Enhanced Nutrient Recovery from Food Waste Anaerobic Digestate

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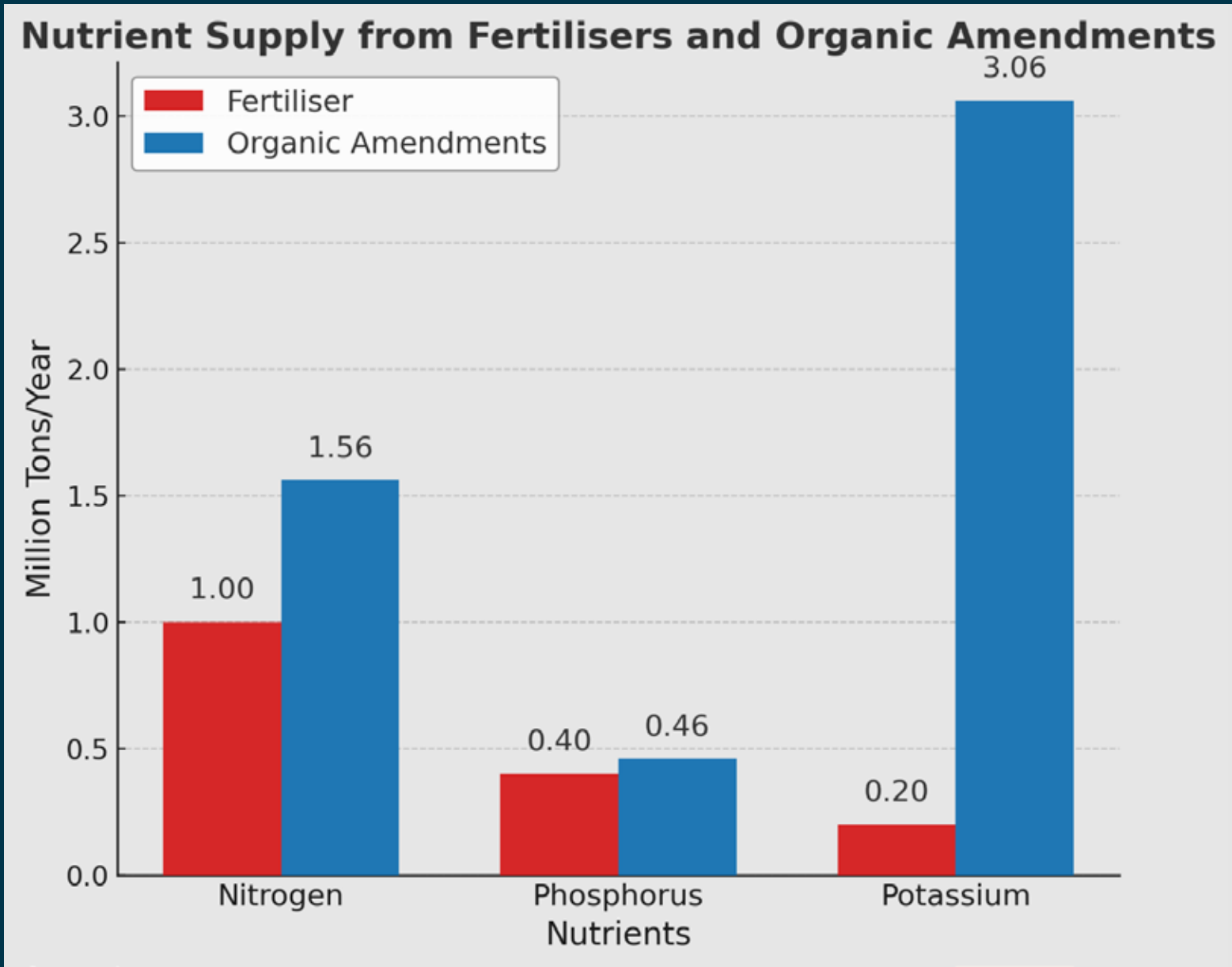
Problem

- Global food waste - 1.3 billion tons per annum
- Typically disposed in landfill or incinerated
- Contributes 20% of total GHG’s

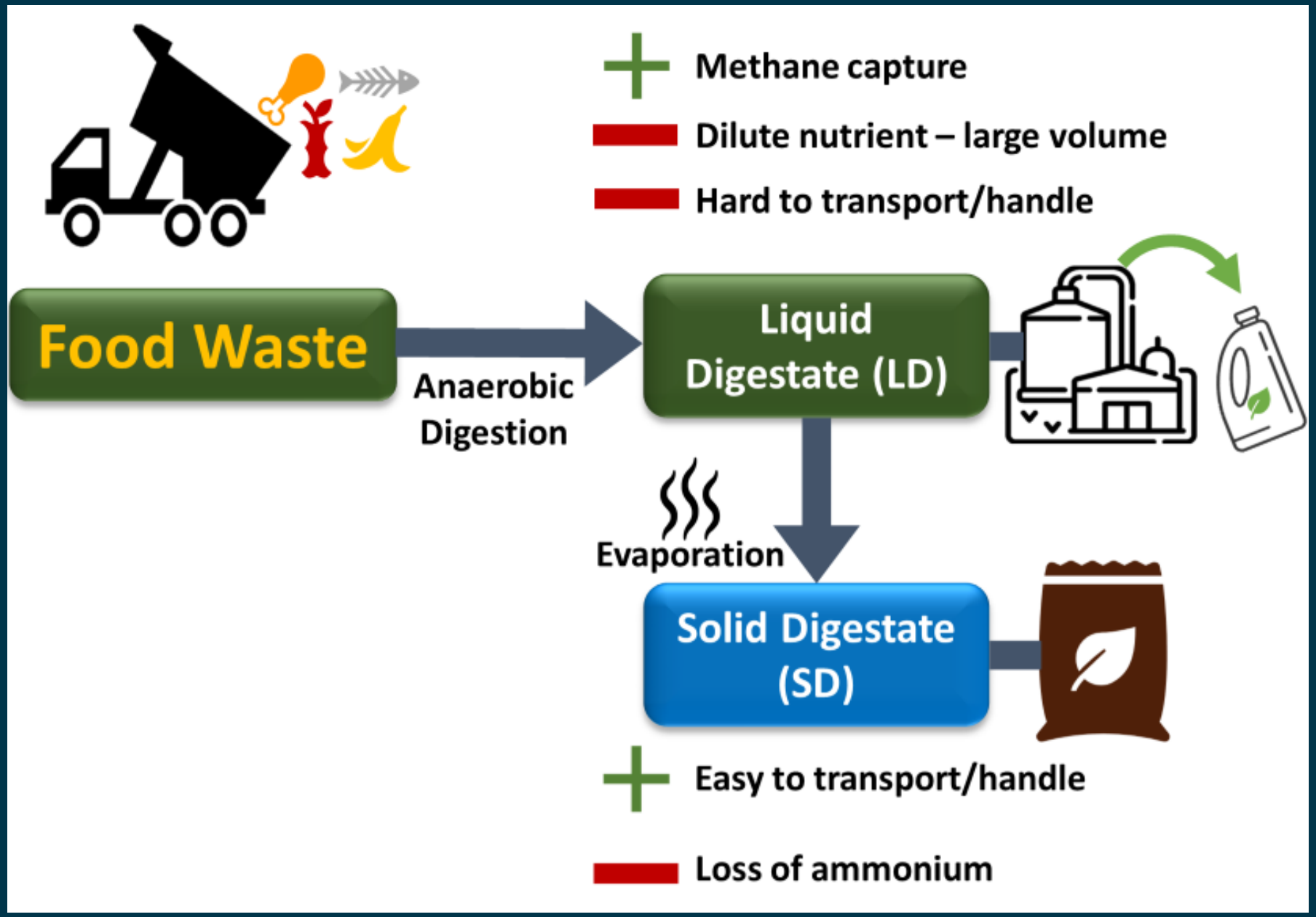
Problem - Australia

(Thangarajan et al., 2013)
https://doi.org/10.1016/j.scitotenv.2013.01.031

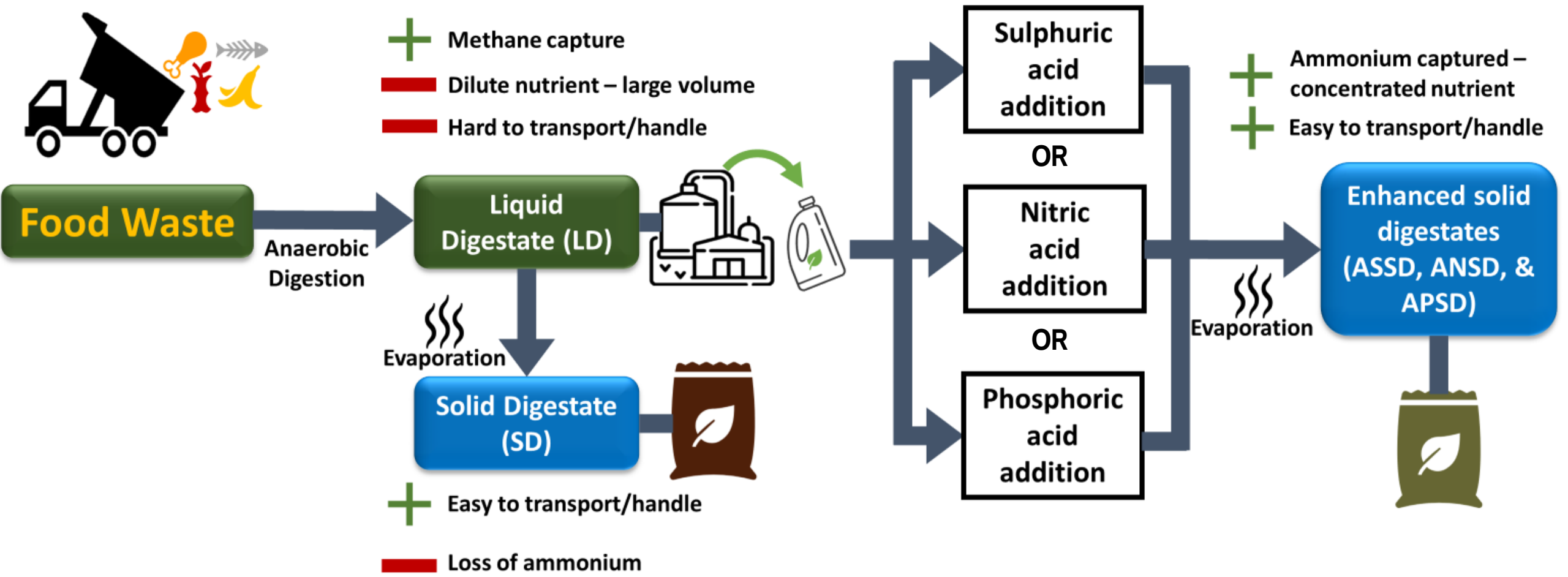
- Australia annually purchases:
  - 5.4 million t of inorganic fertilisers
  - 1.0 Mt N, 0.4 Mt P, 0.2 Mt K
- In contrast, organic sources supply:
  - 1.56 Mt N, 0.46 Mt P, 3.06 Mt K



Solution + Findings



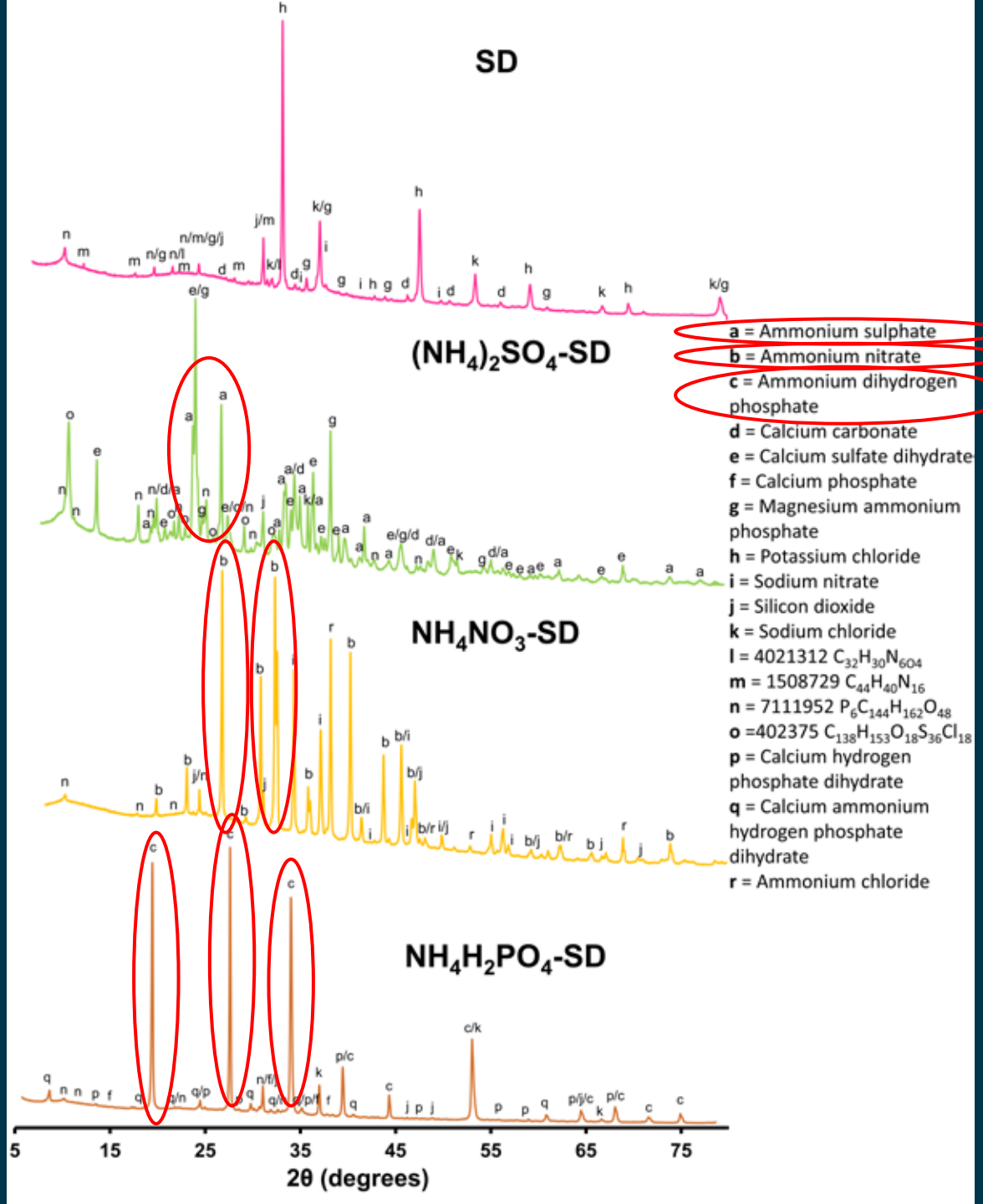
Solution + Findings



Why is acidified digestate important?

- Increases the nutrient content of organic waste by ‘cheap’ acid addition
- Organic N retained – slow-release N
- Low cost to make
- Potential to reduce logistical and storage constraints in anaerobic digestion
- Cheaper to transport compared to liquid digestate becoming more competitive with inorganic fertilisers

XRD confirms crystallinity of ammonium salts

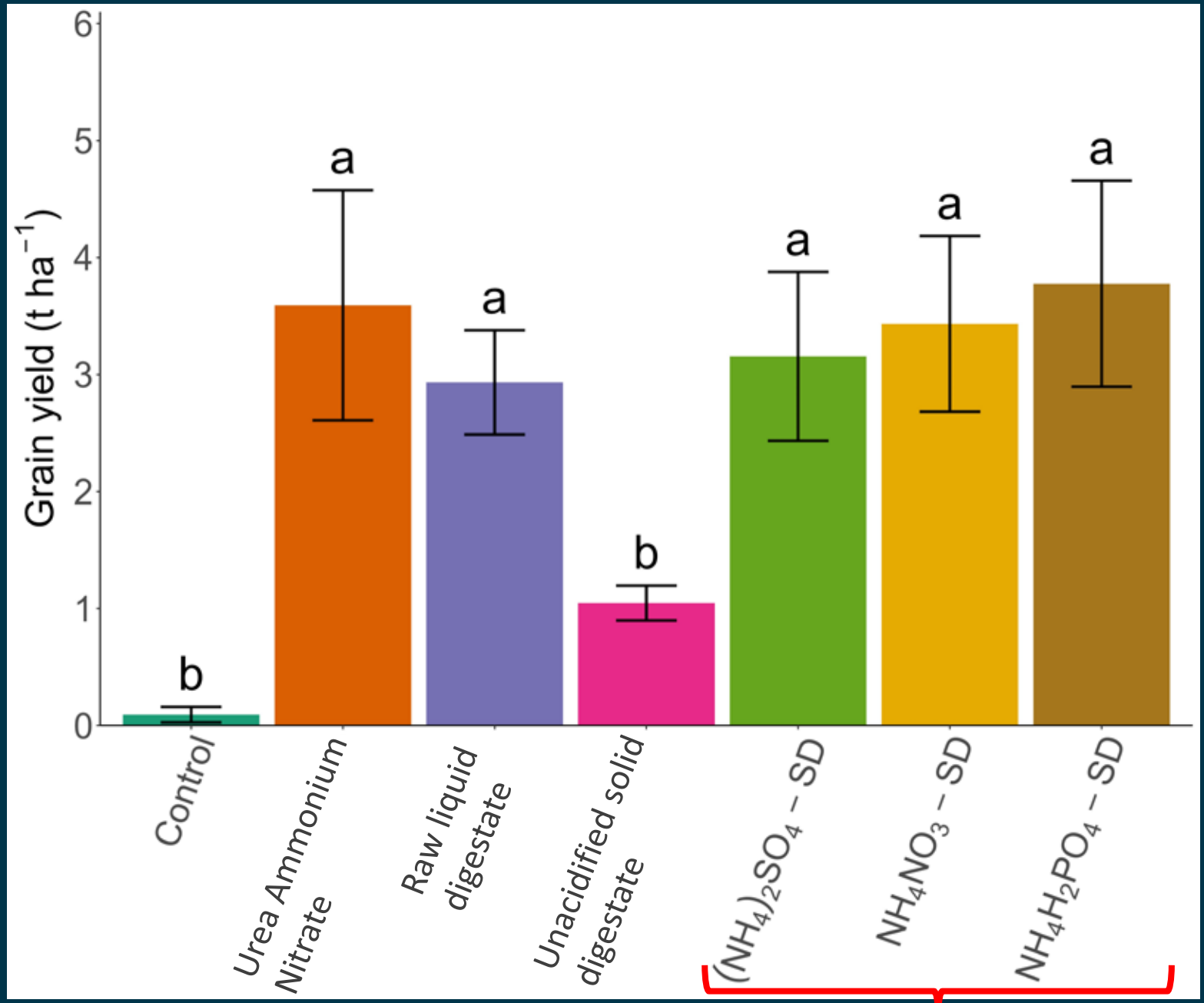


SD:
4.73% total N
0.031% NH_4^+-N
0.0006% NO_3^--N

$(NH_4)_2SO_4$-SD:
9.85% total N
6.37% NH_4^+-N
10.66% S

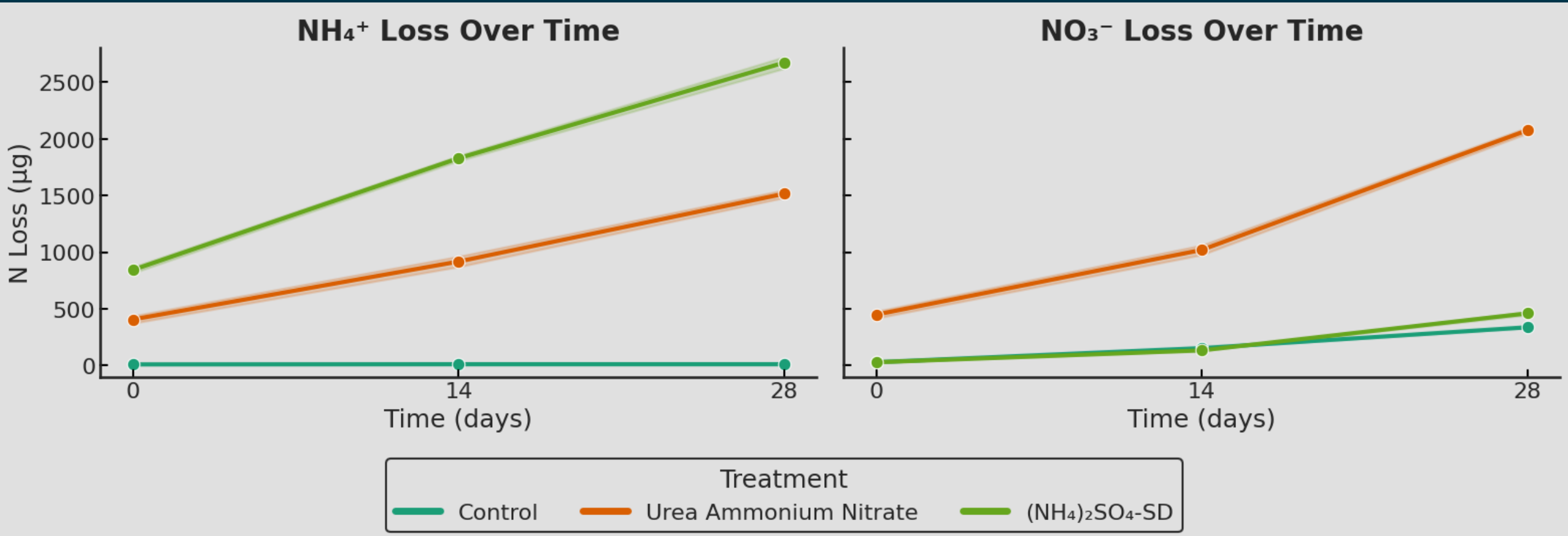
NH_4NO_3-SD:
17.36% total N
6.26% NH_4^+-N
7.4% NO_3^--N

$NH_4H_2PO_4$-SD:
7.29% total N
5.05% NH_4^+-N
17.58% total P
13.3% available P



Scan QR for publications related to research

Extremely Leachable Sandy Soil



Other Findings

- **All digestate treatments** increased genes related to **carbon (SrPA, ChiC, LacZ)** and **nitrogen cycling (amoA, amoB, nirS)**

- Acidified digestates especially supported **beneficial microbial communities** (e.g., **Proteobacteria**), unlike UAN which reduced diversity

Considerations

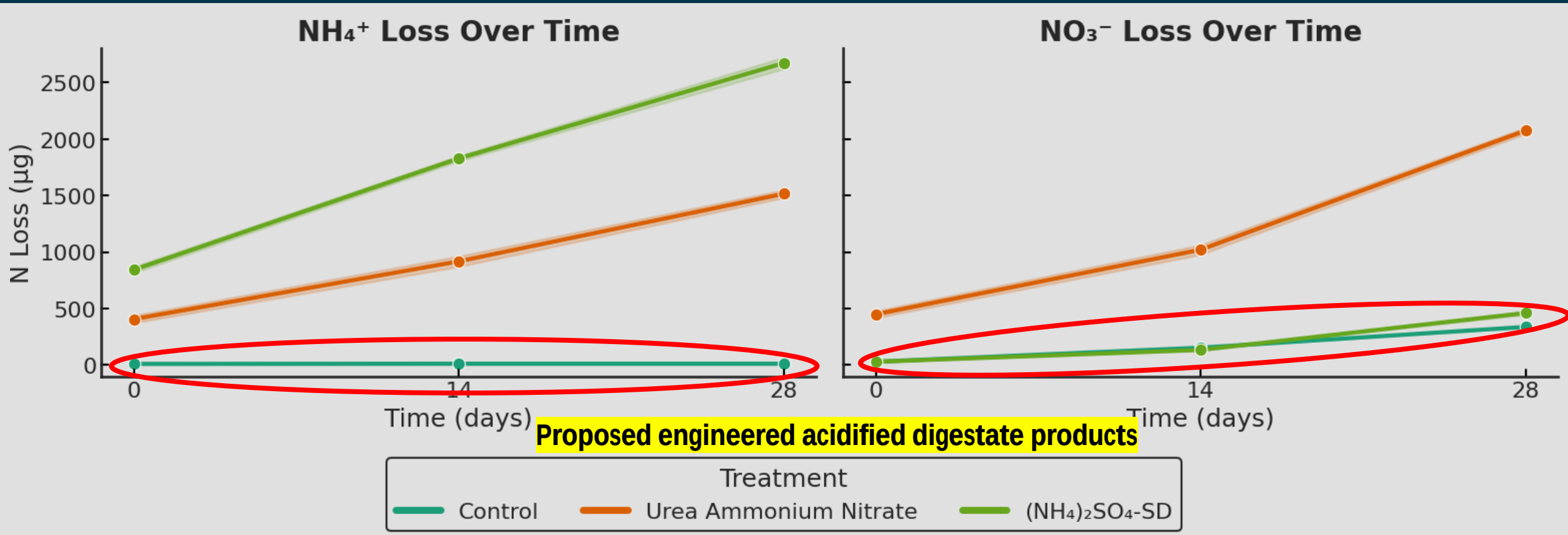
- Currently this has built a foundation for optimising and enhancing the nutrient waste recovery from digestate

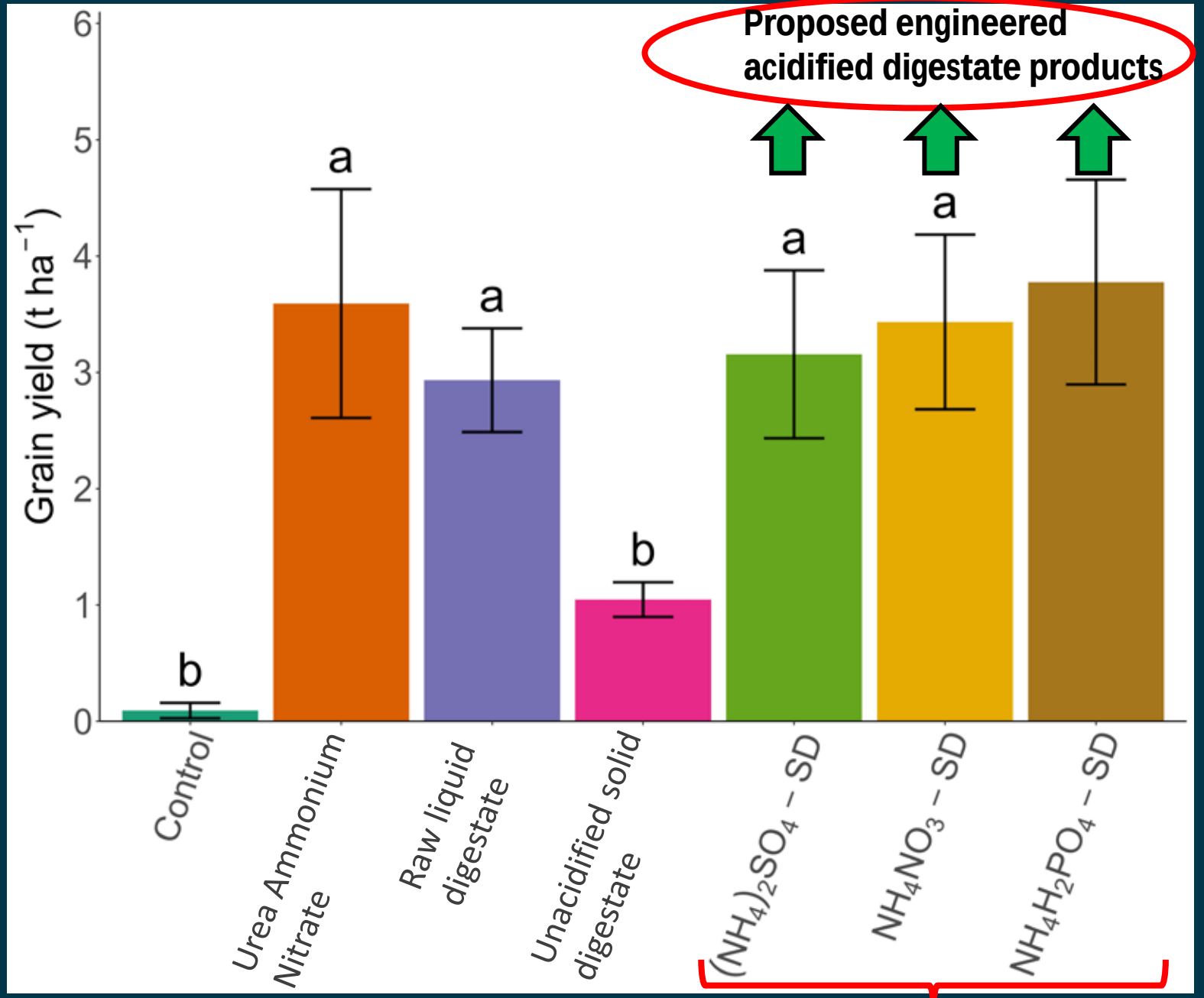
- Engineered acidification and vacuum evaporation infrastructure can be built on this knowledge

Future research

- Engineered fertiliser products that have optimised nutrient release mechanisms:
  - Engineered into granules and coatings are underway
  - Incorporation with nitrogen inhibitors and nitrogen binding substrate to reduce nitrate leaching is underway

Extremely Leachable Sandy Soil




Proposed engineered acidified digestate products
Grain yield (t ha^{-1})
0
1
2
3
4
5
6
b
a
a
b
a
a
Control
Urea Ammonium Nitrate
Raw liquid digestate
Unacidified solid digestate
$(NH_4)_2SO_4$ – SD
NH_4NO_3 – SD
$NH_4H_2PO_4$ – SD
Acidified solid digestates

Thank You!

- Thank you all for listening!