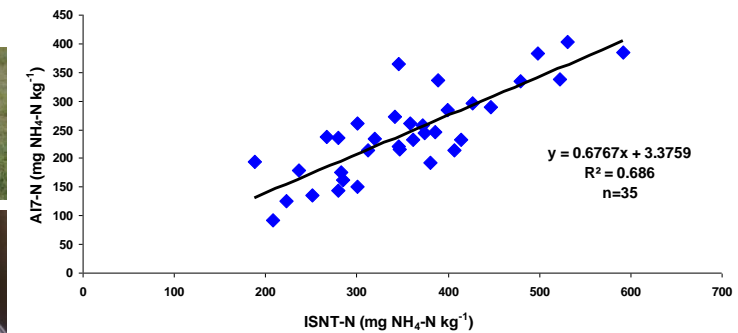


$$y = 0.6767x + 3.3759$$
$$R^2 = 0.686$$
$$n=35$$

Fig 2. Regression model of NH$_4^+$-N mineralised from AI-7 vs. NH$_4^+$-N levels from ISNT method.

Sampling (May-June 2010)

ISNT –Diffusion using mason jars

## 5.Conclusions

• A large range of $N_o$ exists in Irish soils.

• There is potential to adjust N fertiliser recommendations to account for variability in $N_o$.

• The ISNT was the best predictor of soil N mineralization potential.

• Further validation testing is planned to validate the relationships between AI-7 & ISNT predictors and to N herbage uptake in controlled growth conditions for these 37 soils.