

Role of pH and nutrient source on the production and release of aucubin, acteoside and catalpol in hydroponically grown *Plantago lanceolata*

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Introduction

- The incorporation of plantain (*Plantago lanceolata*) in pastures has the potential to reduce N₂O emissions from pastoral systems
- A possible explanation of this reduction is the production of secondary metabolites inducing biologically nitrification inhibition (BNi)
- The mechanisms associated to the release of these compounds are still unclear
- Our aim was to understand the effect of pH and nitrogen (N) source on plantain's BNi metabolites

Materials and methods

- Plantain and ryegrass (*Lolium perenne*, used as control) seeds were planted in rockwool cubes
- 10 day-old seedlings were transferred to a hydroponic system for 45 days (30 L tanks, 8 plants per tank, n=3, Photo 1) and grown in aerated solutions with varying pH (4.2, 5.6, 6.8) and nutrient source (N-NH₄⁺, N-NO₃⁻ or K⁺)
- Nutrient concentration and pH were revised and adjusted weekly
- Concentrations of aucubin, acteoside and catalpol were determined in roots exudates (Liquid chromatography-mass spectrometry – LCMS) and in leaf and root samples (High-performance liquid chromatography - HPLC). Data were analysed using SAS 9.6

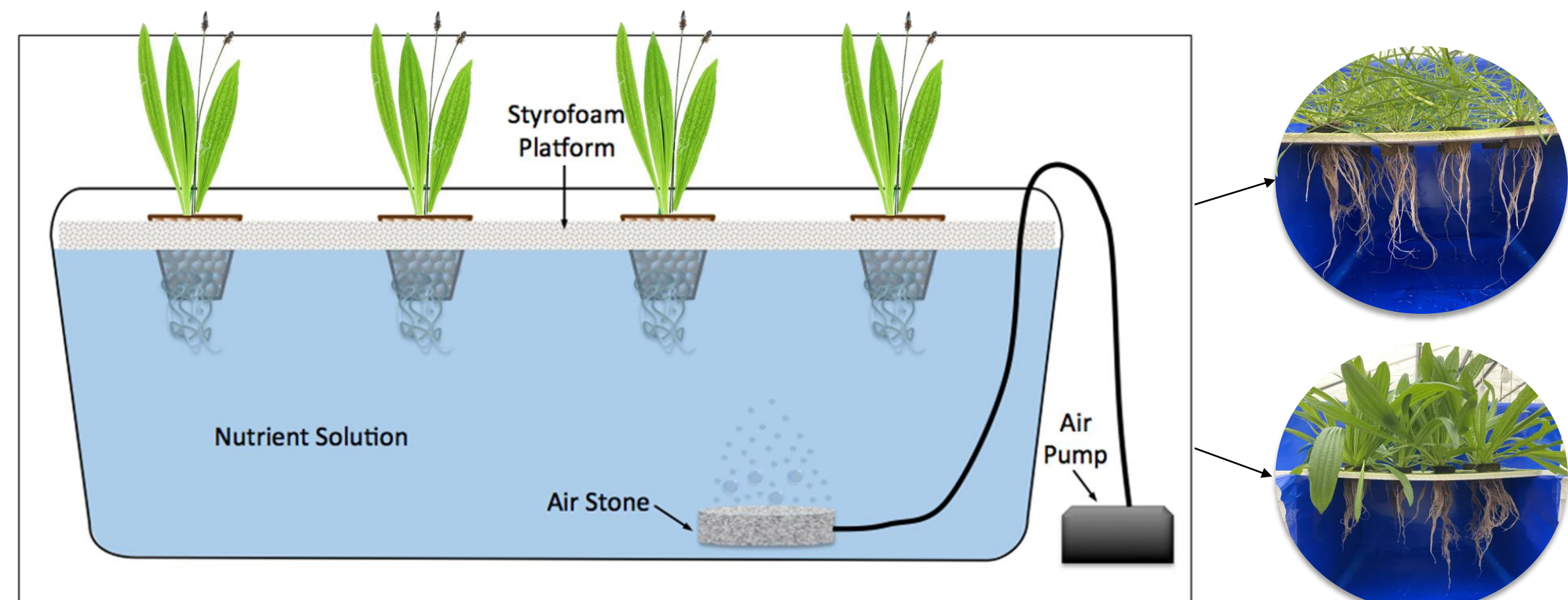


Photo 1. Hydroponic system used in the experiment and closed-up of root development in ryegrass and plantain

Results and discussion

- None of the secondary metabolites were detected in root exudates
- Acteoside and Aucubin were found in higher concentrations in plantain leaves and roots, in comparison to ryegrass (p<0.05)
- Acteoside concentrations in plantain roots were higher at pH 5.6 than at pH 4.2 and pH 6.8 (p<0.07); and when N-NH₄⁺ was used as nutrient source (p<0.05)
- Aucubin concentrations were significantly higher in leaves than in roots, but neither its production nor release was affected by pH or nutrient source
- Catalpol was not detected in leaves or roots

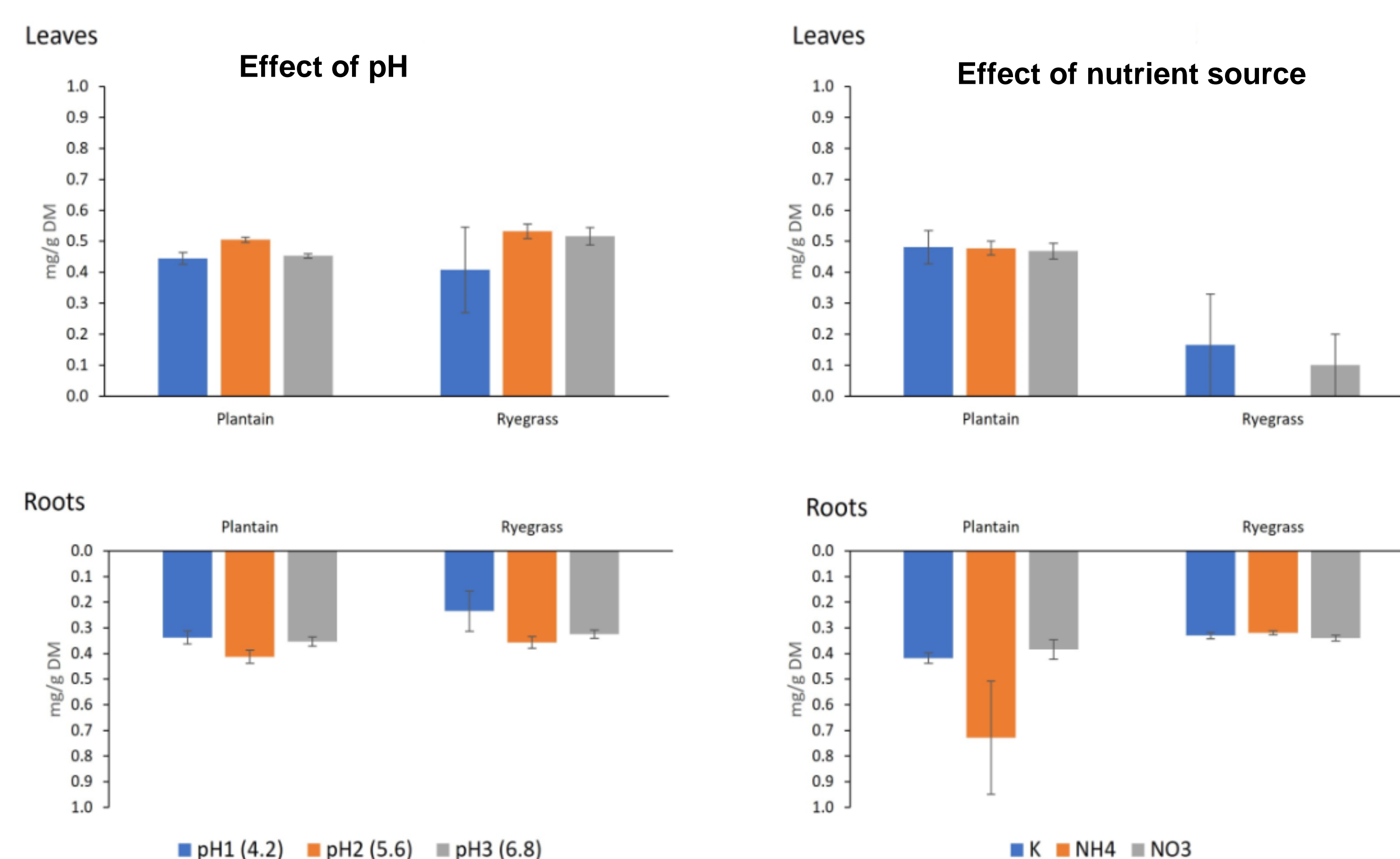


Figure 1. Acteoside concentration (mg g⁻¹ DM) in leaves (top) and roots (bottom) of plantain and ryegrass as effected by pH and nutrient source. Vertical bars denote standard error of the mean (p < 0.05)

Conclusions

- Our results showed that pH and nutrient source only had a significant effect on the concentration of acteoside in plantain roots, with higher concentrations at pH 5.6 and when NH₄⁺ was the N source in solution;
- They also suggest that weakly acid conditions may favour the release of this metabolite;
- Difficulties in the detection of other compounds in different plant tissues suggest an adaptation of the detection methodology may be required.

Acknowledgements

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