Quantifying the supply of plant-available nitrogen from dairy effluents to grow crops

Introduction
Intensive dairy farming in New Zealand generates large volumes of effluent which may be used as a nitrogen (N) source for forage and arable crops. To optimise the use of effluent farmers must understand how effluent characteristics affect N supply patterns, including both the quantum and rate of release.

Objective
To investigate the N supplying power of dairy effluents and link this to effluent characteristics measured at the time of application.

Methodology
• Five slurry and six solid effluents were collected from commercial dairy farms in the Waikato region of New Zealand and analysed for a range of measures relating to N supply.
• An open incubation assay was established in a single, low N cropping soil (0.36% total N). Effluent was applied at a target application rate of 100 kg N/ha and the amended soil incubated in 500 ml filtration units at 20°C and 90% of field capacity for 182 days.
• Units were leached 15 times during the assay and drainage water characterised for inorganic and organic N components. Estimates of N supply were calculated, corrected for background N supply from a non-effluent control, and relationships with a wide range of effluent characteristics assessed.

Results
• Effluent characteristics varied considerably, even within the same effluent type (i.e. slurries or solids) (Figure 1).
• The pattern and magnitude of N supply varied considerably, both within and across effluent types (Figure 2). However on average and after 182 days, more N was released from slurry (36% of total N applied, range of 4–76%) than from solid effluents (16% of total N applied, range of 2–34%).
• Net N supply values (calculated to quantify the proportion of N mineralised from the applied organic pool after 182 days) ranged from –26.5 to 36.7% and –4.6 to 26.3% for slurry and solid effluents respectively. Values were positive for seven of the 11 treatments (indicating a net N immobilisation effect) and negative for the remaining four (indicating a net N immobilisation effect).
• Strong positive correlations were found between water-soluble N and C components and the flush of N during the first 28 days of incubation and with final N supply after 182 days (Table 1).
• There were fewer correlations between effluent characteristics and the rate of N supply in the later stages of the assay (112-182 days) and no statistically significant correlations (P < 0.05) observed between effluent characteristics and the amount of N released from the applied organic N pool.

Conclusions
• Effluent characteristics varied widely and had a strong effect on the quantum and rate of N supply following application to soil.
• Nitrogen supply in the first 28 days correlated strongly with expected effluent characteristics that largely described the inorganic N pool.
• Correlations between effluent characteristics and later supply patterns were less clear and work is ongoing to understand key relationships.