Context and Rationale

- In grazed pasture systems the majority of ingested nitrogen (N) is excreted in animal urine, resulting in high N loading in the animal urine patch.
- The intensification of grazed pasture systems in New Zealand has resulted in increased nitrate ($\text{NO}_3^-$) leaching and associated significant reductions in water quality.
- The use of grass species to increase pasture N uptake has recently become an important area of research towards reducing nitrate-N leaching.

Objective

The objective of this study was to quantify and examine the variability in N uptake capacities of 16 pasture grass species under high N loading.

Methodology

- A glasshouse pot experiment was conducted at Lincoln University examining 16 commercial and weed pasture grass species grown in a typical free-draining Canterbury soil.
- Three dairy cow urine N treatments (N loading rate = 0, 300 or 700 kg N/ha) were applied to established plants in May.
- Simulated rainfall was applied at Canterbury mean rainfall levels from May to August and leachates analysed for N content.
- Pasture was harvested at 21 day intervals for yield and N content.
- Root yield and soil residual N were measured to give an ‘N balance’.

Results

- The highest yielding species were Italian ryegrass and Yorkshire Fog, while Tall fescue cultivars were lowest yielding (Figure 1; $P<0.001$).
- Root yields were largest for Italian ryegrass and Yorkshire fog, while Poa pratensis and Tall fescue ‘Advance’ had the lowest root growth. Root architecture varied between species, where density increased with N loading rate.
- Italian ryegrass had the largest N uptake of 374 kg N/ha for the 700 kg N/ha treatment (Figure 2; $P<0.001$).
- Generally, only moderate increases in total plant N uptake were observed when urine N application rate was increased from 300 to 700 kg N/ha.

Conclusions

- Annual ryegrass was shown to have high N uptakes, which subsequently resulted in lower N leaching losses, while species such as Tall fescue were found to have low potential for reducing N losses.
- Results indicate that pasture grass species may play a critical role in the quantity of N loss from grazed pastures.
- Further research using large lysimeters and field experiments are required to fully assess the viability of the high N uptake species for reducing N leaching losses under field conditions.

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Figure 1: Total shoot yield (g DM/pot) of the 16 glasshouse-grown grass species for the 700 kg (cow urine) N/ha treatment. Species were: Annual Ryegrass cv. Tama (AR); Browntop (BT); Cockfoot (CF); Goose Grass (GG); High Sugar Ryegrass cv. Amber Magic (HS); Italian Ryegrass cv. Feast 2 (IR); Meadow Fescue (MF); Perennial Ryegrass cv. Alto (PR); Phalaris cv. Maru (PL); Poa annua (PO); Prairie Grass (PG); Tall Fescue cv. Advance (TFA); Tall Fescue cv. Flecha (TFF); Timothy cv. Charlton (TM); Perennial Ryegrass x Meadow Fescue cv. Ultra (ULT); Yorkshire fog (YF). Error bars represent $\pm$ 1 SEM.

Figure 2: Total shoot N uptake (kg N/ha) of the 16 glasshouse-grown grass species for the 700 kg (cow urine) N/ha treatment. (Species key: refer Figure 1). Error bars represent $\pm$ 1 SEM.