**Title:** Agnostic fungi: plant traits and tissue stoichiometry explain nutrient transfer in common arbuscular mycorrhizal networks of temperate grasslands

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## Supplemental Information

**Table S1. List of species at each site with number of leaf samples per species.** Donor species are indicated in bold.

| **Species** | **Perenniality** | **Func. group** | **WC** | **TW** | **DC** | **Fungal symbiont** |
|---|---|---|---|---|---|---|
| ***Agrostis capillaris* L.** | Perennial | Grass | 121 | -- | -- | AM[1] |
| ***Alopecurus pratensis* L.** | Perennial | Grass | -- | 210 | -- | AM[1] |
| *Aphanes occidentalis* L. | Annual | Forb | 3 | -- | -- | AM*[2] |
| *Bromus diandrus* Roth | Annual | Grass | 49 | -- | -- | AM*[1] |
| *Bromus hordeaceus* L. | Annual | Grass | 35 | 42 | 96 | AM*[1] |
| *Elymus repens* (L.) Gould | Perennial | Grass | -- | -- | 63 | AM*[1] |
| *Eriophyllum lanatum* (Pursh) Forbes | Perennial | Forb | 8 | -- | -- | AM[2] |
| *Festuca idahoensis* Elmer ssp. *roemeri* (Pavlick) S. Aiken | Perennial | Grass | 18 | -- | -- | AM*[1] |
| *Geranium dissectum* L. | Annual | Forb | 15 | 81 | -- | AM[2] |
| *Holcus lanatus* L. | Perennial | Grass | -- | 6 | -- | AM[1] |
| *Koeleria macrantha* (Ledeb.) Schult. | Perennial | Grass | 18 | -- | -- | AM[2] |
| *Lotus corniculatus* L. | Perennial | Forb | -- | 9 | -- | AM[1] |
| ***Schedonorus arundinaceus* (Schreb.) Dumort.** | Perennial | Grass | -- | -- | 130 | AM[1] |
| ***Sidalcea malviflora* ssp. *virgata* (DC.) A. Gray ex Benth.** | Perennial | Forb | 66 | 129 | 119 | AM[3] |
| *Trifolium subterraneum* L. | Annual | Forb | 48 | -- | -- | AM[1] |
| *Veronica arvensis* L. | Annual | Forb | 3 | -- | -- | AM[1] |
| *Vicia sativa* L. | Annual | Forb | -- | 14 | -- | AM*[1] |
| *Vulpia* spp. | Annual | Grass | 54 | 8 | 21 | AM[1] |
| | | **Total samples** | 438 | 499 | 429 | |

Notes: Fungal symbiont data derived from [1]Chaudhary et al. (2016), [2]Soudzilovskaia et al. (2020), and [3]Dickie et al. (2013). * indicates "to genus," that strategy was extrapolated from a sister species given a lack of data on this species. Nutrient-use strategies include arbuscular mycorrhizal (AM) and nitrogen fixation (N-fixer).

**Table S2. Collection dates for each time point at each site.** Days since labeling given in parentheses after date.

| **Site** | **Label application (time point 0)** | **Time point 1** | **Time point 2** | **Time point 3** |
|---|---|---|---|---|
| ***Ideal days since labeling*** | *0* | *4* | *10* | *21* |
| **Northern** | June 10 | June 14 (4) | June 20 (10) | July 2 (22) |
| **Middle** | May 29 | June 3 (5) | June 11 (13) | June 18 (20) |
| **Southern** | May 9 | May 13 (4) | May 22 (9) | May 30 (21) |

**Table S3. List of fungal ASVs by plant perenniality.**

| **Fungal taxon** | **No. of perennial plants assoc. with** | **No. of annual plants assoc. with** |
|---|---|---|
| *Acaulospora sp877* | 13 | 0 |
| *Claroideoglomus sp744* | 20 | 7 |
| *Claroideoglomus sp745* | 18 | 5 |
| *Claroideoglomus sp746* | 18 | 7 |
| *Claroideoglomus sp749* | 14 | 4 |
| *Claroideoglomus sp751* | 25 | 10 |
| *Claroideoglomus sp757* | 11 | 1 |
| *Claroideoglomus sp758* | 11 | 1 |
| *Claroideoglomus sp781* | 18 | 13 |
| *Claroideoglomus sp782* | 59 | 36 |
| *Claroideoglomus sp783* | 38 | 20 |
| *Claroideoglomus sp784* | 47 | 21 |
| *Claroideoglomus sp811* | 19 | 9 |
| *Claroideoglomus sp812* | 12 | 4 |
| *Claroideoglomus sp813* | 15 | 10 |
| *Claroideoglomus sp815* | 21 | 11 |
| *Claroideoglomus sp816* | 19 | 7 |
| *Claroideoglomus sp817* | 30 | 8 |
| *Glomus sp1024* | 11 | 1 |
| *Glomus sp1025* | 12 | 4 |
| *Glomus sp1029* | 23 | 4 |
| *Glomus sp1031* | 20 | 7 |

| Fungal taxon | No. of perennial plants assoc. with | No. of annual plants assoc. with |
|---|---|---|
| *Glomus sp104* | 12 | 3 |
| *Glomus sp113* | 23 | 10 |
| *Glomus sp114* | 6 | 16 |
| *Glomus sp115* | 21 | 15 |
| *Glomus sp1349* | 13 | 8 |
| *Glomus sp1351* | 18 | 8 |
| *Glomus sp1352* | 15 | 5 |
| *Glomus sp148* | 22 | 11 |
| *Glomus sp149* | 12 | 6 |
| *Glomus sp150* | 27 | 14 |
| *Glomus sp168* | 21 | 12 |
| *Glomus sp169* | 13 | 6 |
| *Glomus sp170* | 15 | 6 |
| *Glomus sp177* | 11 | 1 |
| *Glomus sp191* | 14 | 10 |
| *Glomus sp470* | 15 | 6 |
| *Glomus sp472* | 14 | 4 |
| *Glomus sp488* | 13 | 2 |
| *Glomus sp539* | 13 | 3 |
| *Glomus sp541* | 19 | 3 |
| *Glomus sp565* | 15 | 7 |
| *Glomus sp566* | 12 | 1 |
| *Glomus sp612* | 13 | 3 |
| *Glomus sp614* | 11 | 6 |
| *Glomus sp648* | 12 | 2 |
| *Glomus sp651* | 25 | 10 |
| *Glomus sp661* | 11 | 4 |
| *Glomus sp662* | 14 | 3 |
| *Glomus sp663* | 12 | 8 |
| *Glomus sp667* | 13 | 1 |
| *Glomus sp668* | 14 | 3 |

| Fungal taxon | No. of perennial plants assoc. with | No. of annual plants assoc. with |
|---|---|---|
| *Glomus sp669* | 14 | 5 |
| *Glomus sp670* | 20 | 2 |
| *Glomus sp692* | 14 | 1 |
| *Glomus sp700* | 11 | 2 |
| *Glomus sp701* | 12 | 12 |
| *Glomus sp703* | 19 | 13 |
| *Glomus sp83* | 11 | 0 |
| *Glomus sp85* | 12 | 3 |
| *Glomus sp904* | 18 | 3 |
| *Glomus sp905* | 11 | 2 |
| *Glomus sp906* | 17 | 6 |
| *Glomus sp917* | 29 | 12 |
| *Glomus sp918* | 85 | 48 |
| *Glomus sp919* | 45 | 32 |
| *Glomus sp92* | 11 | 0 |
| *Glomus sp920* | 53 | 33 |
| *Glomus sp921* | 17 | 3 |
| *Glomus sp938* | 14 | 8 |
| *Glomus sp986* | 12 | 1 |
| *Paraglomus sp301* | 19 | 4 |
| *Paraglomus sp302* | 26 | 5 |
| *Paraglomus sp303* | 15 | 4 |
| *Paraglomus sp304* | 25 | 5 |
| *Scutellospora sp1080* | 12 | 6 |
| *Unknown sp21* | 12 | 4 |

Table only includes fungal species associated with at least 10 plants.

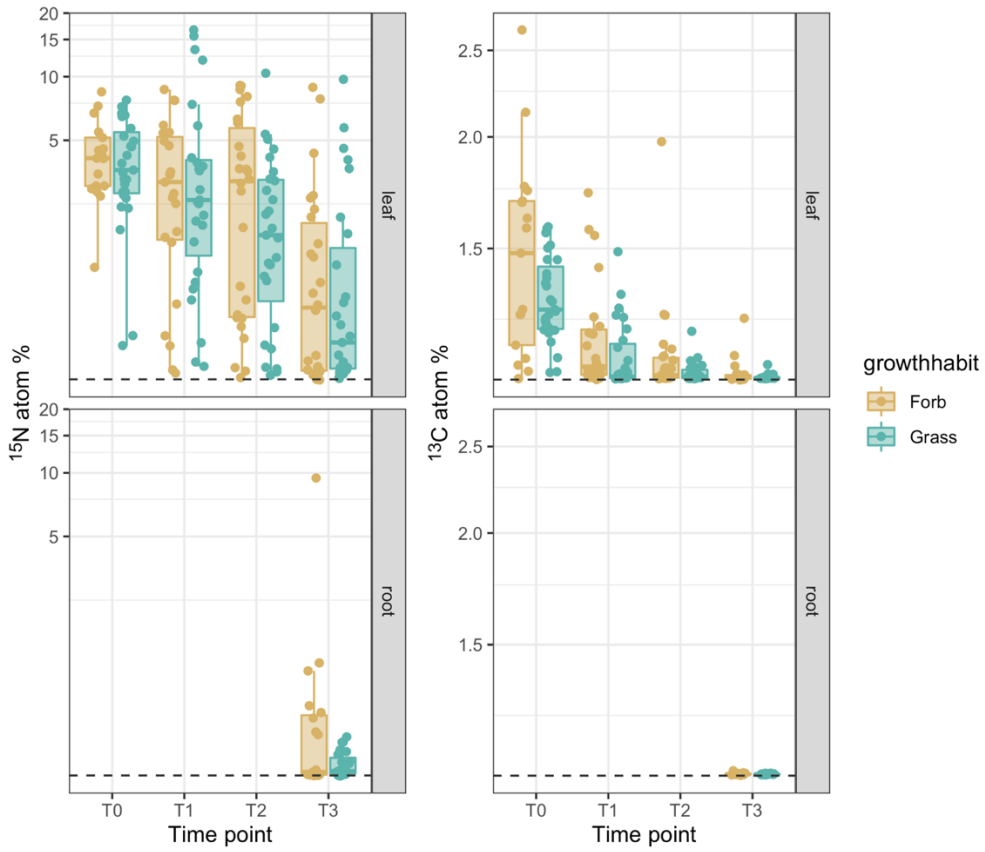


**Figure S1. Enrichment decreases over time in labelled plants.** Time points roughly correspond with T0 = time of labelling, T1 = 4 days later, T2 = 10 days later, T3 = 21 days later. Y-axis is in log10 scale.

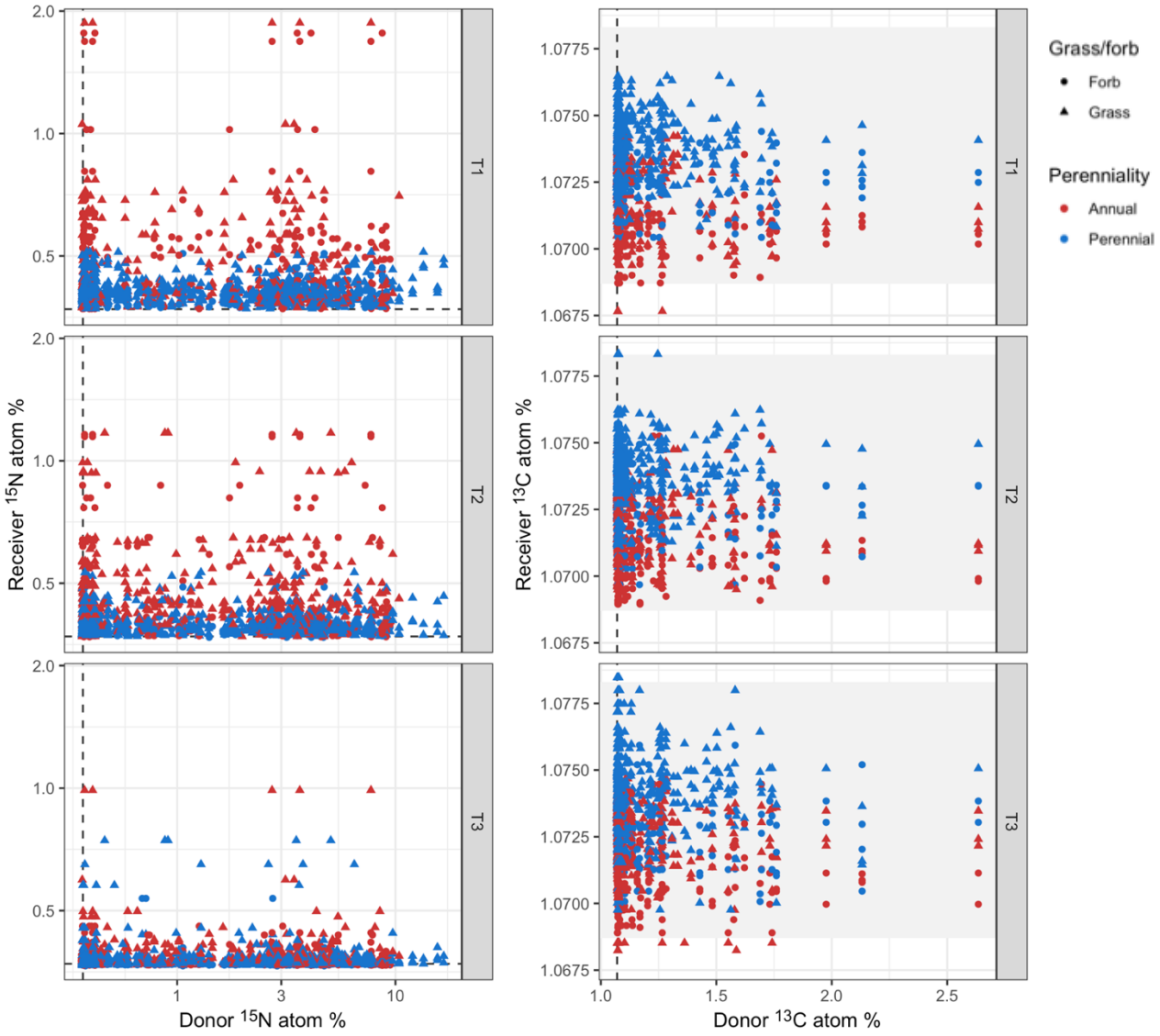


**Figure S2. Receiver enrichment did not correlate with donor enrichment.** Dashed lines indicate natural abundance means; grey boxes indicate range of natural abundance variation shown in Figure 2. (Grey boxes are too small to be visible for $^{15}$N.) $^{15}$N axes are log10 scaled. Note there is a sizeable difference between X- and Y-axes of both elements. Time point facets are time point 1 (~4 days post label), time point 2 (~10 days post label), and time point 3 (~21 days post label). Donors are all sampled at time point 0 (immediately after labelling). Note that five plots are missing from this graph (one each from northern/high diversity/control, northern/low diversity/rain exclusion, central/high diversity/rain exclusion, central/low diversity/rain exclusion, southern/high diversity/control) due to a lack of donor DNA data.

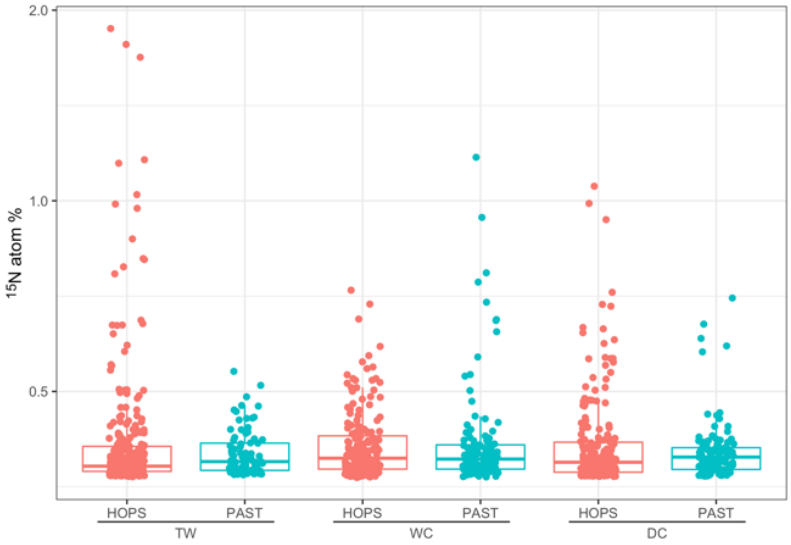


**Figure S3. No trend in $^{15}N$ enrichment across site and rain exclusion treatment.** Y-axis is in log10 scale.

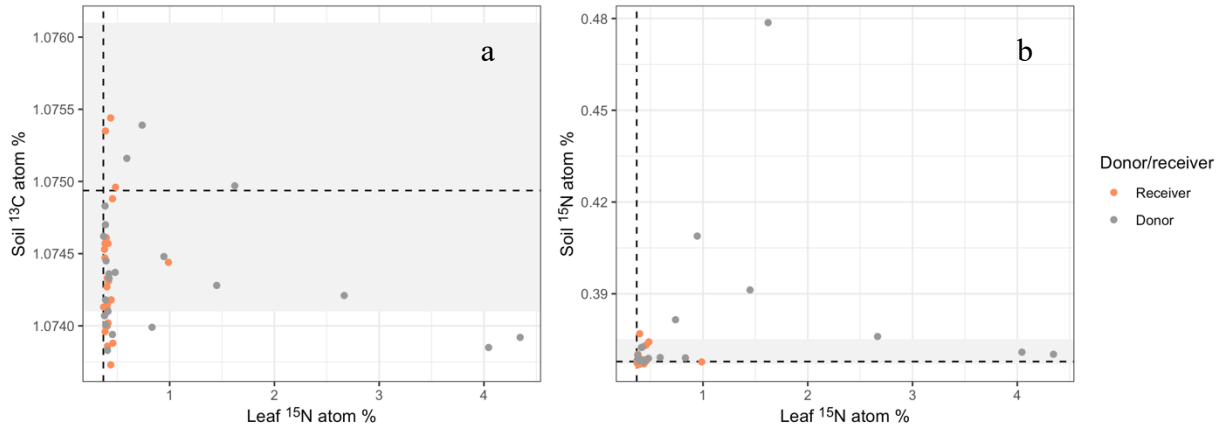


**Figure S4. Limited soil enrichment 21 days after labelling.** Dashed lines indicate average baseline enrichment. Grey boxes indicate range of baseline enrichment. Samples are subset to individuals most highly enriched with foliar $^{15}N$ at each site by restored prairie/introduced pasture as well as their associated donors.

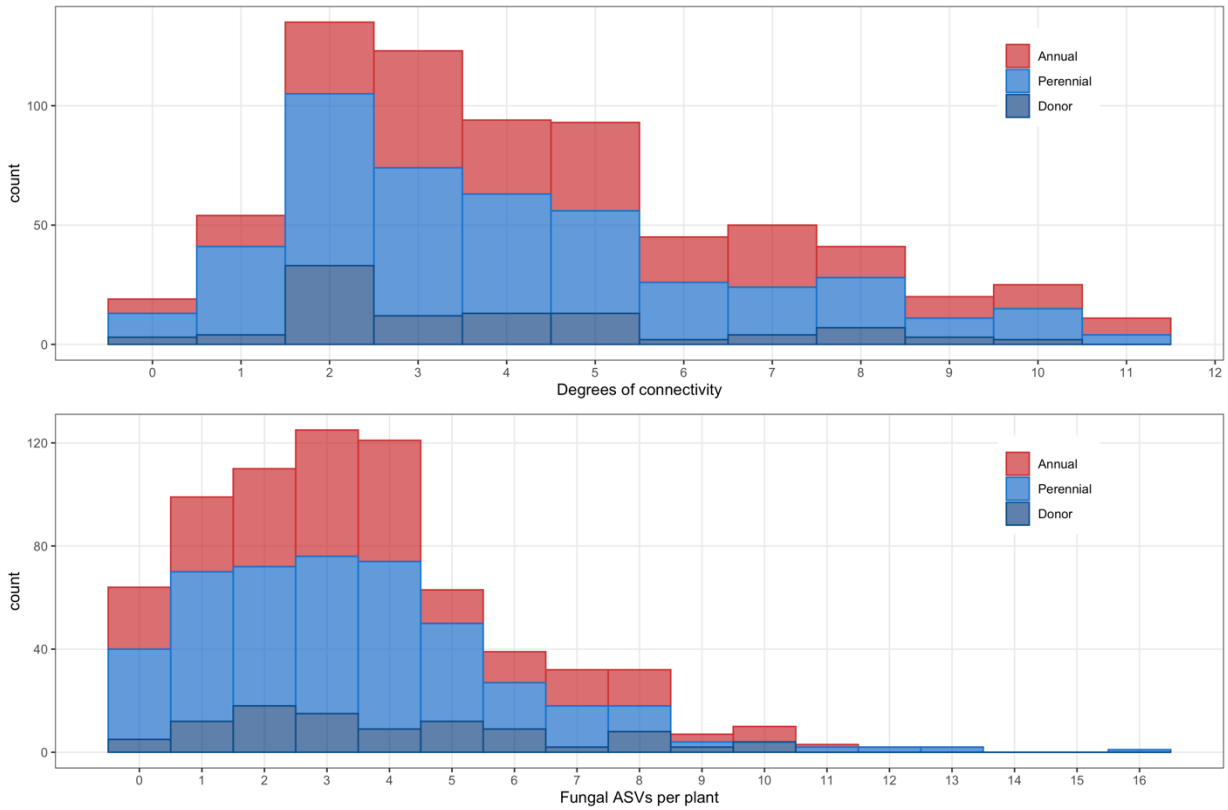


**Figure S5. Histogram of connectivity metrics showing left skew.** Degrees of connectivity indicate how many plants an individual shared at least one fungal ASV with in the same plot. Data are from time point 1 (approximately four days after labeling). Donors are the plants that we applied the isotopic label to.

## SI References

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