Tasmanian Institute of Agriculture

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Nitrate availability prior to waterlogging drives canola biomass resilience but increases fertilizer-mediated Mn uptake

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Waterlogging effects in duplex soils

Duplex soils frequently experience waterlogging, causing nitrate depletion and substantial yield losses in canola.

Fertilizer and amendment application rates for each treatment in pot experiment.

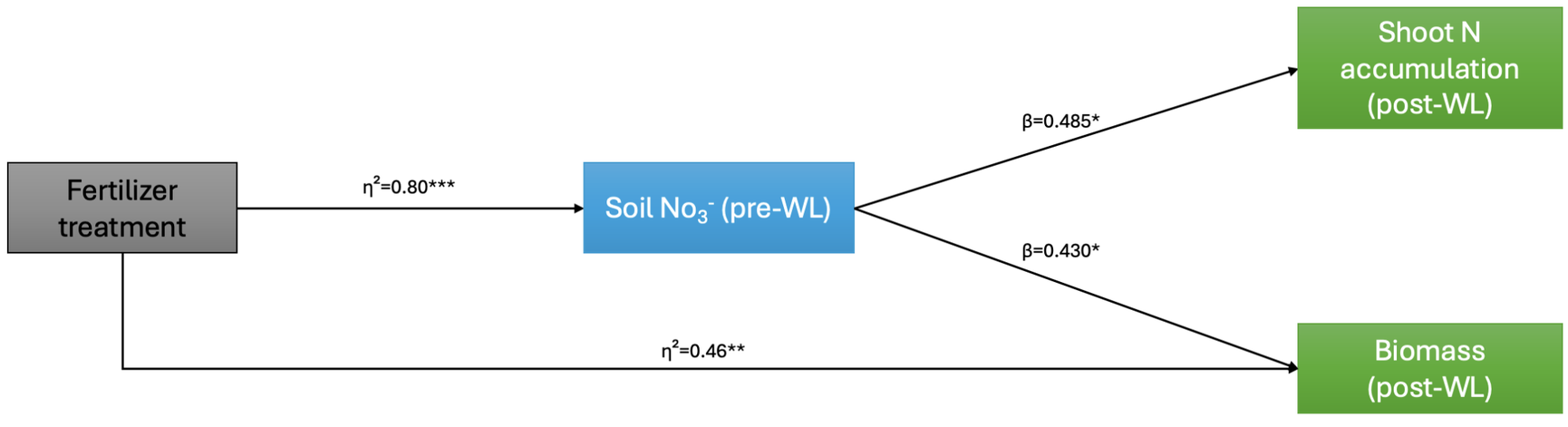
Fertilizer	Mass of amendment (g/pot)
Inorganic	5g base
Fish bone + Base	3.6g Fish bone + 2g base
Chicken manure + Base	7.8g chicken + 2g base
Biochar + Base	75g biochar + 2g base

Inorganic fertilization increases pre-waterlogging nitrate NO_3^-–N than organic fertilizer/amendments

Inorganic fertilization generated 6–8× higher pre-waterlogging NO_3^--N than organic amendments. Higher pre-waterlogging nitrate was strongly associated with higher shoot N uptake and biomass after waterlogging ($\rho > 0.73$; $R^2 > 0.54$).

KEY POINTS

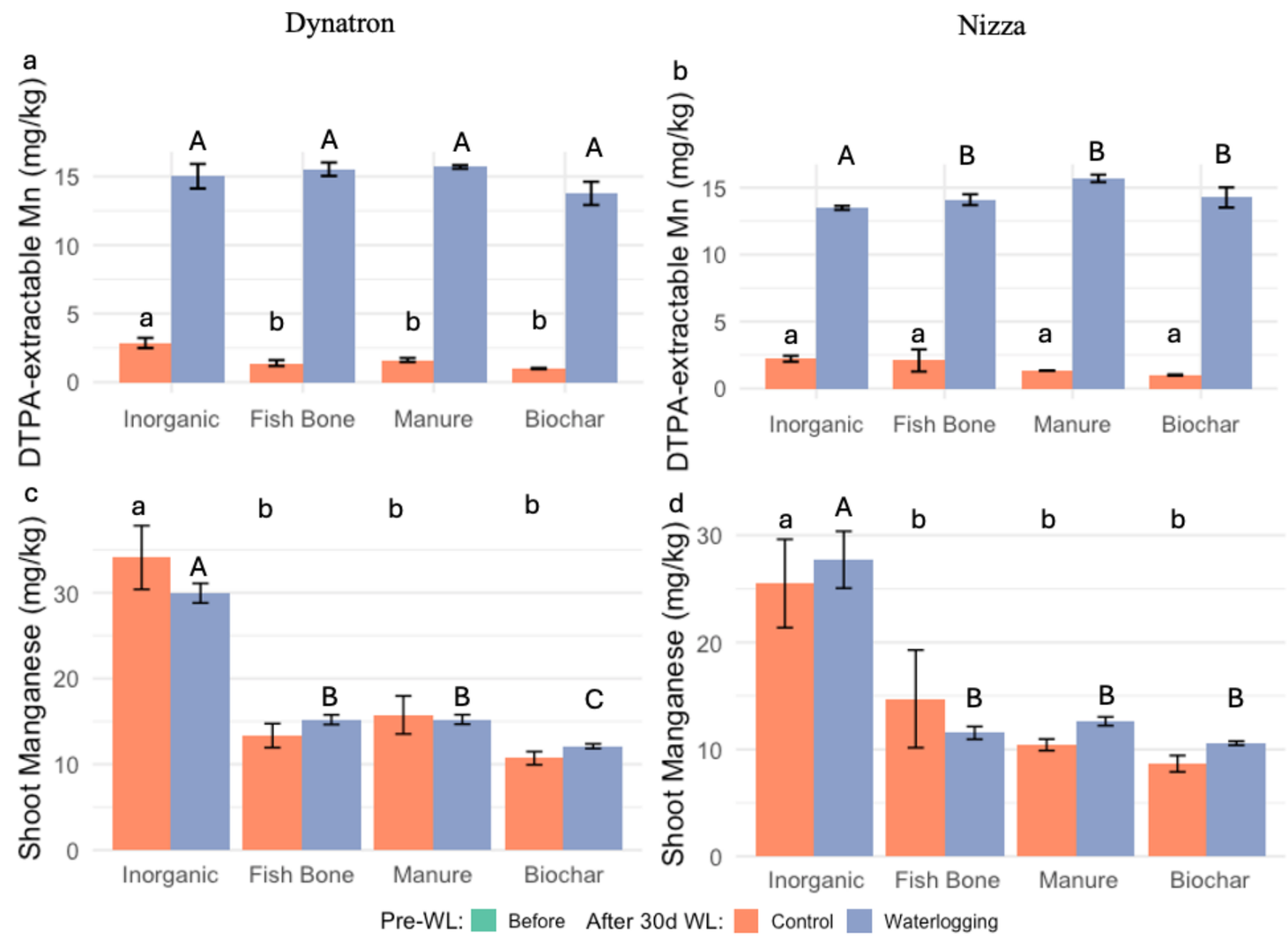
- Inorganic fertilization → pre-WL NO_3^-–N → shoot N uptake ↑ and biomass ↑
- Inorganic fertilization → Mn uptake ↑
- Management implications: Before waterlogging NO_3^-–N → canola resilience under waterlogging.



Structural path model showing the effects of fertilizer treatment on pre-waterlogging soil nitrate (NO_3^--N) and subsequent shoot N and biomass after 1 month of waterlogging. Arrows indicate significant paths ($p < 0.05$). For continuous paths, values are standardized coefficients (β); for categorical paths, values are effect sizes (η^2).

Soil–Plant decoupling of Mn under waterlogging

Waterlogging increased soil DTPA-extractable Mn by 4–7× but shoot Mn did not increase proportionally. Instead, shoot Mn accumulation was strongly regulated by fertilizer type, with inorganic fertilizer producing higher shoot Mn than organic amendments.



Effects of fertilizer treatments and waterlogging on soil DTPA-extractable manganese and shoot manganese concentrations in two canola cultivars (Dynatron and Nizza). (a-b) Soil DTPA-extractable Mn concentrations after 30 days of waterlogging. (c-d) shoot Mn concentrations after 30 days of waterlogging. Lowercase letters indicate pre-waterlogging differences and uppercase letters indicate post-waterlogging differences.

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