Determination of Brachialactone Release Mechanism in *Brachiaria humidicola* by Root Exudate Profiling under Different Elicitors

Supriya Verma[1], Konrad Egenolf[1], Jochen Schöne[2], Sebastian Mira[1], Frank Walker[2], Günter Neumann[3], Georg Cadisch[1], Frank Rasche[1]

[1]University of Hohenheim, Institute of Agricultual Sciences in the Tropics (Hans-Ruthenberg-Institute), Germany
[2]University of Hohenheim, Institute of Phytomedicine, Germany
[3]University of Hohenheim, Institute of Crop Sciences: Nutritional Crop Physiology, Germany

supriyaverma1912@gmail.com

Introduction

The ability of the plants to suppress soil nitrification through the release of nitrification inhibitors from the roots is termed 'Biological Nitrification Inhibition' (BNI). The tropical forage grass *Brachiaria humidicola*(Bh) has been found to release a compound termed "brachialactone" that deters both ammonia monooxygenase (AMO) and hydroxylamine oxidoreductase (HAO) enzymatic pathways in nitrifying organisms such as *Nitrosomonas europaea* (Subbarao, 2009). This ability could be exploited to decrease nitrification related N losses (NO_3^- leaching, NO_2 emissions) and thereby increasing N use efficiency in pasture systems.

Research Objective

The release mechanism of brachialactone has not been really investigated and some critical questions still remained unanswered. The objective of our study was to analyze the effect of different nutritional N forms and pH levels on the exudation pattern of root exudates and while doing that determine the exudation process of brachialactone.

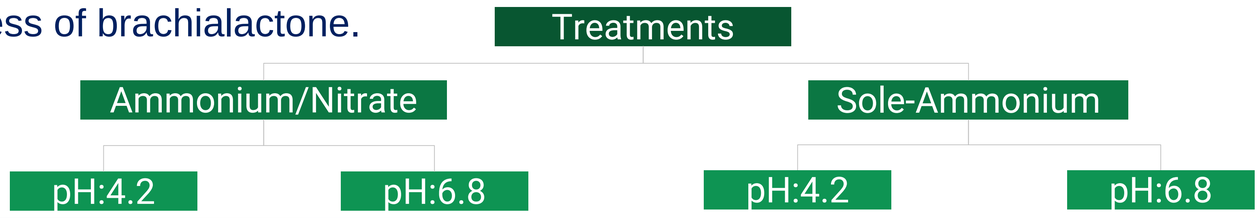


Figure a) Hydroponic tanks in which the plants were grown, **b)** The beakers (miniature hydroponic system) containing different trap solutions according to the treatments.

Materials & Methods

High Bh cultivar "Tully" (genotype CIAT 679) was grown in a hydroponic system for 7 weeks and was then exposed to different N sources and pH treatments for 4 hours. Ammonium/nitrate uptake and exudation levels of brachialactone, sugars, amino acids and carboxylates were monitored under the contrasting treatments. Correlation analysis was performed between brachialactone and other measured analytes.

Results and Discussion

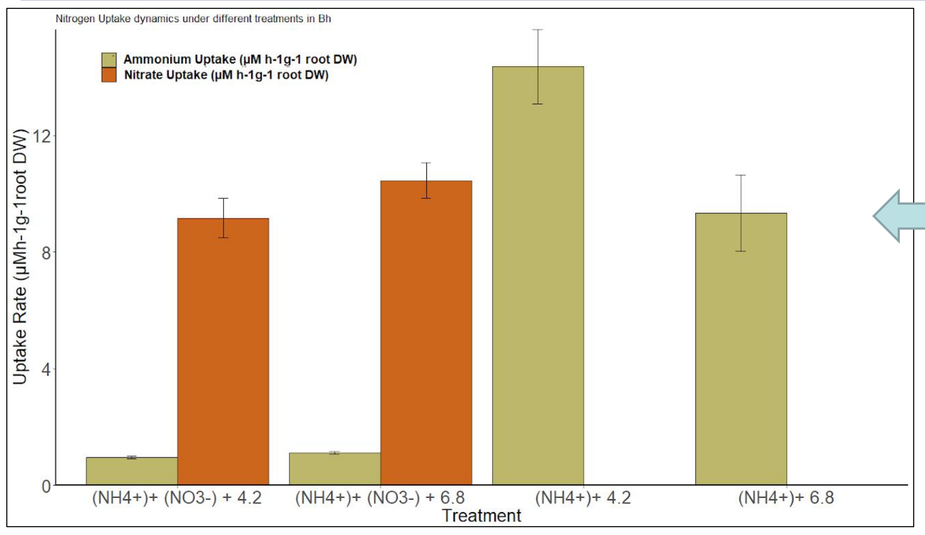


Figure 1 Uptake patterns of ammonium and nitrate under different treatments

- Bh predominantly feeds on nitrate in the presence of both nutritional N forms.
- Very low release of sugars and amino acids and no treatment effects on the release of these metabolites.

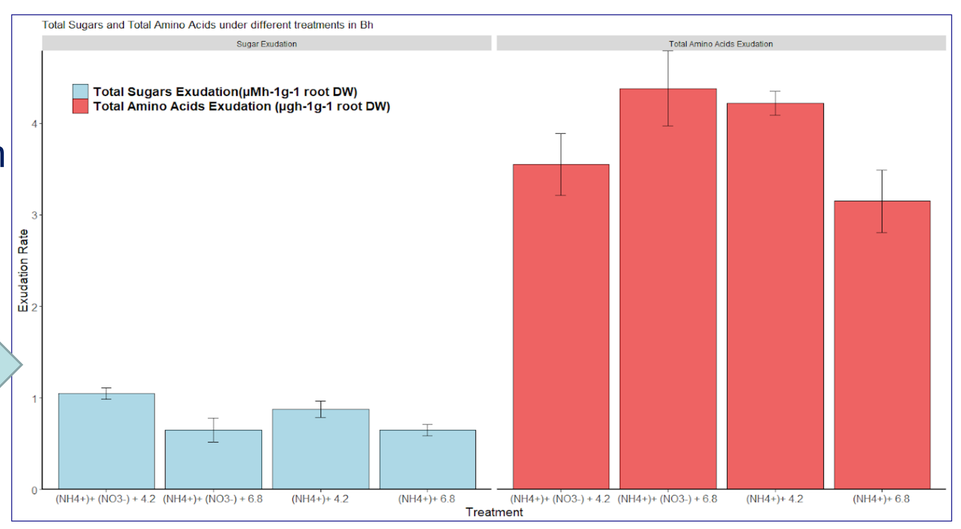


Figure 2 Release patterns of total amino acids and sugars under different treatments

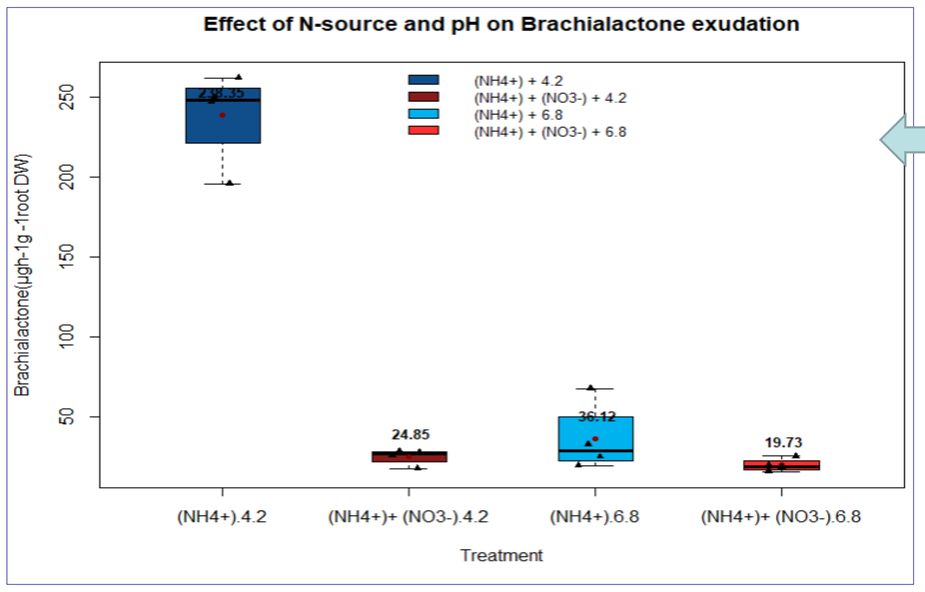


Figure 3 Effect of N-source and pH on brachialactone exudation

- NH_4^+ nutrition in the presence of low rhizosphere pH leads to escalated levels of brachialactone release compared to other treatments.
- Brachialactone exudation is strongly correlated to NH_4^+ uptake.
- It is not correlated with passively released metabolites such as amino acids and sugars.

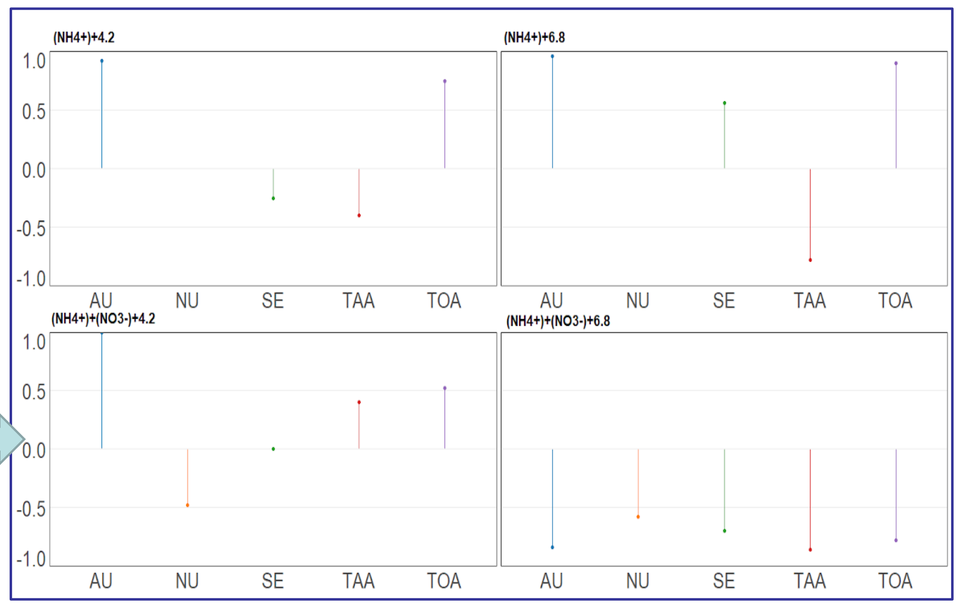
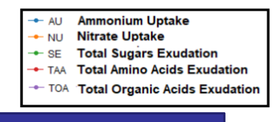


Figure 5 Correlation Analysis of different analytes with brachialactone exudation



Conclusions

- NH_4^+ nutrition and low pH leads to an increase in brachialactone exudation as shown in previous studies.
- Constant release pattern of amino acids and sugars under all the treatments indicated that there was no root plasma membrane damage occurred during the course of our treatments.
- Results from correlation analysis indicates that brachialactone is released by an active mechanism or at least by facilitated diffusion.

This study is conducted within the framework of the **Anton & Petra Ehrmann-Stiftung Research Training Group „Water – People – Agriculture"** at the University of Hohenheim.

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Reference: Subbarao et al. (2009) Evidence for biological nitrification inhibition in *Brachiaria* pastures. *Proceedings of the National Academy of Sciences* 106(41): 17302-17307.