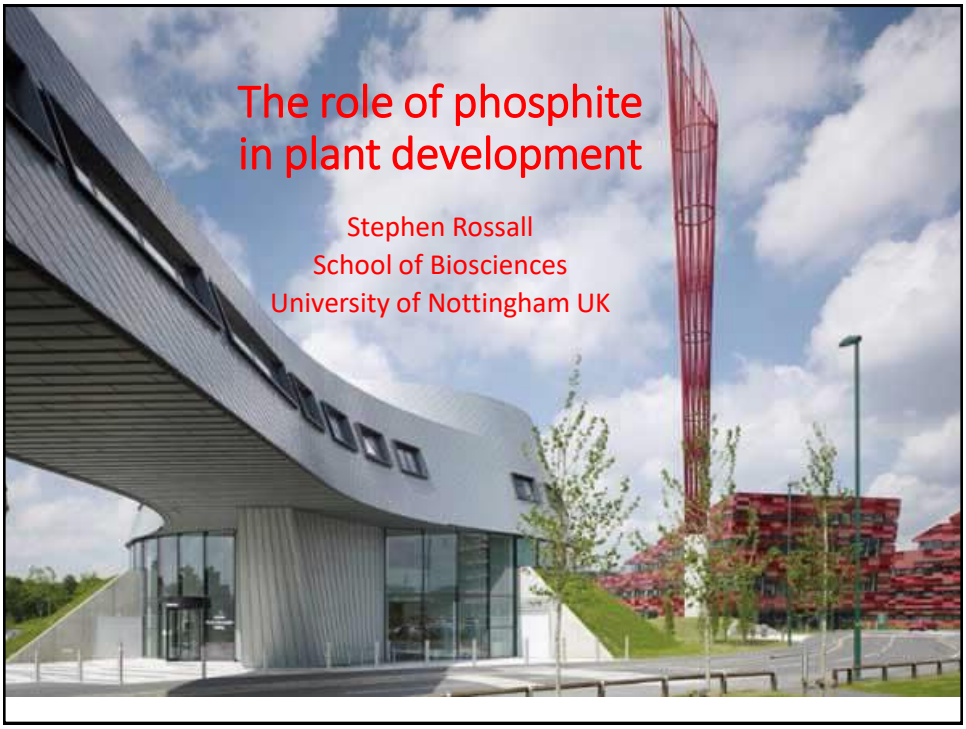


1

University of Nottingham - extent of work

- Supported by a £1.1m research grant from
  - Biotechnology and Biological Sciences Research Council (BBSRC)
  - Phosphite Biostimulant Stewardship Group (PBSG)
- 2017 - to date
- 18 scientists
  - 4 departments
- Papers
  - White paper published
  - 1 paper in submission with Journal of Experimental Botany
  - 1 further paper 2022
- Formats
  - Growth chamber
  - Real time Computed Tomography (CT) scanning
  - Small plot and commercial field trials
  - Laboratory tissue analysis
- Metrics
  - Physiology: root and shoot
  - Abiotic stress
  - Nutrient use efficiency
- Mode of action
  - Gene expression
  - Phytohormone activity

2

Physiological effects

Root growth

Nutrient use efficiency

Abiotic stress

3

Growth chamber – wheat root growth

Control Phosphite

- Foliar Application at Growth Stage (GS) 12 harvested at GS23
- 450g/Ha PO_3 as potassium salt solution
- Typical 30% increase in root dry weight

4

Growth chamber – oilseed (canola) root growth

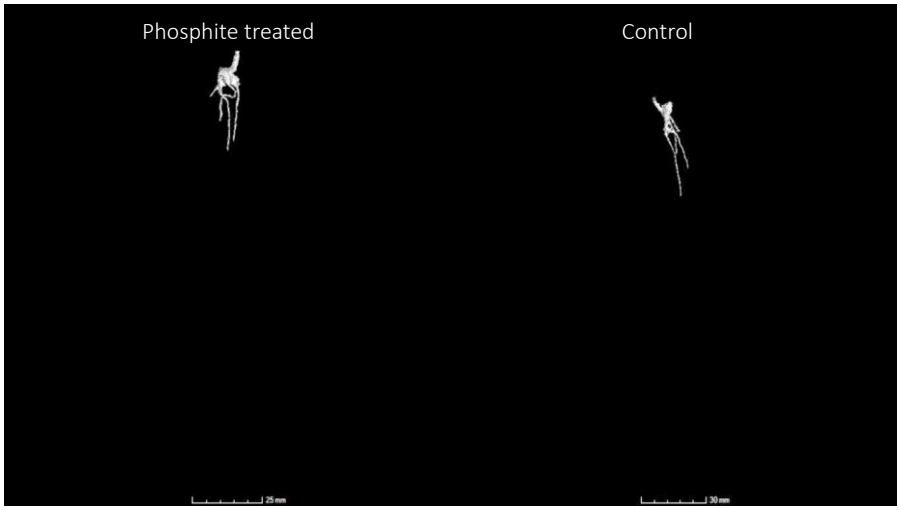
Control

Phosphite

- Foliar Application at GS13; harvested at GS25
- 450g/Ha PO_3 as potassium salt solution
- Typical 40-50% increase in root dry weight

5

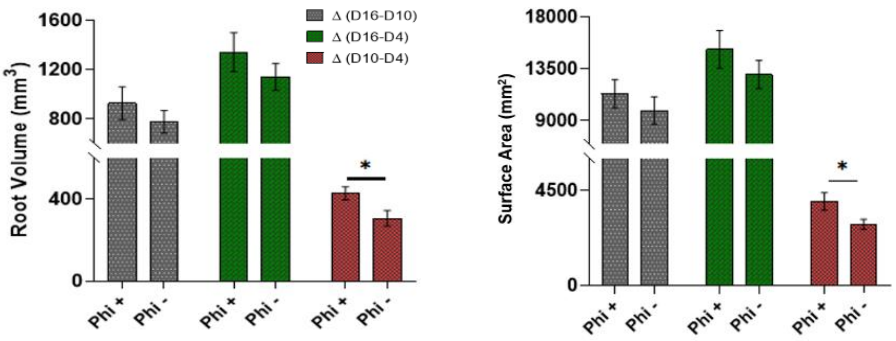
CT scanning – wheat root growth



- Seedlings treated with potassium phosphite 4 days after germination
- CT imaging performed at 0, 6 and 12 days post application

6

CT scanning – wheat root volume and area



- 20% increase in root volume
- 20% increase in root surface area

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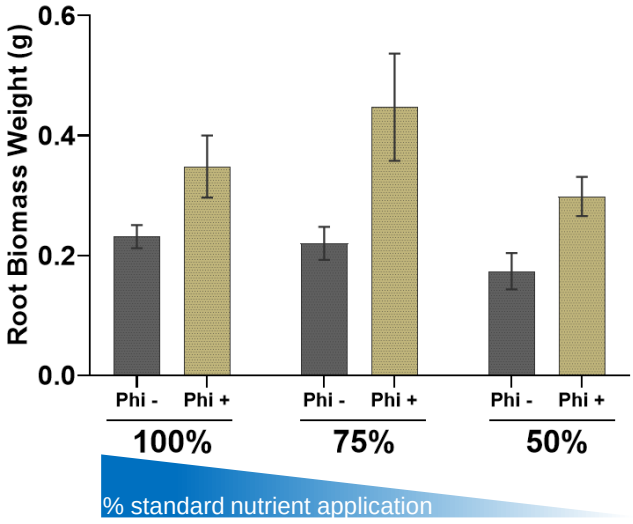
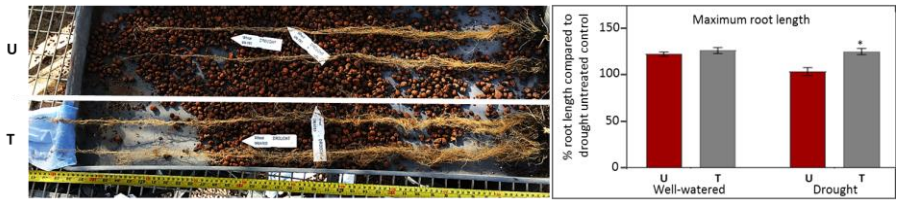
Nutrient use efficiency – wheat (and oilseed)



Phosphite treated plants respond to sub optimal nutrient conditions by significantly increasing root biomass by 30 – 75%

8

Abiotic stress resistance - drought

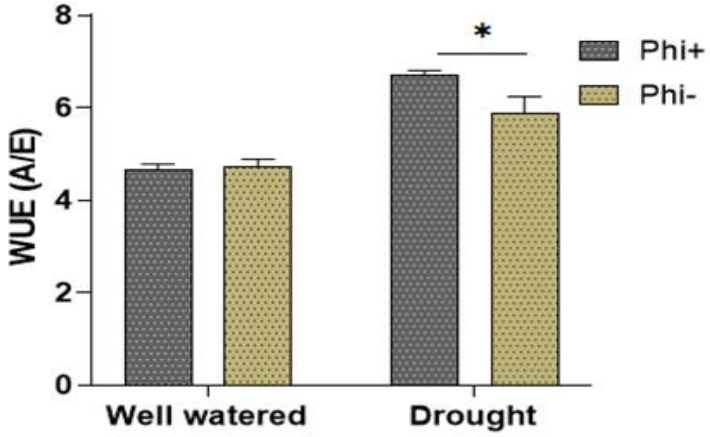


Application GS12-GS16 Growth assessment 30-45 days after treatment.

Phosphite application to wheat under water stress promotes longer roots, with a typical increase of 15-20%

9

Abiotic stress resistance - drought



Phosphite treatment in wheat improves water use efficiency in drought conditions, with a typical increase of 15-20%

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Summary – physiological effects

- Increase in root development
  - biomass
  - total length
  - surface area
- Improvement in nutrient use efficiency
  - particularly in sub-optimal conditions
- Enhanced resistance to abiotic stress - drought
  - increase in root biomass
  - increase in water use efficiency

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Mode of action

Plant development

Gene expression

Phytohormone activity

12

Control of plant development

- This is regulated by changing concentrations of naturally-occurring phytohormones; traditional auxins, cytokinins, gibberellins, abscisic acid and ethylene
- Very different from endocrine hormones in animals
- Phosphite-induced changes in the concentrations of phytohormones causes changes in plant growth and development

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Phytohormone profiling

- Hormone profiling had indicated c-zeatin as a potentially-important candidate. This work is currently on-going.

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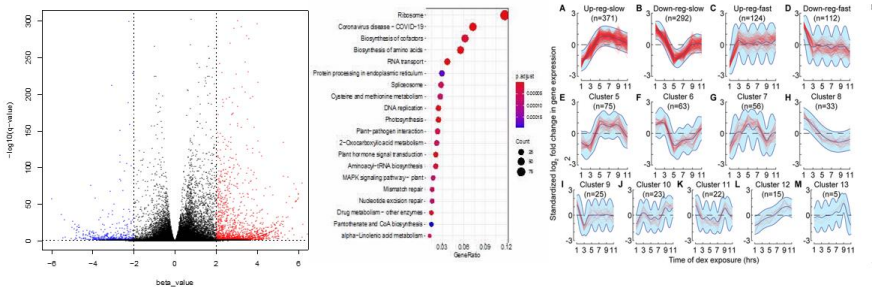
Gene expression

Phosphite treatment shows significant changes in wheat gene expression **within 2 hours of treatment**



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Examples of changes in activity

Complex, on-going analysis being worked on as I speak

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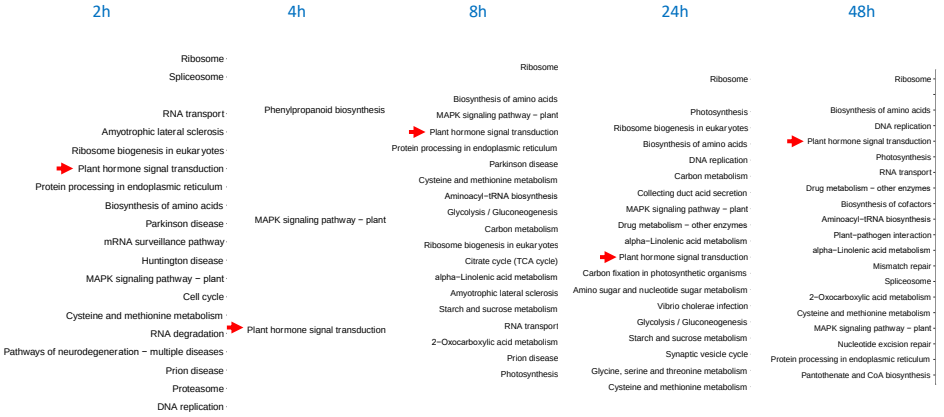
Root ENRICHED GO TERMS-Analysis 1
NB Hormone signal transduction is elevated at all time points



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Next steps

- Work at the University of Nottingham is now underway to validate these findings
  - A second research paper will be submitted by Jun-22
- Please consider this evidence
  - Wheat breeding programmes have not been successful in developing drought tolerance
  - We are unaware any other plant biostimulant with comparable efficacy in terms of root development and drought tolerance
  - Phosphite is probably the most researched and reliable plant biostimulant on the market today

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