Nitrification rates in soils of potato and barley fields receiving carbon amendments

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Aims and Background

Nitrification by soil microbes results in the conversion of ammonium to nitrate, which is the dominant form of nitrogen taken up by most arable plants. Soil nitrification rates can vary seasonally[1] and be influenced by the presence of plants[2]. Early work suggested that carbon inputs to the soil by plant roots immobilized rhizosphere nitrogen. However, recent work indicates that soil nitrification rates are enhanced by addition of organic carbon to the soil[3]. The effect of organic carbon addition to arable soils on soil potential nitrification rate has been investigated in different crop types and farm management systems.

A. Organic vs. inorganic inputs

Soil potential nitrification rates were monitored in potato plots treated with either 35 tonne ha^{-1} compost or 10 tonne ha^{-1} farmyard manure and were compared to untreated controls.

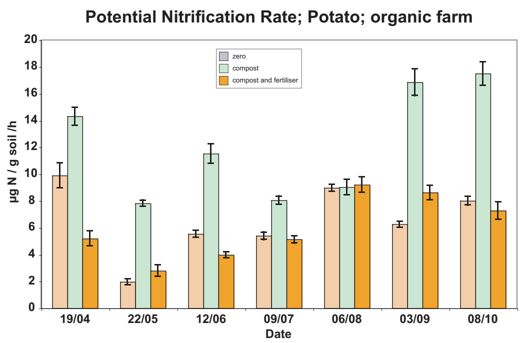


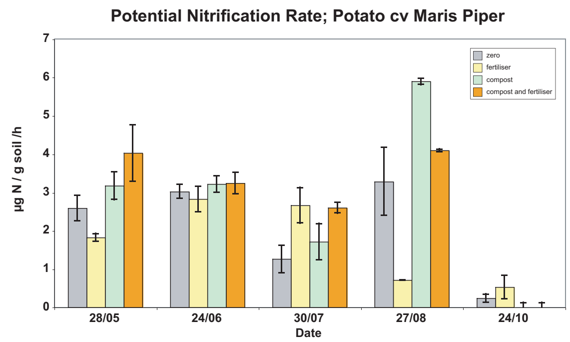
Figure 1 Soil potential nitrification rates in organic potato plots with different organic carbon additions. Values are means (±s.e.) of 12 replicates.

Nitrification rates varied significantly across the growing season and were stimulated dramatically by addition of compost, but not by addition of farmyard manure.

Potato cv Lady Balfour under organic cultivation.

B. Compost vs. slurry and impact of plant type

Soil potential nitrification rates were monitored in barley and potato plots treated with either 35 tonne ha^{-1} compost, or inorganic fertiliser NPK; 110:20:20 for barley, and 147:147:221 for potatoes, or both together, and were compared to untreated controls.



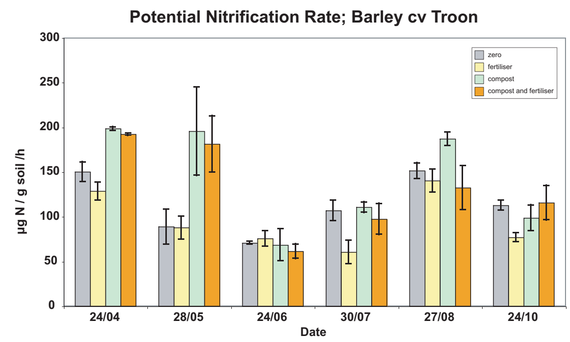


Figure 2 Soil potential nitrification rates in (a) potato and (b) barley plots amended with organic compost or inorganic fertiliser. Values are means (±s.e.) of 4 replicates.

Nitrification rates varied seasonally and were stimulated by organic carbon addition, particularly in barley plots. Rates in potato plots were 100-fold lower than in barley plots and showed a degree of stimulation by compost addition.

Barley cv Troon with different organic carbon and inorganic fertiliser additions.

Conclusions

- Addition of organic carbon can significantly stimulate soil potential nitrification rates, and this effect is increased when higher rates of organic carbon are used (data not shown).
- These data indicate that nitrifying microbial activity is influenced by processes that are carbon-limited.
- Plant effects on soil nitrification indicated that plant type-specific differences exist in the quantity and/or quality of root inputs to the soil.

Methods

Soil cores were sampled throughout the growing season and bulked from 5 replicate points in the plot and passed through a 2 mm sieve. Sub-samples (10 g fresh mass) were incubated with $(NH_4)_2SO_4$ and $NaClO_3$ at 528 and 1590 μg ml^{-1}, respectively for 72 h at 20 °C on a roller bed. After incubation, soils were extracted with 40 ml of 1 M KCl, filtered and nitrite concentrations determined according to Wheatley et al. (2001)[3].

Reference [1]Wheatley, R.E., Caul, S., Ritz, K., Daniell, T., Crabb, D. and Griffiths B.S. (2003) *European Journal of Soil Science,* **54,** 707-714.
[2]Molina, J.AE. & Rovira, A.D. (1964) *Canadian Journal of Microbiology,* **10,** 249-257.
[3]Wheatley, R.E., Ritz, K., Crabb, D. & Caul, S. (2001) *Soil Biology and Biochemistry,* **33,** 2135-2144.