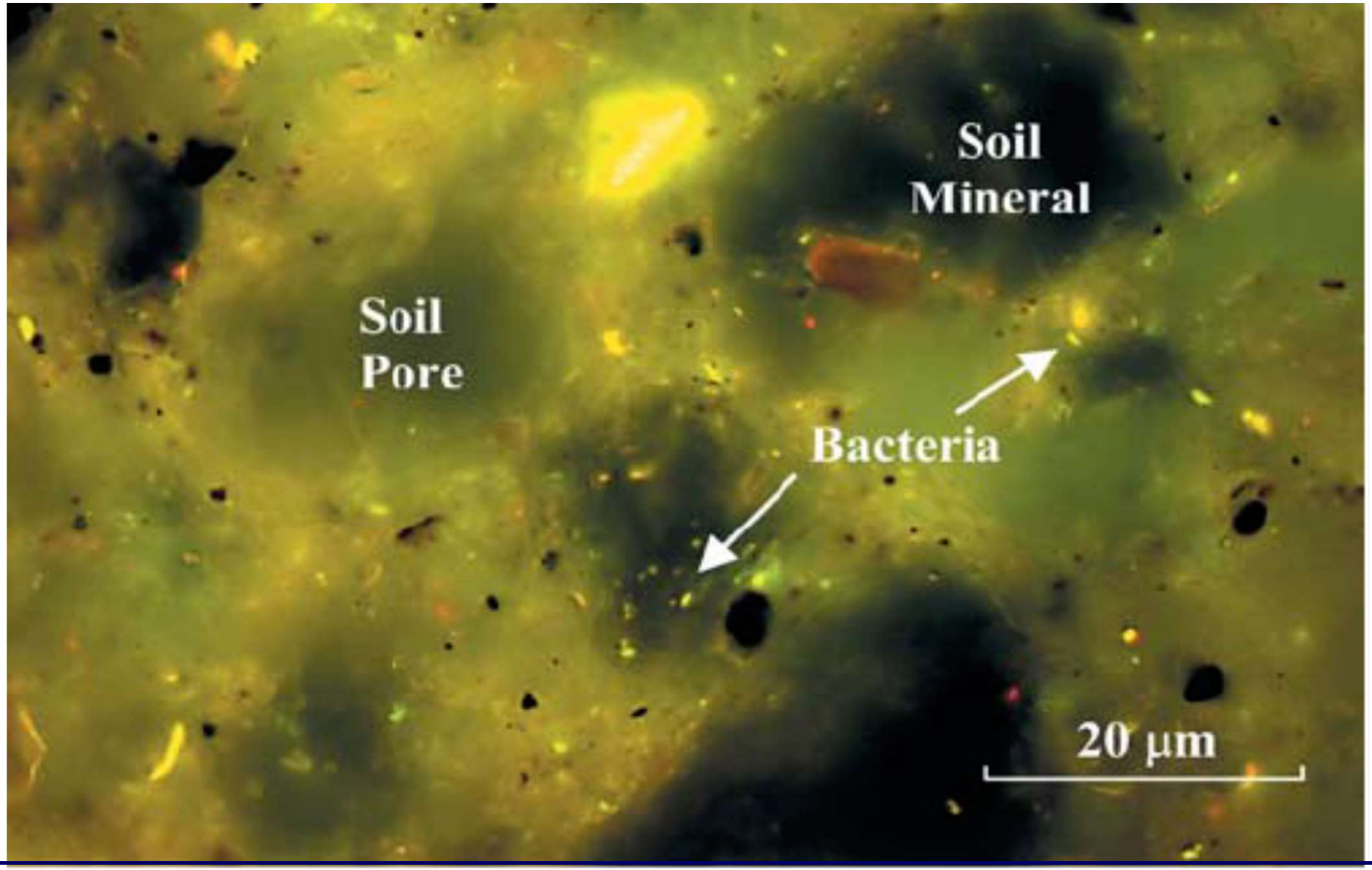
The University of Edinburgh

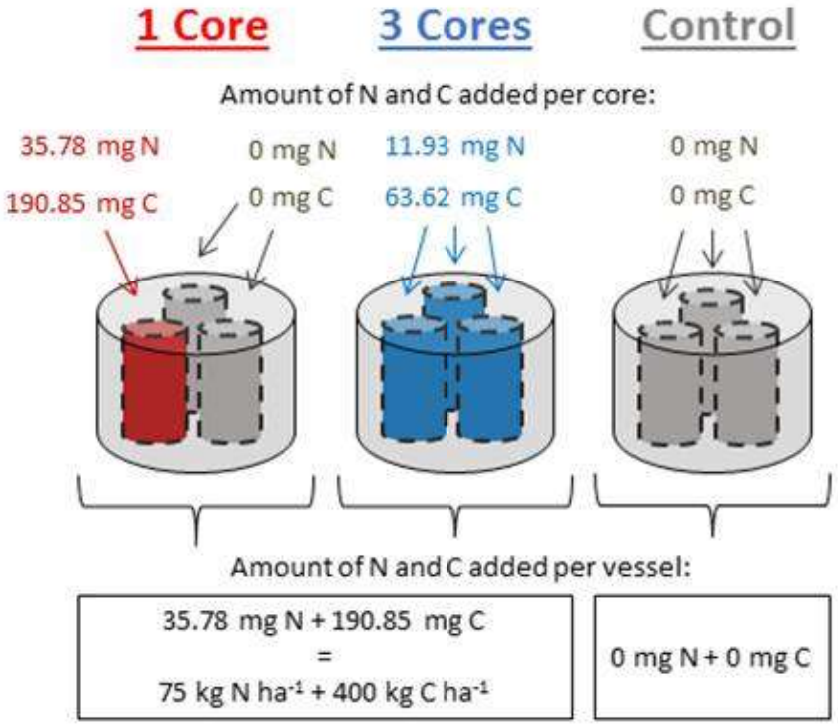
The rhizosphere: a hotspot of N_2O action

Liz Baggs

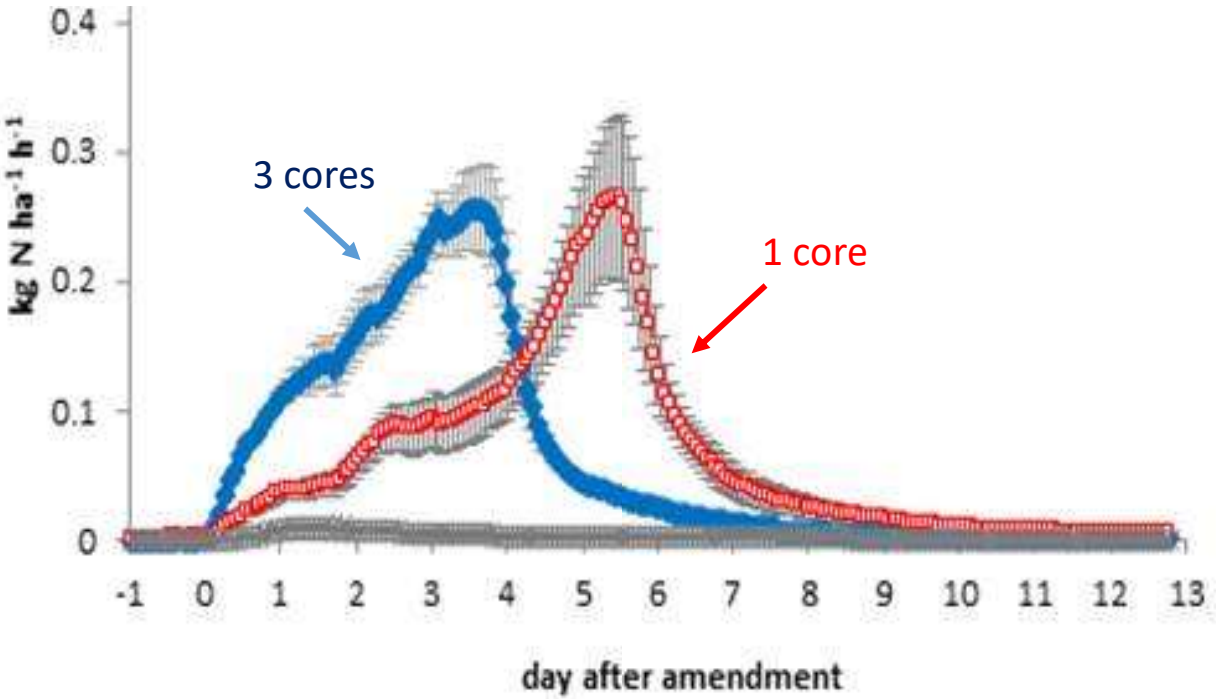
THE UNIVERSITY of EDINBURGH
Global Academy of Agriculture and Food Security



Li et al 2004 Biol Fertil Soils



^{15}N-KNO_3^- glucose



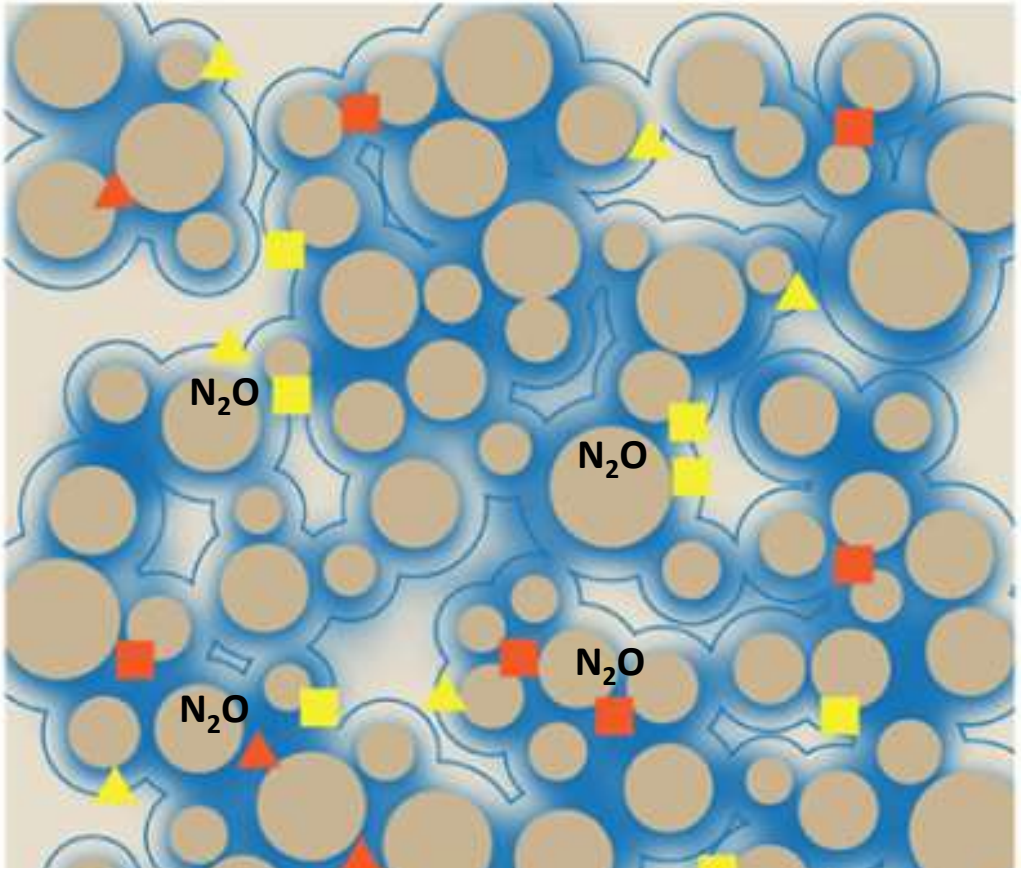
Loick et al 2017. Geoderma

Nitrogen

Oxygen

△ Rhizosphere adapted

□ Bulk soil adapted



Unsaturated soil

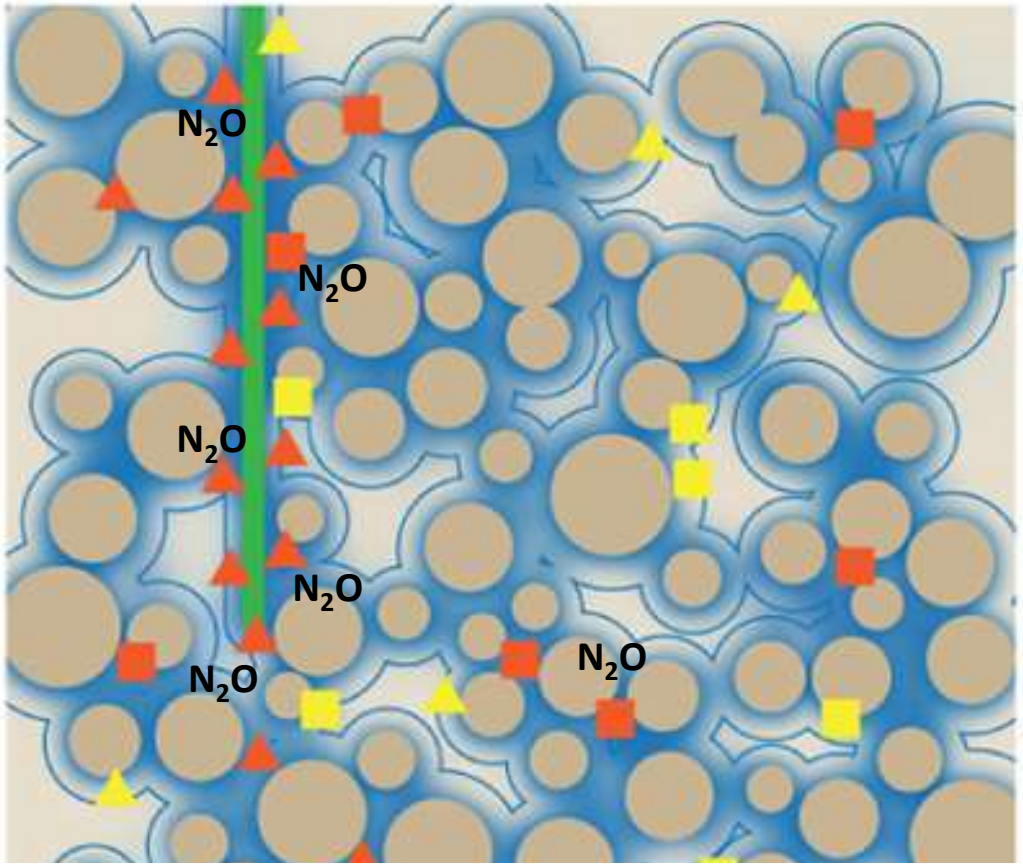
Giles et al 2012. Frontiers in Microbiology

Nitrogen

Oxygen

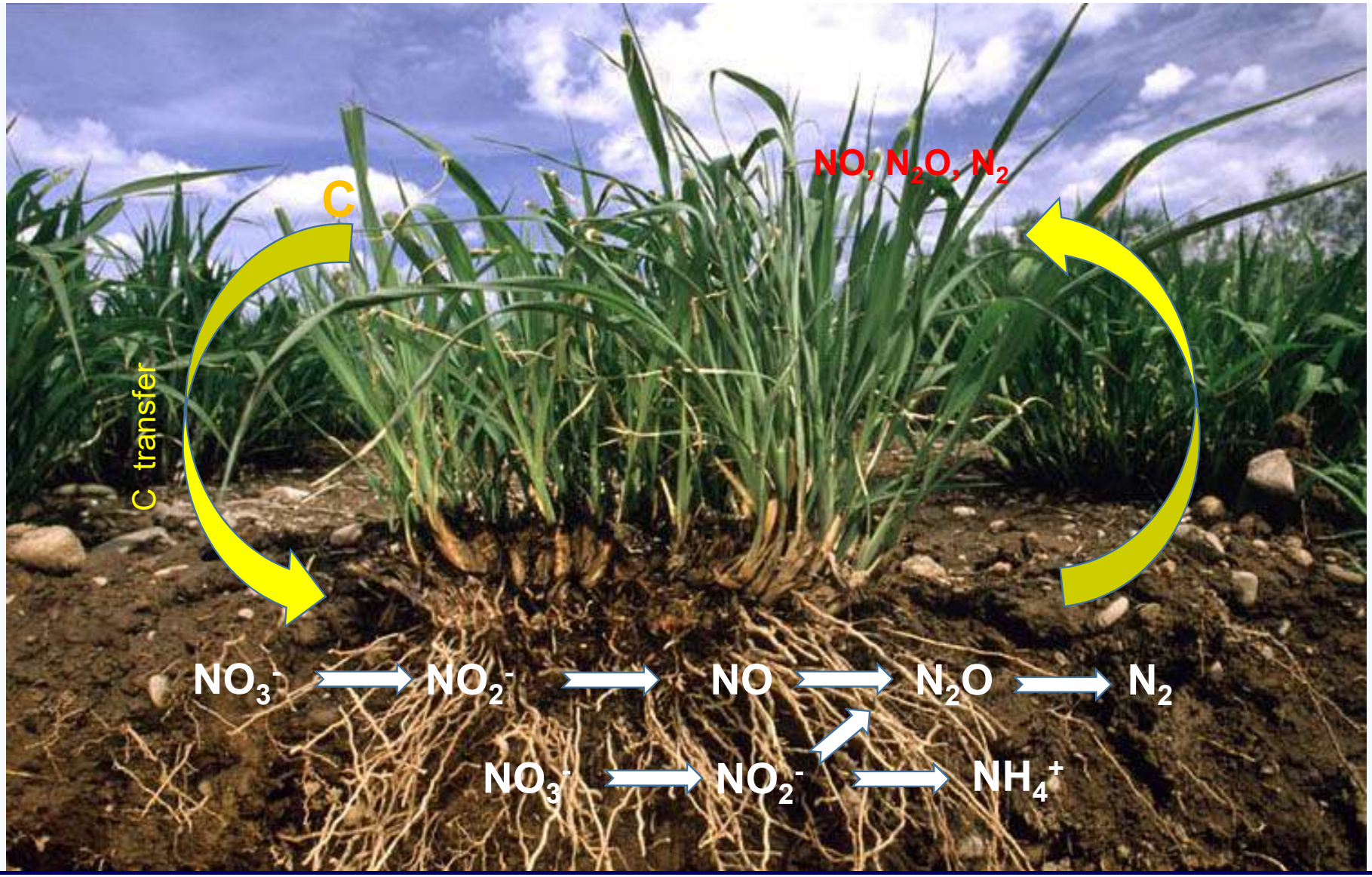
△ Rhizosphere adapted

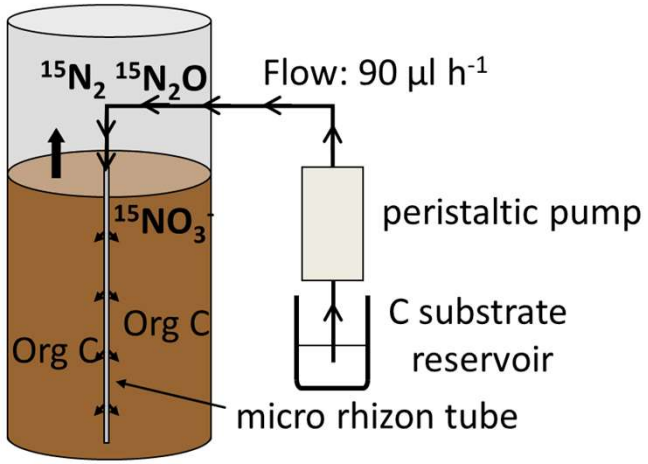
□ Bulk soil adapted



Root in unsaturated soil

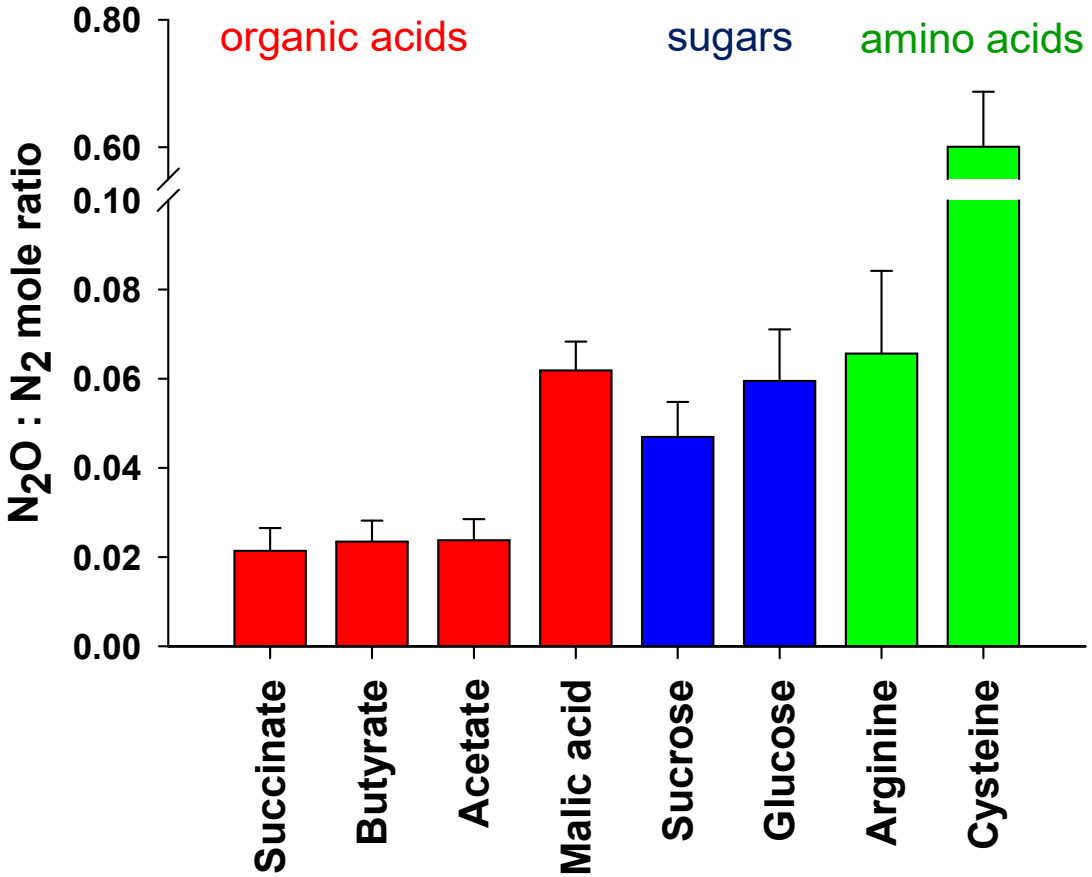
Giles et al 2012. Frontiers in Microbiology


C
C transfer
NO, N_2O, N_2
NO_3^- → NO_2^- → NO → N_2O → N_2
NO_3^- → NO_2^- → NH_4^+

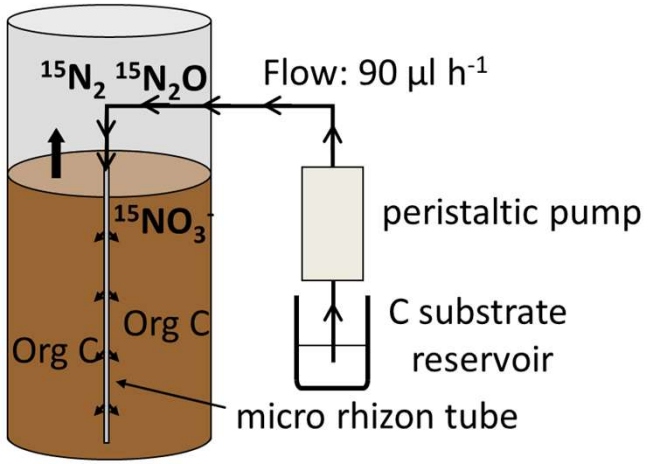


75 µg C g^{-1} day^{-1}

$K^{15}NO_3$
20 g N m^{-2}



Morley et al 2014. PLoS one

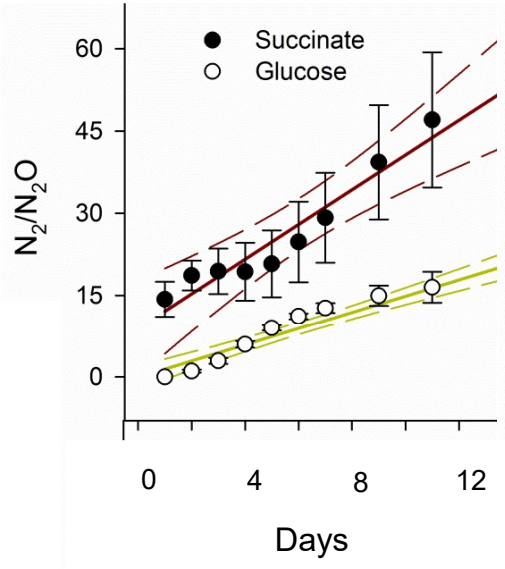


Organic acids: enhanced N_2O reductase efficiency
major constituent of labile root C exudation

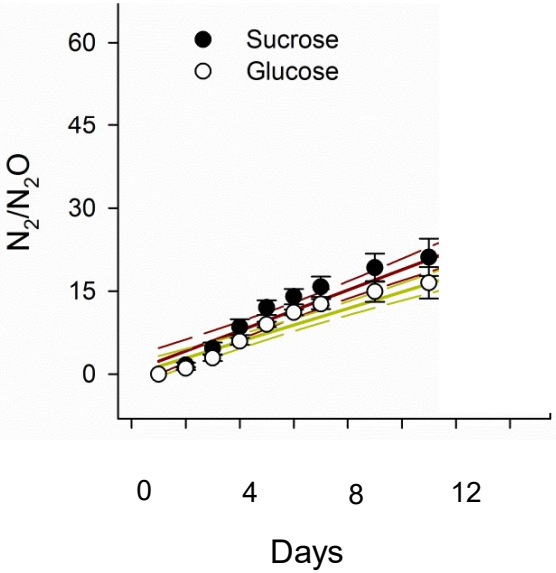
75 µg C g^{-1} day^{-1}

$K^{15}NO_3$
20 g N m^{-2}

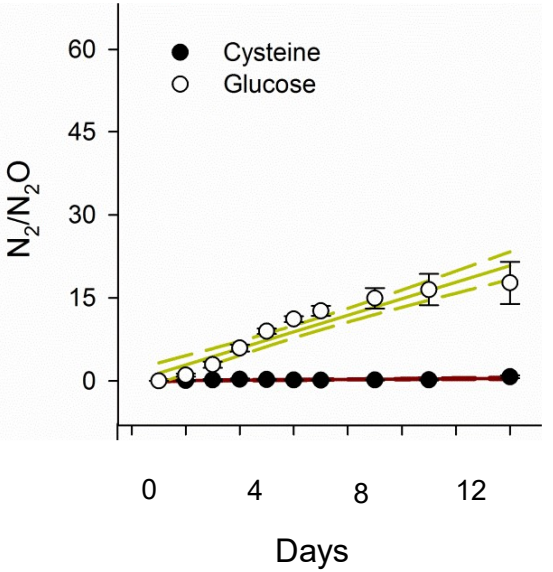
organic acid



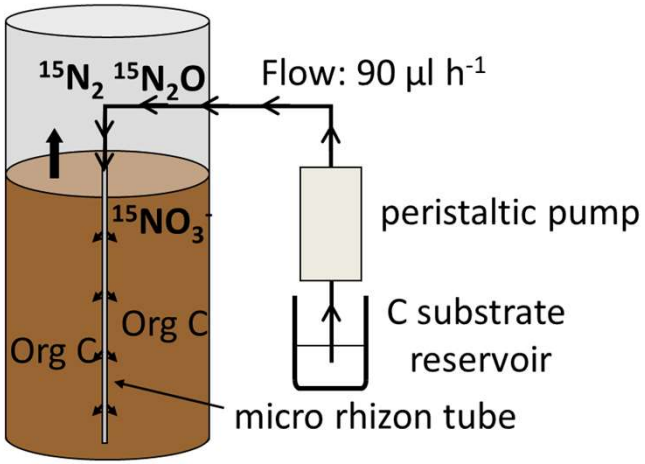
sugar

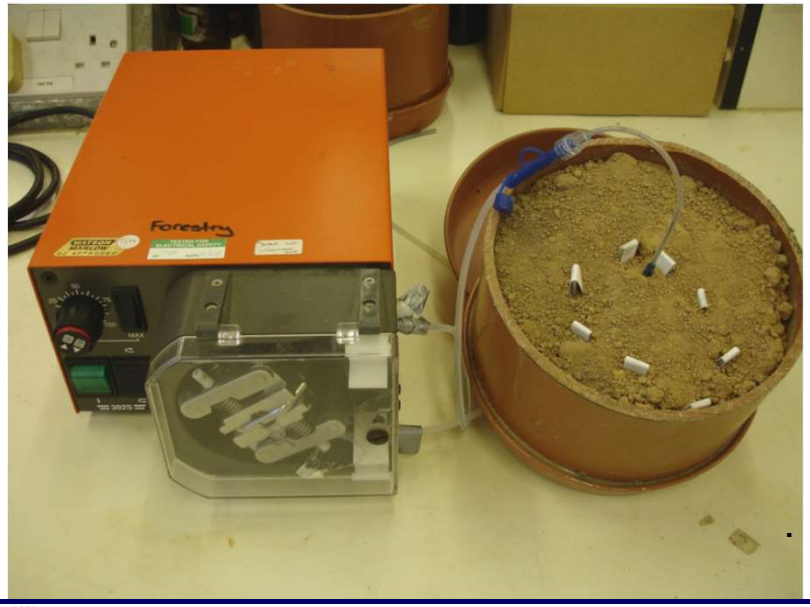


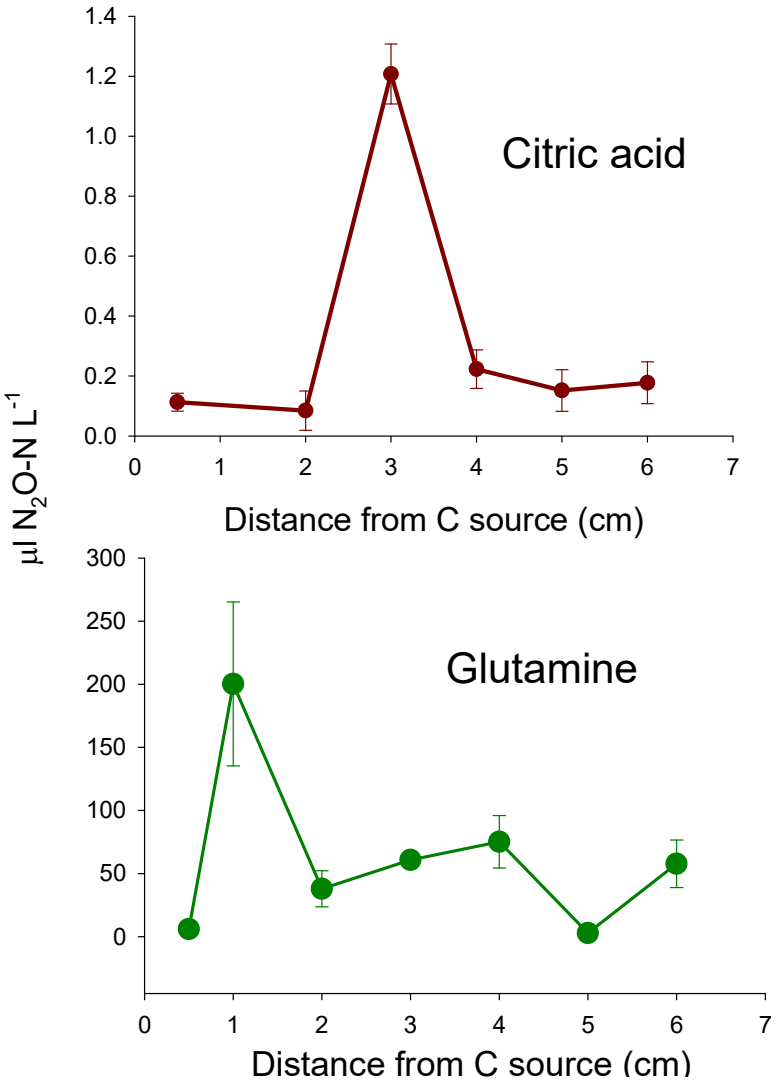
amino acid



Morley et al 2014. PLoS one





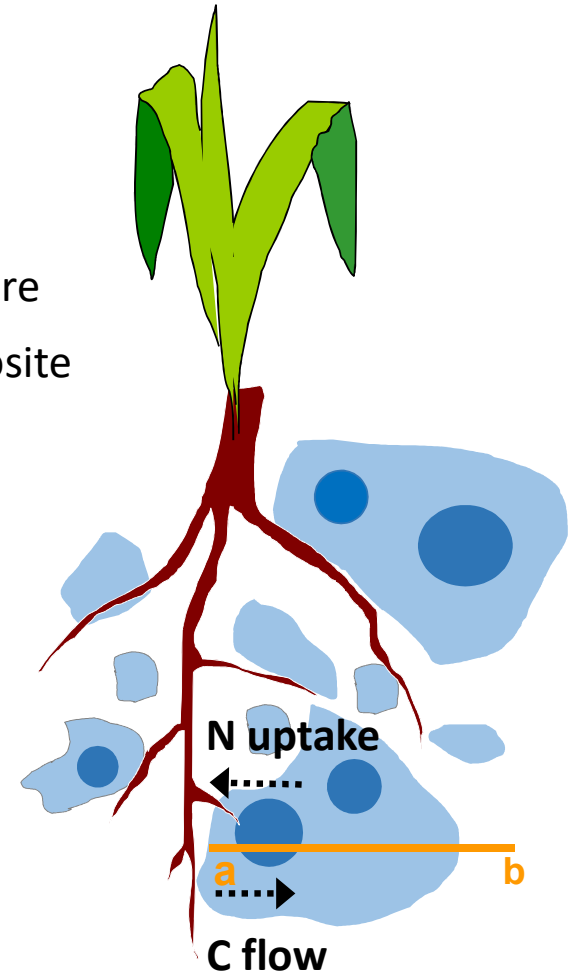


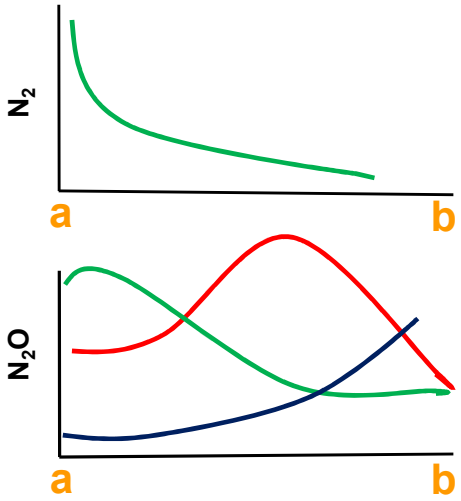
Giles et al 2017. Soil Biol Biochem

Water filled pore

Sub-oxic microsite

Oxic zone



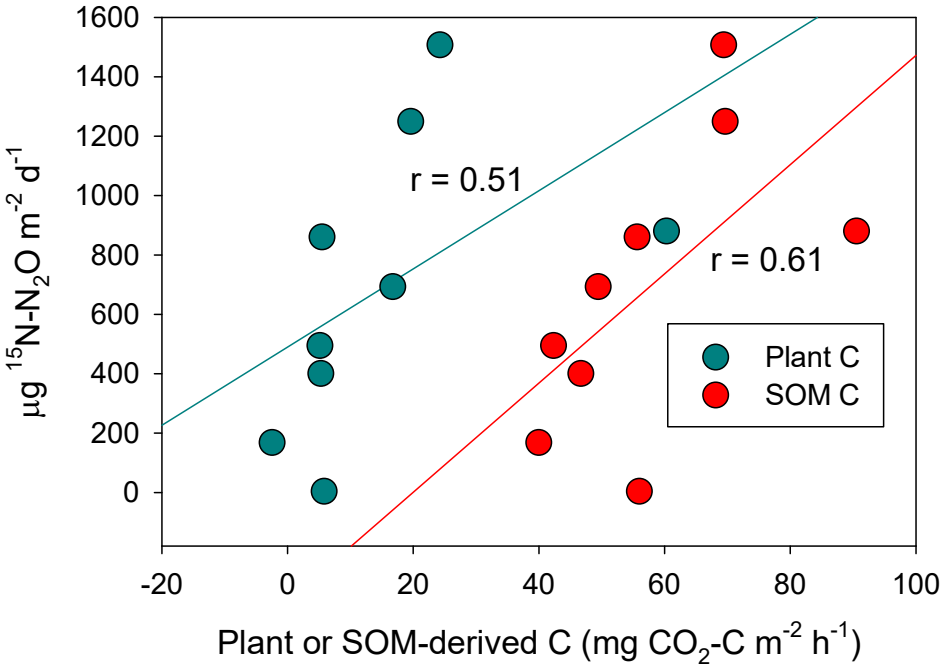


Denitrification

Ammonia oxidation

Nitrate ammonification

Plant- & soil-C driving N_2O production



^{13}C-depleted (-38.5‰) CO_2

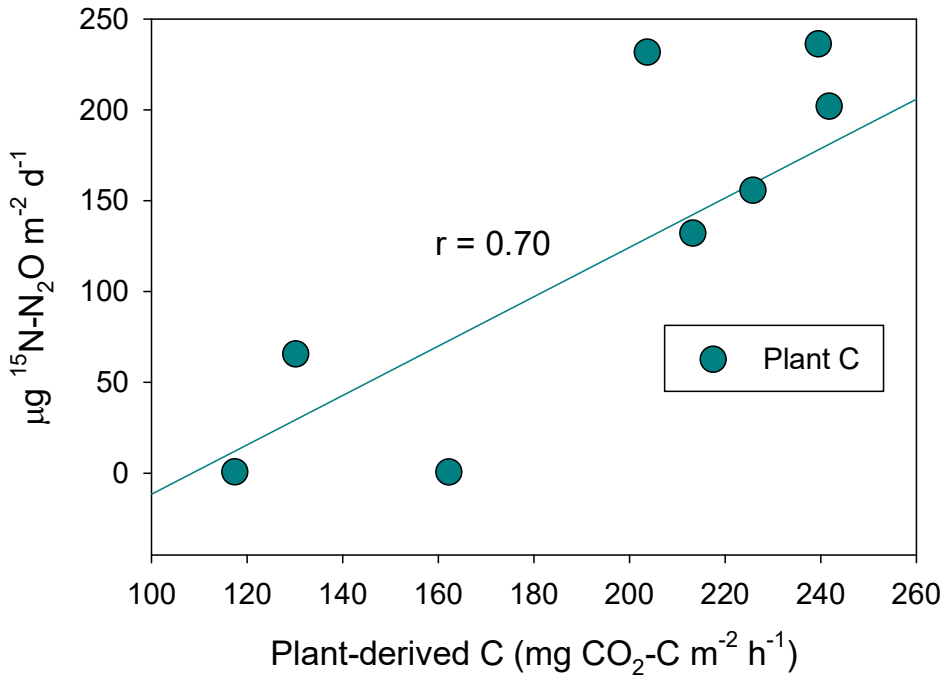
360 µmol mol^{-1}

$K^{15}NO_3$, 20 g N m^{-2}

Low SOM

$\delta^{13}C$-CO_2 to distinguish between plant- and SOM derived C

Plant-C driving N_2O production

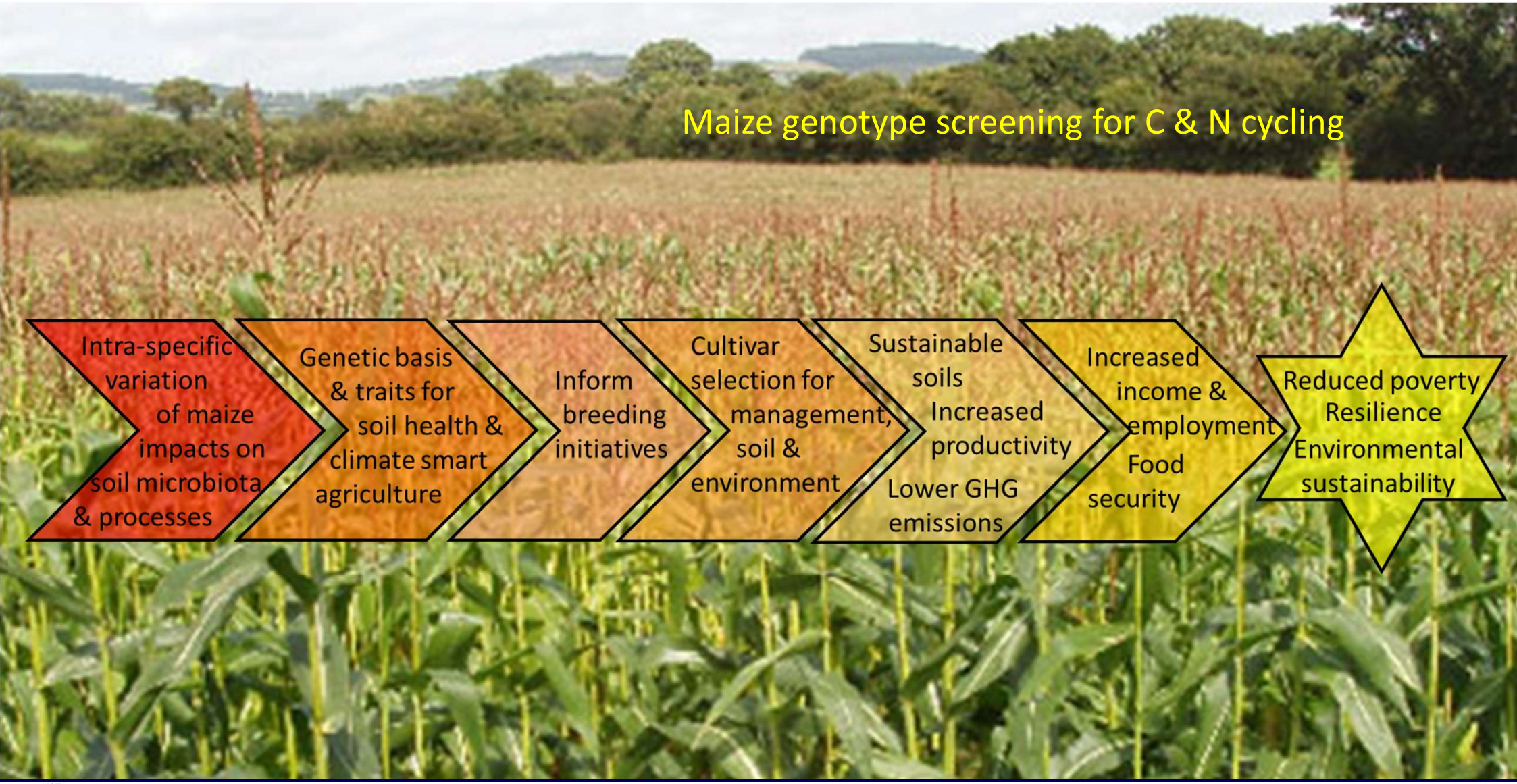


^{13}C-depleted (-38.5‰) CO_2

750 µmol mol^{-1}

$K^{15}NO_3$, 20 g N m^{-2}

High SOM


Maize genotype screening for C & N cycling
Intra-specific variation of maize impacts on soil microbiota & processes
Genetic basis & traits for soil health & climate smart agriculture
Inform breeding initiatives
Cultivar selection for management, soil & environment
Sustainable soils
Increased productivity
Lower GHG emissions
Increased income & employment
Food security
Reduced poverty
Resilience
Environmental sustainability

Thanks to…

collaborators

Lumbani Mwafulirwa

THE UNIVERSITY of EDINBURGH
Global Academy of Agriculture and Food Security

Eric Paterson
Maddy Giles

The James Hutton Institute

Nick Morley

UEA
University of East Anglia

Tim Daniell

The University Of Sheffield.

Nadine Loick
Laura Cardenas

ROTHAMSTED RESEARCH

Christian Thierfelder
Jill Cairns

CIMMYT
International Maize and Wheat Improvement Center

funders

BBSRC
bioscience for the future

NERC SCIENCE OF THE ENVIRONMENT

GCRF
Global Challenges Research Fund