The First China-Australia Symposium on Crop Stress and Climate Adaptation

Fertilizer Type Shapes Soil–Root–Shoot Responses of Faba Bean Varieties to Waterlogging Stress

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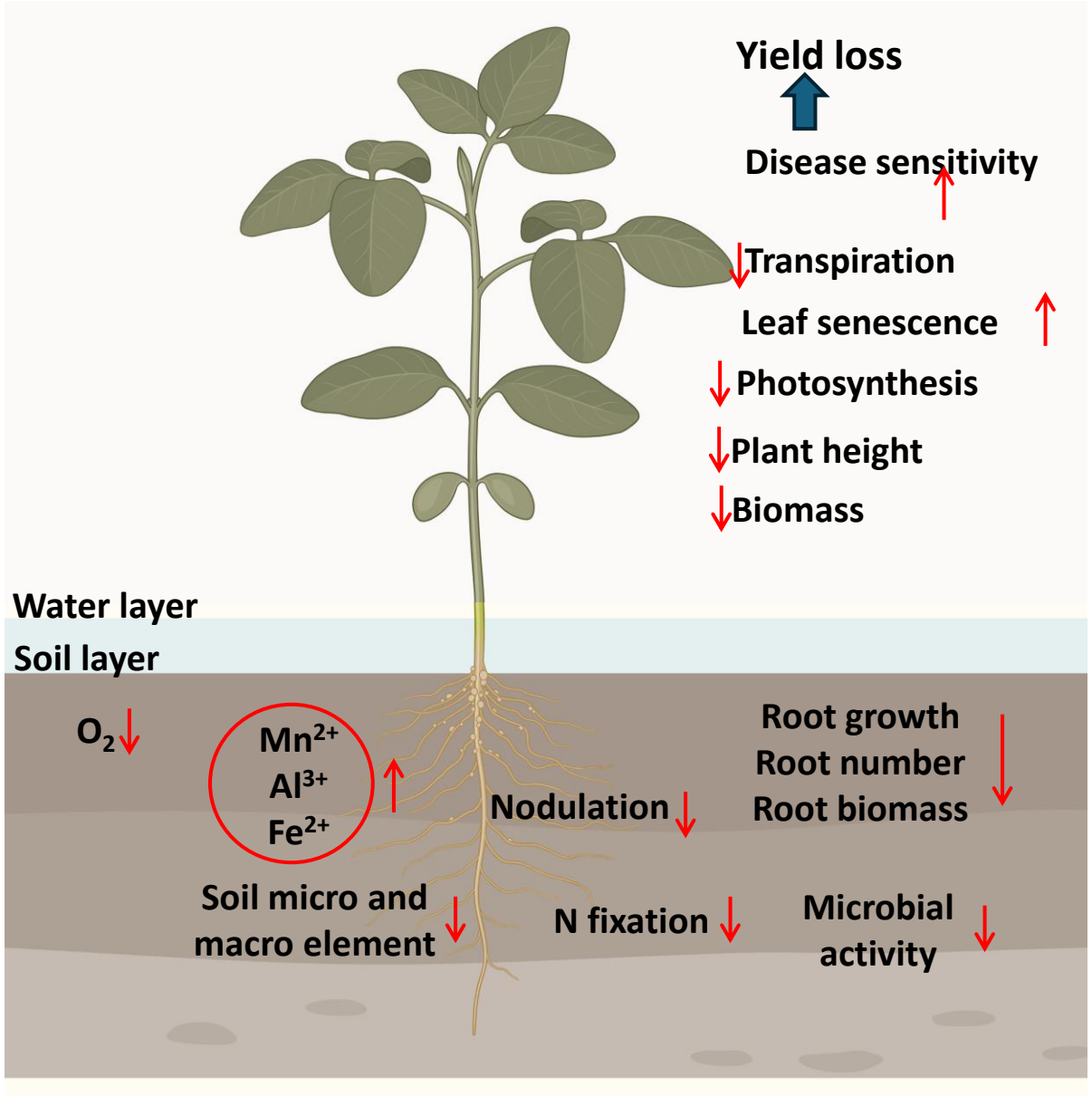
Background

- Waterlogging is one of the major abiotic stress in crop production
- It results in anoxic/hypoxic condition
- Accumulation of toxic elements
- Lower nitrogen fixation
- Waterlogging affects above-ground features
- In Australia, waterlogging causes up to 50% yield reduction, leading to $300M crop loss

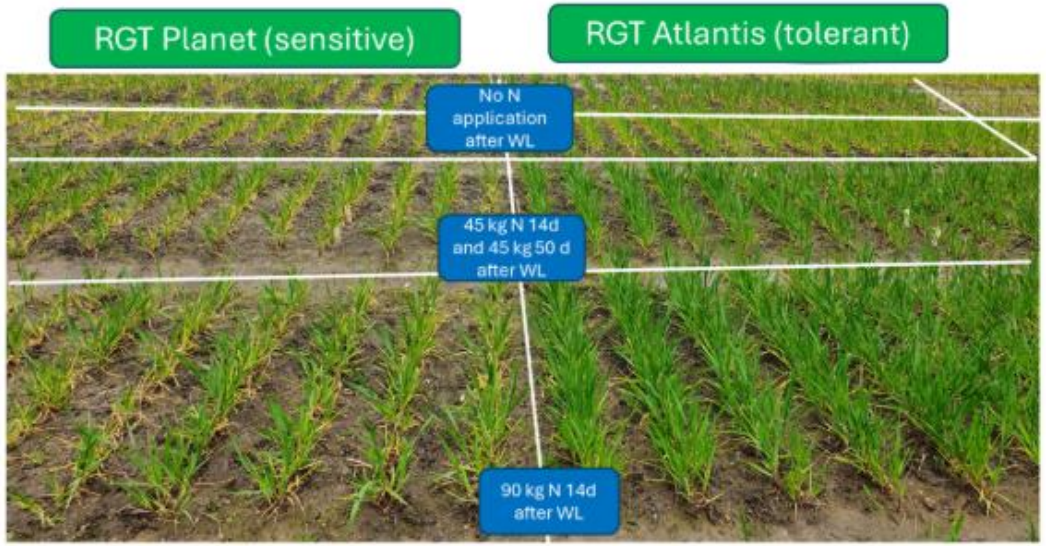


Waterlogging mitigation Strategies

- Fertilizer treatments have been utilized as one of the most promising mitigation strategies

- Fertilizer addition enhances nutrient supply, root recovery, regrowth, and ATP production

- Fertilizer addition resulted in better plant performance in barley



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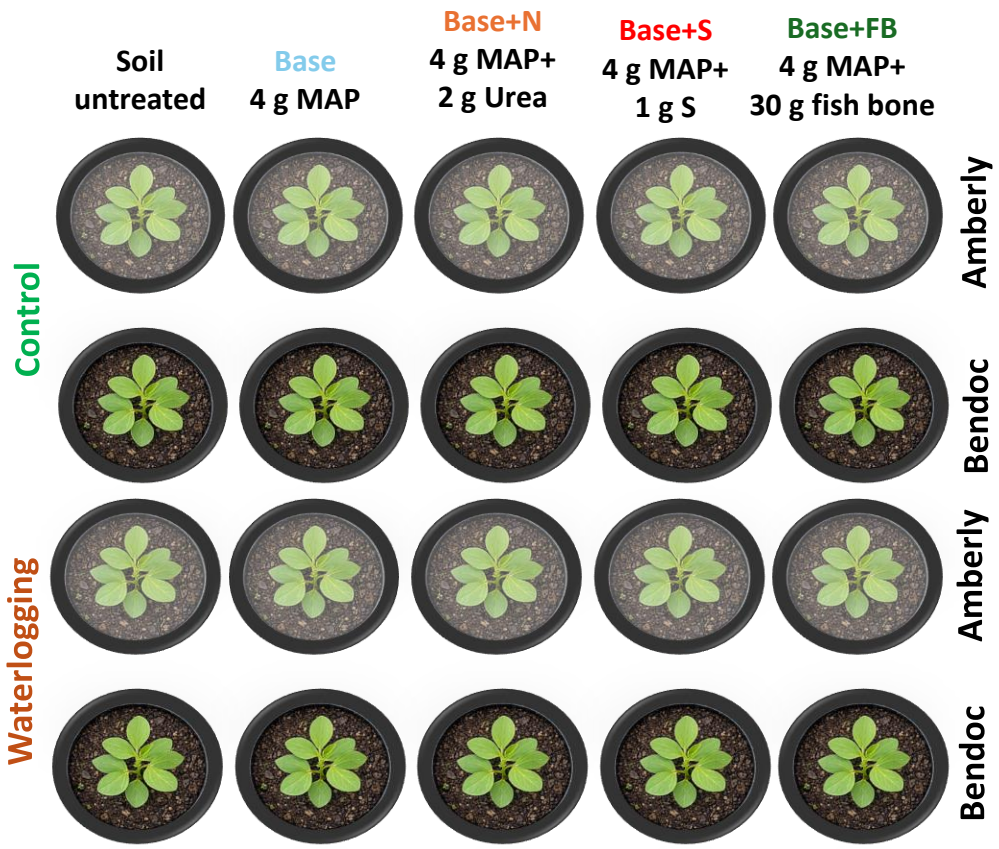
- However, fertilizer type in faba bean waterlogging mitigations are yet to be investigated

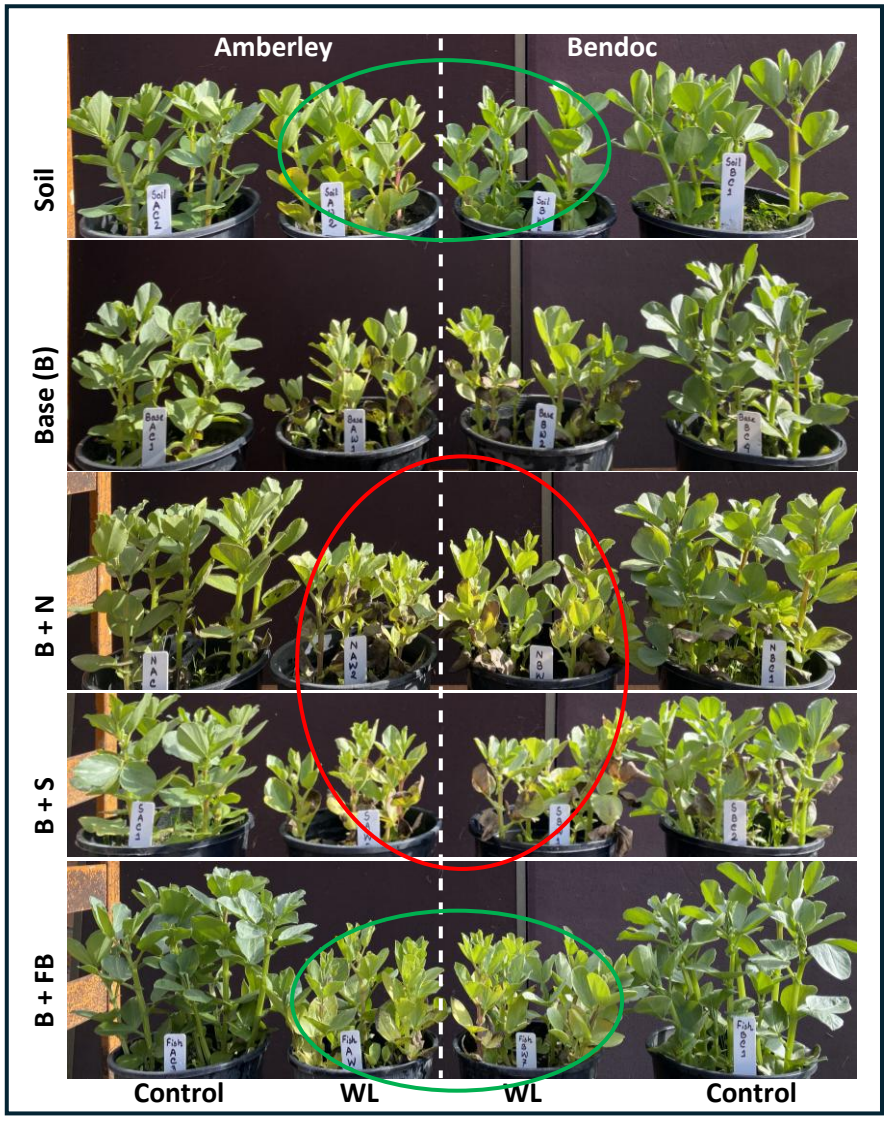
Experimental Overview and Data recording



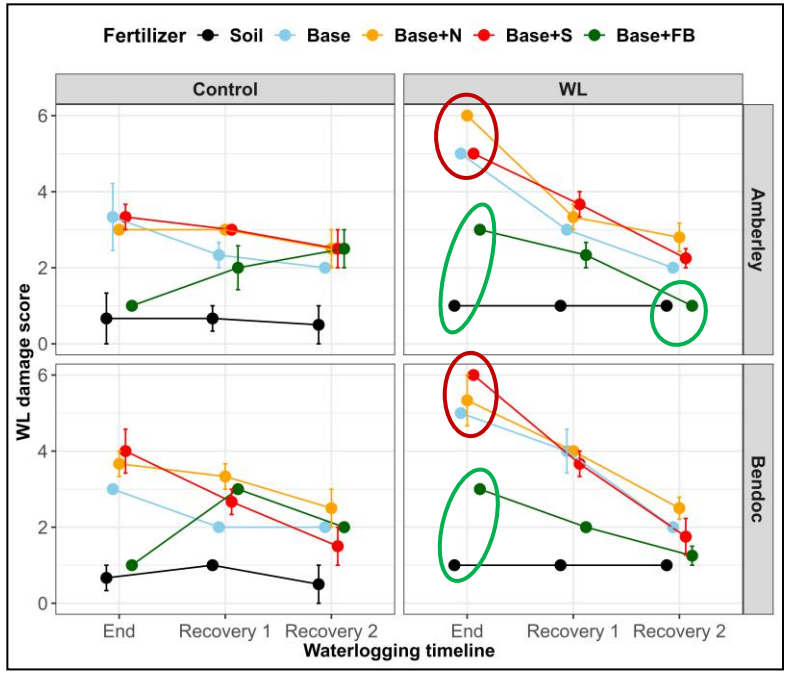
Fertilizer	Composition
Soil	NA
MAP	10% N, 21.9 % P, 1.5% S, 1.6% other
S	100% S
Urea	46.7% N, 20% C, 26.7% O, 6.7% H
Fish Bone	9.95% N, 44.37% C, 6.54% H, Al (148.3), Cd (<1.0), Cr (2.07), Cu (18.03), Fe (587), Pb (<1.0), Mg (1720), Mn (26.47), P (30200), K (9326.67), Na (6976.67), Zn (97.10)

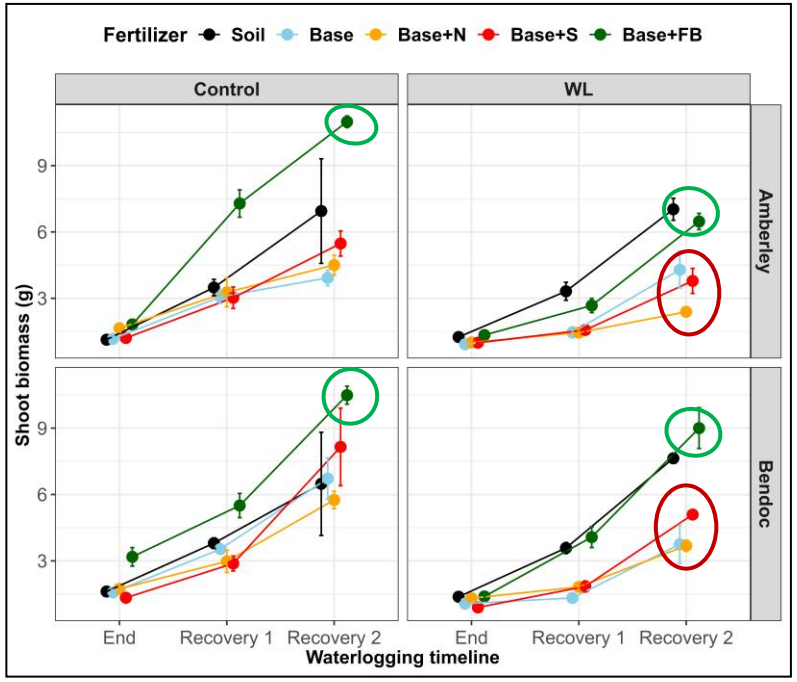
	Sowing	Before WL	14 days WL	33 days WL	33 days recovery	60 days recovery
Plant height		■	■	■	■	■
SPAD		■	■	■	■	■
Licor		■	■	■	■	■
Biomass				■	■	■
Nodule score				■	■	
Damage score				■	■	■
Soil element		■		■		
Root element				■		
Shoot element				■	■	

Waterlogging induced damages



- Higher damage in chemical fertilization
- Base+FB treatment enhanced biomass accumulation
- Chemical fertilizers reduced biomass accumulation





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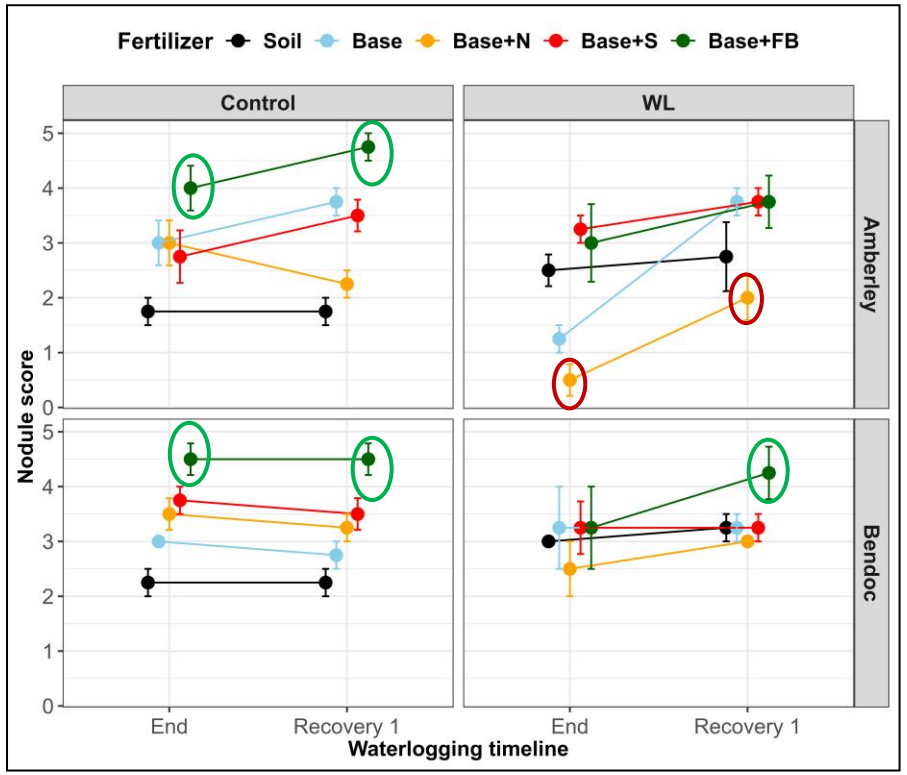
Nodule formation

- Waterlogging reduced nodule number in both varieties
- Base+FB enhanced the active nodule number in Bendoc during recovery
- Base+N suppressed the nodule number, higher impact on Amberley



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Fertilizer driven mechanisms

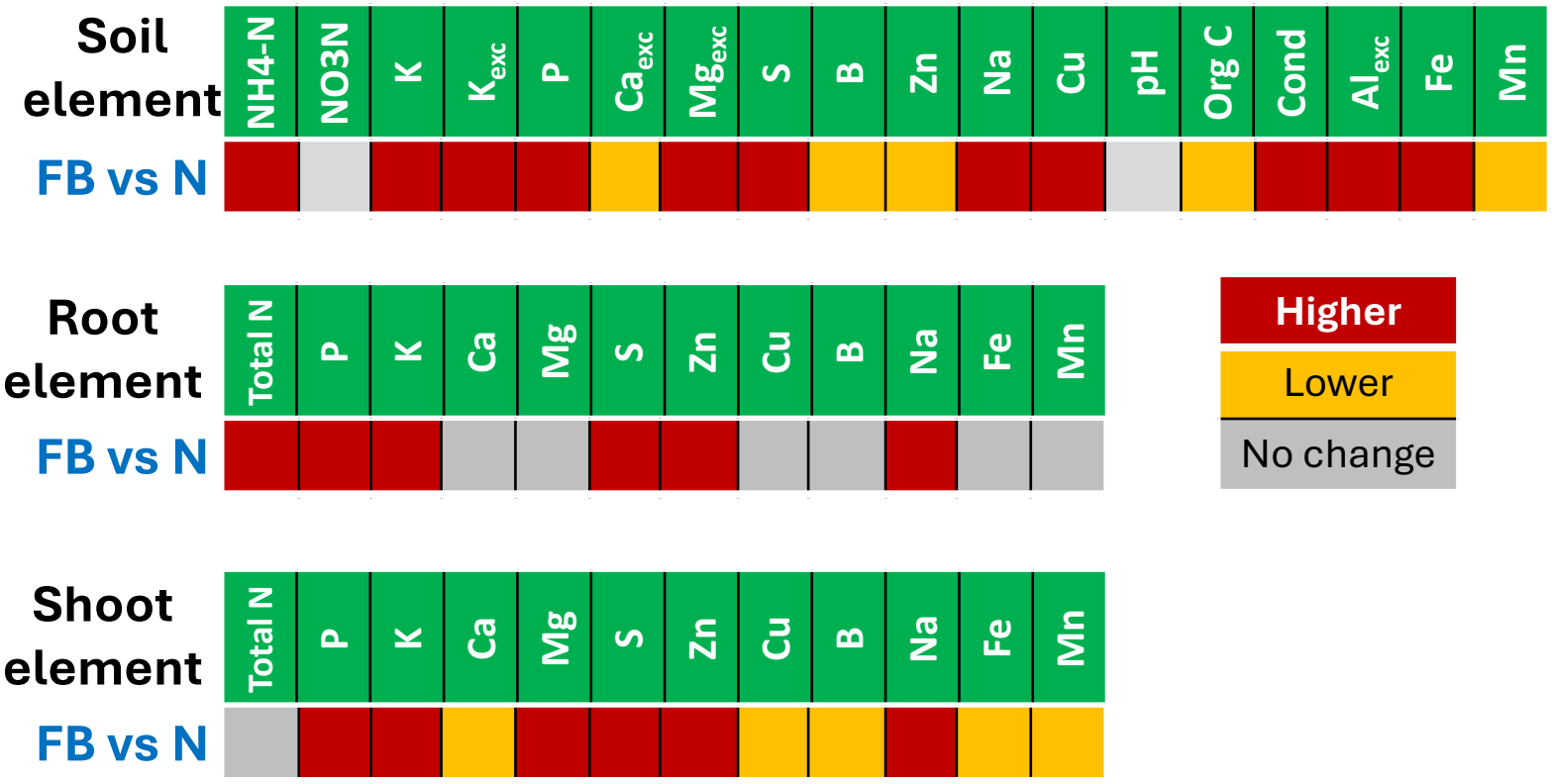
Base+Fish Bone ⇒ Nodule ↑→ Biomass ↑→ SPAD ↑→ Damage ↓ ⇒ WL mitigation ↑

Base+N ⇒ Nodule ↓ →Biomass ↓ → SPAD ↓ →Damage ↑ ⇒ WL mitigation ↓

How these findings align with soil, root, and shoot element?

Fish bone VS N: waterlogging scenario

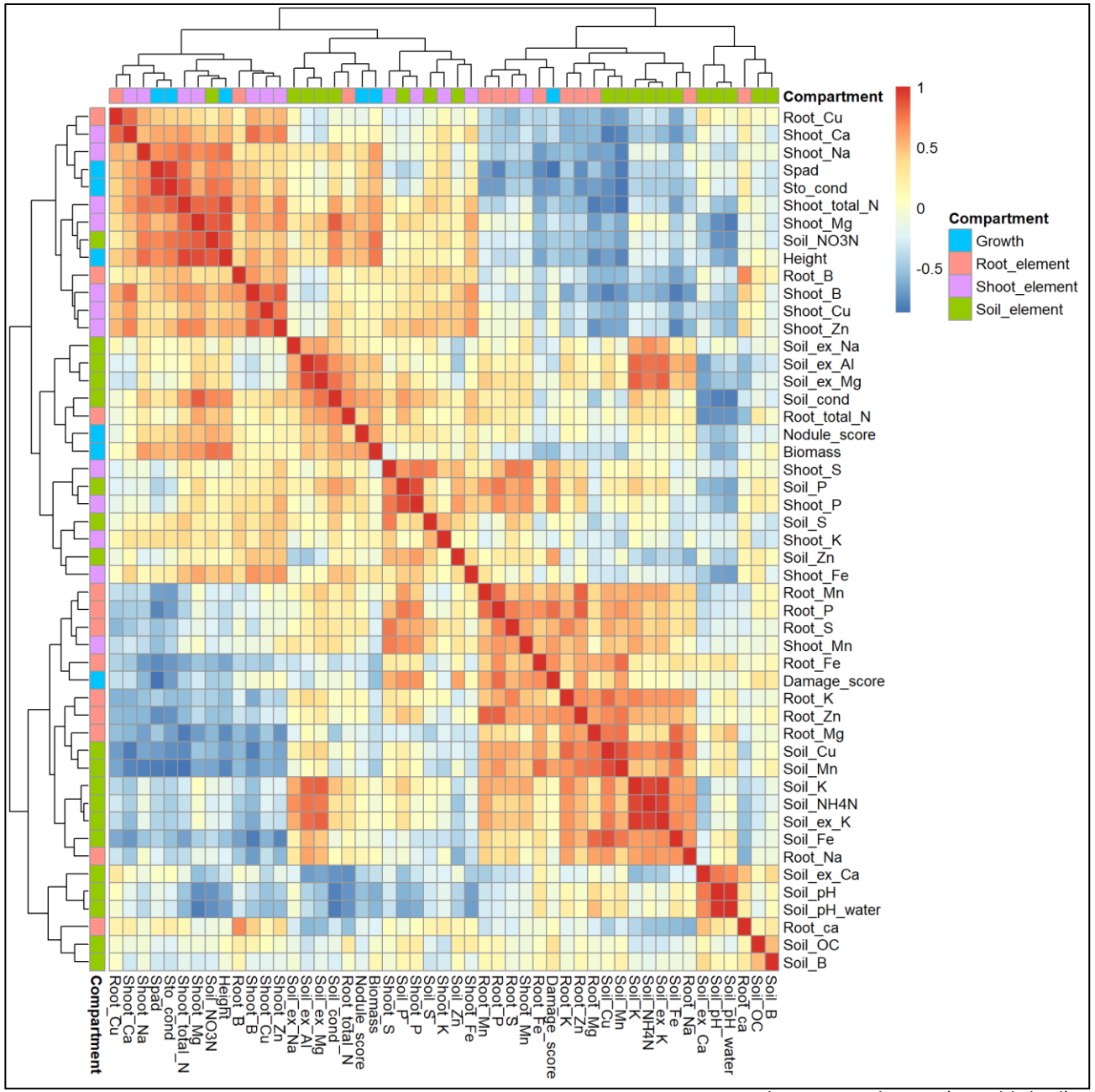
- FB treatment provided higher nutrient access



- FB treatment restricted toxic element uptake in shoot

Correlation among growth and soil-root-shoot element

- Correlation analysis revealed strong linkages between soil chemical properties, nutrient uptake in roots and shoots, and plant performance traits
- Height, biomass, SPAD, and stomatal conductance were positively correlated with shoot total N
- Damage score was positively correlated with shoot Mn (r = 0.65), shoot P (r = 0.62), and root Mn
- Nodule score showed moderate positive associations with biomass (r = 0.58), shoot total N (r = 0.51), leaf SPAD value (r=0.35), and stomatal conductance (r=0.39).



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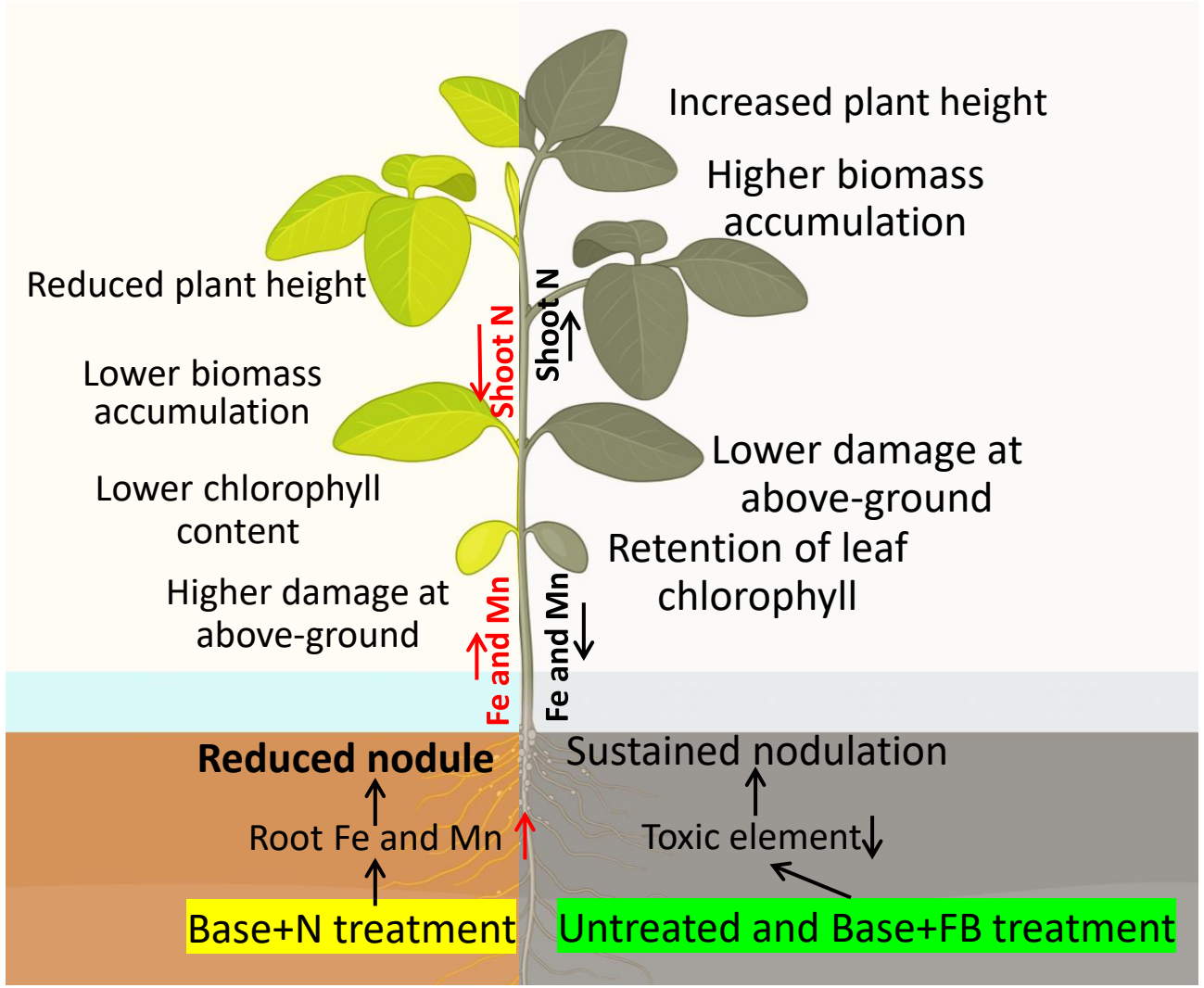
Summary and Future perspective

- Base+N treatment restricted nodule formation, reduced biomass accumulation, and higher damage due to higher root and shoot toxic element
- Base+FB treatment enhanced faba bean adaptations by sustained nodulation, biomass accumulation, chlorophyll retention, and lower damage
- Future study is needed to understand the effect of N and FB treatment on root and soil associated microbes under waterlogging conditions in faba bean



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Acknowledgement

Thank you!

Questions and Suggestions?

Please contact

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