Mixing dicyandiamide (DCD) with cattle feeds: an effective method to deliver a nitrification inhibitor to urine patches

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Background information

- Grazed pastures are an important source of N losses (\(\text{N}_2\text{O}, \text{N}_2, \text{NH}_3, \text{NO}_3^-\))
- Broadcast application of nitrification inhibitor dicyandiamide (DCD) reduce \(\text{NO}_3^-\) leaching and \(\text{N}_2\text{O}\) losses
- N losses occur mainly from urine patches (<20% of grazed area annually or <5% per grazing event)
- Potential to deliver DCD directly to grazing cows to target urine patches
Objective

To Investigate the effect of mixing DCD with several types of cattle feed as a practical method for targeted delivery of DCD to urine patches during grazing

(Assumption = different feed types might impact rumen metabolism and DCD stability)
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- Latin square design: 3 herds of 5 non-lactating dairy cows daily fed DCD mixed with one of 3 feeds (grass silage, maize silage or barley concentrate), 3 periods of 21 days, 1 period = pre-conditioning (4d), day grazing simulation & urine patch sampling (5d), resting (12d), then rotation
- Average feed intake: 3 kg dry matter cow-1 d-1, DCD intake: 30 g cow-1 d-1 (≈ 50 mg DCD/kg live weight/d)

Barley concentrate
Grass silage
Maize silage
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- Non-overlapping urine patches marked (n = 292) and sampled (10 cm)
- Soil extracted (2M KCl), concentrations of DCD, urea-N, and TAN (NH₃ + NH₄⁺)
- Live-weight and body condition

Response variables: Equivalent application rates of DCD (kg DCD/ha) and urea-N+TAN (kg N/ha)
Result 1: effect of feed on DCD appl. rate

No feed effect \( (P = 0.4) \) on average DCD application rate

= all 3 feeds similarly efficient at delivering DCD to urine patches
Result 2: histogram of DCD appl. rates in urine patches

- 80% of values ≥ 10 kg DCD ha⁻¹
- Large range: 0.2 – 195 kg DCD ha⁻¹
- Median: 24.7 kg DCD ha⁻¹
Result 3: DCD vs. N excreted

DCD and urea-N+TAN appl. rates highly correlated ($P < 0.0001$) = DCD excretion higher where N excretion is higher

Potentially a more efficient N mitigation strategy than broadcast application because:
- higher N losses where higher N loading AND higher DCD rates more efficient than low DCD rates
- longer DCD residence time in urine patches
Result 4: live-weight & body condition scores

- Live-weight higher at the end of the experiment than at the start in all treatments (P < 0.0001)
- No significant difference in body condition score (P > 0.05)
Conclusions

- **Low DCD dosage to cows = high DCD excretion rates in urine patches**
- **All 3 feeds equally effective** at delivering DCD to urine patches
- DCD excretion rate **matched** N excretion rate
- Practical, potentially cheaper and more effective mitigation measure
Acknowledgements

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