# Using Phenolic Compounds to Increase Soil Nitrogen Retention


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## Introduction

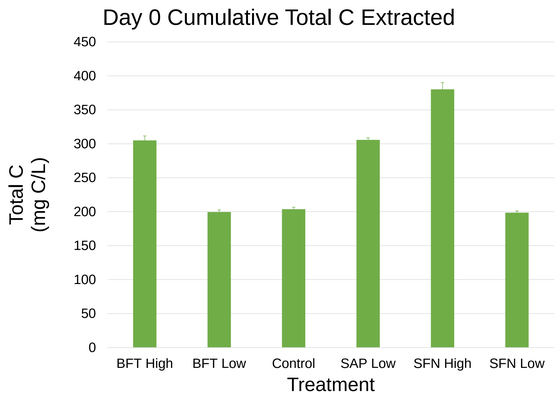
Ruminants and pastures contribute significant amounts of nitrous oxide ($N_2O$), and carbon dioxide ($CO_2$) to the atmosphere and nitrogen (N) to waterways. Phenolics such as tannins and saponins are secondary plant compounds which have been shown to reduce N cycling in forest systems by binding proteins (Waghorn et al. 2008). We hypothesize that finishing beef cattle on tannin-containing legumes such as birdsfoot trefoil (*Lotus corniculatus*) and sainfoin (*Onobrychis viciifolia*) or saponin-containing legumes such as alfalfa (*Medicago sativa)* may reduce soil N mineralization, thus increasing overall N retention in pasture soils.

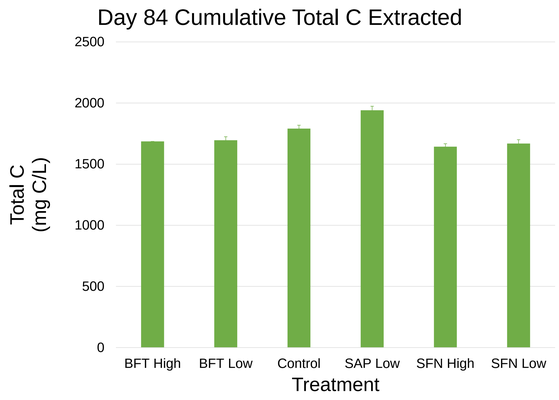
## Methods

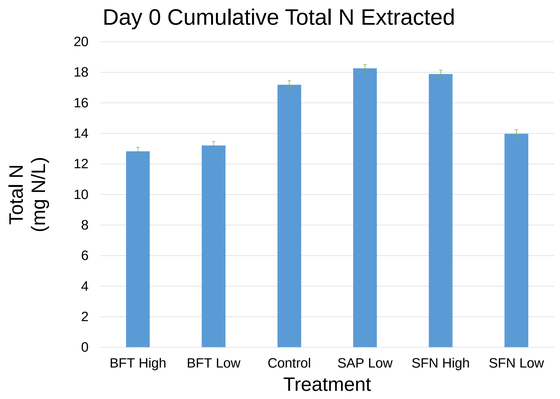
Purified tannins from birdsfoot trefoil (BFT) and sainfoin (SFN) and saponins from alfalfa (SAP) were added to a uniform pasture soil and incubated for 84 days. Saponins were added at a low dose (3 mg/g soil) and tannins were added at low (3 mg/g soil) and high (15 mg/g soil) doses. Nitrate ($NO_3^-$) and ammonium ($NH_4^+$) concentrations, $N_2O$ and $CO_2$ production rates, and soluble carbon (C) and nitrogen (N) were measured throughout the study.

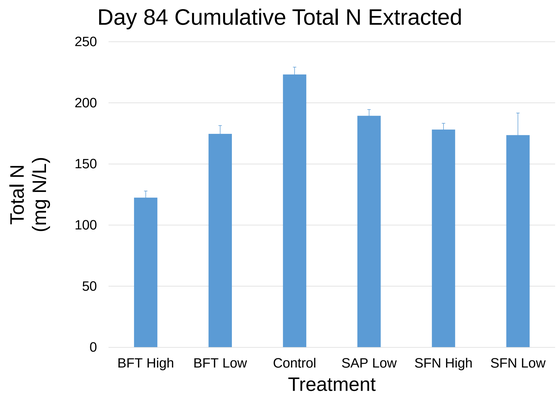

Figure 1: Preparing soil samples for incubation

## Preliminary Results



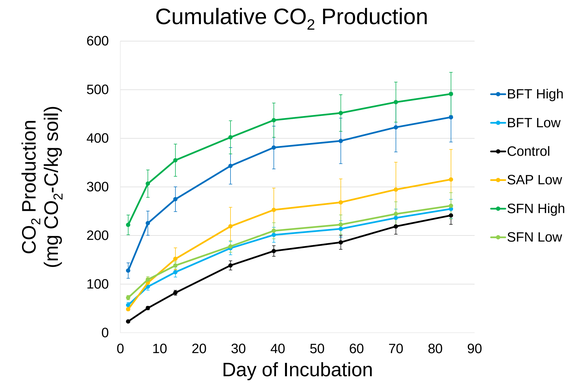



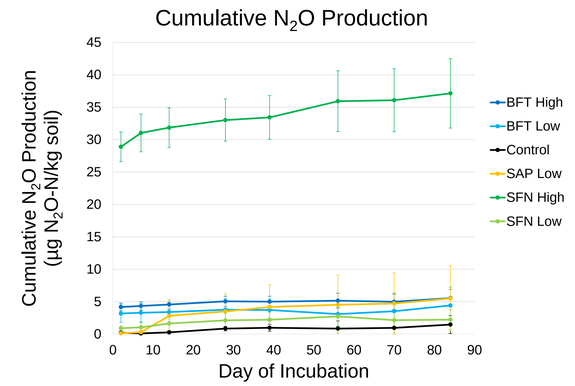



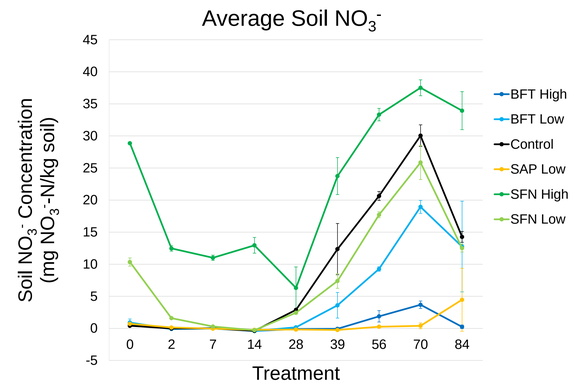

**Panel 1.** Graphs of cumulative soluble C and N extracted from samples over the course of four water extractions. Extractions were performed at the beginning (day 0) and end (day 84) of the incubation period. Treatments yielding less C than the soil control indicate sorption of phenolics to soil organic matter. Treatments yielding less N than the soil control indicate complexation of phenolics with soil proteins.

## Conclusions

Soluble C and N data suggests that phenolics are reacting with soil organic matter and proteins to form stable complexes, thus immobilizing C and N. However, significant microbial activity suggests that the fate of phenolics may also be influenced by biological decomposition processes. Low doses of tannins may be particularly useful for increasing N retention and reducing greenhouse gas emissions in pasture soils.




**Panel 2.** Graphs of soil $CO_2$ production, $N_2O$ production, and nitrate. Greenhouse gas data indicates microbial activity in response to substrate addition. Soil nitrate indicates typical microbial growth patterns.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## References


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