$\delta^{15}N$ leaf signature in Brachiaria humidicola reflects the potential Biological Nitrification Inhibition (BNI)

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**Objectives and Hypothesis**

Investigate if high and low BNI Brachiaria humidicola (Bh) CIAT accessions show contrasting $\delta^{15}N$ signatures in leaves and link this to nitrification inhibition indicators

- High BNI Bh genotypes (CIAT 16888 & CIAT 679) feed on $\text{NH}_4^+$ with a lower $\delta^{15}N$ signature due to nitrification inhibition, whereas low BNI CIAT 26146 (high nitrification) should feed on a respective $\delta^{15}N$ enriched $\text{NH}_4^+$ pool. This should be reflected in the $\delta^{15}N$ signature of leaves.
- Long-term cultivation of Bh with high BNI potential should result in less leaching losses of $^{15}N$ depleted $\text{NO}_3^-$ and therefore in relative lower $\delta^{15}N$ leaf signatures compared to low BNI Bh genotypes, where higher $\delta^{15}N$ leaf signature are expected.

**Results**

- Sig. correlation among $\text{N}$O ratio in soil and $\delta^{15}N$ in leaves at 8 days after N fertilization.
- High BNI Bh showed respective lower $\delta^{15}N$ signatures and less $\text{NO}_3^-$ in topsoil compared to Bh with low BNI potential.
- Soil incubation indicated lower nitrification for high BNI genotypes compared to low BNI genotype.
- Equal $\delta^{15}N$ signatures in October 2013 for the 3 genotypes. Two years later high BNI accessions had sig. lower $\delta^{15}N$ values in leaves compared to low BNI Bh.

**Material & Methods**

- Study site: CORPOICA La Libertad Research station, Llanos de Colombia
- Contrasting BNI Bh genotypes were grown since 2015 in a fully randomized block design. In October 2015 plots were split and either fertilized (+N) or not (-N) with 70 kg N ha$^{-1}$. Soil was collected from -N plots and incubated for potential nitrification determination. Leaves were collected from both split plots of two high BNI (CIAT 679 and CIAT 16888) and one low BNI (CIAT 26146) Bh hybrids at 0, 3, 8 and 11 days after fertilization (DAP) and $\delta^{15}N$ was measured with an IRMS.
- $\delta^{15}N$ natural abundance of the sample relative to the standard (atmospheric $\text{N}_2$) was expressed as: $\delta^{15}N_{\text{sample}} = [\text{R}_{\text{sample}} / \text{R}_{\text{standard}} - 1] \times 1000\%$, where $\text{R}$ represents the isotope ratio ($^{15}N$/^{14}N) and $\text{R}_{\text{standard}}$ is $^{15}N$/^{14}N of atmospheric $\text{N}_2$, i.e. 0.3663 $\pm$ 0.0004 atom $^{15}N$.

**Background**

- The tropical forage grass Brachiaria humidicola (Bh) reduces soil microbial nitrification through release of nitrification inhibitors (NIs) and consequently reduces formation of nitrate (N$\text{O}_3^-$) in soils.
- NO$\text{O}_3$ leaching and nitrous oxide (N$\text{O}_2$) emission might therefore be reduced by biological nitrification inhibition (BNI).
- Intraspécific contrasting BNI potentials in Bh have been observed but screening methods for field plot application need to be further developed to identify promising Bh candidates with high BNI potential.
- Nitrification discriminates strongly against the stable isotope $^{15}N$ and consequently leads to a $^{15}N$ enriched ammonium (N$\text{H}_4^+$) and a $^{15}N$ depleted $\text{NO}_3^-$ pool.
- Long-term losses of $^{15}N$ depleted $\text{NO}_3^-$ via leaching enrich the remaining soil $\text{N}$ relatively with $\delta^{15}N$.

**Conclusions**

- Expected high BNI potential of CIAT 16888 & CIAT 679 was confirmed by lower soil nitrification.
- $\delta^{15}N$ leaf signature was linked to soil nitrification.
- Decreasing $\delta^{15}N$ values in leaves over time indicated reduced losses of $^{15}N$ depleted $\text{NO}_3^-$ due to expected reduction of soil nitrification.
- The $\delta^{15}N$ method has the potential to detect: differences of contrasting Bh accessions in terms of BNI (preferentially low/no uptake of $^{15}N$ depleted $\text{NO}_3^-$). differences of long-term N losses in the field.

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