# Reversing Phosphorus Stratification in Australian Soils with Amino Clay-Functionalized Biochar

### Mohd Arish Usman

Supervisors: Gurwinder Singh, Kavitha Ramadass, Mairon Neves de Figueiredo, Richard Bell, Lukas Van Zwieten, & Ajayan Vinu

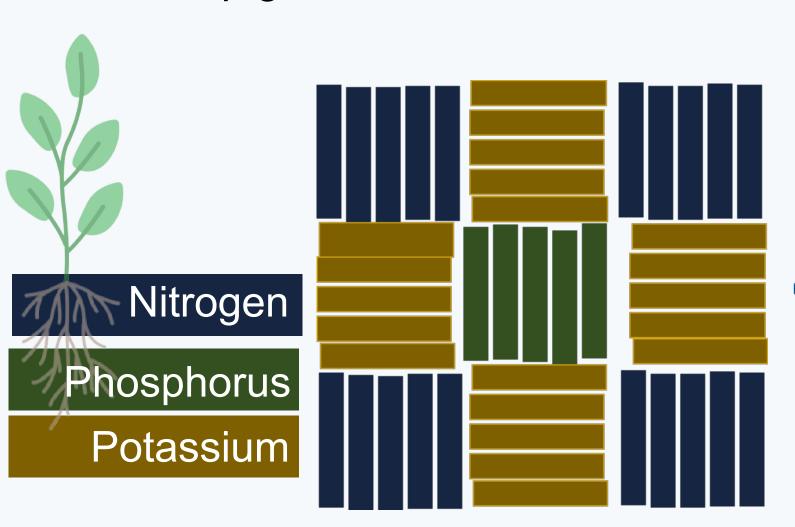
### 1. Overview

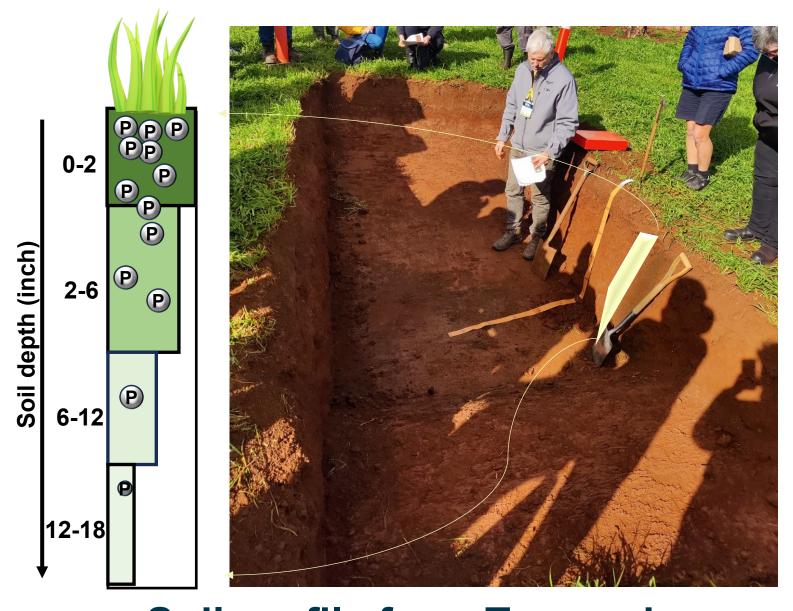
#### Phosphorus (P)

stratification: An oversupply of P in the surface soil and an undersupply of P in soil deeper than 6 inches.

P is typically applied as a fertiliser to the soil surface.

- - Reduced nutrient uptake
  - Lower fertiliser efficiency
  - Yield reduction risk
  - Crop growth constraint





**Soil profile from Tasmania** 

Agricultural soils in Australia often face issues with P & Zinc (Zn) deficiency.

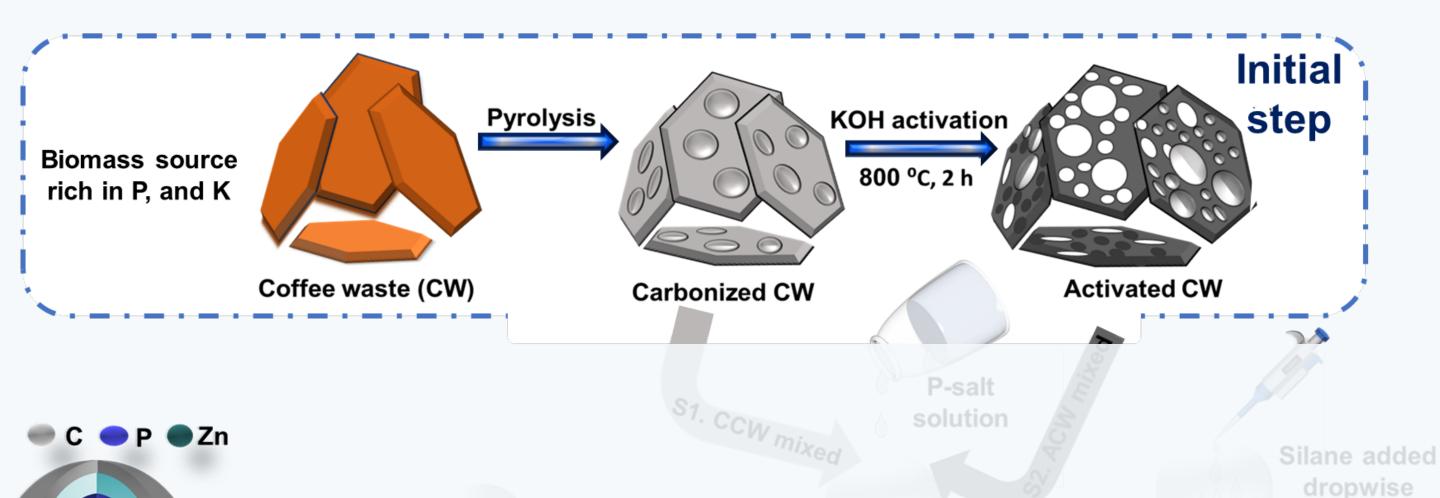
> Crops like wheat, maize, and chickpea exhibit significant yield and quality reduction under **Zn** deficiency.

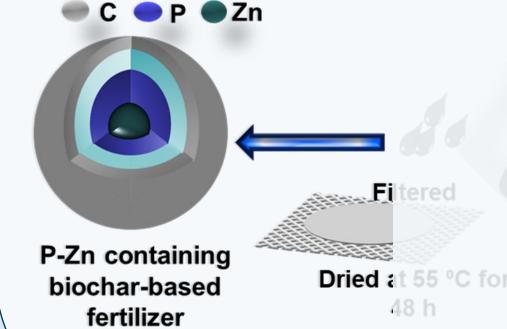
## 2. Approach

Biochar (BC) has a porous structure and unique properties that make it an effective carrier for delivering various nutrients in soil.

**Amino clays** enhance **BCs** ability to adsorb more **P** through electrostatic attraction and re-precipitation in its pores and prolong the period of P release.

Co-delivering **Zn** with **P** improve early root development and can enhance root proliferation into deeper layers, potentially redistributing P vertically.





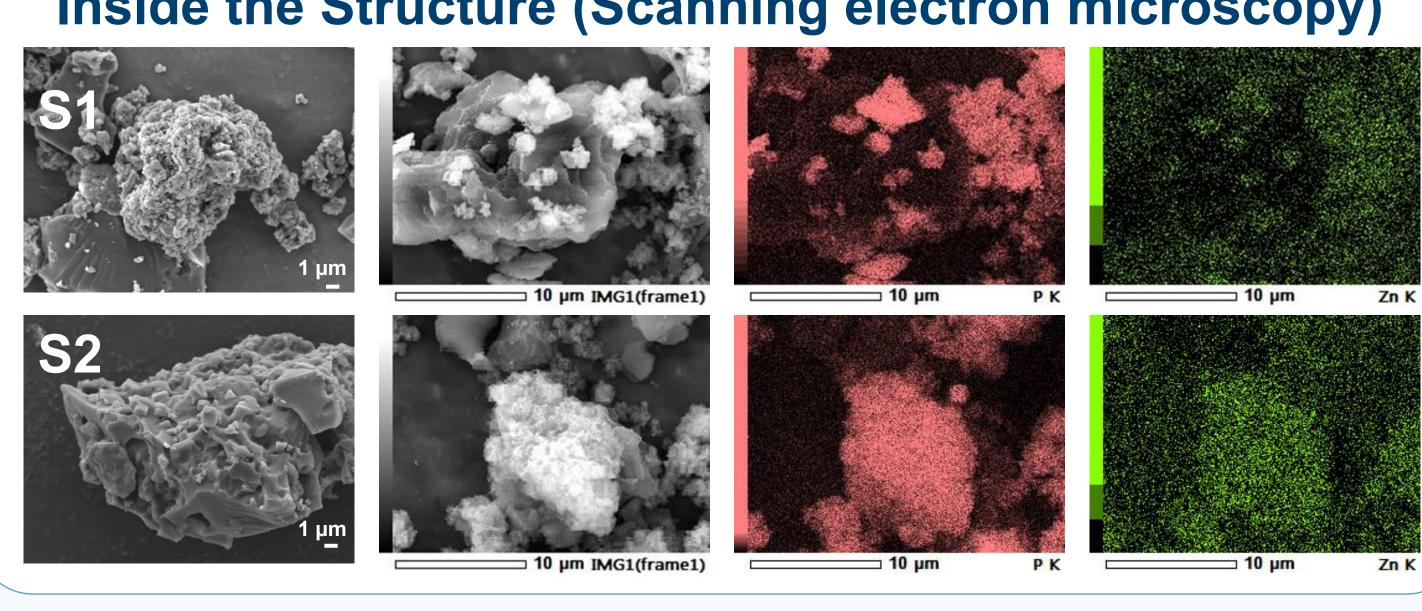
I would be glad to share during a discussion!

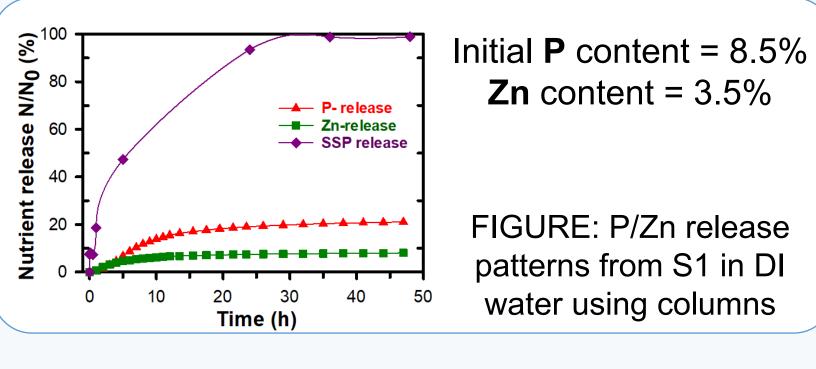
Aminoclay

containing Zn

# 3. Preliminary Results

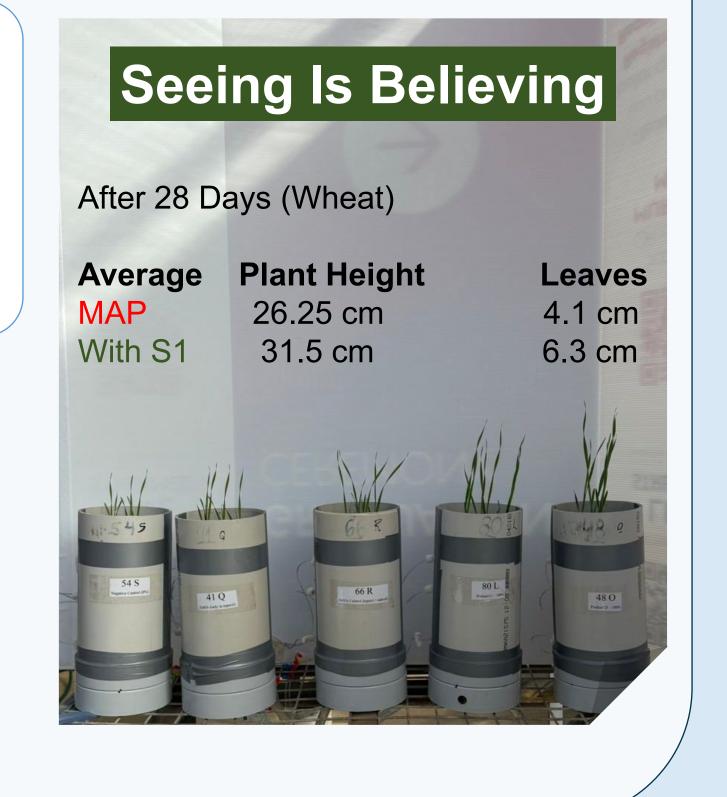
#### Inside the Structure (Scanning electron microscopy)





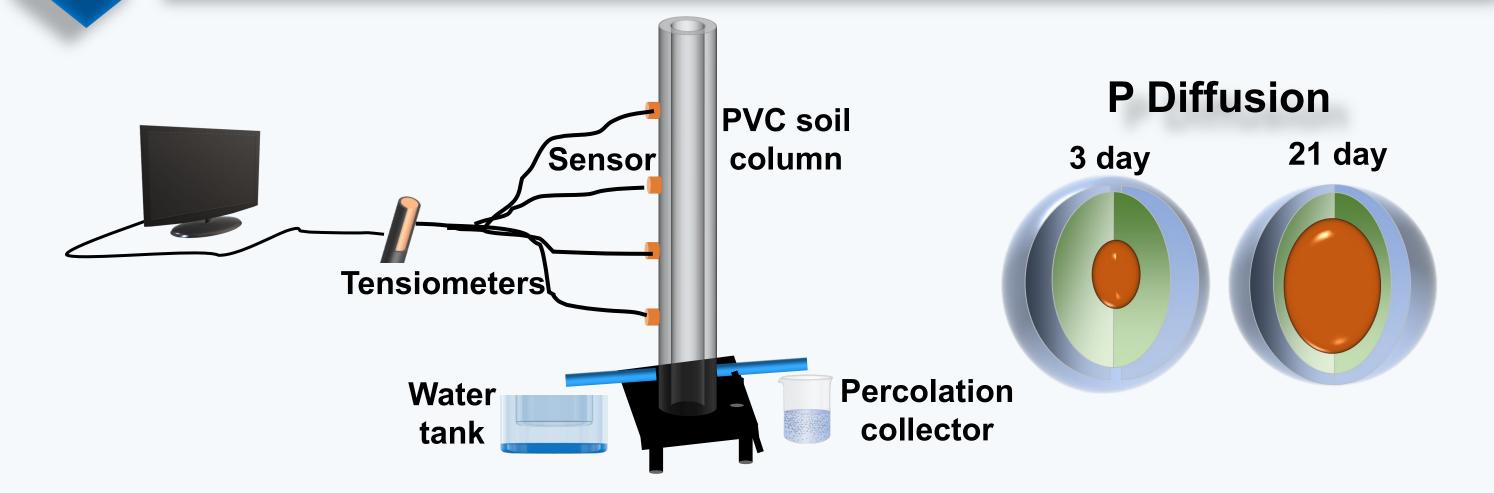
#### **Overall Findings**

- 1. Synthesised P-enriched BC with slow-release characteristics.
- 2. Amino clay modified BC fertiliser significantly improved plant height and leaf growth compared to commercial MAP fertiliser.



## 4. Future Plans

Synthesise BBF granules and investigate dissolution kinetics and Sep diffusion of P from fertiliser granules in soils.







Partnering with agricultural extension networks & scientists to 2026 weave this innovative fertiliser solution into a sustainable, futureready nutrient management strategy for Australian croplands.









