

## ***Interactive comment on “Fungal loop transfer of N depends on biocrust constituents and N form” by Zachary T. Aanderud et al.***

**Zachary T. Aanderud et al.**

zachary\_aanderud@byu.edu

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Authors response-general comment: Thank you for the insights and helping to improve the manuscripts. Hopefully we have addressed all your concerns adequately.

1. It would be helpful to include figure showing the layout of the experiment. Along these lines, might be nice to include photos of plots and types of biocrust as supplemental material

Authors response: We now include a supplemental figure detailing the study design with photos of both crust-types. See attached supplemental figure 1.

2. It is a bit surprising that no tracer is found in the plant, presumably because the plants didn't wake-up with the small wetting event as you suggest. Since this is an

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important component of the loop hypothesis it would be worth adding additional discussion esp. on what is known about the intensity of rainfall required for plants to become active.

Authors response: We now include the following paragraph in the discussion. Good idea, thanks. 4.4 No N translocation to grass Due to the discrete nature of our minor, localized rainfall event, we were not surprised that none of the label entered the leaves of *A. hymenoides*. In the fungal loop hypothesis, a larger rainfall event triggers the plant to become a sink for the N building up in fungi over previous minor rainfall events. We conducted our experiment absent of a larger rainfall event and our 2.5 mm rainfall event was applied over a 5 cm diameter circle of soil in early summer. When a similar precipitation event size (2 mm) was applied across a much larger area (4 x 4 m<sup>2</sup> plot) on Colorado Plateau soils during spring or summer, the predawn water potential of *A. hymenoides* was similar one day after and one day prior to watering (Schwinning et al. 2003). Thus, our minor rainfall event most likely failed to alter the water status of the grass or cause the grass to become a sink for N. Alternatively, the isotopic signal potentially became too depleted as it traveled through biocrust constituents or was adsorbed by soils to sufficiently be acquired by *A. hymenoides* roots and translocated to leaves. In April, at the time of the experiment, *A. hymenoides* was photosynthetically active. If we had added more label or evaluated the isotope signature of roots, we may have detected the <sup>15</sup>N label in the grass tissue.

Minor points line 59: consider specifying that they are 'terrestrial' cyanobacteria since you haven't introduced biocrusts yet

Authors response: done

lines 88-92: Hard to follow

Authors response: We have edited the sentence by including a couple guide words such as host plant and rather than, and added a comma. Hopefully this helps. The sentence now reads, "Larger rainfall events may then activate plants, allowing the host

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plant to receive N from the fungi, and transfer photosynthate to the fungal endophyte. If fungal endophytes are poor competitors for newly released N, preferentially sequester one inorganic N form over another, or more efficiently transform and transport NH<sub>4</sub><sup>+</sup> rather than NO<sub>3</sub><sup>-</sup>, biocrust constituents and N form may influence the translocation of N in fungal loops."

line 149: What are the molar concentrations of K<sup>15</sup>NO<sub>3</sub> and (NH<sub>4</sub>)<sup>15</sup>SO<sub>4</sub> used?

Authors response: We now include the following sentence in the methods, "For the isotopic applications, either 2.60 g of 99 at.% K<sup>15</sup>NO<sub>3</sub> or 1.70 g of 99 at.% (NH<sub>4</sub>)<sup>15</sup>SO<sub>4</sub> was dissolved in 18 mL of deionized water to create a 1.43 M or 0.72 M solution respectively."

line 169: should be isotope 'ratio' not ration

Authors response: done

lines 327-328: "mosses" appears twice

Authors response: thanks

Was biocrust isotope enrichment analyzed at 0 cm radial distance (at the application point)? This would be a good comparison to even see how much of the label actually remained in the soil (NH<sub>4</sub><sup>+</sup> vs NO<sub>3</sub><sup>-</sup>).

Authors response: We agree, but were concerned that we might fail to recapture all of the <sup>15</sup>N in the localized rainfall applications after 24 hours. The 2 cm diameter rainfall simulations had uneven edges due to the biocrust topography. If we missed some of the label inadvertently we would falsely conclude that more <sup>15</sup>N moved than it did. We decided against it.

To further understand the role of fungi in nutrient transport, it would be interesting to see what form the N is in at the various locations from the site of application. Though I expect this would be future research. Authors response: We agree. To

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highlight your point and help others see a wonderful future endeavor we added the following sentence in the discussion right before the closing sentence of section 4.2. The statement now reads, "Unfortunately, based on our design, we were unable to distinguish the form of N captured or translocated by biocrust constituents. More information is needed to identify the importance of N form and the movement of organic N within fungal loops."

Please also note the supplement to this comment:

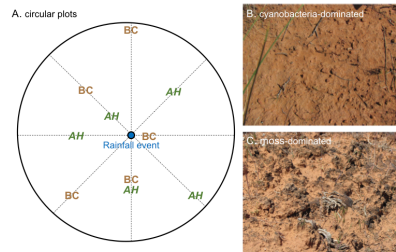
<https://www.biogeosciences-discuss.net/bg-2017-433/bg-2017-433-AC1-supplement.pdf>

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Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-433>, 2017.

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**Supplemental Figure 1** The field design of circular plots (radius = 1.0 m) receiving minor, localized rainfall events. An example of five biocrust (BC) and *Achnatherum hymenoides* (AH) samples occurring randomly along eight axes (e.g., N, NE, E, SE, S, SW, W, and NW) radiating from the center of each plot (A). An isotopically labeled (0.30 mg <sup>15</sup>N) rainfall event (2.5 mm) was sprayed onto a central circle (radius = 5 cm). Rainfall events occurred on the surfaces of cyanobacteria-dominated (B) and moss-dominated biocrust.



**Fig. 1.**