

# Legume research in Cambridge and its implications for sustainable production

Sigrid Heuer – Head of Pre-Breeding NIAB

Giles Oldroyd – Director of Cambridge Crop Science Centre (CSC)



# Enabling *Genes to Field* research



Russell R Geiger  
Rob and Sue Cawthorn



Driven by impact, fuelled by excellence





# NIAB – Agricultural research in the UK since 1919

- **13 UK regional field trials centres**
- **100+ UK field trial sites, 140k+ plots**



- **Commercial & statutory work**  
e.g., variety testing, seed certification
- **Pathology** (pathogen collection, diagnostic & research)
- **main crops in Cambridge :**
  - ✓ Legumes
  - ✓ Potatoes
  - ✓ Wheat

- **Strawberries**
- **Raspberries**
- **Apples**
- **Tomato**
- ...







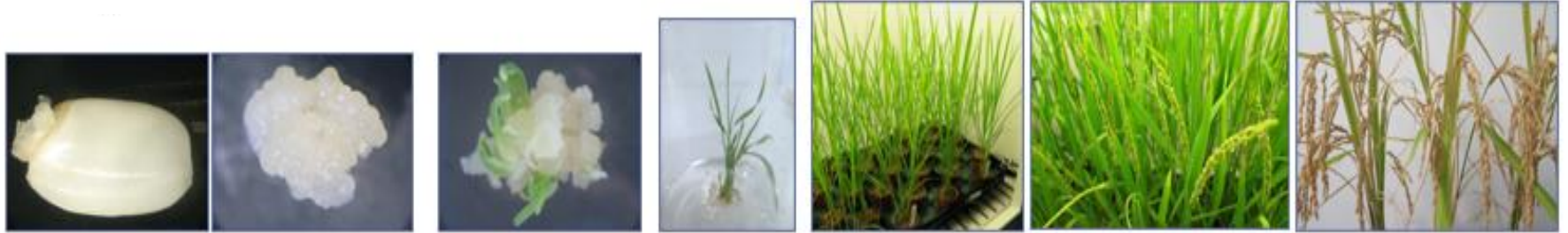
# Prospect of Legume Program at NIAB:



Faba Bean  
Chickpea  
Soybean  
Lentil

...

# NIAB Crop Transformation



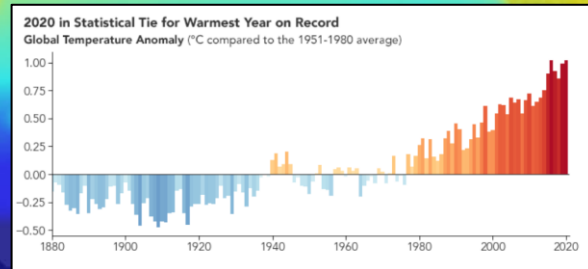
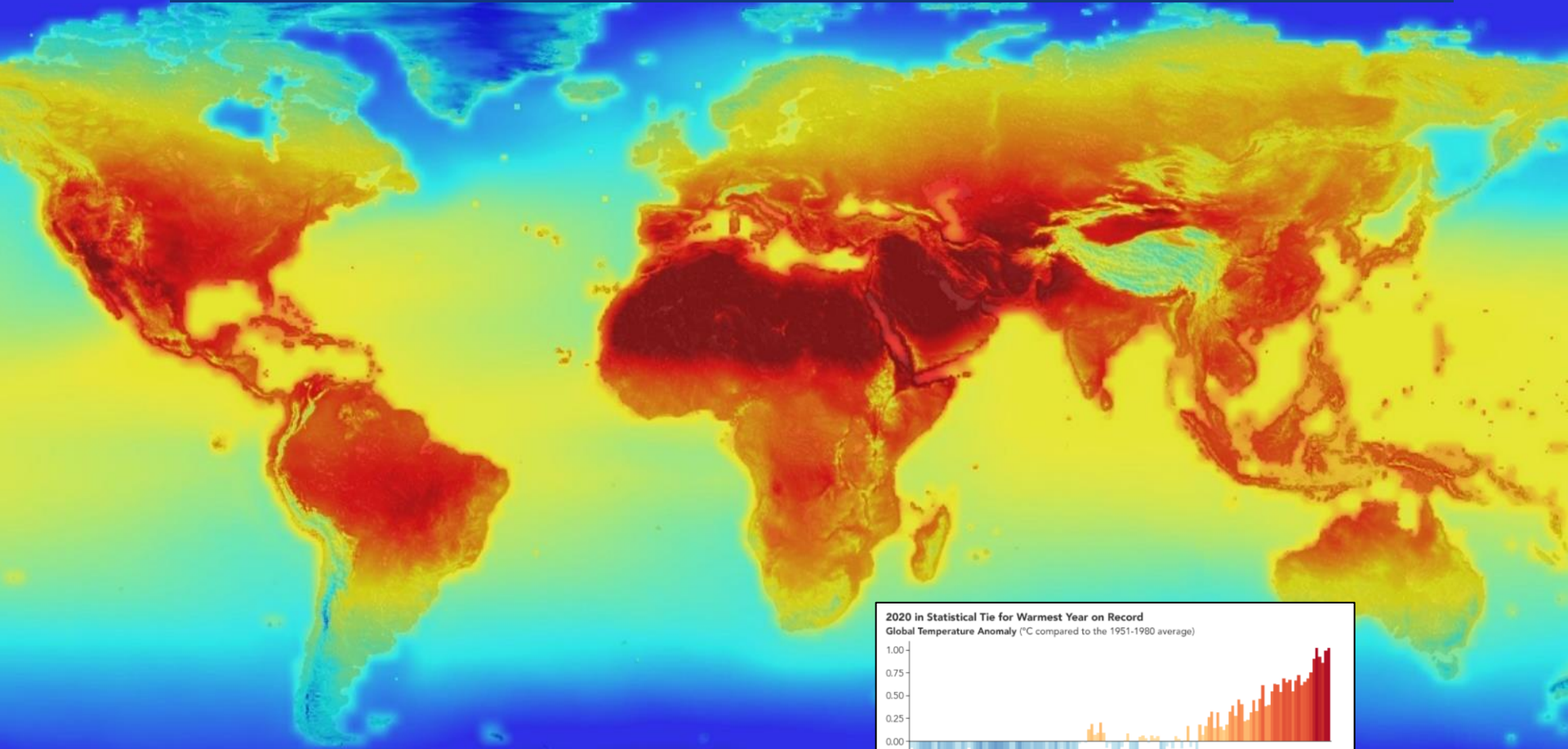
**Emma Wallington**

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- ✓ Wheat
- ✓ Barley
- ✓ Rice
- ✓ Oats
- ✓ Maize

- ✓ Oilseed rape
- ✓ Potato
- ✓ Medicago
- ✓ Soybean
- ... Legumes

# Enhancing heat tolerance in African legumes



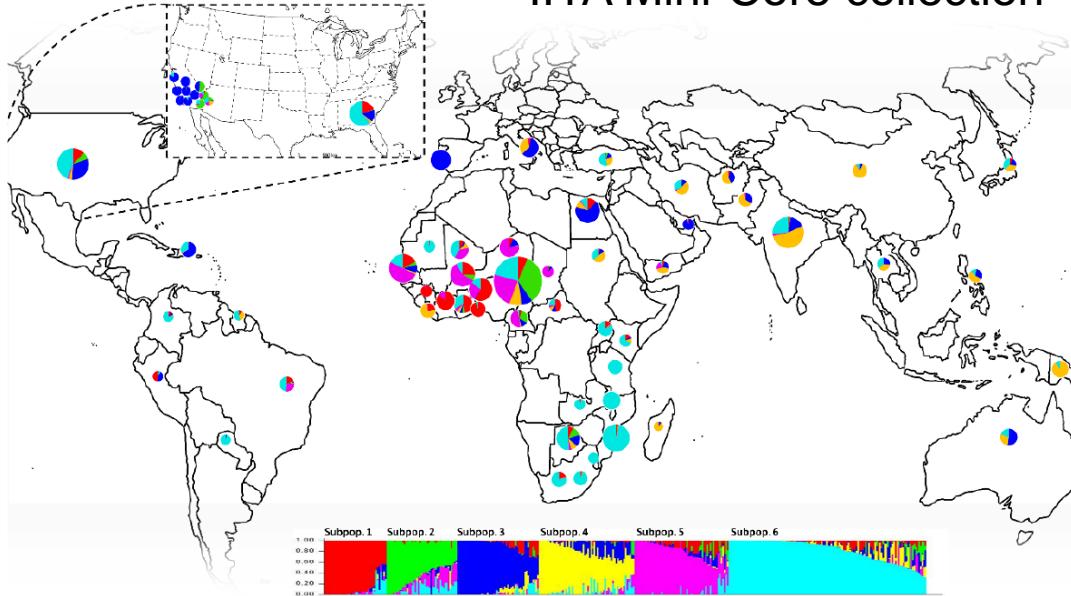
<https://www.nasa.gov/press-release/nasa-releases-detailed-global-climate-change-projections>

<https://earthobservatory.nasa.gov/images/147794/2020-tied-for-warmest-year-on-record>

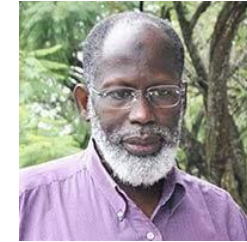


# Heat tolerance in Cowpea

## IITA Mini-Core collection



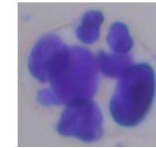
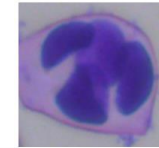
Muñoz-Amatriaín et al. 2021



Ousmane Boukar



Natasha Yelina



Pollen defect, grain and yield loss

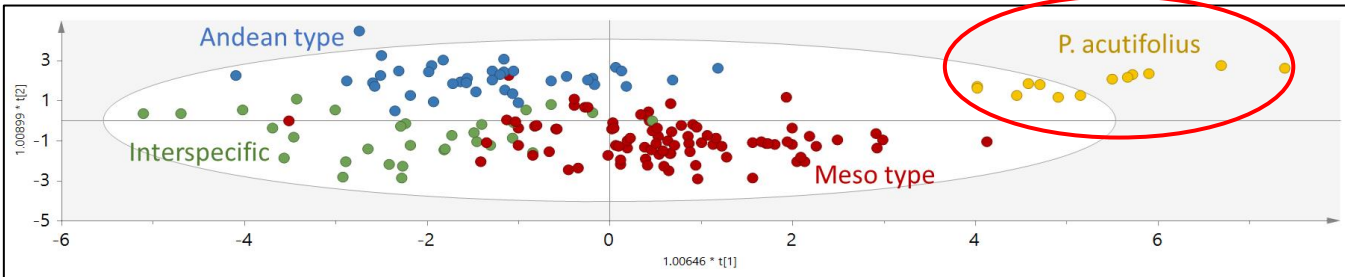
- ✓ Identify tolerant cowpea
- ✓ Understand tolerance mechanisms
- ✓ Develop breeding material



# Genetic diversity for heat tolerance in Phaseolus

(BBACO project)

## Primary metabolites differentiate main types



Steve Beebe



Tess Dilks



Claudia Lowe

### Heat tolerant 4 (HTA4)

### Calima

### DAA9 x (SAR4 x DAB295)

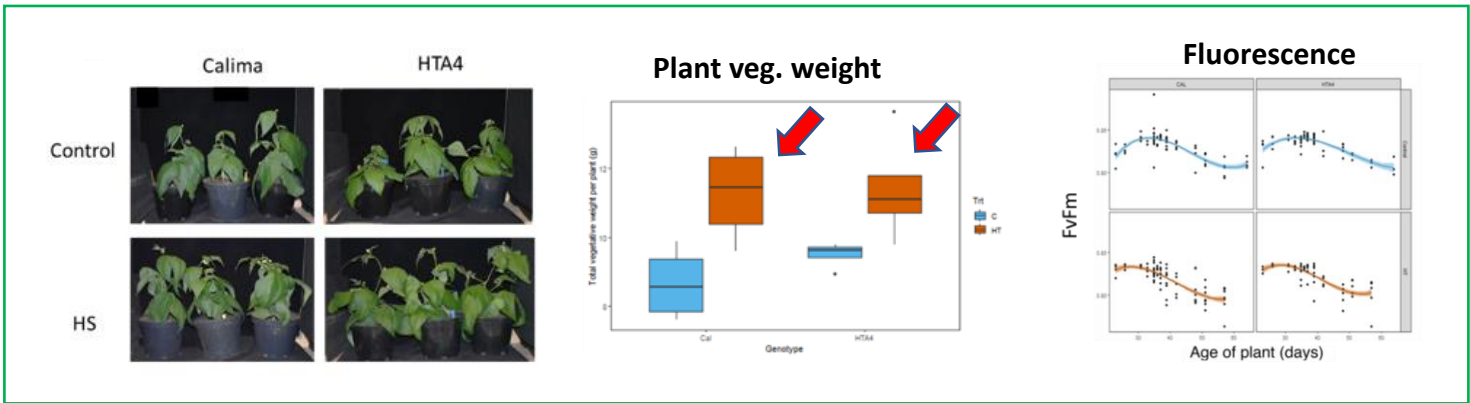


- Genotyping & crosses ongoing
- KT: Nominate additional parents

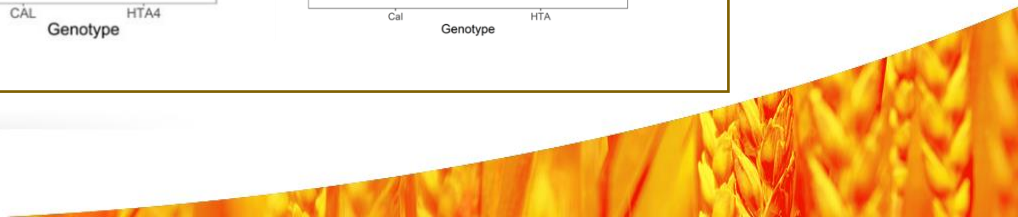
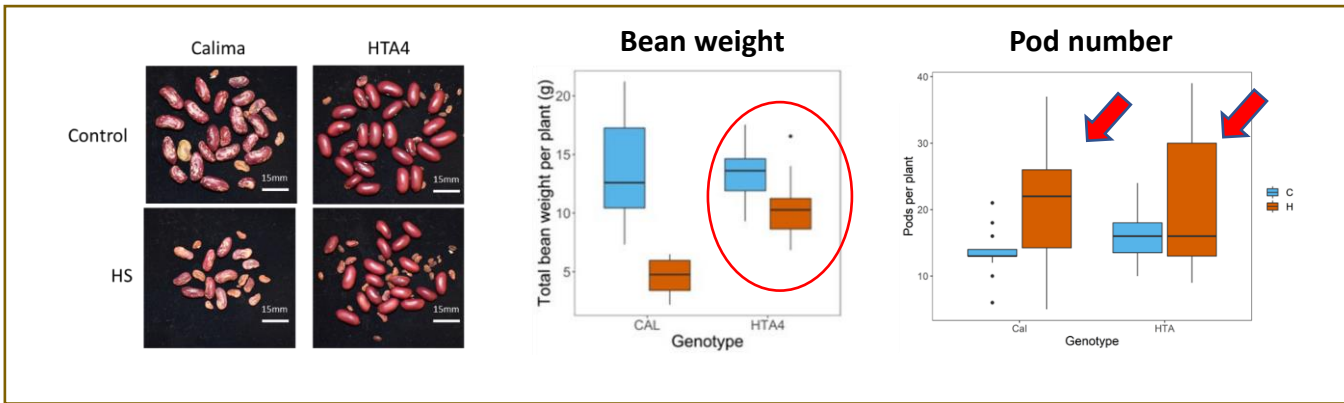
# Dissecting tolerance mechanisms in HTA4

Control: 26°C / 19°C  
 High T: 31°C / 24°C

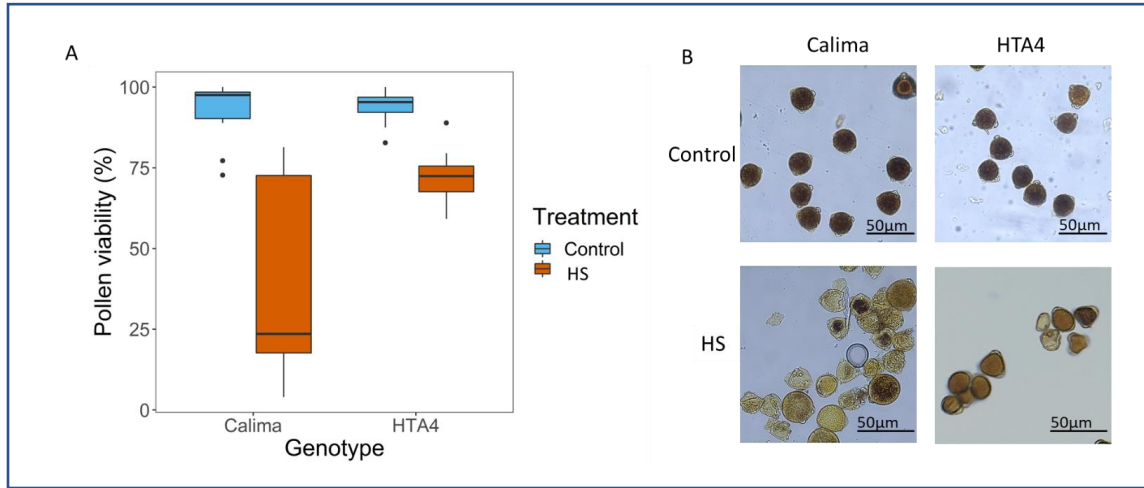
Vegetative growth increased under HT



## Reproductive phase is heat sensitive

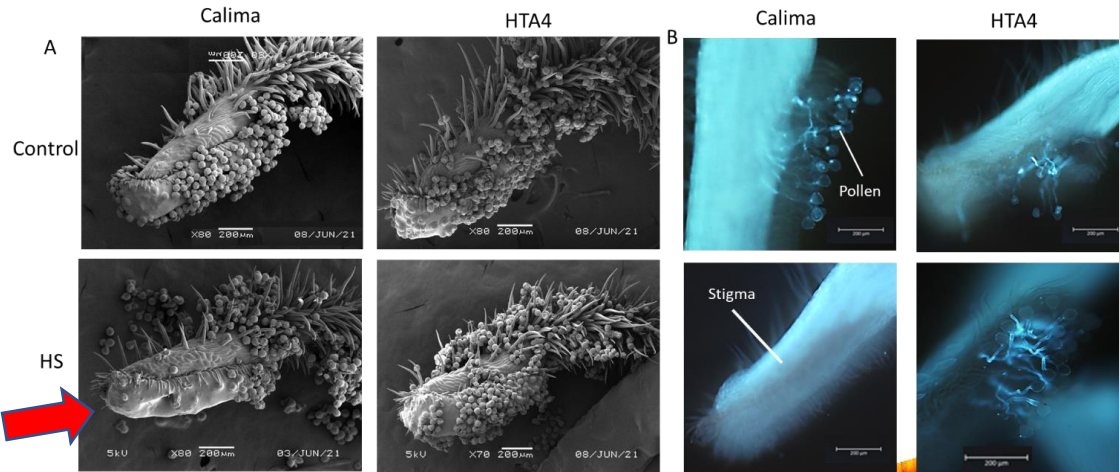






- ✓ **Primary metabolites stigma**
- ✓ **RNAseq & metabolomics leaves**

No pollen on stigma



# Bean Enhance – Translation award

## Angular Leaf Spot – Uganda (& Tanzania)

**Tom Wood**  
tom.wood@niab.com

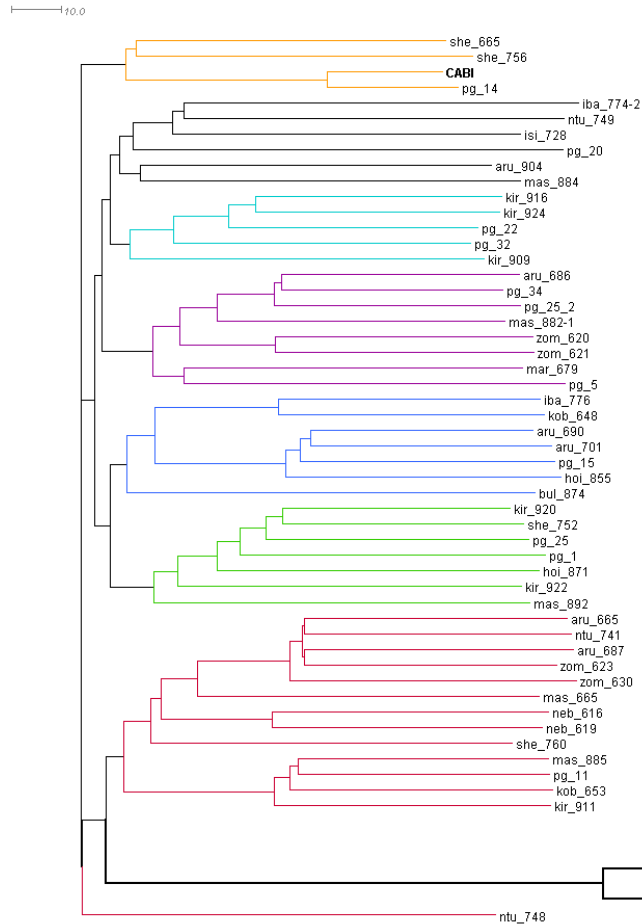
### Aims:

- Expand ALS Pathogenomics network for monitoring and surveillance - high/low incidence sites Ug and Tz
- **Pathotyping against differential sets**
- **Resistance screening**
- Training and capacity building for small scale seed producers and farmers
- Practical diagnostics (LAMP)





## South-Western, North-Western



*P. griseola* f sp *mesoamericana*

- Diverse race structure
- Possible to determine between race types on genetic profile?

South-Western, Western Nile,  
North

*P. griseola* f sp *griseola*

Pg\_pg\_23  
Pg\_she\_754  
Pg\_isi\_729\_b  
Pg\_iba\_771  
Pg\_iba\_770  
Pg\_ntu\_739

# Transforming agricultural sustainability through beneficial microbial associations

**Giles Oldroyd FRS (he/they)**

Russell R Geiger Professor of Crop Science

Crop Science Centre | Sainsbury Laboratory  
University of Cambridge



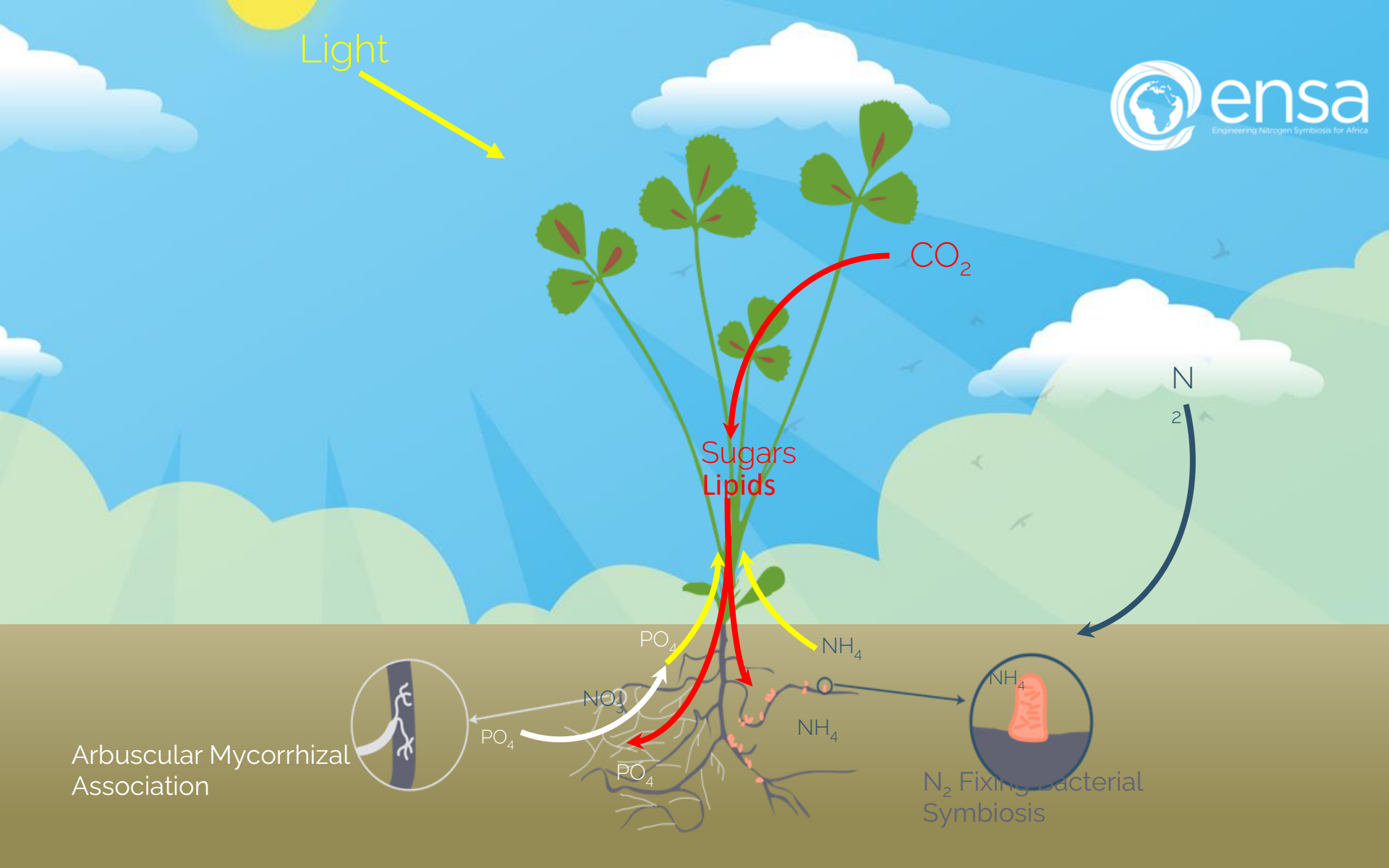
Foreign, Commonwealth  
& Development Office

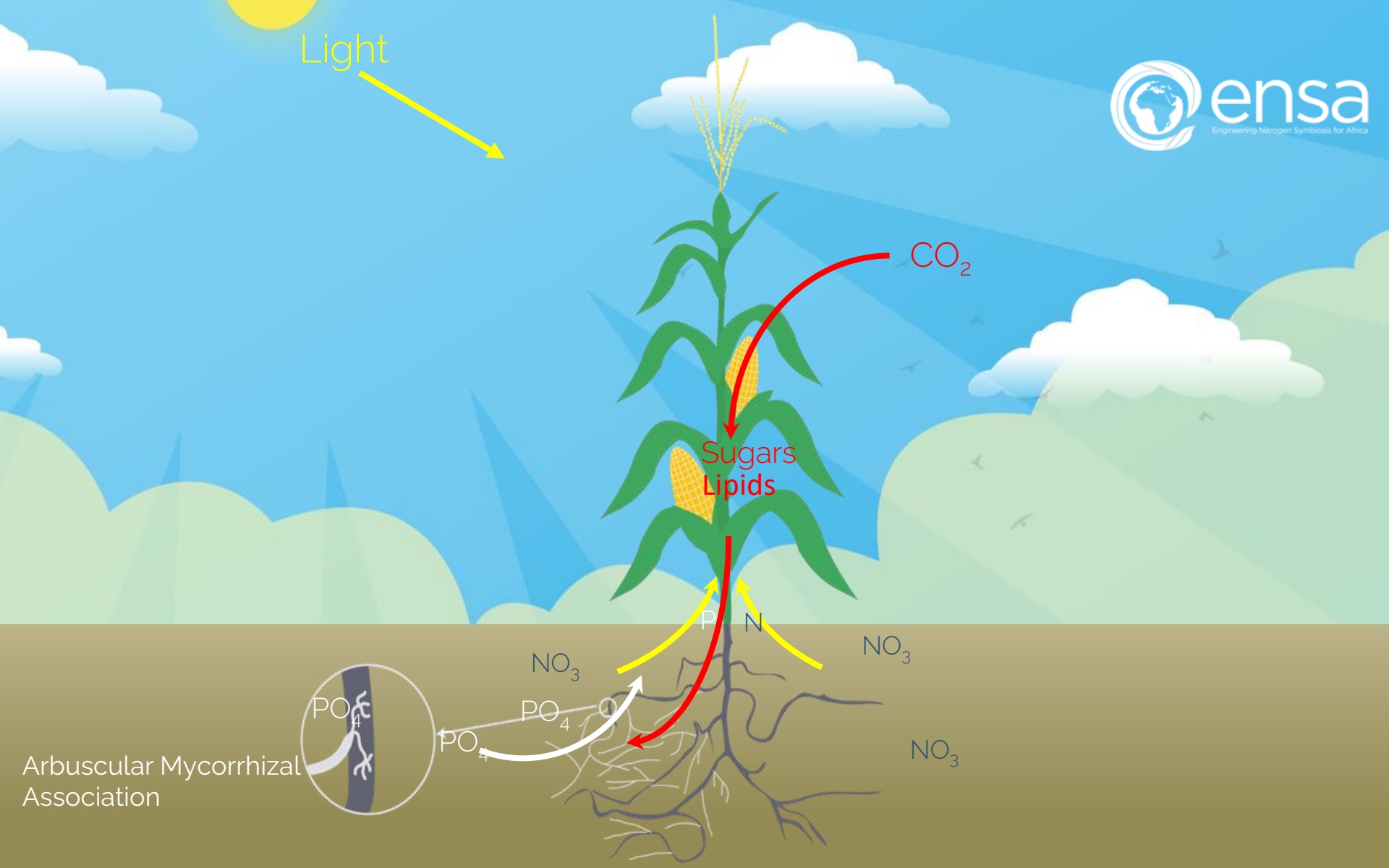






**CROP  
SCIENCE  
CENTRE**





Light

$\text{CO}_2$

Sugars  
Lipids

P N

$\text{NO}_3^-$

$\text{NO}_3^-$

$\text{NO}_3^-$

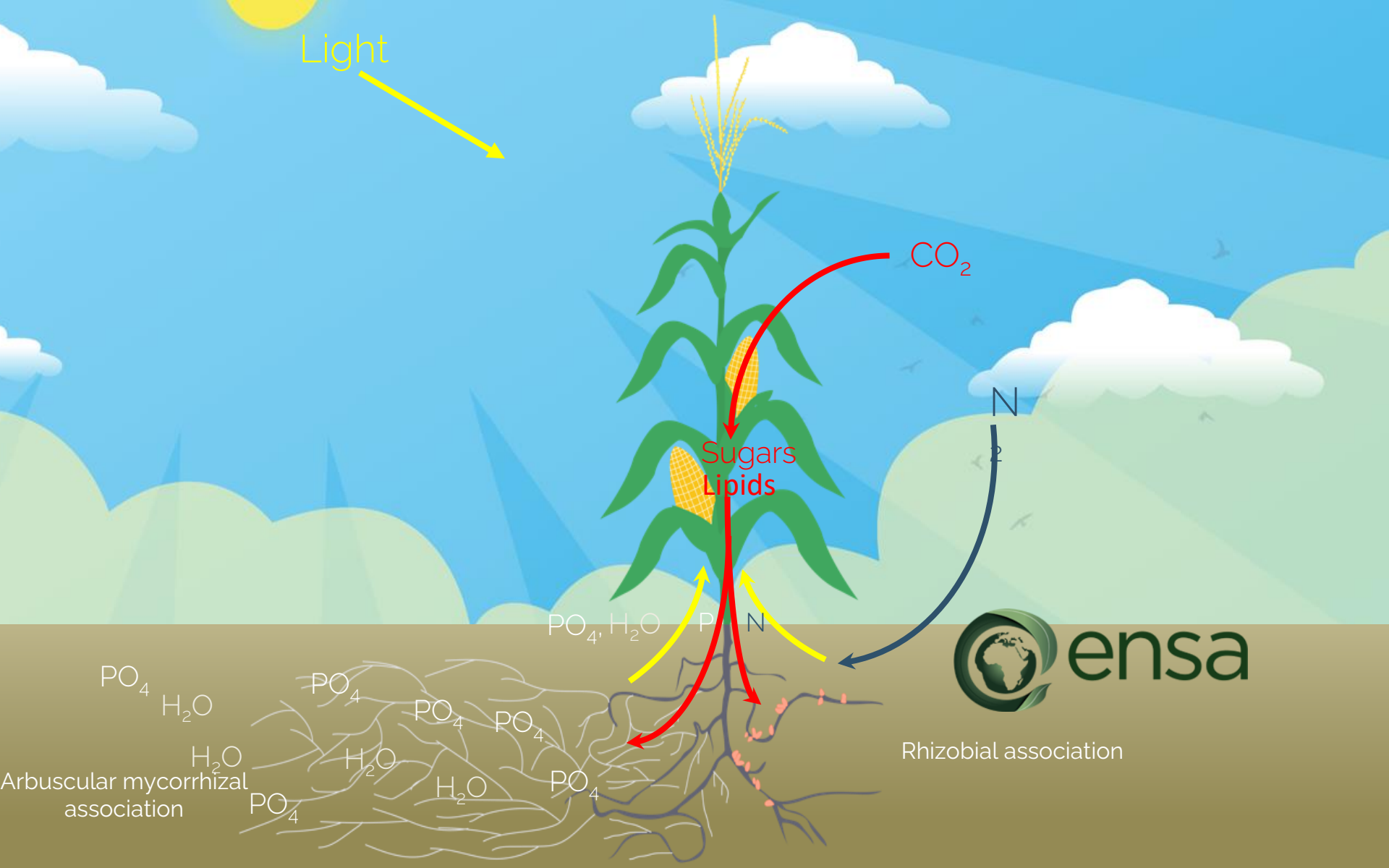


PO<sub>4</sub>

PO<sub>4</sub>

Arbuscular Mycorrhizal  
Association





Light

CO<sub>2</sub>

Sugars  
Lipids

PO<sub>4</sub> H<sub>2</sub>O P N

N  
P



Rhizobial association

Arbuscular mycorrhizal  
association

PO<sub>4</sub> H<sub>2</sub>O

PO<sub>4</sub>

PO<sub>4</sub>

PO<sub>4</sub>

PO<sub>4</sub>

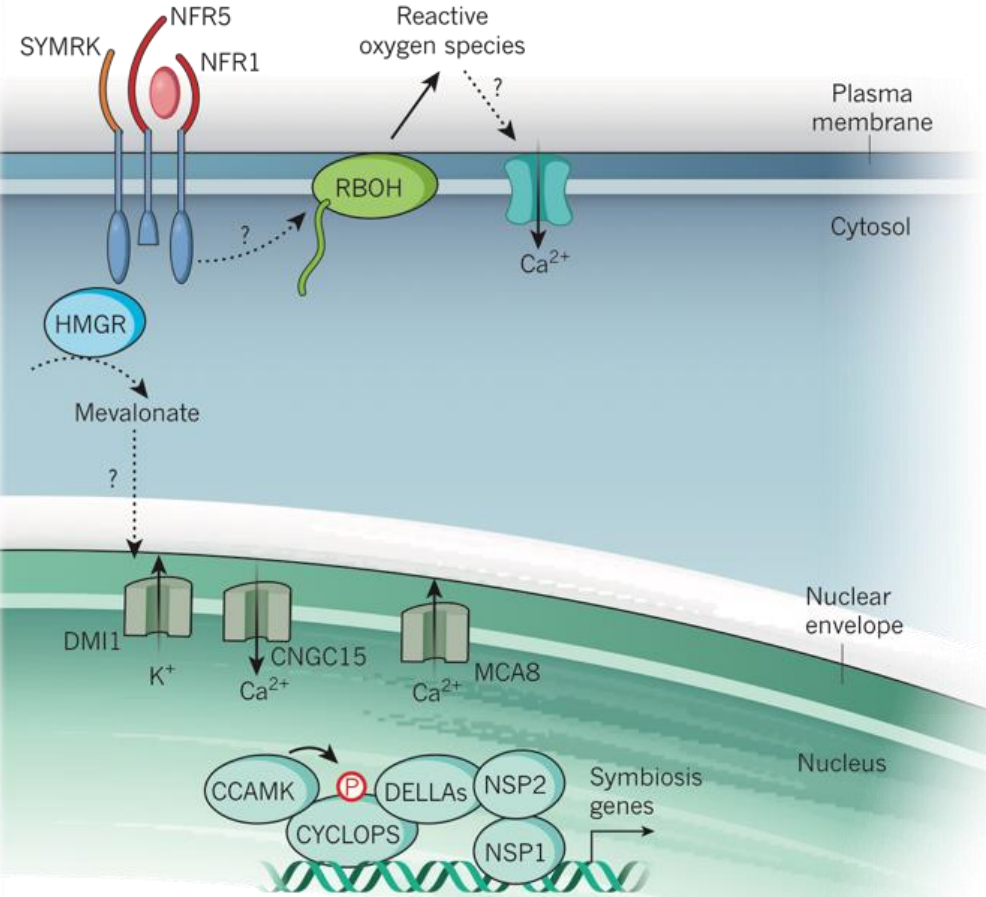
H<sub>2</sub>O

H<sub>2</sub>O

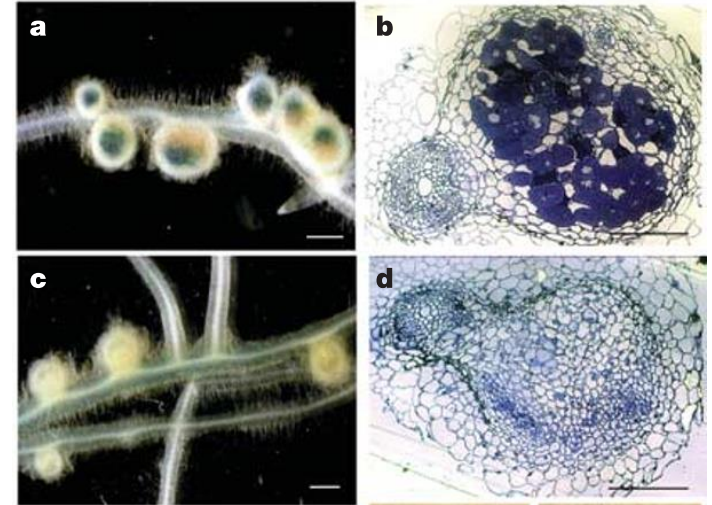
H<sub>2</sub>O

PO<sub>4</sub>

**Symbiosis signalling**  
Nod-LCOs



Zipfel and Oldroyd, *Nature* 2017



Gleason et al, *Nature* 2006

