**Supplementary information**

Supplementary methods:

*Beta-diversity soil fungi and bacteria:*

Soil DNA was extracted from the soils using the PowerSoil® DNA Isolation Kit (MoBio, Carlsbad, CA, USA) and the library preparation for bacteria was done using tagged primers for 16S as described in detail in Dassen et al., 2017. For fungi, library preparation was done using tagged primers for ITS as described in Gweonn et al., 2015. Soil DNA was sequenced on the Illumina MiSeq platform (250 bp paired-end) by Beijing Genomics Institute ([www.bgi.com](http://www.bgi.com); Shenzhen, China).

*Statistical analysis soil beta diversity:*

Sequences for bacteria and fungi were analyzed separately. Sequences were placed in OTUs and to account for differences in read numbers each OTU was standardized as a percentage of the total number of OTUs as described in Hannula et al., 2017. Unconstrained, principal coordinate analyses (PCoA/metric multi-dimensional scaling) were performed on dissimilarity matrices that were calculated from the OTU data. Furthermore, constrained, ANOSIM (Analysis of similarity, 999 permutations, using Bray-Curtis distance) were performed separately for bacteria and fungi, with root size (R+/R-) of the conditioning species, functional group (G/F) of the conditioning species and identity of the species (12 soil conditioning plant species) that conditioned the soils, as explanatory variables. All multivariate analyses on soil communities were conducted in R version 3.0.3 (R Core Team 2014), using the vegan package (Oksanen et al., 2017).

Supplementary Results:

*Growth of individual plants and leaf consumption of individual plants across six communities:*

In community I, functional group effects on plant biomass were found for three out of the four plant species. *Holcus lanatus* tended to grow larger on forb-conditioned soils, compared to grass-conditioned soils (F1,37 = 4.44; p=0.04, see Fig S2). Similarly, *Plantago lanceolata* grew larger on forb-conditioned soils than on grass-conditioned soils (F1,37= 6.63; p=0.01, see Fig S2). Contrastingly, *Taraxacum officinale* grew larger on grass-conditioned soils than on forb-conditioned soils and was significantly affected by soil conditioning species as well (FG: F1,37 = 15,81; p<0.01 S: F7,31 = 6.90; p=0.01, see Fig S2). Leaf consumption of *P. lanceolata* was significantly affected by identity and functional group of the species that conditioned the soil (FG: F1,37 = 19.25; p<0.01, S: F7,31 = 2.77; p=0.02, see Fig S3). *T. officinale* consumption was affected by functional group of the soil-conditioning species. Caterpillars fed more on *Taraxacum* growing on grass-conditioned than on forb-conditioned soils (F1,37 = 6.90; p=0.01, see Fig S3).

In community II, *Anthoxanthum odoratum* grew significantly larger on soil conditioned by forbs than on grass-conditioned soils (F1,35= 6.74; p=0.01, see Fig S2). By contrast, *Taraxacum officinale* grew larger on grass-conditioned soils than on forb-conditioned soils and was significantly affected by soil conditioning species as well (FG: F1,38 = 22.63; p<0.01 S: F7,32 = 4.65; p<0.01, see Fig S2). *Crepis capillaris* was significantly affected by soil conditioning species (F7,32= 2.8; p=0.02, see Fig S2).

In community III, *Crepis capillaris* produced more biomass on grass soils (F1,35 = 6,28; p<0.01, see Fig S2).

In community IV, *Briza media* grew larger on forb-conditioned soils than on grass-conditioned soils (F1,29 = 5,43; p=0.03, see Fig S2). *Gnaphalium sylvaticum* growth was significantly affected by identity of the soil conditioning species (F7,23 = 2.55; p=0.04, see Fig S2).

In community V, only *Myosotis arvensis* biomass was affected by identity and functional group of the species that conditioned the soil; they grew larger on grass-conditioned soils than on forb-conditioned soils (FG: F1,32 =6.68; p=0.01, S: F7,26 = 4.2; p=0.00, see Fig S2). Consumption on *G. sylvaticum* leaves was significantly higher on *Gnaphalium* that grew on grass soils than on forb soils (F1,32 = 5.93; p=0.02, see Fig S3).

In community VI, *Festuca ovina* biomass was significantly affected by identity and functional group of the species that conditioned the soil; *Festuca* grew larger on soil conditioned by forbs (FG: F1,36=6.83; p=0.01, S: F7,30 =2.68; p=0.03, see Fig S2). *Myosotis arvensis* was significantly affected by identity of the species that conditioned the soil (S: F7,30 =2.99; p=0.02, see Fig S2).

The majority of the consumption (depending on the communities) was on *Plantago, Geranium* and *Myosotis*, but it should be noted that grasses were not left untouched. Interestingly, consumption was not observed on *Crepis*,a forb. In all cages, the caterpillar fed on more than one host plant, and in the majority of the cages, caterpillars fed on all four plant species in the community. Because of the difference in species composition, the six communities differed in quality as a food source, leading to differences in caterpillar growth, as can be seen especially in community II. The low (but consistent on all soils) biomass of the caterpillars, as well as the low consumption of each individual plant species on *Crepis, Taraxacum, Alopecurus* and *Anthoxanthum* suggests that these species are not optimal food plants for herbivore growth (Fig 4B and Fig S3, community II).

*Beta-diversity soil fungi and bacteria:*

Beta diversity was significantly affected by soil conditioning plant species, as well as functional group for both the soil fungi (Soil: R=0.49; p<0.001; Functional group: R=0.19; p<0.001, see Supplementary Figure S4A) and soil bacteria (Soil: R=0.36; p<0.001; Functional group: R=0.19; p<0.05, see Supplementary Figure S4B). However, beta diversity was not affected in either group by the root size of plant species (Fungi: R= 0.009; p=0.23; Bacteria: R=0.008; p=0.26).

**Supplementary figure legends**

Supplementary Figure S1: Effects of soil conditioning of species of grasses and forbs on individual shoot biomass of all plant species (four total) per community (six communities). White bars represent large-rooted forbs, hatched white bars represent small-rooted forbs; grey bars represent large-rooted grasses, hatched grey bars represent small-rooted grasses. Error bars represent standard errors. Ac= *Agrostis capillaris*, Ao= *Anthoxanthum odoratum*, Ap= *Alopecurus pratensis*, Bm= *Briza media*, Cc= *Crepis capillaris*, Fo= *Festuca ovina*, Gm= *Geranium molle*, Gs= *Gnaphalium sylvaticum*, Hl= *Holcus lanatus*, Ma= *Myosotis arvensis*, Pl= *Plantago lanceolata*, To= *Taraxacum officinale*. Statistics in the panels represent main effects of soil identity (S) and soil functional group (FG) derived from one-way ANOVAs. Asterisks represent significance: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

Supplementary Figure S2: Effects of soil conditioning of species of grasses and forbs on areas consumed by herbivores on all individual plant species (four total) per community (six communities). White bars represent large-rooted forbs, hatched white bars represent small-rooted forbs; grey bars represent large-rooted grasses, hatched grey bars represent small-rooted grasses. Error bars represent standard errors. Ac= *Agrostis capillaris*, Ao= *Anthoxanthum odoratum*, Ap= *Alopecurus pratensis*, Bm= *Briza media*, Cc= *Crepis capillaris*, Fo= *Festuca ovina*, Gm= *Geranium molle*, Gs= *Gnaphalium sylvaticum*, Hl= *Holcus lanatus*, Ma= *Myosotis arvensis*, Pl= *Plantago lanceolata*, To= *Taraxacum officinale*. Statistics in the panels represent main effects of soil identity (S) and soil functional group (FG) derived from one-way ANOVAs. Asterisks represent significance: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

Supplementary Figure S3: Effects of soil conditioning of species of grasses and forbs on community root biomass. White bars represent large-rooted forbs, striated white bars represent small-rooted forbs; grey bars represent large-rooted grasses, striated grey bars represent small-rooted grasses. Error bars represent standard errors. Community composition for each community is as follows; Community I: Ap, Hl, Pl, To; Community II: Ap, Ao, Cc, To; Community III: Ao, Hl, Pl, Cc; Community IV: Gm, Gs, Bm, Fo; Community V: Gs, Ma, Ac, Bm; Community VI: Gm, Ma, Ac, Fo. Community composition is also represented by differently colored grass or forb symbols above each panel. Ac= *Agrostis capillaris*, Ao= *Anthoxanthum odoratum*, Ap= *Alopecurus pratensis*, Bm= *Briza media*, Cc= *Crepis capillaris*, Fo= *Festuca ovina*, Gm= *Geranium molle*, Gs= *Gnaphalium sylvaticum*, Hl= *Holcus lanatus*, Ma= *Myosotis arvensis*, Pl= *Plantago lanceolata*, To= *Taraxacum officinale*. Statistics in the panels represent main effects of soil identity (S), root size (R) and soil functional group (FG) derived from one-way ANOVAs. Asterisks represent significance: \* = p<0,05; \*\*= p<0,01; \*\*\*= p<0,001.

Supplementary Figure S4: Effects of soil conditioning on beta diversity of A) soil fungi and B) soil bacteria. Plots shown are the first two axes of PCoA analyses performed on sequence data for ITS (fungi) and 16S (bacteria) markers. Dots represent means of the replicates for each soil (n=5 for each soil, error bars represent standard errors for the means). Black dots represent grasses, white dots represent forbs. Species names are abbreviated as follows; Ac= *Agrostis capillaris*, Ao= *Anthoxanthum odoratum*, Ap= *Alopecurus pratensis*, Bm= *Briza media*, Cc= *Crepis capillaris*, Fo= *Festuca ovina*, Gm= *Geranium molle*, Gs= *Gnaphalium sylvaticum*, Hl= *Holcus lanatus*, Ma= *Myosotis arvensis*, Pl= *Plantago lanceolata*, To= *Taraxacum officinale*. Statistics in the panels represent main effects of soil identity (S) and soil functional group (FG) derived from permutational multivariate ANOVAs. Asterisks represent significance: \* p < 0.05; \*\* p < 0.01; \*\*\* p < 0.001.

**Supplementary Figures**

Supplementary Figure S1



Supplementary Figure S2



Supplementary Figure S3



Supplementary Figure S4



Supplementary TableS1: Soil characteristics of live and sterilized field soil. Means are shown with standard errors. For live soils n=8, for sterilized soils n=2.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Live field soil | | Sterile field soil | |  |  |
|  | mean | se | mean | se | Method | Standard |
| pH | 4.85 | 0.06 | 5.05 | 0.15 | pH in 1:10 v:v KCl2; 1:10 v:v Ca2Cl2; 1:10 v:v H2O, potentiometry | (NEN-ISO 10390) |
| Organic matter (%) | 3.29 | 0.14 | 3.00 | 0.00 | Loss on ignition at 550 °C, C measured at 600 °C IR-spectrophotometry | (ISO 10694) |
| C/N ratio | 15.00 | 0.46 | 16.00 | 0.00 | Derived value |  |
| N-total mg N/kg | 1226.00 | 173.00 | 1085.00 | 25.00 | N after burning with thermal resistance | (ISO 13878) |
| P-total mg P2O5/100g | 69.00 | 7.67 | 75.00 | 1.00 | P soluble in Ammonium lactate-acetic acid, DA spectrophotometry | (NEN 5793); (NEN-ISO 15923-1) |
| K-total mmol+/kg | 1.48 | 0.05 | 1.80 | 0.10 | K exchange with 0.0166M Cobalthexamine trichloride solution (Cohex) | ICP AES (ISO 23470) |
| S-total mg S/kg | 195.00 | 8.66 | 180.00 | 10.00 | Total S after sample preparation | (NEN 15587-2); ICP AES (NEN 6966) |  |
| N-available kg N/ha | 112.13 | 1.72 | 108.00 | 1.00 | Derived value |  |
| P-available mg P/kg | 4.33 | 0.49 | 5.70 | 0.70 | P soluble in 0.01M Ca2Cl2 1:10 m/V DA spectrophotometry | (NEN 5704); (NEN-ISO 15923-1 |
| K-available mg K/kg | 49.86 | 12.88 | 35.00 | 1.00 | K soluble in 0.01M Ca2Cl2 1:10 m/V DA spectrophotometry | NEN 5704; ICP-AES (NEN 6966) |
| S-available kg S/ha | 6.13 | 0.30 | 6.00 | 1.00 | Derived value |  |

Supplementary Table S2: The twelve plant species that were used in this study with functional group and root size. R- represents small rooted species and R+ represents large rooted species. F represents forbs, G grasses. Root biomass, shoot biomass and Root:Shoot Ratios were measured at six weeks and the presented data are mean values (with standard errors between brackets; n=3 for all species).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Symbol** | **Plant species** | **Root size** | **Functional group** | **Root biomass (g)** | **Shoot biomass (g)** | **Root:Shoot Ratio (g)** |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Briza media* | R- | G | 0.19 (0.05) | 0.35 (0.02) | 0.54 (0.11) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Festuca ovina* | R- | G | 0.67 (0.07) | 0.83 (0.03) | 0.81 (0.06) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Agrostis capillaris* | R- | G | 0.69 (0.07) | 0.89 (0.16) | 0.80 (0.07) |
|  |  |  |  |  |  |  |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Alopecurus pratensis* | R+ | G | 1.00 (0.15) | 1.36 (0.1) | 0.76 (0.18) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Anthoxanthum odoratum* | R+ | G | 1.40 (0.18) | 1.48 (0.12) | 0.95 (0.12) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PG82ZPC7\bush-151473_960_720[1].png* | *Holcus lanatus* | R+ | G | 1.82 (0.35) | 1.24 (0.11) | 1.46 (0.22) |
|  |  |  |  |  |  |  |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Gnaphalium sylvaticum* | R- | F | 0.41 (0.03) | 0.87 (0.01) | 0.47 (0.04) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Myosotis arvensis* | R- | F | 0.91 (0.02) | 1.10 (0.06) | 0.83 (0.02) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Geranium molle* | R- | F | 1.00 (0.09) | 1.65 (0.19) | 0.61 (0.02) |
|  |  |  |  |  |  |  |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Plantago lanceolata* | R+ | F | 1.67 (0.13) | 1.82 (0.14) | 0.92 (0.05) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Crepis capillaris* | R+ | F | 1.99 (0.13) | 1.08 (0.06) | 1.84 (0.16) |
| *D:\Users\robinh\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.IE5\PMLGIFBH\growing-plant-md[1].png* | *Taraxacum officinale* | R+ | F | 2.12 (0.05) | 0.78 (0.02) | 2.72 (0.05) |

Supplementary Table S3: Overview of a) the selected small-rooted and large-rooted grasses and forb that occur in each individual community, b) the fractional factorial combinations of communities and conditioned soils.

P:\PhD NIOO\PhD Robin\Exp 1 Community Insect Experiment Robin Oktober15February2016\Manuscript_Comments\Supplementary Table S1 Community composition and experimental combinations.tif

Supplementary Table S4: Output of one-way ANOVAs performed on raw data of each individual plant species within every community, with conditioning species (S) as factor. Statistically significant differences (p < 0.05) are presented in **bold** and values in *italics* indicate trends (0.05 < p < 0.10)*.*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Plant | | Herbivore | | | |
|  |  | Shoot biomass | | Consumed area | | Aphid number | |
| Factors | d.f. | F | p | F | P | F | P |
| **Com I** |  |  |  |  |  |  |  |
| *Alopecurus* |  |  |  |  |  |  |  |
| S | 7, 31 | 0.73 | 0.65 | 0.68 | 0.69 | 1.10 | 0.39 |
| FG | 1, 37 | *2.91* | *0.10* | 0.00 | 0.95 | 1.58 | 0.22 |
| *Holcus* |  |  |  |  |  |  |  |
| S | 7, 31 | 1.87 | 0.11 | 0.94 | 0.49 | 1.26 | 0.30 |
| FG | 1, 37 | **4.44** | **0.04** | 0.14 | 0.71 | 0.44 | 0.51 |
| *Plantago* |  |  |  |  |  |  |  |
| S | 7, 31 | *1.99* | *0.09* | **2.77** | **0.02** |  |  |
| FG | 1, 37 | **6.63** | **0.01** | **19.25** | **0.00** |  |  |
| *Taraxacum* |  |  |  |  |  |  |  |
| S | 7, 31 | **3.52** | **0.01** | 1.28 | 0.29 |  |  |
| FG | 1, 37 | **15.81** | **0.00** | **6.90** | **0.01** |  |  |
| **Com II** |  |  |  |  |  |  |  |
| *Anthoxanthum* |  |  |  |  |  |  |  |
| S | 7, 32 | *1.90* | *0.10* | 0.62 | 0.74 | 0.22 | 0.98 |
| FG | 1, 38 | **6.74** | **0.01** | 0.37 | 0.55 | 0.89 | 0.35 |
| *Alopecurus* |  |  |  |  |  |  |  |
| S | 7, 32 | 0.74 | 0.64 | 0.66 | 0.70 | 1.19 | 0.33 |
| FG | 1, 38 | 1.49 | 0.23 | 1.87 | 0.18 | 1.27 | 0.27 |
| *Crepis* |  |  |  |  |  |  |  |
| S | 7, 32 | **2.76** | **0.02** | 0.87 | 0.54 |  |  |
| FG | 1, 38 | 2.13 | 0.15 | 0.06 | 0.81 |  |  |
| *Taraxacum* |  |  |  |  |  |  |  |
| S | 7, 32 | **4.65** | **0.00** | 1.42 | 0.23 |  |  |
| FG | 1, 38 | **22.63** | **0.00** | *3.21* | *0.08* |  |  |
| **Com III** |  |  |  |  |  |  |  |
| *Anthoxanthum* |  |  |  |  |  |  |  |
| S | 7, 29 | 0.91 | 0.51 | 0.58 | 0.77 | 1.23 | 0.32 |
| FG | 1, 35 | 0.00 | 0.99 | 1.41 | 0.24 | 1.58 | 0.22 |
| *Holcus* |  |  |  |  |  |  |  |
| S | 7, 29 | 0.91 | 0.52 | 1.21 | 0.33 | 1.15 | 0.36 |
| FG | 1, 35 | **6.28** | **0.02** | *3.09* | *0.09* | 2.37 | 0.13 |
| *Crepis* |  |  |  |  |  |  |  |
| S | 7, 29 | 1.77 | 0.13 | 0.70 | 0.67 |  |  |
| FG | 1, 35 | 1.59 | 0.22 | 0.64 | 0.43 |  |  |
| *Plantago* |  |  |  |  |  |  |  |
| S | 7, 29 | 1.27 | 0.30 | 1.59 | 0.18 |  |  |
| FG | 1, 35 | 0.06 | 0.80 | 0.12 | 0.74 |  |  |
| **Com IV** |  |  |  |  |  |  |  |
| *Briza* |  |  |  |  |  |  |  |
| S | 7, 23 | 1.21 | 0.34 | 0.70 | 0.67 | 0.53 | 0.80 |
| FG | 1, 29 | **5.43** | **0.03** | 0.38 | 0.54 | 0.26 | 0.61 |
| *Festuca* |  |  |  |  |  |  |  |
| S | 7, 23 | 0.81 | 0.59 | 0.62 | 0.74 | 1.46 | 0.23 |
| FG | 1, 29 | 0.11 | 0.75 | 0.20 | 0.66 | 1.41 | 0.25 |
| *Geranium* |  |  |  |  |  |  |  |
| S | 7, 23 | 1.02 | 0.44 | *2.09* | *0.09* |  |  |
| FG | 1, 29 | 1.26 | 0.27 | 0.83 | 0.37 |  |  |
| *Gnaphalium* |  |  |  |  |  |  |  |
| S | 7, 23 | **2.55** | **0.04** | *2.14* | *0.08* |  |  |
| FG | 1, 29 | 0.05 | 0.82 | 0.92 | 0.35 |  |  |
| **Com V** |  |  |  |  |  |  |  |
| *Agrostis* |  |  |  |  |  |  |  |
| S | 7, 26 | *1.99* | *0.10* | 0.73 | 0.65 | 0.47 | 0.85 |
| FG | 1, 32 | *3.28* | *0.08* | 2.14 | 0.15 | 0.07 | 0.79 |
| *Briza* |  |  |  |  |  |  |  |
| S | 7, 26 | 1.73 | 0.15 | 0.18 | 0.99 | 0.52 | 0.81 |
| FG | 1, 32 | 1.31 | 0.26 | 0.10 | 0.76 | 0.42 | 0.52 |
| *Gnaphalium* |  |  |  |  |  |  |  |
| S | 7, 26 | 0.82 | 0.58 | 0.91 | 0.51 |  |  |
| FG | 1, 32 | *3.24* | *0.08* | **5.93** | **0.02** |  |  |
| *Myosotis* |  |  |  |  |  |  |  |
| S | 7, 26 | **4.15** | **0.00** | 0.97 | 0.48 |  |  |
| FG | 1, 32 | **6.68** | **0.01** | 0.01 | 0.91 |  |  |
| **Com VI** |  |  |  |  |  |  |  |
| *Agrostis* |  |  |  |  |  |  |  |
| *S* | 7, 30 | 1.70 | 0.15 | 1.81 | 0.12 | 1.27 | 0.30 |
| FG | 1, 36 | 0.01 | 0.95 | 1.22 | 0.28 | 1.80 | 0.19 |
| *Festuca* |  |  |  |  |  |  |  |
| S | 7, 30 | **2.68** | **0.03** | 1.43 | 0.23 | 1.89 | 0.11 |
| FG | 1, 36 | **6.83** | **0.01** | 0.12 | 0.73 | 1.37 | 0.25 |
| *Geranium* |  |  |  |  |  |  |  |
| S | 7, 30 | 1.79 | 0.12 | 0.65 | 0.71 |  |  |
| FG | 1, 36 | 0.05 | 0.83 | 0.01 | 0.91 |  |  |
| *Myosotis* |  |  |  |  |  |  |  |
| S | 7, 30 | **2.99** | **0.02** | 1.13 | 0.37 |  |  |
| FG | 1, 36 | 2.81 | 0.10 | 0.49 | 0.49 |  |  |

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