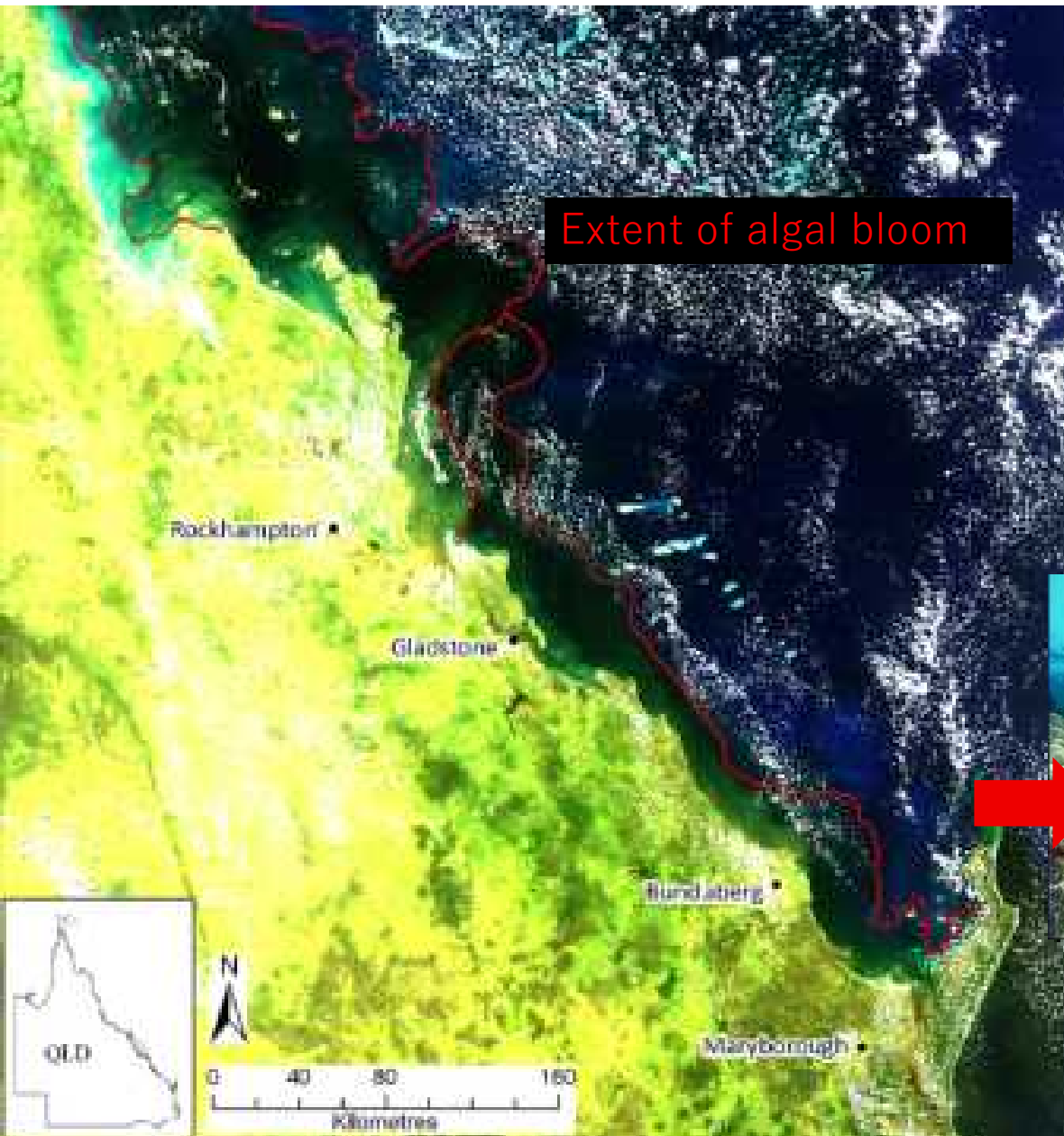


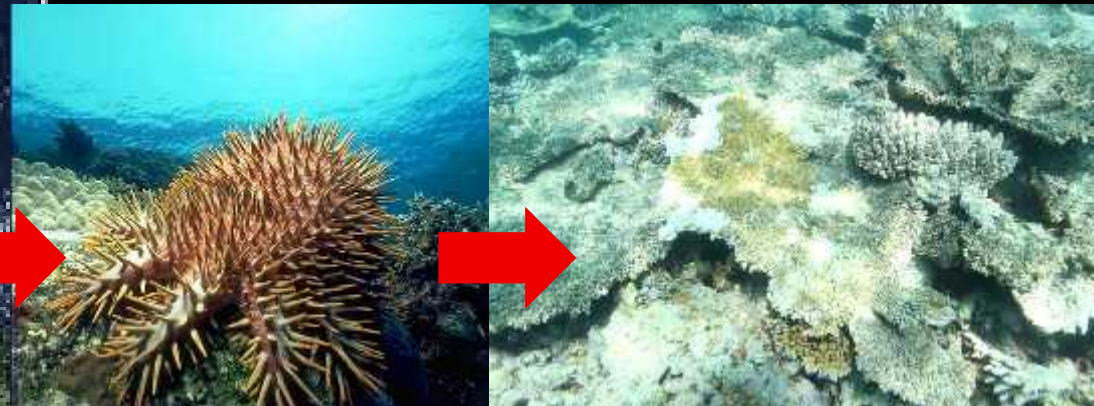
Addressing the nitrogen problem in sugarcane production to reduce pollution of the Great Barrier Reef

N Robinson, R Brackin, C Paungfoo-Lonhienne, T Lonhienne, M Westermann, M Salazar, YK Yeoh, P Hugenholtz, MA Ragan, M Redding, C Pratt, WJ Wang, A Royle, L DiBella, P Lakshmanan, S Schmidt





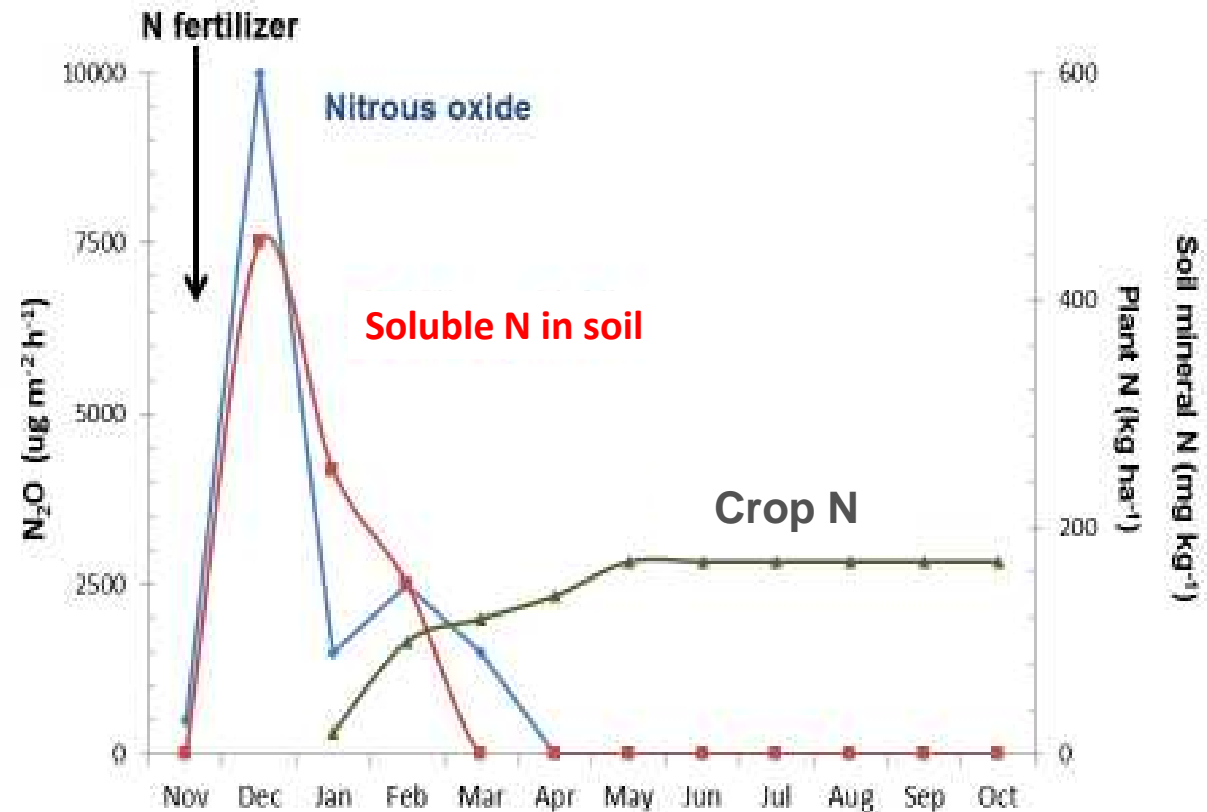
Nitrogen run-off from sugarcane fields enters the Great Barrier Reef lagoon



Brodie et al. 2012
Marine Pollution Bulletin

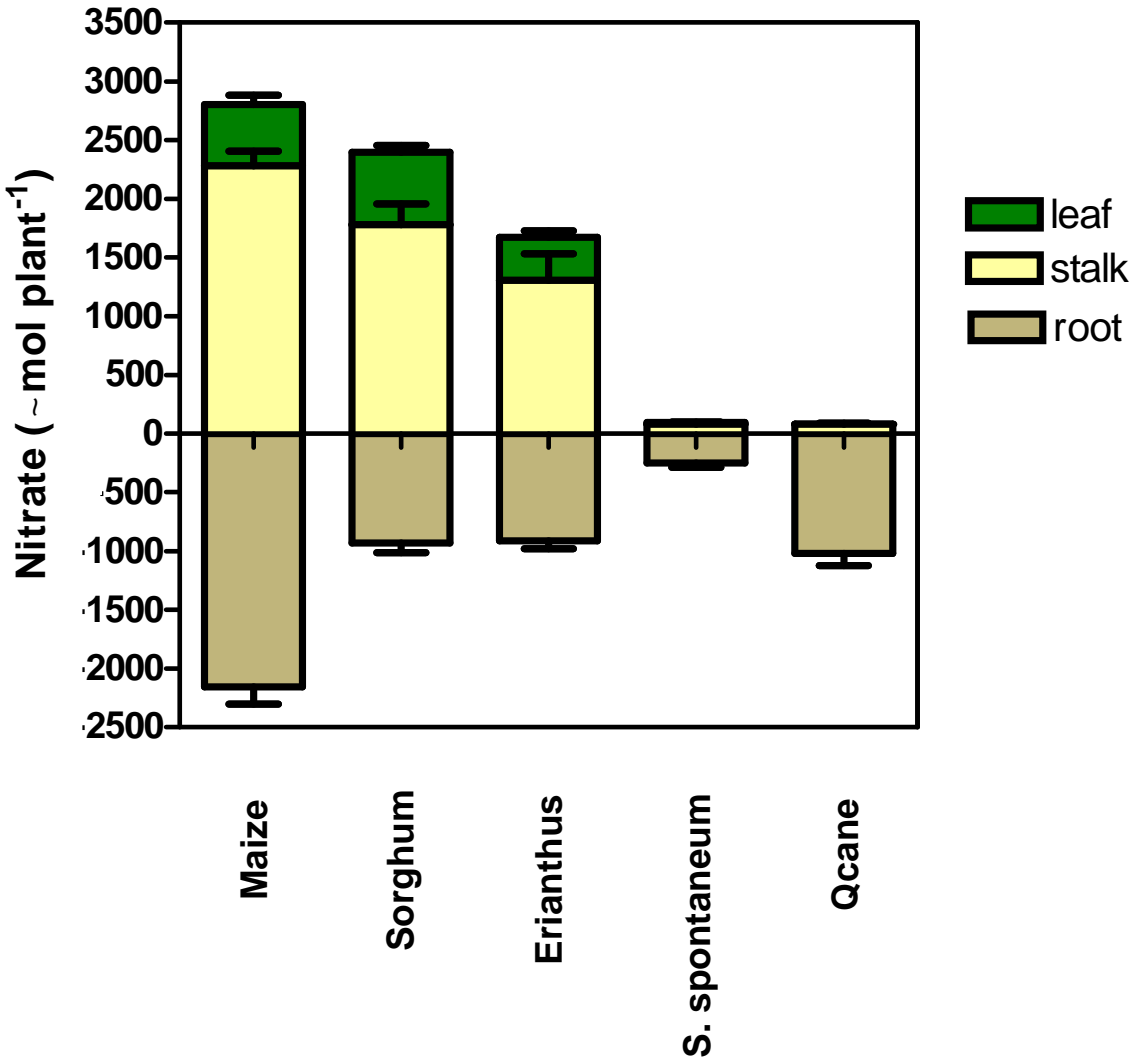
Improving nitrogen efficiency aligning supply and crop demand

- Selecting and breeding N efficient sugarcane
- Next-generation fertilisers
- Legume intercrops for biologically fixed N
- Understanding soil biology and N cycling

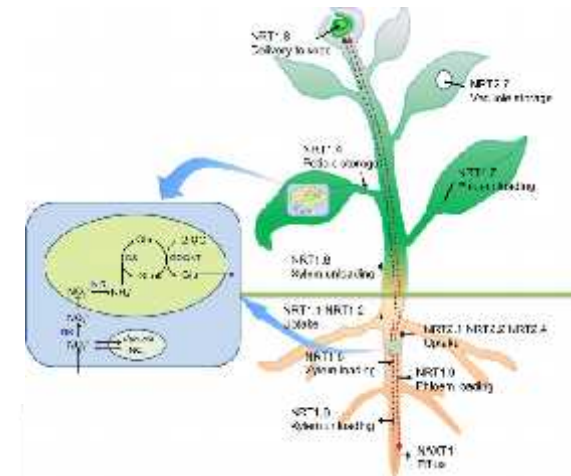


Adapted from Allen et al. (2010); Kingston et al. (2008)

Improving external N efficiency: ability to acquire and store nitrate

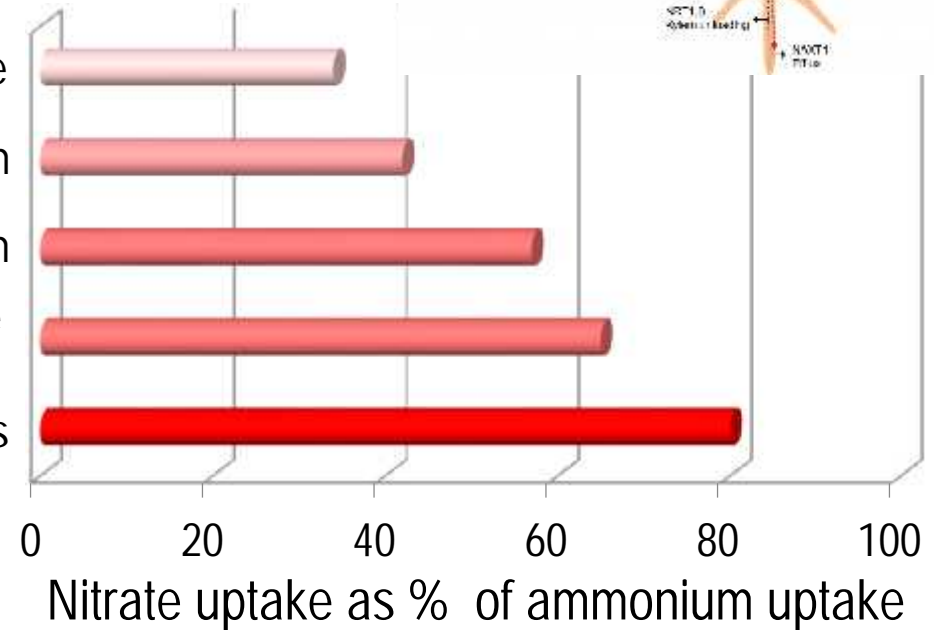


Improving nitrate use with understanding of molecular mechanisms



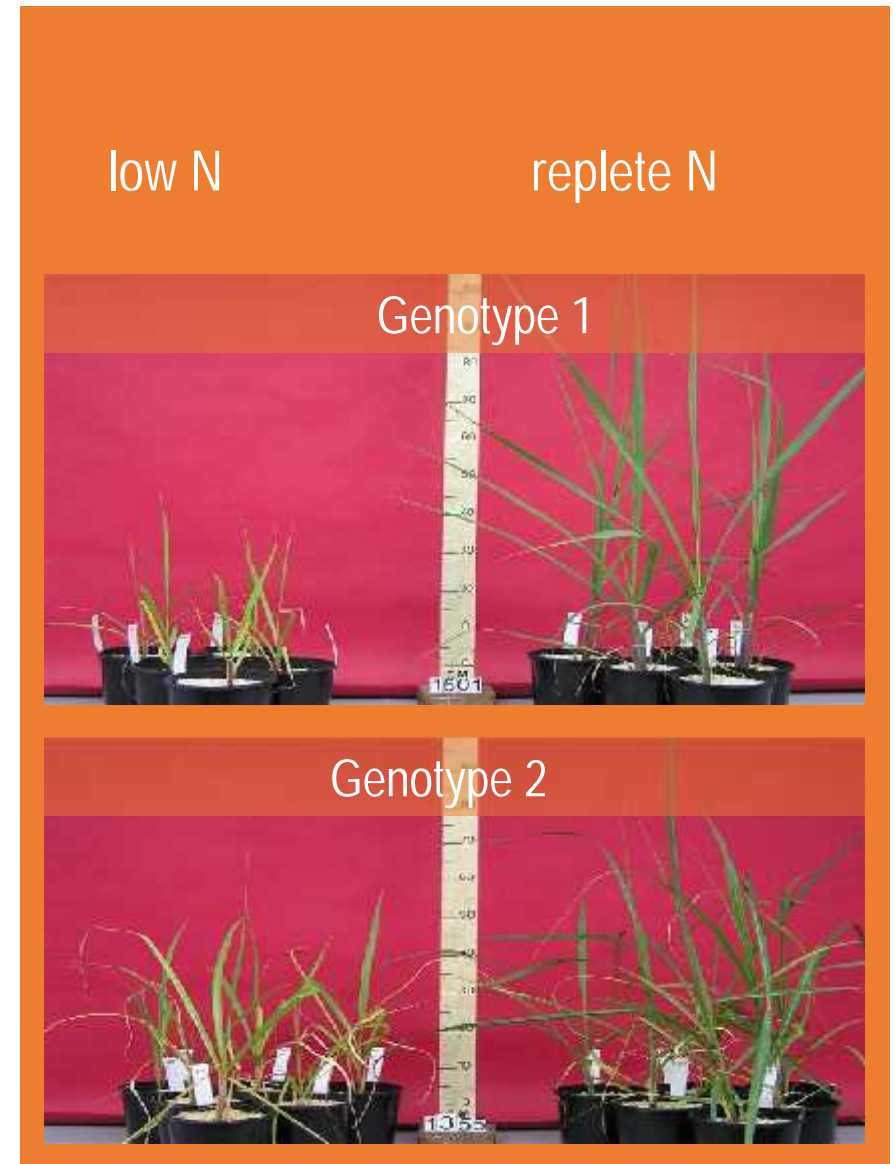
- a. Selecting and breeding N efficient sugarcane
- b. Next-generation fertilisers
- c. Legume intercrops for biologically fixed N
- d. Understanding soil biology and N cycling

Commercial sugarcane
 Saccharum spontaneum
 Saccharum officinarum
 Commercial sugarcane
 x Erianthus
 Erianthus



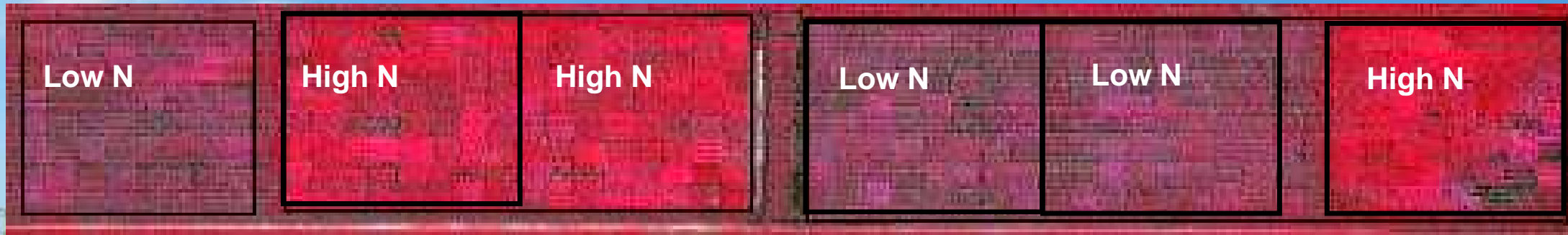
Improving internal N efficiency (biomass per unit N)

- a. Selecting and breeding N efficient sugarcane
- b. Next-generation fertilisers
- c. Legume intercrops for biologically fixed N
- d. Understanding soil biology and N cycling



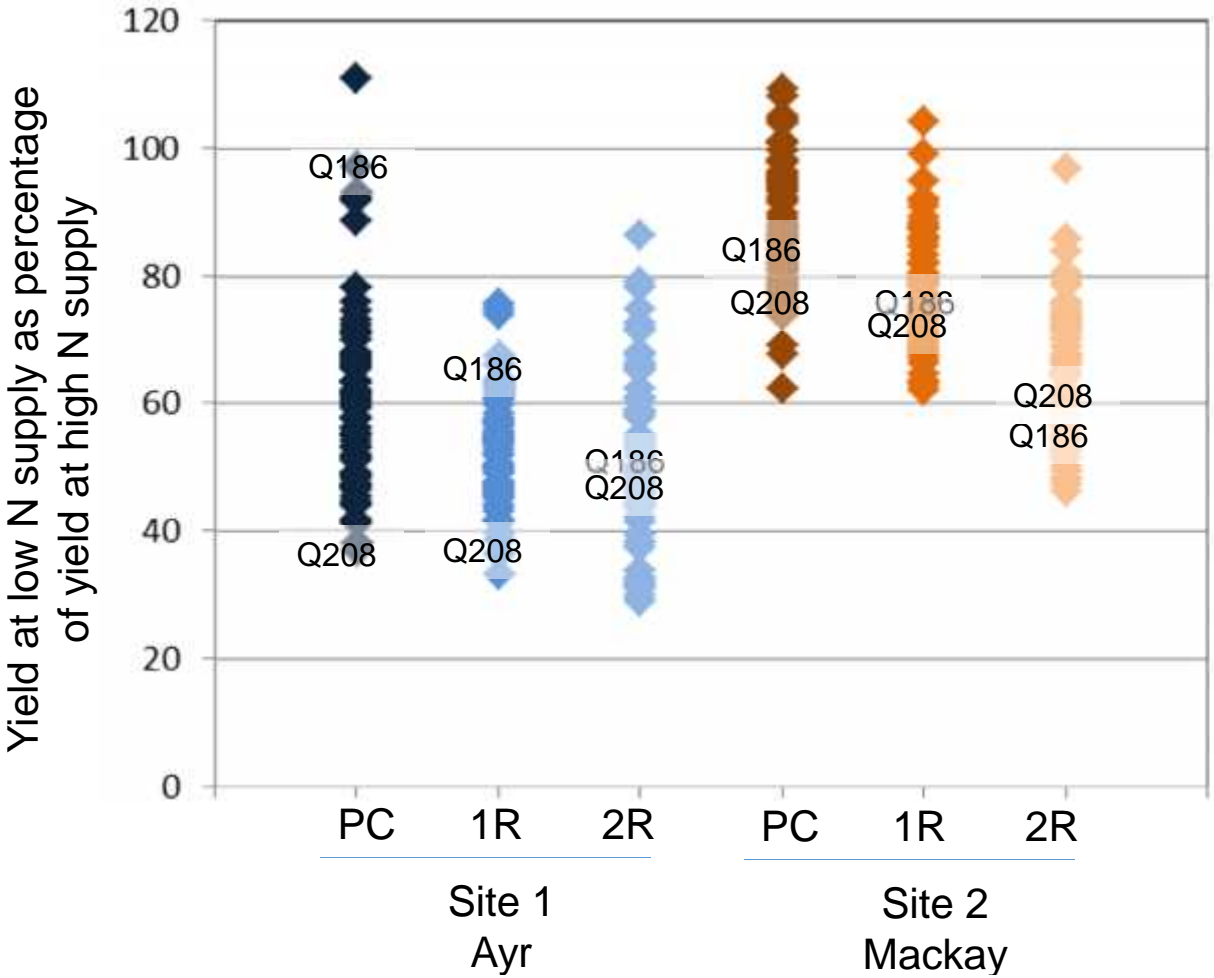
3 year field trials with low (~ 40 kg N) and recommended N (~ 200 kg N)

- 64 genotypes: commercial, foreign, parental lines, introgression crosses



Satellite image January 2013 2nd ratoon, 5 months old crop

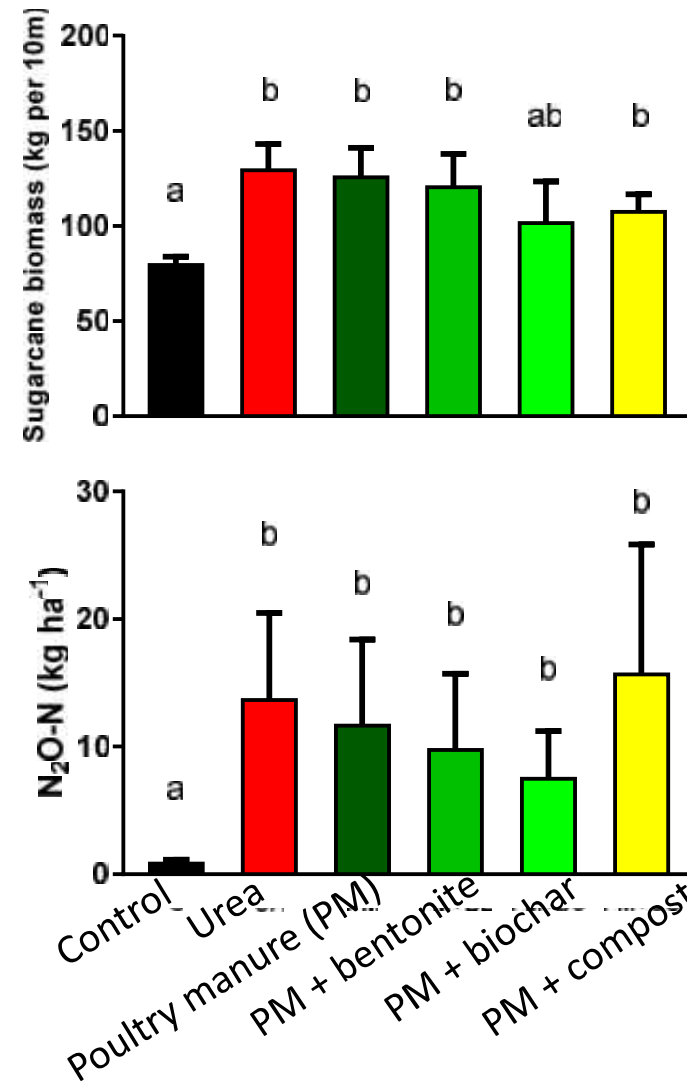
Performance at low relative to high N supply identifies efficient genotypes (two Australian varieties highlighted among 64 genotypes)



PC Plant Crop
 1R 1st ratoon crop
 2R 2nd ratoon crop

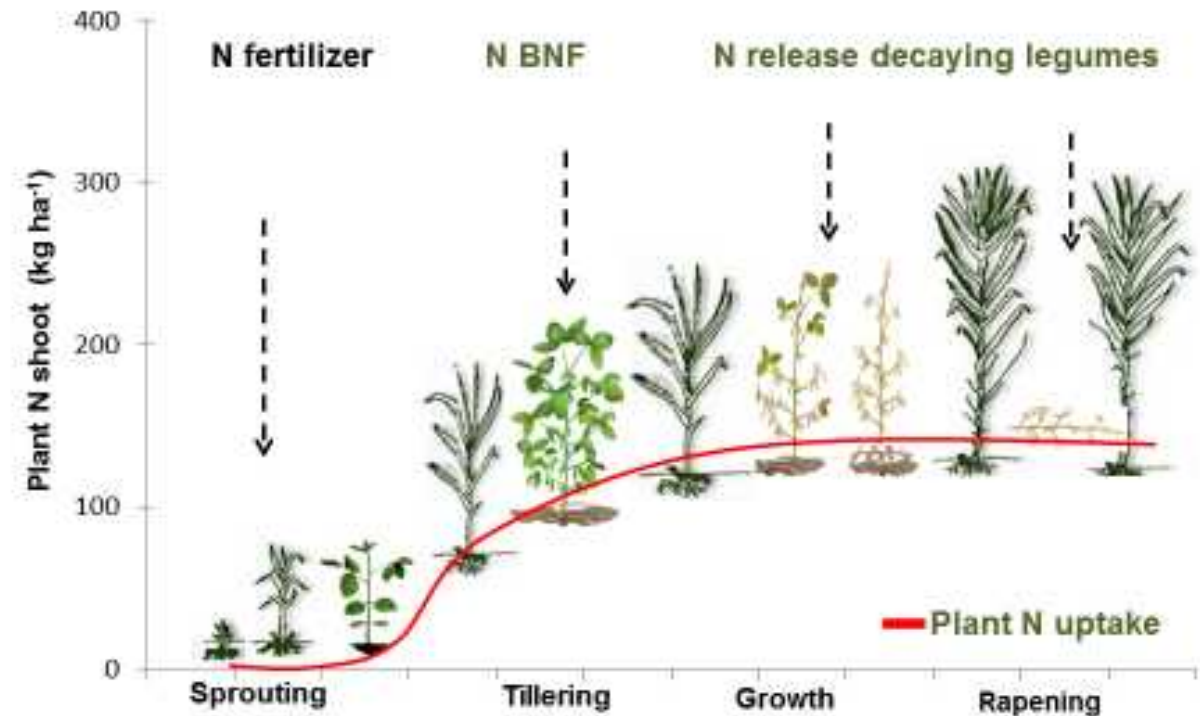
Next-Gen fertilisers based on re-purposed wastes and sorbers

- a. Selecting and breeding N efficient sugarcane
- b. Next-generation fertilisers
- c. Legume intercrops for biologically fixed N
- d. Understanding soil biology and N cycling



Biologically fixed legume-N to complement fertiliser-N

- a. Selecting and breeding N efficient sugarcane
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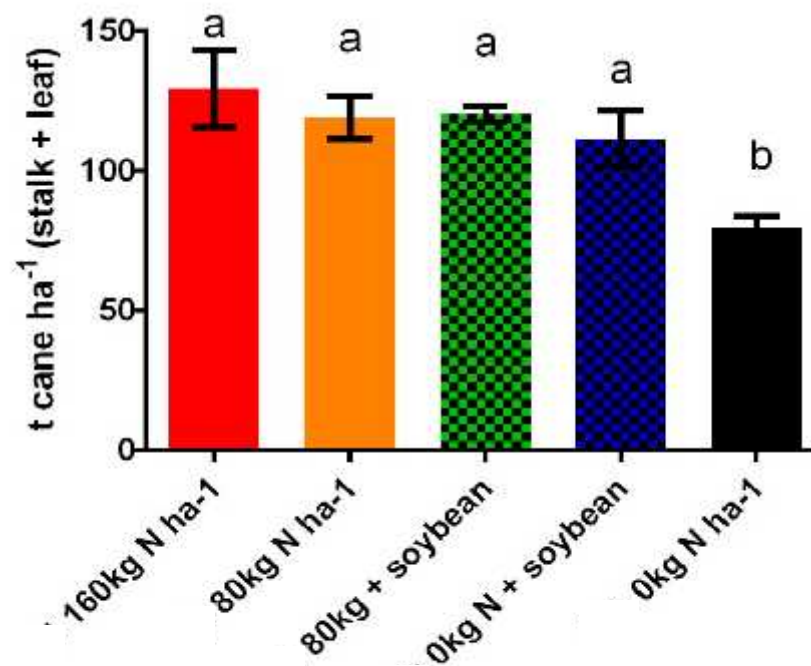


Monica Salazar Poster #53

Increased sugarcane yield with intercropped legumes



Sunshine Coast Australia (2014-15 season)



Monica Salazar Poster #53

New tools for unraveling soil biology and N cycling

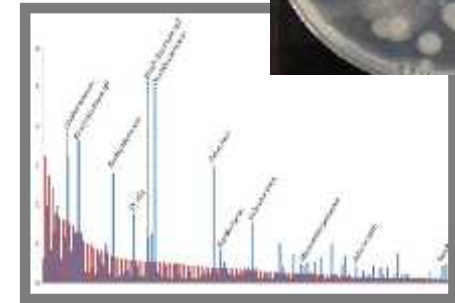
- a. Selecting and breeding N efficient sugarcane
- b. Next-generation fertilisers
- c. Legume intercrops for biologically fixed N
- d. Understanding soil biology and N cycling



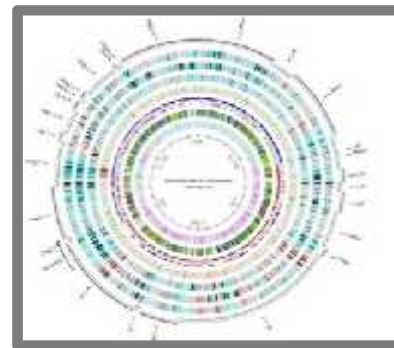
Soil N fluxes



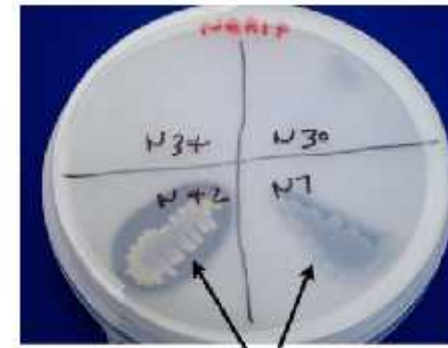
Microbial community survey, metagenomics, isolation



Microbe Characterisation



Genome and transcriptome analyses



Biological N fixation has long been discussed as an N source as diazotrophs are associated with sugarcane



160 kg N/ha



40 kg N/ha



Roots+Rhizosphere

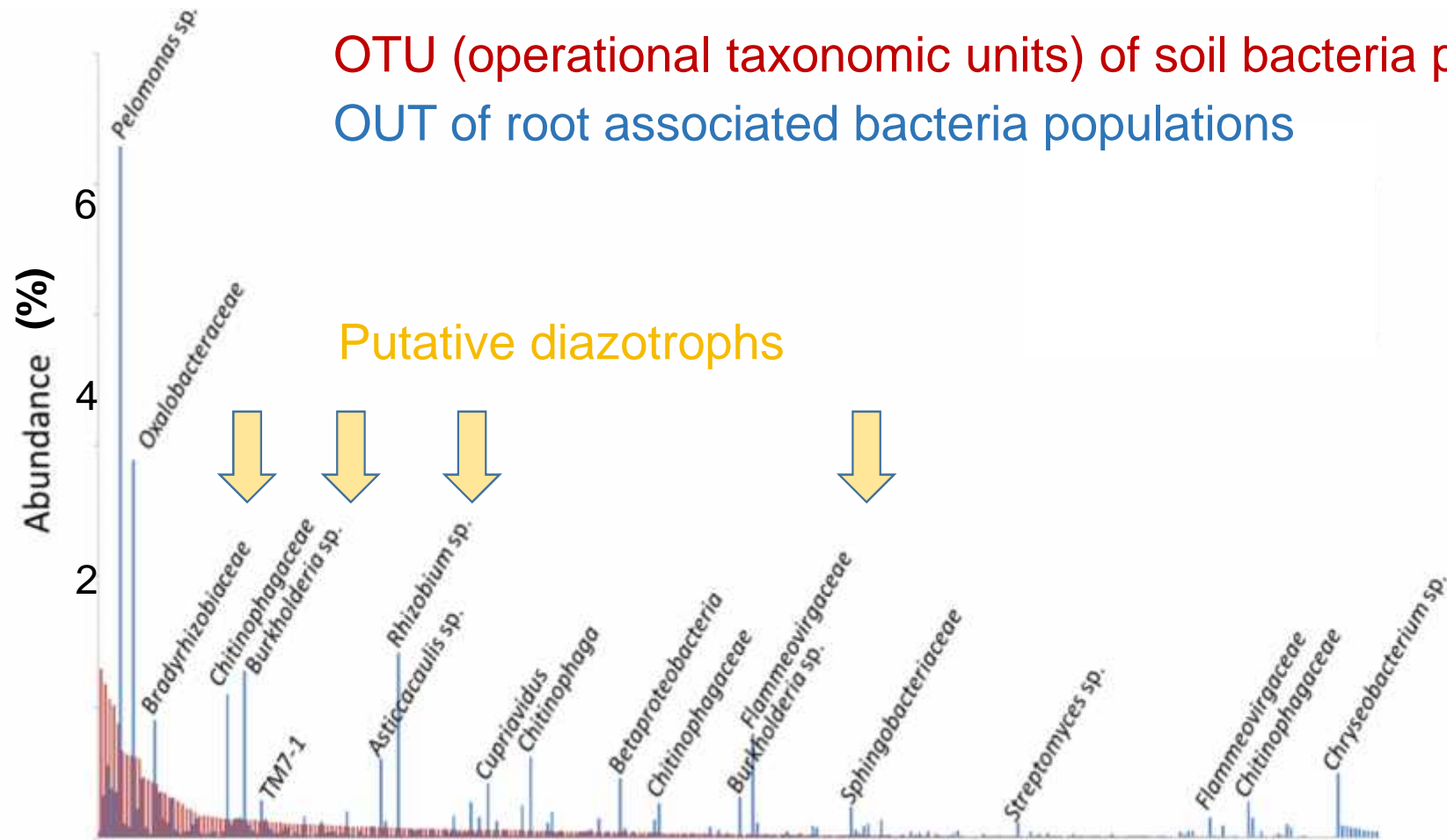


Bulk Soil

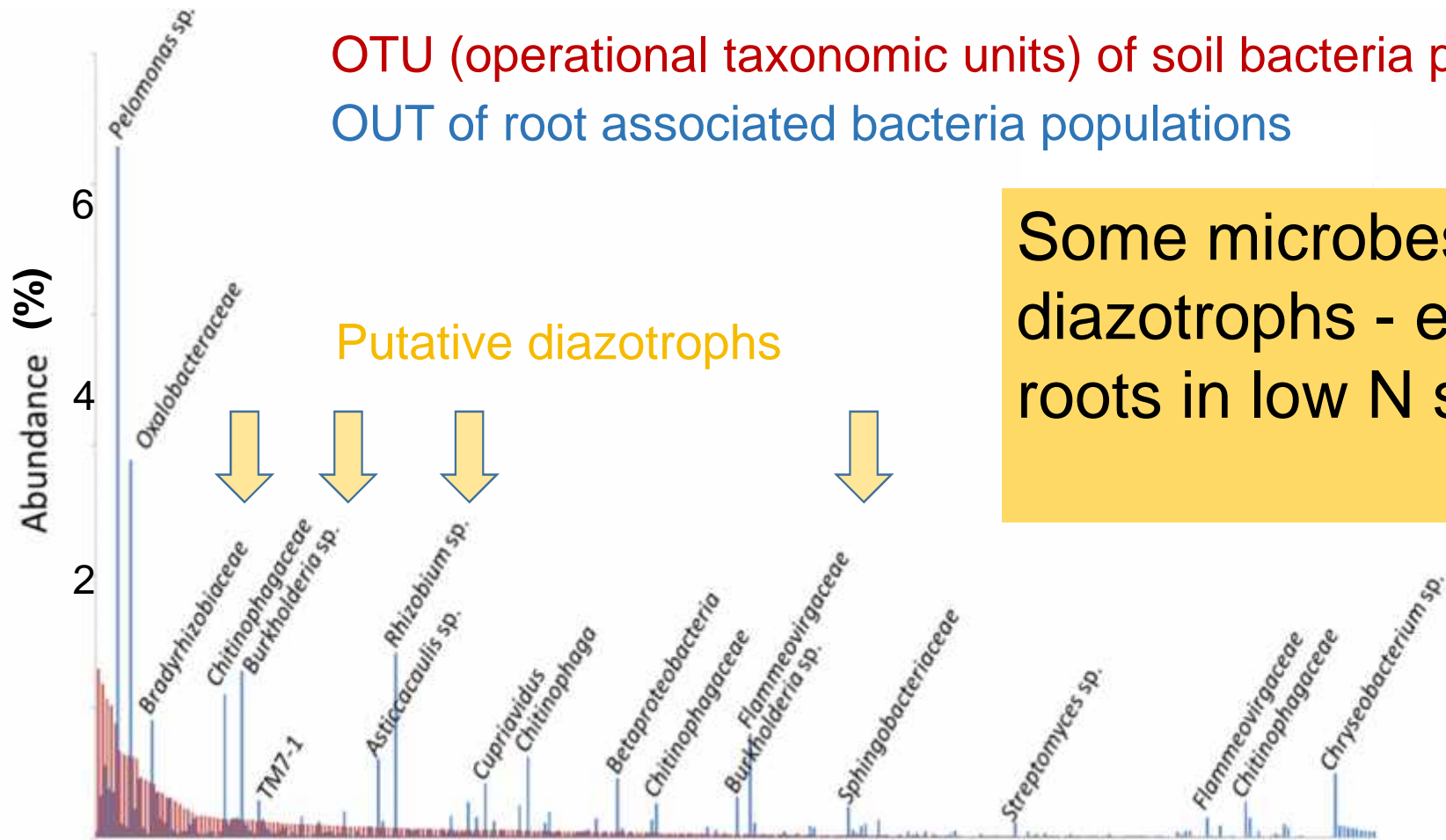
432 samples

Are there more diazotrophs with less N fertiliser ?

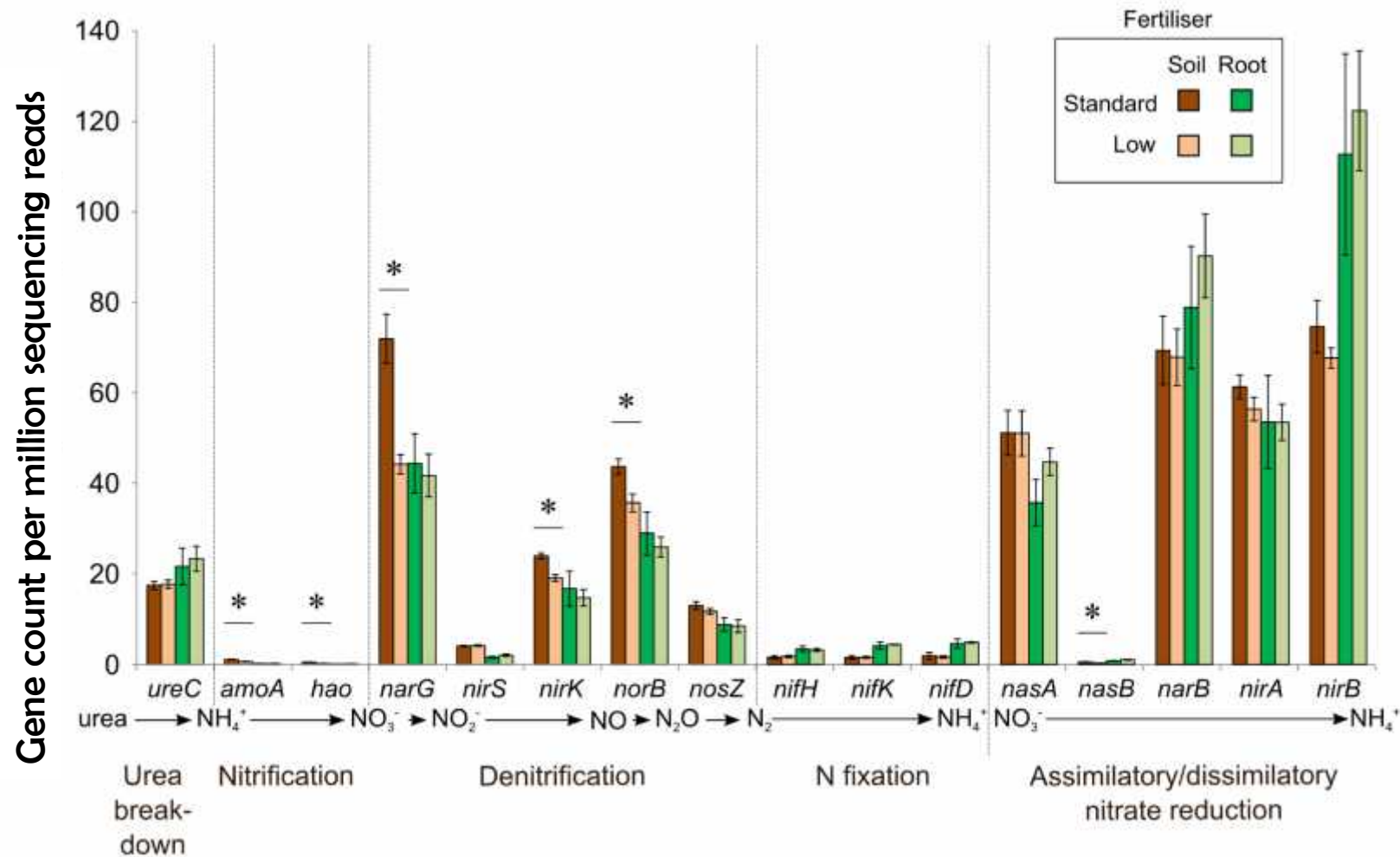
Subset of soil microbes recruits to root+rhizosphere



Subset of soil microbes recruits to root+rhizosphere



Metagenomics confirm *nif*-gene abundance unaffected by N supply although we find more genes involved in urea/ammonium/nitrate conversion in high N soil



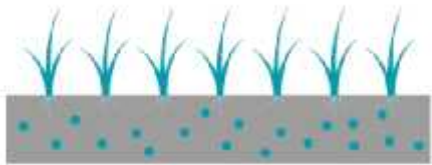
Improving nitrogen efficiency by aligning N supply and crop demand



Long-term progress towards 2018 modelled pollutant load reduction targets



More efficient fertiliser use needed



Inshore marine remained in poor condition

