

# Fine-Root Ecology Database (*FRED*): A Global Collection of Root Trait Data with Coincident Site, Vegetation, Edaphic, and Climactic Data, Version 2



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## Summary:

To address the need for a centralized root trait database, we compiled the Fine-Root Ecology Database (FRED) from published and unpublished data sources. We have continued to add to the FRED database since the release of FRED 1.0, and a new version of FRED is now available. FRED 2.0 houses 50% more data, with more than 105,000 observations of root traits; ancillary data on associated site, vegetation, edaphic, and climatic conditions from across the globe have also increased concurrently.

FRED is focused on fine roots (roots less than 2 mm in diameter), as coarse roots are studied using different methodology, often at very different scales, and have different traits and trait interpretations. However, FRED accepts data collected from roots of all sizes, and already contains several observations of coarse roots. Data collection will continue for the foreseeable future.

## Related Publications:

More details about FRED and the motivation for undertaking this monumental data compilation can be found in:

Iversen CM, McCormack ML, Powell AS, Blackwood CB, Freschet GT, Kattge J, Roumet C, Stover DB, Soudzilovskaia NA, Valverde-Barrantes OJ, van Bodegom PM, Violle C. 2017. Viewpoints: A global Fine-Root Ecology Database to address belowground challenges in plant ecology. *New Phytologist* 215: 15-26. <https://doi.org/10.1111/nph.14486>

McCormack ML, Powell AS, Iversen CM. 2018. Letter: The Fine-Root Ecology Database version 2 - bigger, better, and free. *Eos, in press*.

## Data Products:

The FRED 2.0 release consists of a data file and three companion files:

**FRED2\_20180518.csv:** One comma-separated (.csv) file (~69 MB) with compiled root trait data and ancillary data from published or contributed data sources.

**FRED2\_Data sources\_20180518.pdf:** One (.pdf) file with a list of the more than 1200 data sources cited in FRED 2.0.

**FRED2\_User Guidance Document\_20180518.pdf:** One (.pdf) file with guidelines and supplementary information regarding the content and usage of FRED 2.0. Current document.

**FRED2\_Map\_20180518.png** One (.png) file with the 2285 distinct locations of the observations housed in FRED 2.0.

## Data and Documentation Access:

FRED 2.0 is freely available to the public with unrestricted access. The data and companion files are available for download at <http://roots.ornl.gov/public-release>. For inquiries and suggestions, contact Colleen Iversen at [iversencm@ornl.gov](mailto:iversencm@ornl.gov) or contact the FRED team through the contact form at <http://roots.ornl.gov/contact>. As faulty data are discovered and corrected, the necessary corrections are added to a list at <http://roots.ornl.gov/updates>.

## Data Citation:

### Cite this data set as follows:

Iversen CM, Powell AS, McCormack ML, Blackwood CB, Freschet GT, Kattge J, Roumet C, Stover DB, Soudzilovskaia NA, Valverde-Barrantes OJ, van Bodegom PM, Violle C. 2018. **Fine-Root Ecology Database (FRED): A Global Collection of Root Trait Data with Coincident Site, Vegetation, Edaphic, and Climatic Data, Version 2.** Oak Ridge National Laboratory, TES SFA, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A. Access online at: <https://doi.org/10.25581/ornlsfa.012/1417481>

Please also see **Data Use and Referencing FRED** in Section 2.

## Version History:

The current version of FRED, FRED 2.0, supersedes FRED 1.0.

FRED 1.0 was available at <http://roots.ornl.gov>, from February 28, 2017 until June 8, 2018.

The first version, *FRED* 0.0 (Version 0), has been integrated into the TRY Plant Trait Database, and was released with TRY 4.0 ([www.try-db.org](http://www.try-db.org)).

Note that FRED 0.0 is only available from the authors of FRED upon request through the contact form at <http://roots.ornl.gov/contact>, while FRED 1.0 is available at <http://roots.ornl.gov/previous-release>.

<b>FRED Version</b>	<b>Availability</b>	<b>Current Download Location</b>
FRED 2.0	June 8, 2018 – present	<a href="http://roots.ornl.gov/public-release">http://roots.ornl.gov/public-release</a>
FRED 1.0	February 28, 2017 – June 8, 2018	<a href="http://roots.ornl.gov/previous-release">http://roots.ornl.gov/previous-release</a>
FRED 0.0	July 20, 2107 – present	<a href="http://www.try-db.org">www.try-db.org</a> and <a href="http://roots.ornl.gov/contact">http://roots.ornl.gov/contact</a>

## FRED Sponsor:

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### 1. Data Acquisition:

Version 2 of FRED contains more than 105,000 observations of some 300 different types of root traits as well as associated ancillary data pertaining to site, vegetation, edaphic, and climactic conditions, from over 1200 data sources. FRED is focused on fine roots (roots less than 2 mm in diameter), as coarse roots are studied using different methodology, often at very different scales, and have different traits and trait interpretations. However, FRED accepts data collected from roots of all sizes, and already contains several observations of coarse roots.

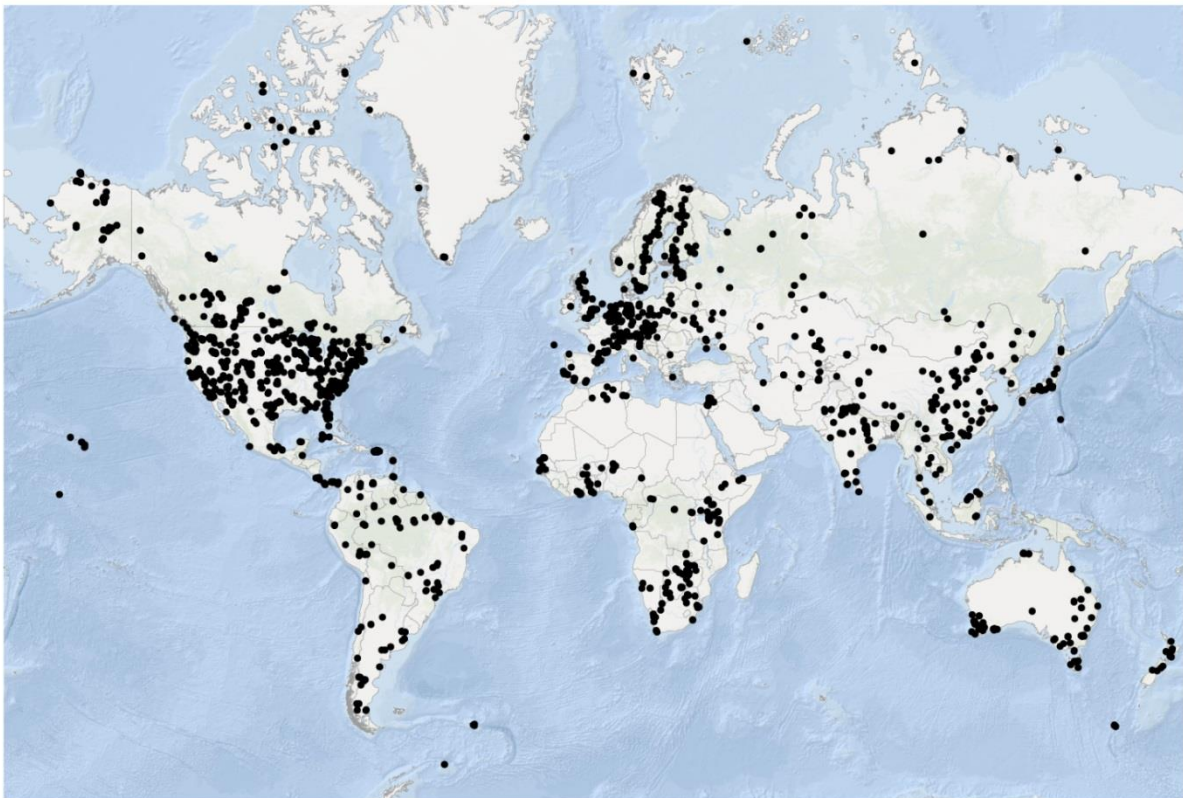
#### Trait and Site Data

Data were acquired from the publicly-available data sources presented in the companion file, **FRED2\_Data sources\_20180518.pdf**. While we used explicitly-presented numbers whenever possible, many data were only available in graphic form. We extracted data from graphs using Grab It! Graph Digitizer, an application from Datatrend Software ([www.datatrendsoftware.com](http://www.datatrendsoftware.com)).

All data were quality-checked prior to the publication of FRED 2.0: For text-based variables, we examined all cells to ensure that their content relates to their specific categories. We ordered each numerical value from least to greatest and plotted the values, checking apparent outliers against the data in their respective sources, and correcting or removing incorrect or impossible values. For statistical metrics (e.g. sample size, standard error, standard deviation), we checked to ensure that each accompanies a main value.

## Derived Locations

Only ~61% of the observations in FRED 2.0 were reported with geo-referenced locations. To facilitate spatial analyses and visualization, we derived two additional location variables for the FRED 2.0 database. ‘Latitude\_Main’ and ‘Longitude\_Main’ (column IDs F01185 and F01186, respectively) were derived to best describe the data collection location. Coordinate values were set, in order of priority, as (1) the single latitude/longitude point location reported in the original data source, (2) the average of the minimum and maximum latitudes/longitudes reported in the original data source, or (3) an estimated latitude/longitude based on the description of the sampling location reported in the original data source and using Google Earth to obtain an approximate location. This process increased the number of geo-referenced locations to 99% of the observations.



**Fig. 1** Map of the locations of root trait observations (‘Latitude\_Main’ and ‘Longitude\_Main’) included in FRED 2.0. FRED 2.0 houses data from 2285 distinct locations, more than double that of FRED 1.0.

## 2. Data Use Guidelines:

### FRED Data Use and Intellectual Property Rights – Guiding Principles

We actively encourage the broader scientific community to contribute published and unpublished data to FRED.

**Here's the bottom line:** When you submit published datasets or unpublished data sources, all persons who contributed to the development of the data set (data contributors) agree that the data will be publicly available through the FRED website (<http://roots.ornl.gov>). Furthermore, all data contributors agree that there is no requirement on either the part of FRED or the persons downloading FRED for analysis (data users) that the data contributors be contacted regarding use of their data.

Data users are expected to follow professional scientific norms of citing and referencing inputs to their research. This does not preclude data users from contacting data contributors for purposes of collaboration.

### Inclusion of Data into FRED

#### *Data sources included in Version 2:*

Data that have been gleaned from peer-reviewed open literature are assumed to be in the public domain and have been included in FRED without contacting the authors for permission. Authors may have been contacted if there was a question about their data. Similarly, data sets that are the result of previous data compilation activities and have been made available to the public through a data archive (e.g., ORNL DAAC) have also been included in FRED without contacting the compilers or the original data contributors for permission. In both cases the data contributor and the complete reference of each data source have been included for all respective observations.

#### *Published data sources in future Versions:*

As above, published data and data sets may be added to the database by FRED data managers as they become publicly available. To facilitate more efficient incorporation and full accuracy of data presentation, researchers are encouraged to become data contributors (<http://roots.ornl.gov/contributors>). Data contributors are encouraged to submit their published data to FRED (<http://roots.ornl.gov/upload>). Upon submission of published data, all data contributors agree that the data will be publicly available through the *FRED* website (<http://roots.ornl.gov/public-release>) with no requirement that the data contributors be contacted upon the download or use of their data.

#### *Unpublished data sources in future Versions:*

We are only soliciting unpublished data that the contributors are willing to make freely available to the broader community with unrestricted access. These data may include, for example, more detail on published data (e.g., data from individual replicates rather than the published plot mean), or data that have never been included in a publication (or are not freely available through the published work). Upon submission of unpublished data, all data contributors agree that the data will be publicly available through the FRED website (<http://roots.ornl.gov/public-release>) with no requirement that the data contributors be contacted upon the download or use of their data. Researchers who contribute unpublished data will become data contributors

(<http://roots.ornl.gov/contributors>) and will also be listed as authors on the DOI for the release of the version of FRED that contains their data (e.g., Iversen *et al.*, 2018 for FRED 2.0; see below).

We provide a searchable list of published and unpublished data sources that have been incorporated into FRED thus far at <http://roots.ornl.gov/data-sources>.

### **Data Use and Referencing FRED**

Users are requested to:

***Reference the FRED 2.0 database with the following data citation and DOI in any resulting publications or data synthesis products:***

Iversen CM, Powell AS, McCormack ML, Blackwood CB, Freschet GT, Kattge J, Roumet C, Stover DB, Soudzilovskaia NA, Valverde-Barrantes OJ, van Bodegom PM, Violle C. 2018.

**Fine-Root Ecology Database (FRED): A Global Collection of Root Trait Data with Coincident Site, Vegetation, Edaphic, and Climatic Data, Version 2.** Oak Ridge National Laboratory, TES SFA, U.S. Department of Energy, Oak Ridge, Tennessee, U.S.A. Access online at: <https://doi.org/10.25581/ornlsfa.012/1417481>.

***Ensure traceability of FRED data and reproducibility of your analyses.***

Where possible and feasible, cite the original papers or data sources used in your analysis as they are listed in FRED 2.0 (this could be a separate table or list in your publication). Describe the criteria that you used to subset the FRED 2.0 data (e.g., different root categories, spatial or temporal limits, species, trait types, etc.) so that another user could repeat the process.

***Send a citation or copy of your publication to FRED.***

We would like to know that FRED 2.0 data are being used (and so would our sponsor at the U.S. Department of Energy), and other potential users may like to see how FRED 2.0 data have been applied.

***Provide feedback to FRED.***

Are there any mistakes in the data or units? How can we improve the website, data search capabilities, etc.? Are there additional root trait data that should be added to *FRED*?

### **Collaboration**

Data users are encouraged to use the name and contact information of the data contributors included for each data source if they would like to pursue collaboration.

### **3. Privacy Statement:**

FRED respects the privacy of all of our users and we take seriously our responsibility to protect all personal information that we collect. To that end, we collect only what we need to ensure good customer service, to support systems operation, and to facilitate summary reporting of data downloads and general user characteristics and data usage. Ultimately, we want satisfied users, because today's users are tomorrow's data contributors to FRED.

#### **When you request to download data from FRED, you are asked to:**

- Confirm that you have read and agree to the Data Use Guidelines;
- Provide your Name and a valid Email Address;
- Provide basic location information – your Institution or Affiliation, City, and Country; and
- Describe your Data Usage Plan and a Primary Data Use.

**The information you provide will be retained for the duration of the project and possibly longer within mandated archives of our research activities.**

#### **Your Email Address will be stored in our database, and:**

- Your Email Address will only be used to notify you of important updates or problems (if any) with the data products you have downloaded.
- The domain name of your Email Address will be used in aggregate to summarize the number of data products downloaded, what types of users are downloading data, and their general locations. These summary statistics will not identify individual users.
- Individual Email Addresses will be identified in summary reports about FRED data downloads. These reports are only available to data system personnel and will not be made public.

#### **Your Name and Location will be stored in our database, and:**

- Your Name will only be available to data system personnel and will not be made public.
- Your Institution or Affiliation, City, Country and IP address will be used in aggregate to summarize the number of data products downloaded, what types of users are downloading data, and their general locations. These summary statistics will not identify individual users.

#### **Your proposed Data Usage Plan and Primary Data Use information will be stored in our database, and:**

- Your specific Data Usage Plan information will be used to assess the utility of FRED for multiple different types of projects, and to help steer future data collation. The details of your plan are only available to data system personnel and are not made public.
- Primary Data Use information will be used in aggregate to follow how users generally plan to use these data. These summary statistics will not identify individual users.

#### 4. Tips for Using *FRED*:

The trait observations included in *FRED* 2.0 have been collected from many different types of roots. You may want to consider selecting only a subset of these root measurements for your analysis (for example, living roots only, absorptive fine roots only, or first-order roots only).

In addition to important root traits such as diameter (or diameter class) and color, ancillary root sampling metadata can facilitate accurate comparisons of root traits within- and among species by indicating whether roots were:

- Fine roots, coarse roots, belowground stems, rhizomes, a mixture of these organs, or the total root or belowground system [Column ID F00055]
- Within a specific range of root diameters [Column ID F00949 and F00950]
- A given age [Column ID F00061]
- Associated with a specific root functional class (e.g., absorptive or transport fine roots, or a mixture of both) or heterorhizy class (e.g., fibrous or pioneer roots) [Column IDs F00060 and F00066]
- Associated with a specific root order (generally 1-7) [Column ID F00056] or range of root orders [Column IDs F00057 and F00058]
- Ordered according to a centripetal or centrifugal numbering scheme [Column ID F00059]
- Living or dead (or a mixture of both) [Column ID F00064]
- Collected from a given soil depth [Column ID F00985]

In turn, ancillary data associated with plant growing conditions indicate the conditions under which the root traits were measured, for example, whether roots were:

- Collected from plants growing *in situ* (i.e., under field conditions), in pots, or in hydroponic solutions [Column ID F01156] and if plants were specifically grown indoors or outdoors [Column ID F01158]
- Collected from across observational gradients, or from experimental treatments that included nutrient, water, temperature, elevated [CO<sub>2</sub>], burning, disturbance, girdling, or light manipulations and their associated controls [Column ID F01159]

These are only a few of the many ways in which the root trait observations in *FRED* 2.0 can be organized for comparison.



## 5. FRED 2.0 Data File Description:

**FRED2\_20180518.csv** is a comma-separated value (.csv) file of ~69 MB with over 105,000 primary observations of root traits from over 1,200 documented data sources. The (1) Associated statistical metric observations (Table 2) and (2) Ancillary data observations regarding associated site, vegetation, edaphic, and climatic conditions are more numerous. For instance, Ancillary data may repeat for all rows reported at the same geographic location.

### Data File Organization

#### Header Rows:

The **FRED2\_20180518.csv** contains five header rows; which Table 1 describes in the order of their appearance:

**Table 1.** Header rows (i.e., the first 5 rows) are descriptive, and do not have unique row IDs.

Header position	Header name	Example	Description
1 <sup>st</sup>	Column names in FRED 2.0	Root N content	Name of root trait or ancillary data type selected by <i>FRED</i> curators.
2 <sup>nd</sup>	Units	mg/g	Units of data in column.
3 <sup>rd</sup>	Definition	Mass of nitrogen per root mass for sampled roots.	Definition of root trait or ancillary data type, as in the Data Dictionary of this document.
4 <sup>th</sup>	Column ID	F00261  (F00001 to F01414)	Unique identifier for column. If column is moved, renamed, or otherwise changed in future versions, Column ID remains the same.
5 <sup>th</sup>	Name in TRY	Root nitrogen content per dry mass	The name of root trait or ancillary data type in the TRY 4.0 database ( <a href="http://www.try-db.org">www.try-db.org</a> ) if applicable.

#### Data Rows:

Root trait observations, associated statistical metrics, and ancillary data are in rows 6 – 35216, with unique Row IDs (i.e., F00002 [Notes\_Row ID]) ranging from 1 to 35475.

The data rows, as provided, are sorted by [**Notes\_Row ID**].

#### No Data Values:

Fields with “No Data” are represented as blank cells. The data are not really missing; rather no observations were available for that particular trait or ancillary data column in the original data source.

**The Following Generalizations and Abbreviations Have Been Used in FRED 2.0:**

- “Root mass” refers to root dry mass unless otherwise stated (e.g., “root fresh mass”).
- Each trait or ancillary data value is the mean of collected data unless otherwise stated.
- The word “root” in a trait name or description refers to the part specified in the “belowground part” column (Column ID F00055) and therefore may refer to coarse roots, fine roots, or the total root system, but also to belowground stem, rhizome, or other belowground non-root entities.

See Table 2 for Statistical Metrics used in FRED 2.0 and for column identification.

See Table 3 for Abbreviations used for units in FRED 2.0 and in the Data Dictionary.

**Table 2:** Statistical metrics and definitions associated with many traits or ancillary data types.

<b>Statistical term</b>	<b>Definition</b>
<b>n</b>	Sample size: number of observations for specified parameter
<b>SE</b>	Standard error of specified parameter; $SD/(\sqrt{n})$ for specified parameter
<b>SD</b>	Standard deviation of specified parameter
<b>Median</b>	Value below which 50% of observed data for specified parameter falls
<b>Upper quartile</b>	Value below which 75% of observed data for specified parameter falls
<b>Lower quartile</b>	Value below which 25% of observed data for specified parameter falls
<b>95<sup>th</sup> percentile</b>	Value below which 95% of observed data for specified parameter falls
<b>5<sup>th</sup> percentile</b>	Value below which 5% of observed data for specified parameter falls
<b>95 percent confidence margin</b>	Difference between 95th percentile and 5th percentile value
<b>Min</b>	Minimum value observed for specified parameter
<b>Max</b>	Maximum value observed for specified parameter
<b>Modal</b>	Value for specified parameter that occurs most in the data set
<b>Upper bound</b>	If data are presented for pre-defined interval, the upper bound of that interval
<b>Lower bound</b>	If data are presented for a pre-defined interval, the lower bound of that interval

**Use of Associated statistical metric notation for FRED 2.0 Column ID definition:**

For example, the primary root trait column (e.g., Column ID=F00277) is the mean value by definition and the associated statistical metrics (Column IDs F00278 – F00285) define the values in their respective columns. Excerpt from Data Dictionary:

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00277	Root P content	mg/g	n [F00278] SE [F00279] SD [F00280] Min [F00281] Max [F00282] Median [F00283] Upper quartile [F00284] Lower quartile [F00285]	Mass of phosphorous per root mass for sampled roots.

**Table 3:** Abbreviations used for units in FRED 2.0. Note that some items that are commonly presented as superscripts (e.g., cm<sup>2</sup>) or subscripts (e.g., CO<sub>2</sub>) will appear in FRED 2.0 without this special formatting (e.g. cm2 and CO2, respectively). Similarly, the abbreviation “u” is used for micro- instead of the commonly used “μ”. This was done to avoid the use of special text characters in the database which may not be compatible with some software or analyses.

Abbreviation	Stands for
μg	Micrograms
μm	Micrometers
μm	Micrometers
μm <sup>2</sup>	Square micrometers
μmol	Micromoles
μmol	Micromoles
branch	Root branch
-cbar	Negative centibars
cm	Centimeters
cm <sup>2</sup>	Square centimeters
cm <sup>3</sup>	Cubic centimeters
cmolc	Centimoles of charge
d	Days
degrees_C	Degrees Celsius
FW	Fresh weight
g	Grams
g_C	Grams root carbon
h	Hours
ha	Hectares (square hectometers)
kg	Kilograms
km	Kilometers

Abbreviation	Stands for
L	Liters
m	Meters
m <sup>2</sup>	Square meters
m <sup>3</sup>	Cubic meters
mg	Milligrams
Mg	Megagrams (metric tons)
min	Minutes
ml	Milliliters
mm	Millimeters
mm <sup>2</sup>	Square millimeters
mmol	Millimoles
mmolc	Millimoles of charge
mo	Months
MPa	Megapascals
mV	Millivolts
ng	Nanograms
nmol	Nanomoles
per_mil	Thousandths
pmol	Picomoles
s	Seconds
yr	Years

## 6. Data Dictionary

The Data Dictionary (Table 4) contains the identifiers and the descriptions for the 1135 columns in FRED 2.0.

**Column ID** is the unique and unchanging identifier for the root trait, associated statistical metric, ancillary data observation, or descriptive field listed in **Column name**. **Units / Format** and **Description** for the respective column follow.

Note that the complete **Description** is included in the **FRED2\_20180518.csv** file. (Yes, this does make the 3<sup>rd</sup> Header row quite long.)

Similar root trait or ancillary data types may have the same prefix (e.g., ‘Notes\_’, ‘Data\_’, ‘Plant taxonomy\_’, etc.). ‘Notes\_’ refer to ancillary data that are often descriptive in nature. All root traits begin with ‘Root’ or have ‘root’ in the name of the trait. The data file could be sorted by the Column ID to group by prefix and would, in effect, sort the file by trait. The data rows, as provided, are sorted by [**Notes\_Row ID**].

As mentioned above, the **Associated statistical metrics** define the value represented by the primary **Column ID**.

A note about some data values: we used Grab It!, a point-and-click application, to extract data from graphs and charts. Data derived from Grab It! are presented with up to 14 decimal places. However, this does not necessarily correspond to the number of significant figures in the source data; the additional decimal places should be treated with caution. Likewise, some data have been converted from their reported units or format and thereby contain extra decimal places. Such instances are noted in the column, “Notes\_Miscellaneous notes” [F00079].

**Table 4.** Data Dictionary

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00001	Version_FRED version number			<i>FRED</i> version number in which data in row first appeared. Version 0 is not acknowledged in version 1 and subsequent versions.
F00002	Notes_Row ID			Number to designate specific row.
F00003	Abbreviated article citation			Abbreviated citation of contributing data source, e.g. “Doe et al 2015”
F00004	Data source_Citation			Long-form citation of contributing data source.
F00005	Data source_DOI			DOI (digital object identifier) of contributing data source.
F00006	Data set_Citation			If the data are from a previously compiled dataset other than <i>FRED</i> , long-form citation of contributing dataset.
F00007	Data set_DOI			If the data are from a dataset other than <i>FRED</i> , DOI (digital object identifier) of contributing dataset.
F00008	Notes_Site ID			Identifier used in data source to distinguish between multiple data collection sites.
F00009	Data_Raw or unpublished	“main article”, “supplement”, “contributed”, or blank		Denotes data in row are raw data (including individual replicates corresponding with previously published means) or unpublished. “Main article” means raw data are from the primary published work, “supplement” means data are from a published supplemental document to the article, and “contributed” means the author directly contributed the data to <i>FRED</i> .
F00010	Data_Duplicate data	“x” or blank		“x” denotes that <i>FRED</i> includes both unpublished (or with additional individual replicates corresponding with previously published means) and published versions of data.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00017	Plant taxonomy_Family			Family of plant, according to data source.
F00018	Plant taxonomy_Genus			Genus of plant, according to data source.
F00019	Plant taxonomy_Species			Species epithet of plant, according to data source.
F00020	Plant taxonomy_Subspecies			Variety, cultivar, or subspecies of plant, according to data source.
F01286	Accepted genus_TPL			Genus of plant according to The Plant List: <i>The Plant List</i> (2013). Version 1.1. Published on the Internet; <a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
F01287	Accepted species_TPL			Species epithet of plant according to The Plant List: <i>The Plant List</i> (2013). Version 1.1. Published on the Internet; <a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
F01344	Accepted subspecies_TPL			Variety or subspecies of plant according to The Plant List: <i>The Plant List</i> (2013). Version 1.1. Published on the Internet; <a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
F01413	Species name unresolved			"Unresolved" means species name is listed as unresolved in The Plant List. "Absent" means species name is not listed in the Plant List at all.
F01289	Plant taxonomy_Family_TPL			Family of plant according to The Plant List: <i>The Plant List</i> (2013). Version 1.1. Published on the internet; <a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
F01290	Plant taxonomy_Order_APW			Order of plant. For Angiosperms, this was determined using <a href="http://www.mobot.org/MOBOT/research/APweb/">the Angiosperm Phylogeny Website (APW)</a> : Stevens, P. F. (2001 onwards). Angiosperm Phylogeny Website. Version 14, July 2017 [and more or less continuously updated since]. Online at <a href="http://www.mobot.org/MOBOT/research/APweb/">http://www.mobot.org/MOBOT/research/APweb/</a> . For other plant groups (Gymnosperms, Pteridophytes, and

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
				Bryophytes) this was determined first using APW, but in cases where there were discrepancies within APW, and to maintain consistency in suffix nomenclature (i.e. all orders ending in “iales”), additional sources were used including the USDA Plants Database ( <a href="https://plants.usda.gov/">https://plants.usda.gov/</a> ) and the Missouri Botanical Garden ( <a href="http://www.missouribotanicalgarden.org/plant-science/plant-science/research/plant-identification.aspx">http://www.missouribotanicalgarden.org/plant-science/plant-science/research/plant-identification.aspx</a> )
<b>F01291</b>	Plant taxonomy_Group_TPL			Group of plant according to The Plant List: <i>The Plant List</i> (2013). Version 1.1. Published on the internet; <a href="http://www.theplantlist.org/">http://www.theplantlist.org/</a>
<b>F00027</b>	Notes_Mixed community	“x” or blank		“x” in this column denotes the data in the row are community-level (i.e., if root samples were taken from a mixed community of species). Blank indicates the data are attributable to a single species.
<b>F00042</b>	Growth form_Leaf habit	“deciduous”, “deciduous / evergreen”, “evergreen”		Whether plant is deciduous or evergreen. Data are from the categorical traits data package from the TRY database: Kattge, J., Bönsch, G., Günther, A., Wright, I., Zanne, A., Wirth, C., Reich, P.B. and the TRY Consortium (2012) TRY - Categorical Traits Dataset. Data from: TRY - a global database of plant traits. TRY File Archive <a href="https://www.try-db.org/TryWeb/Data.php#3">https://www.try-db.org/TryWeb/Data.php#3</a>
<b>F00041</b>	Growth form_Leaf type	“broadleaved”, “needleleaved”, “scale-shaped”, “microphyll”, “scale-shaped / needleleaved”, “without leaves”, “pinnate”		Plant leaf type, according to the categorical traits data package from the TRY database: Kattge, J., Bönsch, G., Günther, A., Wright, I., Zanne, A., Wirth, C., Reich, P.B. and the TRY Consortium (2012) TRY - Categorical Traits Dataset. Data from: TRY - a global database of plant traits. TRY File Archive <a href="https://www.try-db.org/TryWeb/Data.php#3">https://www.try-db.org/TryWeb/Data.php#3</a>



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00043	Plant photosynthetic pathway	“C3”, “C4”, “CAM”		<p>Photosynthesis strategy of plant, according to the categorical traits data package from the TRY database: Kattge, J., Bönišch, G., Günther, A., Wright, I., Zanne, A., Wirth, C., Reich, P.B. and the TRY Consortium (2012) TRY - Categorical Traits Dataset. Data from: TRY - a global database of plant traits. TRY File Archive <a href="https://www.try-db.org/TryWeb/Data.php#3">https://www.try-db.org/TryWeb/Data.php#3</a>. In cases where a species was categorized as having multiple pathways, a single pathway was assigned according to the primary data source, the USDA Plants database (<a href="https://plants.usda.gov/">https://plants.usda.gov/</a>), or following a search of primary literature. In these cases, this is indicated in Notes_Miscellaneous notes [F00079].</p>
F00032	Plant growth form	“fern”, “graminoid”, “herb”, “herb/shrub”, “herb/shrub/tree”, “lichen”, “moss”, “shrub”, “shrub/tree”, “tree”, “climber”		<p>Growth form of plant, according to the categorical traits data package from the TRY database: Kattge, J., Bönišch, G., Günther, A., Wright, I., Zanne, A., Wirth, C., Reich, P.B. and the TRY Consortium (2012) TRY - Categorical Traits Dataset. Data from: TRY - a global database of plant traits. TRY File Archive <a href="https://www.try-db.org/TryWeb/Data.php#3">https://www.try-db.org/TryWeb/Data.php#3</a>. If growth form data are not available in TRY categorical traits database, the database from Engemann et al 2016 was used instead when applicable: Engemann K, Sandel B, Boyle BL, Enquist BJ, Jørgensen PM, Kattge J, McGill BJ, Morueta-Holme N, Peet RK, Spencer NJ, Violle C, Wiser SK, Svenning J-C. 2016. A plant growth form dataset for the New World. <i>Ecology</i>. DOI: 10.1002/ecy.1569. "Climber" is used for species designated in the "climber" column of the TRY categorical traits package or designated as "vine" in the Engemann database, and includes vines and lianas.</p>

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00044	Plant growth form_Woodiness	“woody”, “woody / non-woody”, “non-woody”		Whether plant is woody or non-woody, according to the categorical traits data package from the TRY database: Kattge, J., Bönišch, G., Günther, A., Wright, I., Zanne, A., Wirth, C., Reich, P.B. and the TRY Consortium (2012) TRY - Categorical Traits Dataset. Data from: TRY - a global database of plant traits. TRY File Archive <a href="https://www.try-db.org/TryWeb/Data.php#3">https://www.try-db.org/TryWeb/Data.php#3</a>
F00055	Belowground Part	“CR”, “FR”, “R”, “BS”, “TR”, “TB”, “unspecified”, “unspecified roots”		Plant parts included in row data. CR = coarse roots (roots with diameter greater than 2 mm), FR = fine roots (roots with diameter less than 2 mm), R = rhizomes, BS = belowground stems, TR = total root system, and TB = total belowground system. “TR” is used when all plant roots are considered but the source does not specify whether or not coarse roots are present. “TB” is used when all belowground plant mass is considered but the source does not name all the plant parts comprised therein. Note that the FR category may contain roots measured from all roots from 0 to 2 mm in diameter, or may contain more restricted measures, e.g. 0 to 1 mm. The specific ranges of diameters included or allowed for a given sample are reported as the upper and lower bounds for root diameter classes in F00949 and F00950, respectively.
F00056	Root order			Root branching order, with 1 being either the distal (centripetal, i.e. morphometric scheme) or basal root (centrifugal, i.e. developmental scheme) depending on the classification scheme. Refer to F00059 (Root order classification scheme) for further information regarding the classification of root order.
F00057	Min_Root order			For an interval covering a range of root orders, the lowest order in the interval.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00058	Max_Root order			For an interval covering a range of root orders, the highest order in the interval.
F00059	Notes_Root order classification scheme	“centrifugal”, “centripetal”		Whether order scheme was centrifugal or centripetal. A centrifugal scheme counts the basal root as first order, with the distal root tip counted as the highest order (coarsest to finest). This is also known as the developmental approach. A centripetal scheme counts the distal tip as the first order, with the basal root counted as the highest order (finest to coarsest). This is also known as the morphometric approach.
F00060	Root functional class	“absorptive”, “transport”		Whether fine roots are absorptive fine roots (orders 1-3 or designated by author’s assessment) or transport fine roots (order >3 or designated by author’s assessment).
F00949	Root diameter class_Lower bound	mm		For diameter-based categories, the minimum diameter defining the category.
F00950	Root diameter class_Upper bound	mm		For diameter-based categories, the maximum diameter defining the category.
F00061	Root age	d		Age of a sampled root as determined by time since root appearance.
F00062	Root age_Lower bound	d		Minimum age of roots for which data in row are measured.
F00063	Root age_Upper bound	d		Maximum age of roots for which data in row are measured.
F00064	Root vitality_Roots living or dead	“living”, “dead”, “both”		Whether roots are considered to be alive or dead at time of sampling.
F00065	Notes_Method of determining dead roots			Basis for how the authors determined whether roots were living or dead.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00066	Root heterorhizy_Fibrous or pioneering	“fibrous”, “pioneer”		Whether observed roots are fibrous or pioneer (framework) roots.
F00067	Soil depth_Sampling depth	cm		The depth at which the measurement is taken.
F00068	Soil depth_Upper sampling depth	cm		The minimum (shallower) depth at which the measurement is taken if soil depth is presented as a categorical interval. A negative number means the authors consider the interval to begin above the soil layer (typically a litter layer or organic layer).
F00069	Soil depth_Lower sampling depth	cm		The maximum (deeper) depth at which the measurement is taken if soil depth is presented as a categorical interval.
F00072	Soil block_Length	cm		Length of soil blocks if collected.
F00073	Soil block_Width	cm		Width of soil blocks if collected.
F00074	Soil block_Height	cm		Height/depth of soil blocks if collected.
F00075	Soil block_Volume	cm <sup>3</sup>		Volume of soil blocks if collected.
F00097	Root aerenchyma porosity fraction	percent		Percent porosity of root aerenchyma.
F01374	Root porosity fraction	Percent	Median [F01374] Minimum [F01375] Maximum [F01376] Upper quartile [F01377] Lower quartile [F01378]	Percent total porosity of root.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F00100</b>	Root aerenchyma fraction of cross section	percent	n [F00101] SE [F00102]	Percentage of root cross-sectional area that consists of aerenchyma.
<b>F00103</b>	Root aerenchyma presence	“yes” or “no”		Whether aerenchyma are present in root.
<b>F00104</b>	Root cortex thickness	μm	n [F00105] SE [F00106] SD [F00107]	Thickness of root cortex.
<b>F00108</b>	Root exodermal wall thickness	μm		Thickness of exodermal wall from root scans.
<b>F00109</b>	Root passage cell number in exodermis	number		Number of passage cells in exodermis.
<b>F00110</b>	Root passage cell number per root circumference	number/mm		Number of passage cells per mm root circumference.
<b>F00111</b>	Mycorrhiza_Root length fraction that contains arbuscules	percent	SE [F00112]	Percentage of root length that contains arbuscules, determined using a random intercept method.
<b>F00113</b>	Mycorrhiza_Root length fraction that contains vesicles	percent	SE [F00114]	Percentage of root length that contains fungal vesicles, determined using a random intercept method.
<b>F00157</b>	Root phellem	number		Number of phellem layers in root.
<b>F00122</b>	Root stele cross-sectional fraction	percent	n [F00123] SE [F00124]	Percentage of root cross-sectional area that is occupied by the stele.
<b>F00118</b>	Root stele diameter	μm	n [F00119] SE [F00120] SD [F00121]	Diameter of root stele.
<b>F00115</b>	Root stele diameter/root diameter ratio	ratio	n [F00116] SE [F00117]	Stele diameter divided by root diameter.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00125	Root stele/root cortex ratio	ratio	n [F00126]	Proportion of root cross sectional area occupied by the stele divided by proportion of root cross sectional area occupied by the cortex.
F00134	Root conduit number per root stele area	number/mm <sup>2</sup>	n [F00135] SE [F00136]	Number of conduits per stele cross-sectional area.
F00142	Root conduit diameter	μm	n [F00143] SE [F00144]	$D_h = \left[ \left( \frac{1}{n} \right) \sum_{i=1}^n d^4 \right]^{1/4}$ where $d$ is conduit lumen diameter and $n$ is conduit number.
F00154	Root conduit wall thickness	μm	n [F00155] SE [F00156]	Thickness of conduit wall from root scans.
F00150	Root metaxylem cell wall thickness	μm	SE [F00151]	Thickness of the cell wall in the root metaxylem.
F00128	Root metaxylem cell wall thickness/vessel diameter ratio	percent	SE [F00129]	Percentage of metaxylem vessel diameter that consists of cell wall thickness.
F00140	Root metaxylem vessel diameter	μm	SE [F00141]	Vessel diameter of root metaxylem.
F00132	Root number of tracheary elements	number	SE [F00133]	Number of tracheary elements present in root, with secondary cell-wall thickening counted per xylem pole.
F01313	Root number of vessels	number	n [F01314] SE [F01327]	Number of vessels per root cross-section.
F00152	Root protoxylem cell wall thickness	μm	SE [F00153]	Thickness of the cell wall in the root protoxylem.
F00130	Root protoxylem cell wall thickness per protoxylem diameter	percent	SE [F00131]	Percentage of protoxylem vessel diameter that consists of cell wall thickness.
F00148	Root protoxylem diameter	μm	SE [F00149]	Vessel diameter of root protoxylem.
F01324	Root stele cross-sectional area	μm <sup>2</sup>	SE [F01325]	Cross-sectional area of root stele.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F01319</b>	Root vessel cross-sectional area	$\mu\text{m}^2$	n [F001320] SE [F01326]	Cross-sectional area per root vessel.
<b>F00145</b>	Root vessel diameter	$\mu\text{m}$	n [F00146] SE [F00147]	Diameter of root vessels.
<b>F01321</b>	Root vessel number per root cross-sectional area	number/ $\text{mm}^2$	n [F01322]	Number of vessels in root per root cross-sectional area.
<b>F01311</b>	Root xylem cross-sectional area	$\mu\text{m}^2$	n [F01312]	Cross-sectional area of root xylem.
<b>F01315</b>	Root xylem cross-sectional fraction	percent	n [F01316]	Percentage of root cross-sectional area occupied by xylem.
<b>F00137</b>	Root xylem vessel number per root stele area	number/ $\text{mm}^2$	n [F00138] SE [F00139]	Number of xylem vessels per root stele cross-sectional area.
<b>F00187</b>	Root branching architecture_Root length per higher order root length	ratio		Root length for a given order divided by the length of the roots in the higher order.
<b>F00179</b>	Root branching intensity (branching ratio)_Number of roots per higher order root	ratio	n [F00180] SE [F00181]	Number of roots in a given order divided by the number of roots in the higher order.
<b>F00182</b>	Root branching intensity_root tips per higher order root length	number/cm	SE [F00184] Min [F00185] Max [F00186] Median [F01371] Upper quartile [F01372] Lower quartile [F01373]	Number of lower order roots per centimeter length of higher-order root.
<b>F01339</b>	Root branching intensity_root tips per total root length	number/cm	n [F01340] SE [F01341] Min [F01342]	Number of lower-order roots per total root length in category.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			Max [F01343]	
<b>F00210</b>	Root dichotomous branching index		n [F00211] SE [F00212]	Determined by formula $[P_e - \min(P_e)] / [\max(P_e) - \min(P_e)]$ . DBI of 1 indicates a completely herringbone topology, while DBI of 0 indicates a completely dichotomous topology.
<b>F00213</b>	Root external path length ( $P_e$ )	number	n [F00214] SE [F00215]	Sum of the number of links in all paths from each external link (root segment between two nodes) to the base link (the link from which all other links descend). (Definition from Beidler et al. 2015, DOI: 10.1111/nph.13123).
<b>F01414</b>	Root forks per root length	number/cm		Number of root forks per cm of root length.
<b>F00199</b>	Root fractal dimension			Fractal dimension of scanned roots.
<b>F00170</b>	Root link branching angle	degrees	n [F00171] SE [F00172]	Mean angle between a link (segments of roots between two nodes or a node and a tip) and the extension of the link before it.
<b>F00203</b>	Root link length	cm	n [F00204] SE [F00205] SD [F00206]	Length of root links (segments of roots between two nodes or a node and a tip).
<b>F00173</b>	Root links per root branch	number/branch	n [F00174] SE [F00175]	Number of links (segments of roots between two nodes or a node and a tip) per root branch.
<b>F00219</b>	Root tips per ground area	number/m <sup>2</sup>	n [F00220] SE [F00221]	Total number of root tips per square meter of ground area (sampled from a given depth increment).
<b>F00216</b>	Root tips per minirhizotron frame	number/frame	SE [F00218]	Number of root tips observed per minirhizotron frame.
<b>F00222</b>	Root tips per plant	number/plant	n [F00223]	Total number of root tips for an entire plant.
<b>F00176</b>	Root tips per root branch	number/branch	n [F00177] SE [F00178]	Number of root tips and root endings per root branch.



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00224	Root tips per soil volume	number/L	SE [F00225]	Number of root tips per liter of soil.
F00226	Root topological index (TI)			Slope of the linear regression of $\log_{10}(P_e)$ against $\log_{10}\mu$ , in which $P_e$ is external path length and $\mu$ represents magnitude (number of root tips in the system). A greater TI indicates a more “herringbone” branching system.
F00207	Specific root fork density (SRFD)	number/g	n [F00208] SE [F00209]	Number of root bifurcations per gram of root mass.
F00192	Specific root tip abundance (SRTA)	number/mg	n [F00193] SE [F00194] SD [F00195]	Number of root tips per milligram of root mass.
F00245	Root cellulose and hemicellulose content per root mass	percent		Sum of concentrations of cellulose and all hemicelluloses in root.
F00237	Root cellulose content	percent	n [F00238] SE [F00239]	Concentration of cellulose in root.
F00240	Root cellulose content per root C content	percent		Percentage of root carbon that is cellulose.
F00242	Root hemicellulose content per root C content	percent_C		Percentage of root carbon that is hemicellulose.
F00243	Root hemicellulose content per root mass	percent	n [F01389] SE [F00244]	Percentage of root mass that is hemicellulose.
F00246	Root construction cost	g/g	n [F00247] SE [F00248]	Grams of glucose equivalent per gram of root dry weight.
F00253	Root C content	mg/g	n [F00254] SE [F00255] SD [F00256]	Mass of carbon per root mass for sampled roots.
F00249	Root Ca content	mg/g	n [F00250]	Mass of calcium per root mass for sampled roots.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			SE [F00251] SD [F00252]	
<b>F01299</b>	Root Ca content per root fresh mass	mg/g_FW		Mass of calcium per root fresh weight for sampled roots.
<b>F00289</b>	Root K content	mg/g	n [F00290] SE [F00291] SD [F00292]	Mass of potassium per root mass for sampled roots.
<b>F01302</b>	Root K content per root fresh mass	mg/g_FW		Mass of root potassium per fresh mass for sampled roots.
<b>F00257</b>	Root Mg content	mg/g	n [F00258] SE [F00259] SD [F00260]	Mass of magnesium per root mass for sampled roots.
<b>F01300</b>	Root Mg content per root fresh mass	mg/g_FW		Mass of magnesium per root fresh weight for sampled roots.
<b>F00273</b>	Root 15N content	per_mil		Concentration of nitrogen stable isotope in sampled roots, determined with a mass spectrometer.
<b>F00261</b>	Root N content	mg/g	n [F00262] SE [F00263] SD [F00264] Min [F00265] Max [F00266] Median [F00267] Upper quartile [F00268] Lower quartile [F00269]	Mass of nitrogen per root mass for sampled roots.
<b>F00270</b>	Root N content per root length	mg/m	n [F00271]	Root nitrogen mass per meter of root length.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			SE [F00272]	
<b>F00276</b>	Root N_Molar organic N content	mmol/g		Millimoles of organic nitrogen in root per gram of root mass.
<b>F00277</b>	Root P content	mg/g	n [F00278] SE [F00279] SD [F00280] Min [F00281] Max [F00282] Median [F00283] Upper quartile [F00284] Lower quartile [F00285]	Mass of phosphorous per root mass for sampled roots.
<b>F01301</b>	Root P content per root fresh mass	mg/g_FW		Mass of root phosphorus per fresh mass for sampled roots.
<b>F00293</b>	Root S content	mg/g	n [F00294] SE [F00295]	Mass of sulfur per root mass for sampled roots.
<b>F01303</b>	Root S content per root fresh mass	mg/g_FW		Mass of root sulfur per fresh mass for sampled roots.
<b>F00296</b>	Root Al content	mg/g	n [F01338] SE [F00297]	Mass of aluminum per root mass for sampled roots.
<b>F01304</b>	Root Al content per root fresh mass	mg/g_FW		Mass of root aluminum per fresh mass for sampled roots.
<b>F00298</b>	Root As content	mg/kg	n [F00299] SE [F00300]	Mass of arsenic per root mass for sampled roots.
<b>F00301</b>	Root B content	mg/kg	n [F00302] SE [F00303] SD [F00304]	Mass of boron per root mass for sampled roots.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00305	Root Cd content	mg/kg	n [F00306] SE [F00307]	Mass of cadmium per root mass for sampled roots.
F00308	Root Cl <sup>-</sup> ion content	mg/g	SE [F00310]	Mass of Cl <sup>-</sup> ions per root mass for sampled roots, determined with flame photometer.
F00311	Root Cr content	mg/kg	n [F00312] SE [F00313]	Mass of chromium per root mass for sampled roots.
F00314	Root Cu content	mg/kg	n [F00315] SE [F00316] SD [F00317]	Mass of copper per root mass for sampled roots.
F00318	Root Fe content	mg/g		Mass of iron per root mass for sampled roots.
F00322	Root Mn content	mg/g	n [F00323] SE [F00324] SD [F00325]	Mass of manganese per root mass for sampled roots.
F01305	Root Mn content per root fresh mass	mg/g_FW		Mass of root manganese per fresh mass for sampled roots.
F00334	Root Na content	mg/g	SE [F01388]	Mass of sodium per root mass for sampled roots.
F00331	Root Na <sup>+</sup> content	mg/g	SE [F00333]	Mass of Na <sup>+</sup> ions per root mass, determined by silver ion titration.
F00326	Root Ni content	mg/kg	n [F00327] SE [F00328]	Mass of nickel per root mass for sampled roots.
F00319	Root Pb content	mg/kg	n [F00320] SE [F00321]	Mass of lead per root mass for sampled roots.
F00329	Root Si content	mg/g	SE [F00330]	Mass of silicon per root mass for sampled roots.
F00335	Root Zn content	mg/kg	n [F00336] SE [F00337]	Mass of zinc per root mass for sampled roots.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00380	Root 12 phenol content per root C content	mg/g_C	SE [F00381]	Total concentration of twelve monophenols extracted from root.
F00342	Root acid hydrolyzable compounds content	mg/g	n [F00343] SD [F00344] SE [F00345]	Concentration of acid soluble compounds in root.
F00370	Root acid-insoluble fraction (AIF)	percent	n [F00371] SE [F00373]	Root acid-insoluble carbon fraction.
F00431	Root alkyl C content per root C content	mg/g_C	n [F00432] SE [F00433]	Fraction of root carbon that is in alkyl groups.
F00346	Root arabinans content	percent		Concentration of arabinans in root.
F00437	Root aromatic C content per root C content	mg/g_C	n [F00438] SE [F00439]	Fraction of root carbon that is in aromatic groups.
F00340	Root ash C content per root C content	Percent_C		Percentage of root carbon that is ash.
F00347	Root ash content	percent		Concentration of ash in root.
F00348	Root bound phenol content per root C content	mg/g_C	SE [F00349]	Concentration of phenolic compounds that are bound to cell walls through ester/ether linkages per root carbon content.
F00350	Root cinnamyl phenol content per root C content	mg/g_C	SE [F00351]	Concentration of cinnamyl phenols in root per root carbon content.
F01330	Root condensed tannins	mg/g	n [F01331] SE [F01332]	Concentration of condensed tannins in root.
F00352	Root ethanol soluble fraction	percent		Percentage of root tissue that is soluble in ethanol.
F00353	Root free phenol content per root C content	ug/g_C	SE [F00354]	Concentration of phenolic compounds that are nonassociated forms in cell vacuoles per root carbon content.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00355	Root galactans fraction	percent		Concentration of galactans in root.
F00358	Root lignin content	percent	n [F00359] SE [F00360]	Concentration of lignin in root.
F00361	Root lignin content per root C content	percent_C		Percentage of root carbon that exists as lignin.
F00356	Root lignin phenol content per root C content	mg/g_C	SE [F00357]	Total concentration of monophenols that constitute lignin in root per root carbon content.
F00338	Root lignin phenol vegetation index (LPVI)		SE [F00339]	$[S\%(S\% + 1)/(V\% + 1) + 1] * [C\%(C\% + 1)/(V\% + 1) + 1]$ , where V%, S%, and C% are the respective percentages of vanillyl phenol, syringyl phenol, and cinnamyl phenol in root lignin. Indicator for taxonomic source identification.
F00362	Root lipid content	percent	n [F01391] SE [F01387]	Concentration of lipids in root.
F00364	Root mannans content	percent		Concentration of mannans in root.
F00365	Root neutral detergent soluble fraction	percent		Percentage of root mass that is soluble in neutral detergent.
F00366	Root non-acid hydrolyzable compounds content	mg/g	n [F00367] SD [F00368] SE [F00369]	Concentration of compounds in root that are not acid soluble.
F00374	Root nonpolar compounds content	mg/g	n [F00375] SD [F00376] SE [F00377]	Concentration of nonpolar compounds in root.
F00434	Root O-alkyl C content per root C content	mg/g_C	n [F00435] SE [F00436]	Fraction of root carbon that is in O-alkyl groups.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00378	Root <i>p</i> -hydroxy phenol content per root C content	mg/g_C	SE [F00379]	Concentration of <i>p</i> -hydroxybenzoic acid, <i>p</i> -hydroxyacetophenon, and <i>p</i> -hydroxybenzaldehyde phenols in root per root C content.
F00382	Root phenols content	mg/g	n [F01239] SE [F00383]	Concentration of phenols per unit root dry mass.
F01328	Root phenols_chlorogenic acid molarity per root mass	μM chlorogenic acid/g		Micromoles of chlorogenic acid yielded per root mass from ethanol boiling extraction and Folin-Ciocalteu's phenol reagent. See page 1221 of Zadworny et al. 2017, DOI: 10.1111/gcb.13514, for further information.
F00384	Root polar compounds content	mg/g	n [F00385] SD [F00386] SE [F00387]	Concentration of polar compounds in root.
F00388	Root polyphenol content	percent	n [F00389] SE [F00390]	Concentration of polyphenols in root.
F00391	Root rhamnan content	percent		Concentration of rhamnans in root.
F01329	Root starch fraction	percent		Percentage of root mass consisting of starches.
F00392	Root structural C content per root C content	percent		Percentage of root carbon that is structural.
F00393	Root syringyl phenol content per root C content	mg/g_C	SE [F00394]	Concentration of syringyl phenols in root per root carbon.
F00395	Root vanillyl phenol content per root C content	mg/g_C	SE [F00396]	Concentration of vanillyl phenols in root.
F00397	Root water or ethanol soluble compounds fraction	percent	SE [F00398]	Percentage of root tissue that is soluble in water or ethanol.
F00399	Root water soluble compounds fraction	percent	SE [F00400]	Percentage of root tissue that is soluble in water.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00401	Root water soluble compounds per root mass	percent		Percentage of root tissue that consist of water-soluble sugars, as determined by a phenol–sulfuric acid assay.
F01281	Root water soluble phenol compounds per root mass	percent		Percentage of root tissue that consists of water-soluble phenols.
F00402	Root xylan content	percent		Concentration of xylans in root.
F00407	Root 3,5-dihydroxybenzoic acid groups/vanillyl phenols ratio	percent	SE [F00408]	Percent of 3,5-dihydroxybenzoic acid to vanillyl phenols in root. Indicative of degradation status.
F00403	Root acid/aldehyde ratio for syringyl phenols	ratio	SE [F00404]	Ratio of acid to aldehyde in root syringyl phenols. Indicative of diagenetic state of lignin.
F00405	Root acid/aldehyde ratio for vanillyl phenols	ratio	SE [F00406]	Ratio of acid to aldehyde in root vanillyl phenols. Indicative of diagenetic state of lignin.
F00413	Root C/N ratio	ratio	n [F00414] SE [F00415] SD [F00416]	Ratio of carbon to nitrogen in root by mass.
F00417	Root cinnamyl phenol/vanillyl phenol ratio	ratio	SE [F00418]	Ratio of cinnamyl phenol to vanillyl phenol in root. Index for woody or nonwoody source.
F00419	Root lignin/N ratio	ratio	n [F01390] SE [F00420]	Ratio of lignin concentration to N concentration in root.
F00409	Root NAH/root N ratio	ratio	n [F00410] SE [F00411] SD [F00412]	Ratio of non-acid hydrolysable compounds to nitrogen in root tissue.
F00421	Root organic N/root total N ratio	ratio		Root organic N concentration divided by total root N concentration.
F00422	Root polyphenol/root N ratio	ratio		Ratio of root polyphenol concentration to root N concentration.



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00423	Root syringyl/vanillyl phenol ratio	ratio	SE [F00424]	Ratio of syringyl phenol to vanillyl phenol in root. Index for taxonomic level (angiosperm or gymnosperm) of plant from which phenol was derived.
F00425	Root vanillyl phenol/lignin phenol ratio	ratio	SE [F00426]	Ratio of vanillyl phenol to lignin phenol in root. Indicative of lignin quality.
F00427	Root non-structural C content per root C content	percent_C		Percentage of root carbon that is non-structural
F00428	Root total non-structural carbohydrate content (TNC)	mg/g	n [F00429] SE [F00430]	Glucose equivalents per dry weight of roots, determined colorimetrically.
F00461	Root decomposition_Annual k constant	yr <sup>-1</sup>	SE [F00462]	The $k$ constant for the root in the exponential decay function $M_t = M_0 e^{-kt}$ , where $M_t$ is the mass of litter after time $t$ , and $M_0$ is the initial mass of litter.
F00466	Root decomposition_Annual N immobilized in decomposing roots	mg/g/yr	n [F00467] SE [F0468]	Amount of nitrogen immobilized over the course of a year in decomposing roots.
F00465	Root decomposition_Annual necromass decomposition rate per ground area	g/m <sup>2</sup> /yr		Amount of root necromass that decomposes over the course of a year.
F00457	Root decomposition_Estimated cumulative monthly mass loss	kg/m <sup>2</sup> /mo		Difference between cumulative growth rate and fine root biomass.
F01364	Root decomposition_Fraction C remaining	percent	SE [F01365]	For decomposition experiment, percentage of original root carbon remaining.
F00458	Root decomposition_Fraction mass remaining	percent	n [F00459] SE [F00460]	For decomposition experiment, percentage of original root mass remaining.
F00591	Root decomposition_Fraction N remaining	percent	n [F00592] SE [F00593]	For decomposition experiment, percentage of original root nitrogen remaining.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F00463</b>	Root decomposition_Monthly k constant	mo <sup>-1</sup>		K constant (decomposition constant, see F00461) for a single month.
<b>F00464</b>	Root decomposition_Monthly necromass decomposition rate per ground area	g/m <sup>2</sup> /mo		Amount of root necromass that decomposes over the course of a month.
<b>F00476</b>	Root age survivorship fraction	percent	SE [F00477] 95% confidence margin [F007478]	Percentage of roots that live to the age presented in the “root age” column.
<b>F00469</b>	Root mean lifespan_d	d	n [F00471] 5 <sup>th</sup> percentile [F00472] 95 <sup>TH</sup> percentile [F00473] SE [F00474]	Mean lifespan of roots observed, expressed in days.
<b>F01295</b>	Root mean lifespan_Main_d	d		Mean lifespan in days. This column combines data from both “Root mean lifespan_d” (F00470) and “Root mean lifespan_yr” (F01292) columns. If source originally presents lifespan in years or months, lifespan is converted to days for this value.
<b>F01292</b>	Root mean lifespan_yr	yr		Mean lifespan of roots observed, expressed in years.
<b>F00470</b>	Root median lifespan_d	d	SE [F00475]	Median lifespan of roots observed, expressed in days.
<b>F01296</b>	Root median lifespan_Main_d	d		Median lifespan in days. This column combines data from both “Root median lifespan_d” (F00470) and “Root median lifespan_yr” (F01293) columns. If source originally presents lifespan in years or months, lifespan is converted to days for this value.
<b>F01293</b>	Root median lifespan_yr	yr		Median lifespan of roots observed, expressed in years.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F00483</b>	Root survivorship_Fraction of root tips surviving after one year	percent roots/yr	n [F00484]	Percentage of root tips that survive after one year.
<b>F00480</b>	Root survivorship_Fraction roots surviving for exposition period	percent	n [F00481] SE [F00482]	Percentage of roots which survive for the time interval represented in the row (i.e., the time period between the dates in the “[date] beginning collection” and “[date] ending collection” columns).
<b>F00479</b>	Root survivorship_Fraction roots surviving for growing season	percent		Percentage of roots which survive over the course of a growing season.
<b>F00518</b>	Root growth_Annual C production per ground area	Mg_C/ha/yr	n [F00519] SE [F00520]	Amount of root carbon produced in one year.
<b>F00546</b>	Root growth_Annual length production per ground area	m/m <sup>2</sup> /yr	n [F00547] SE [F00548] 5 <sup>th</sup> percentile [F00549] 95 <sup>th</sup> percentile [F00550]	Annual increase in total root length per unit ground area.
<b>F00553</b>	Root growth_Annual length production per minirhizotron surface area	mm/cm <sup>2</sup> /yr	SE [F00554]	New root length observed per square centimeter of minirhizotron surface per year.
<b>F00521</b>	Root growth_Annual mass production per ground area	g/m <sup>2</sup> /yr	n [F00522] SE [F00523] 5 <sup>th</sup> percentile [F00524] 95 <sup>th</sup> percentile [F00525]	Amount of root mass produced in one year.
<b>F00510</b>	Root growth_Annual net new length production per ground area	m/m <sup>2</sup> /yr	n [F00511]	Live root length density appearance minus live root length density disappearance, adjusted to an annual value by subtracting net new length growth from the value for the previous sampling date, dividing by the number of days

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
				between sampling dates, and multiplying the result by the number of days in the year.
<b>F00571</b>	Root growth_Annual surface area production per ground area	m <sup>2</sup> /m <sup>2</sup> /yr	5 <sup>th</sup> percentile [F00572] 95 <sup>th</sup> percentile [F00573] SE [F01358]	Root surface area produced per square meter of ground area per year.
<b>F00559</b>	Root growth_Bimonthly number of roots born per ingrowth screen area	number/cm <sup>2</sup> /2mo	SE [F00560]	Inferred number of roots born per square centimeter of in-growth screen per two months.
<b>F00543</b>	Root growth_Cumulative length production per ground area	m/m <sup>2</sup>	n [F00544] SE [F00545]	Cumulative root length density appearance per unit ground area.
<b>F00527</b>	Root growth_Cumulative mass production per ground area	Mg/ha	SE [F00528]	Total root mass produced since the beginning of the study.
<b>F00526</b>	Root growth_Cumulative monthly mass ingrowth per screen area	kg/m <sup>2</sup> /mo		Cumulative rate of root growth into in-growth mesh, in kg per mesh cross-sectional area per month.
<b>F00507</b>	Root growth_Cumulative net length production per ground area	m/m <sup>2</sup>	n [F00508] SE [F00509]	Difference between cumulative live root appearance and cumulative live root disappearance.
<b>F00538</b>	Root growth_Daily elongation rate	mm/d	SE [F00539]	Rate at which elongation occurs for the roots where it does occur.
<b>F00568</b>	Root growth_Daily length production per coarse root length	cm/d/cm		Total fine root length production per day per length of woody root.
<b>F00551</b>	Root growth_Daily length production per minirhizotron surface area	mm/cm <sup>2</sup> /d	SE [F00552]	New root length observed per square centimeter of minirhizotron surface per day.
<b>F00569</b>	Root growth_Daily mass production per coarse root length	mg/d/cm		Total fine root mass produced per day per length of woody root.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00529	Root growth_Daily mass production per ground area	g/m <sup>2</sup> /d		Amount of root mass produced in one day.
F00537	Root growth_Elongation fraction	percent		Percentage of roots that have elongated since the previous measurement.
F00513	Root growth_Fraction peak production	unitless	SE [F00514]	The root production rate observed at a specific point divided by the maximum root production rate observed during the entire observation period.
F00286	Root growth_Length produced per P content	m/mg	n [F00287] SE [F00288]	Root length produced per unit mass of root phosphorus.
F00556	Root growth_Length production per ground area and exposition period	km/m <sup>2</sup>	n [F00557] SE [F00558]	Increase in root length per square meter of ground area during the observation period specified in the “[year/month/day] beginning data collection” and “[year/month/day] ending data collection” columns.
F00540	Root growth_Length production per minirhizotron frame	mm/frame	SE [F00542]	Root length produced per minirhizotron frame.
F00566	Root growth_Length recovery from pruning	cm	SE [F00567]	Root length recovery from pruning.
F00534	Root growth_Mass production per ground area and exposition period	Mg/ha	n [F00535] SE [F00536]	Root biomass produced for the time interval specified in “main exposition period” and “production duration” or “in growth duration” (columns F01294 and F0076,F01283,F01284, or F01280).
F01276	Root growth_Mass production per plant per growing season	g/plant/growing season		Increase in belowground biomass per plant (by dry weight) over the course of one growing season.
F00531	Root growth_Monthly mass ingrowth per screen area	kg/m <sup>2</sup> /mo		Monthly rate of root growth into in-growth mesh, in kg per mesh cross sectional area per month.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00532	Root growth_Monthly mass production per ground area	g/m <sup>2</sup> /mo		Amount of root mass produced in one month.
F00533	Root growth_Monthly mass production per soil volume	mg/cm <sup>3</sup> /mo		Root mass produced per cubic centimeter of soil each month.
F00903	Root growth_Number of roots per area of ingrowth screen	number/cm <sup>2</sup>	SE [F00905]	Number of roots per square cm of in-growth screen.
F00561	Root growth_Predicted amplitude of monthly net root production	Log10 (Number of roots/0.2m <sup>2</sup> )		Log of predicted amplitude of monthly net root production if it occurs (i.e. if mRIQ>0), based on negative binomial distribution. See Mao et al. 2013 (DOI: 10.1007/s11104-012-1324-2)for further details.
F00562	Median_Root growth_Probability monthly net root production greater than 0	unitless	Upper quartile [F00563] Lower quartile [F00564] 95% confidence interval [F00565]	Probability that monthly net root production is greater than 0 roots per 0.2 m <sup>2</sup> , based on modelling by logistic regression. See Mao et al. 2013 (DOI: 10.1007/s11104-012-1324-2) for further details.
F00574	Root growth_Surface area production per ground area and exposition period	m <sup>2</sup> /m <sup>2</sup>	n [F00575] SE [F00576]	Increase in root surface area per square meter of ground area during the observation period specified in the "Exposition period_Main" column" [F01294]
F00570	Root pruning recovery	Percent		Percentage pruned woody roots that recovered by proliferating fine roots.
F00515	Root relative growth rate (RGR)_Root length	m/m/d	SE [F00517] Median [F01366] Maximum [F01367] Upper quartile [F01368]	[ln (each growth response at 30, 60 and 90 days of the treatments) - ln (each growth response at 0, 30 and 60 days of the treatments, respectively)]/30 days; see Imada et al. 2008 (DOI: 10.1111/j.1365-2435.2008.01454.x) for more details.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			Lower quartile [F01369] Minimum [F01370]	
<b>F00500</b>	Root mortality_Annual root length mortality per ground area	m/m <sup>2</sup> /yr	n [F00501] SE [F00502]	Annual mortality of root length density.
<b>F00498</b>	Root mortality_Annual root length mortality per minirhizotron surface area	mm/cm <sup>2</sup> /yr	SE [F00499]	Observed length of roots which dies per minirhizotron surface per year.
<b>F00490</b>	Root mortality_Annual root mass mortality per ground area	g/m <sup>2</sup> /yr	n [F00491] SE [F00492]	Amount of root biomass that dies in one year per square meter of ground area.
<b>F00487</b>	Root mortality_Cumulative root length disappearance per ground area	m/m <sup>2</sup>	n [F00488] SE [F00489]	Cumulative root length density disappearance observed per ground area.
<b>F00493</b>	Root mortality_Cumulative root length mortality per minirhizotron frame	mm/frame	SE [F00495]	Root length mortality observed per minirhizotron frame since the beginning of observation.
<b>F00496</b>	Root mortality_Daily root length mortality per minirhizotron surface area	mm/cm <sup>2</sup> /d	SE [F00497]	Observed length of roots which dies per minirhizotron surface per day.
<b>F00505</b>	Root mortality_Fraction initial intersections with ingrowth screen lost	percent	SE [F00506]	For in-growth screen, percentage of root-screen contacts lost after installation.
<b>F00485</b>	Root mortality_Monthly mass disappearance per soil volume	mg/cm <sup>3</sup> /mo		Mass of root biomass that disappears per cubic centimeter of soil per month. Calculated based on loss of mass.
<b>F00486</b>	Root mortality_Monthly necromass increase per soil volume	mg/cm <sup>3</sup> /mo		Amount of root biomass that dies per cubic centimeter of soil per month. Calculated based on change in necromass.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00503	Root mortality_Monthly number of roots lost per ingrowth screen area	number/cm <sup>2</sup> /2mo	SE [F00504]	Inferred number of roots to die per square centimeter of ingrowth screen per two months.
F00577	Root mortality_Root N loss per annual plant N uptake	percent		Nitrogen lost through fine root mortality as a percentage of annual whole-plant nitrogen uptake.
F00578	Root mortality_Root N loss per plant N content per ground area	percent		Nitrogen lost through fine root mortality as a percentage of whole-plant N storage (root nitrogen per ground area).
F00579	Root turnover_Annual biomass turnover per ground area	g/m <sup>2</sup> /yr	n [F00580] SE [F00581]	Root mass multiplied by turnover rate.
F00589	Root turnover_Estimated rate per growing season	season <sup>-1</sup>		Number of days in growing season divided by median lifespan of roots.
F00585	Root turnover_Mass per dry season	season <sup>-1</sup>	SE [F00586]	Turnover during dry season as defined in original data source.
F00587	Root turnover_Mass per wet season	season <sup>-1</sup>	SE [F00588]	Turnover during wet season as defined in original data source.
F00582	Root turnover_Annual root system replacement	yr <sup>-1</sup>	n [F00583] SE [F00584] Median [F01359] Max [F01360] Upper quartile [F01361] Lower quartile [F01362] Min [F01363]	Turnover as the inverse of belowground net primary productivity.
F00609	Mycorrhiza_Fraction contact exploration mycorrhizae	percent	SE [F00610]	Percentage of mycorrhizal tips that are of the contact exploration type.



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00611	Mycorrhiza_Fraction long-distance exploration mycorrhizae	percent	SE [F00612]	Percentage of mycorrhizal tips that are of the long-distance exploration type.
F00613	Mycorrhiza_Fraction medium-distance exploration mycorrhizae	percent		Percentage of mycorrhizal tips that are of the medium-distance exploration type.
F00617	Mycorrhiza_Fraction mycorrhizal root tips that are living	percent		Percentage of mycorrhizal tips that are living.
F00638	Mycorrhiza_Fraction of root length	percent	n [F00639] SE [F00640] SD [F01306]	Percentage of root length colonized by mycorrhizal fungi, identified by the presence of mycorrhizal hyphae, arbuscules, or vesicles. This column contains information from both AM and EM colonization reported in columns F00622 and F00626, and additional data when mycorrhizal type was unspecified or both colonization types were present.
F00622	Mycorrhiza_Fraction root length colonized by AM mycorrhizae	percent	n [F00623] SE [F00624] SD [F00625]	Percentage of root length which shows colonization by arbuscular mycorrhizal fungi. These data may also be contained in column F00638.
F00626	Mycorrhiza_Fraction root length colonized by EM mycorrhizae	percent	SE [F00628]	Percentage of root length which shows colonization by ectomycorrhizal fungi. These data may also be contained in column F00638.
F00619	Mycorrhiza_Fraction root tips colonized by mycorrhizae	percent	n [F00620] SE [F00621]	Percentage of root tips that are colonized by mycorrhizal fungi.
F00615	Mycorrhiza_Fraction short-distance exploration mycorrhizae	percent	SE [F00616]	Percentage of mycorrhizal tips that are of the short-distance exploration type.
F00606	Mycorrhiza_Length of AM hyphae per soil mass	mm/g		Millimeters of arbuscular mycorrhizal hyphae per gram of soil, determined by dispersing soils in sodium metaphosphate solution, passing through a series of sieves, collecting hyphae on filters, and examining hyphae through a microscope.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00641	Mycorrhiza_Number of AM spores per soil mass	spores/g	n [F00642] SE [F00643] SD [F00644]	Number of arbuscular mycorrhizae spores per gram of soil, determined by isolating the spores using the wet-sieving technique and counting them under a microscope.
F00635	Mycorrhiza_Number of root tips per root length colonized by mycorrhizae	number/cm	n [F00636] SE [F00637]	Number of tips per cm of root on root branch that contains mycorrhizal fungi.
F00607	Mycorrhiza_PLFA proxy for EM mass per ground area	g/m <sup>2</sup>	SE [F00608]	Grams of external ectomycorrhizal mycelium biomass in soil per square meter of ground area for a given sampling depth, estimated based on PLFA with a conversion factor of 2 nmol 18:2ω6.9 per milligram of fungal biomass.
F01333	Mycorrhiza_PLFA proxy for mycorrhizal hyphal C per soil mass	mg/kg	SE [F01334]	Milligrams of mycorrhizal hyphal carbon per kilogram of soil mass, estimated from PLFA biomarkers as specified in: Chen, W. et al. 2016. DOI: 10.1073/pnas.1601006113.
F00645	Mycorrhiza_Type	“AM”, “EM”, “EeM”, “ErM”, “mycorrhizal”, “NM”		Type of mycorrhizae formed. “AM” = arbuscular mycorrhizae; “EM” = ectomycorrhizae; “EeM” = ectendomycorrhizae; “ErM” = ericoid mycorrhizae”; “mycorrhizal” means mycorrhizae are present but type is unknown; “NM” = non-mycorrhizal.
F00631	Mycorrhiza_Visual estimate of root colonization intensity	percent	n [F00632] SE [F00633]	Intensity of mycorrhizal colonization based on the following classes: 0% for 0 class; < 1% for first; 1–10% for second; 10–50% for third; 50–90% for fourth; and finally > 90% for the fifth class. The mean of each class was then used in calculating a mean percent intensity of all the roots examined using the program MYCOCALC’ (AMI). Definition from: Eissenstat DM, Kucharski JM, Zadworny M, Adams TS, Koide RT. 2015. Linking root traits to nutrient foraging in arbuscular mycorrhizal trees in a temperate forest. New Phytologist 208: 114-121. DOI: 10.1111/nph.13451

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00649	Root nodules_Nodule mass on dead roots per ground area	g/m <sup>2</sup>	SE [F00651]	Total dry weight of all root nodules collected from dead roots in soil cores.
F00646	Root nodules_Nodule mass on living roots per ground area	g/m <sup>2</sup>	SE [F00648]	Total dry weight of all root nodules collected from living roots in soil cores.
F01288	Mycoheterotrophy	“x” or blank		“x” denotes the presence of mycoheterotrophy. Blank indicates the data are not related to mycoheterotrophy or that mycoheterotrophy data were not available.
F00659	Root microbes_Bacterial biomass C content per root mass	mg/g		Concentration of bacterial carbon in root material, estimated based on calculated average conversion factor of muramic acid to fungal carbon.
F00658	Root microbes_Fungal biomass C content per root mass	mg/g		Concentration of fungal carbon in root material, estimated based on calculated average conversion factor of glucosamine to fungal carbon.
F00660	Root microbes_Fungal C/bacterial C ratio	ratio		Ratio of root fungal carbon to root bacterial carbon.
F00656	Root microbes_Microbial biomass C content per root mass	mg/g		Carbon from microbial biomass in roots, calculated from root ergosterol and the ergosterol/microbial biomass carbon ratio of the rhizosphere soil.
F00657	Root microbes_Microbial biomass N content per root mass	mg/g		Nitrogen from microbial biomass in roots, calculated from root ergosterol and microbial biomass C/N ratio of the rhizosphere soil.
F00652	Root microbes_Root glucosamine content per root mass	mg/g		Concentration of glucosamine measured in root material.
F00629	Root microbes_Root length hyphal fraction	percent	SE [F00630]	Percentage of root length that contains fungal hyphae, determined using a random intercept method.
F00653	Root muramic acid content	mg/kg		Concentration of muramic acid measured in root material.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F01317</b>	Root cross-sectional area	$\mu\text{m}^2$	n [F01318] SE [F01323]	Cross-sectional area of root.
<b>F00679</b>	Root diameter	mm	n [F00680] SE [F00681] SD [F00682] Min [F00683] Max [F00684] Median [F00685] Upper quartile [F00686] Lower quartile [F00687] Modal [F00688]	Diameter of roots observed.
<b>F00689</b>	Root dry matter content (RDMC)	ratio	n [F01310] SE [F00690]	Root dry mass divided by root fresh mass.
<b>F00691</b>	Root color_White or brown	“White”, “Brown”		Whether observed roots are considered to be white or brown.
<b>F00733</b>	Root hair density	number/ $\text{mm}^2$	n [F00734] SE [F00735]	Number of root hairs per root surface area.
<b>F00736</b>	Root hair diameter	$\mu\text{m}$	n [F00737] SE [F00738]	Diameter of root hairs.
<b>F00692</b>	Root hair incidence	percent	n [F00693] SE [F00694] SD [F00695]	Percentage of fine roots that contain root hairs, by the gridline method.
<b>F00696</b>	Root hair length	$\mu\text{m}$	n [F00697] SE [F00698] SD [F00699]	Length of root hairs.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F00700</b>	Root hair volume per root mass	cm <sup>3</sup> /g	n [F00701] SE [F00702]	Volume of root hairs per gram of root mass, estimated using specific root length.
<b>F00703</b>	Root length from base to tip	cm	n [F00704] SE [F00705] SD [F00706] 95 <sup>th</sup> percent confidence interval min [F00707] 95 <sup>th</sup> percent confidence interval max [F00708]	Distance from root base to tip.
<b>F00709</b>	Root tissue density (RTD)	g/cm <sup>3</sup>	n [F00710] SE [F00711] SD [F00712] Min [F00713] Max [F00714] Median [F00715] Upper quartile [F00716] Lower quartile [F0717]	Weight of roots sampled divided by volume of roots.
<b>F00718</b>	Specific root area (SRA)	cm <sup>2</sup> /g	n [F00719] SE [F00720] SD [F00721] Median [F00722] Lower quartile [F00723]	Root surface area divided by root mass.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			Min [F00724] Max [F00725] Upper quartile [F00726]	
<b>F00727</b>	Specific root length (SRL)	m/g	n [F00728] SE [F00729] SD [F00730] Min [F00731] Median [F01345] Upper quartile [F01346] Lower quartile [F01347] Max [F00732]	Length of roots divided by root mass.
<b>F00743</b>	Root acid phosphatase activity per root mass	umol_pNP/g/h	n [F00744] SE [F00745] Max [F00746] Upper quartile [F00747] Median [F00748] Lower quartile [F00749] Min [F00750]	Acid phosphatase activity per unit root mass.
<b>F00754</b>	Root exudation_C exudation rate per root mass	µg_C/g_fine root/h	n [F00755] SE [F00756]	Carbon exudation rate by mass of fine roots.
<b>F00751</b>	Root exudation_Fraction estimated root mass	percent	n [F00752] SE [F00753]	Collected exudates scaled as proportion of estimated biomass accumulation.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01404	Root exudation_molar C exudation rate per root area	$\mu\text{mol}_C/\text{m}^2/\text{h}$		Root carbon exudation rate in terms of micromoles of Carbon exuded per root area.
F00760	Root phosphatase activity per root length	$\mu\text{g}/\text{m}/\text{h}$	n [F00761] SE [F00762]	Phosphatase activity of roots, based on release of <i>p</i> -nitrophenol from a solution of <i>p</i> -nitrophenyl phosphate per meter of root length per hour.
F00757	Root phosphatase activity per root mass	$\text{umol}_p\text{-NP}/\text{g}/\text{min}$	n [F00758] SE [F00759]	Hydrolysis of <i>p</i> -nitrophenyl phosphatase to <i>p</i> -nitrophenol after incubation at 37°C for 1 hour.
F00780	Plant N uptake rate_Annual N uptake per ground area	$\text{kg}/\text{ha}/\text{yr}$	n [F00781] SE [F00782]	Total amount of nitrogen taken up by plants per hectare over the course of a year.
F01396	Plant N uptake_daily uptake of molar 15N-Glycine per shoot dry mass	$\mu\text{mol}/\text{g}/\text{d}$	SE [F01397]	Uptake of 15N-Glycine tracer over the course of 24 hours per root dry mass, estimated with the equation $F = [T(AS - AB)]/AF$ , where T is the plant N concentration AS is the atom percent excess 15N in the sample, AB is the atom percent excess 15N in the natural sample, and AF is the atom percent excess 15N in the tracer.
F01392	Plant N uptake_daily uptake of molar 15NH4+ per shoot dry mass	$\mu\text{mol}/\text{g}/\text{d}$	SE [F01393]	Uptake of 15N-NH4+ tracer over the course of 24 hours per root dry mass, estimated with the equation $F = [T(AS - AB)]/AF$ , where T is the plant N concentration AS is the atom percent excess 15N in the sample, AB is the atom percent excess 15N in the natural sample, and AF is the atom percent excess 15N in the tracer.
F01394	Plant N uptake_daily uptake of molar 15NO3- per shoot dry mass	$\mu\text{mol}/\text{g}/\text{d}$	SE [F01395]	Uptake of 15N-NO3- tracer over the course of 24 hours per root dry mass, estimated with the equation $F = [T(AS - AB)]/AF$ , where T is the plant N concentration AS is the atom percent excess 15N in the sample, AB is the atom percent excess 15N in the natural sample, and AF is the atom percent excess 15N in the tracer.
F01398	Plant N uptake_daily uptake of molar total 15N per shoot dry mass	$\mu\text{mol}/\text{g}/\text{d}$	SE [F01399]	Combined uptake of 15N-NH4+, 15N-NO3-, and 15N-Glycine tracers over the course of 24 hours per root dry

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
				mass, estimated with the equation $F = [T(AS-AB)]/AF$ , where T is the plant N concentration AS is the atom percent excess 15N in the sample, AB is the atom percent excess 15N in the natural sample, and AF is the atom percent excess 15N in the tracer.
F00766	Root K uptake_Fraction K uptake capacity per soil depth interval	percent		Estimated potassium uptake capacity of roots at the depth interval specified in Soil depth_Upper sampling depth (F00068) and Soil depth_Lower sampling depth (F00069) relative to the plant's total uptake capacity.
F00770	Root N uptake_Cumulative N uptake	g/m <sup>2</sup>	n [F00771] SE [F00772]	Total root nitrogen uptake since the first observation per meter square of ground area.
F00773	Root N uptake_Hourly uptake of 15NH <sub>4</sub> <sup>+</sup> per root fresh mass	ng/mg FW/h	SD [F00774]	Hourly uptake of nitrogen by roots per root fresh mass, as determined by a root bioassay using 15NH <sub>4</sub> <sup>+</sup> . Reported in terms of nanograms of NH <sub>4</sub> <sup>+</sup> .
F00775	Root N uptake_Hourly uptake of molar NH <sub>4</sub> <sup>+</sup> per root fresh mass	nmol/g_FW/h	SD [F00776]	Hourly uptake of nitrogen by roots per root fresh mass, as determined by a root bioassay using <sup>15</sup> NH <sub>4</sub> <sup>+</sup> . Reported in terms of nmol of NH <sub>4</sub> <sup>+</sup> .
F00777	Root N uptake_Hourly uptake per unit root mass	μg/g/h	n [F00778] SE [F00779]	Amount of nitrogen taken up per unit root mass per hour.
F01405	Root N uptake_molar inorganic N uptake per root area	μmol/m <sup>2</sup> /h		Hourly uptake of inorganic nitrogen in terms of micromoles of nitrogen per root area.
F01406	Root N uptake_molar NH <sub>4</sub> <sup>+</sup> uptake per root area	μmol/m <sup>2</sup> /h		Hourly uptake of nitrogen by roots per root surface area, as determined by a root bioassay using <sup>15</sup> NH <sub>4</sub> <sup>+</sup> . Reported in terms of μmol of NH <sub>4</sub> <sup>+</sup> .
F01407	Root N uptake_molar NO <sub>3</sub> <sup>-</sup> uptake per root area	μmol/m <sup>2</sup> /h		Hourly uptake of nitrogen by roots per root surface area, as determined by a root bioassay using <sup>15</sup> NO <sub>3</sub> <sup>-</sup> . Reported in terms of μmol of NO <sub>3</sub> <sup>-</sup> .



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01408	Root N uptake_molar organic N uptake per root area	$\mu\text{mol}/\text{m}^2/\text{h}$		Hourly uptake of organic nitrogen in terms of micromoles of nitrogen per root area.
F00769	Root N turnover_Annual turnover per ground area	$\text{g}/\text{m}^2/\text{yr}$		Annual root nitrogen turnover per meter square of ground area.
F00763	Root P uptake_Fraction maximum P uptake rate	fraction	n [F00764] SE [F00765]	Fraction of maximum phosphorus uptake rate achieved by age group specified in F00062 and F00063.
F00784	Root P uptake_Hourly uptake of H <sub>2</sub> PO <sub>4</sub> <sup>-</sup>	$\text{ng}/\text{mg}/\text{h}$	SD [F00785]	Hourly uptake of H <sub>2</sub> PO <sub>4</sub> , as determined by a root bioassay.
F00786	Root P uptake_Rate per root mass	$\text{pmol}/\text{g}/\text{s}$	SE [F00787]	Rate of phosphorus uptake per gram of root per second.
F00788	Root P uptake_Rate per root surface area per second	$\text{pmol}/\text{cm}^2/\text{s}$	SE [F00789]	Phosphorus uptake per unit root area, determined with tissue cassettes.
F00791	Root preferred N form			Form or forms of nitrogen preferentially taken up by roots. NH <sub>4</sub> -N is NH <sub>4</sub> , NO <sub>3</sub> -N is NO <sub>3</sub> , and ON is organic nitrogen. If multiple forms are preferred, their relative preference to each other is shown with >=, <=, or = symbols.
F00796	Root Rb uptake_Hourly Rb uptake per root mass	$\text{ng}/\text{mg}/\text{h}$	SD [F00798]	Hourly uptake rate of rubidium by roots, as determined by a root bioassay using <sup>86</sup> Rb <sup>+</sup> , reported in terms of nanograms taken up per fresh weight of roots per hour.
F00792	Root Rb uptake_Hourly uptake of molar Rb <sup>+</sup> per root fresh mass	$\text{nmol}/\text{g\_FW}/\text{h}$	SE [F00794] SD [F00795]	Hourly uptake rate of rubidium by roots per root fresh mass, as determined by a root bioassay using <sup>86</sup> Rb <sup>+</sup> , reported in nmol taken up per fresh weight of roots per hour.
F00802	Root respiration rate per root dry mass_CO <sub>2</sub> release	$\text{nmol\_CO}_2/\text{g}/\text{s}$	n [F00803] SE [F00804]	Root respiration rate of CO <sub>2</sub> per g root dry mass per second.
F00799	Root respiration rate per root dry mass_O <sub>2</sub> uptake	$\text{nmol\_O}_2/\text{g}/\text{s}$	n [F00800] SE [F00801]	Root respiration rate of O <sub>2</sub> per root dry mass, as measured in a respiration chamber.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00807	Root respiration rate per root length_CO2 release	nmol_CO <sub>2</sub> /m/s	n [F00808] SE [F00809]	Root respiration rate of CO <sub>2</sub> per meter of root length, as measured in a respiration chamber.
F00805	Root respiration rate per root mass_C release	μg_C/g/s	n [F00806]	Root respiration rate, converted from terms of nmol O <sub>2</sub> g <sup>-1</sup> s <sup>-1</sup> , converted to ug C g <sup>-1</sup> s <sup>-1</sup> using a respiratory quotient of 1.25. See Matamala & Schlesinger 2000 (DOI: 10.1046/j.1365-2486.2000.00374.x) for further details.
F00819	Root water uptake per root length	ml/cm/d		Daily water uptake in milliliters, per centimeter of root length.
F00815	Root water uptake per root surface area	cm <sup>3</sup> /cm <sup>2</sup> /s	n [F00816] SD [F00817] SE [F00818]	Water absorption rate per surface area of root.
F00822	Root water uptake_Hourly uptake rate per soil volume	cm <sup>3</sup> /cm <sup>3</sup> /h		Rate of water uptake by roots, divided by the volume of soil from which roots take up water.
F00812	Root water uptake_Hydraulic conductivity (Lp)	cm <sup>3</sup> /cm/s/(MPa × 10 <sup>6</sup> )	SE [F00813]	Hydraulic conductivity of roots.
F00841	Aboveground/belowground net primary production ratio	ratio	SE [F00842]	Annual aboveground net primary production (NPP) divided by belowground NPP.
F00838	Belowground/aboveground mass ratio	ratio	n [F00839] SE [F00840]	Ratio of belowground biomass (g m <sup>-2</sup> ) to aboveground biomass (g m <sup>-2</sup> ).
F00844	Fine root C/leaf C ratio	ratio		Ratio of fine root carbon to leaf carbon.
F00843	Fine root mass/leaf mass ratio	ratio		Ratio of fine-root mass to leaf mass.
F00846	Root mass fraction (RMF)	ratio	n [F00847] SE [F00848] Min [F00849] Max [F00850]	Root biomass divided by total plant biomass.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			Median [F01384] Upper quartile [F01385] Lower quartile [F01386]	
<b>F00851</b>	Root/shoot ratio	ratio	n [F00852] SE [F00853] Min [F01379] Max [F01380] Median [F01381] Upper quartile [F01382] Lower quartile [F01383]	Ratio of root tissue mass to shoot mass, where rhizomes are counted as shoot mass.
<b>F00854</b>	Coarse root/fine root mass ratio	ratio		Ratio of coarse root biomass to fine root biomass.
<b>F00864</b>	Root length fraction per root diameter class	percent	n [F00865] SE [F00866]	Percentage of root length composed of a specific root diameter class.
<b>F00867</b>	Root length fraction per root order class	percent	n [F00868] SE [F00869]	Percentage of root length composed of a specific root order.
<b>F00855</b>	Root mass fraction per root diameter class	percent	SE [F00857] Median [F01348] Upper quartile [F01349] Lower quartile [F01350] Min [F01351] Max [F01352]	Percentage of root biomass contributed by a particular diameter class.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00858	Root mass fraction per root order class	percent	n [F00859] SE [F00860]	Percentage of root biomass contributed by a particular root order.
F00884	Root mass_Fraction per species	percent		Percentage of total root mass composed of a particular species in a community.
F00870	Root necromass/biomass ratio	ratio	SE [F00871]	Dead root mass divided by live root mass.
F00872	Root surface area fraction per root order class	percent	SE [F00874]	Percentage of total root surface area that a specific root order comprises.
F00953	Root tip fraction per root diameter class	percent		Proportion of total number of root tips comprised by a particular diameter class.
F00875	Taproot mass fraction	percent	n [F00876] SE [F00877]	Percentage of root mass that consists of the taproot.
F00954	Rooting depth	cm	SE [F00955] Min [F01409] Max [F01410]	Depth which includes all observed roots.
F00959	Rooting depth_Extrapolated 50 percent rooting depth	m		Depth which includes 50% of total roots in profile, extrapolated from logistic dose-response model described in Schenk & Jackson 2003, DOI: 10.3334/ORNLDAAAC/659
F00960	Rooting depth_Extrapolated 95 percent rooting depth	m		Depth which includes 95% of total roots in profile, extrapolated from logistic dose-response model described in Schenk & Jackson 2003, 10.3334/ORNLDAAAC/659
F00957	Rooting depth_Interpolated 50 percent rooting depth	m		Depth which includes 50% of all observed roots in profile, calculated by fitting logistic dose-response curve to cumulative root profile and interpolating to maximum sampling depth, using the equation $D_{550} = D_{50} * (\frac{R_{max}}{0.5R_{S max}} - 1)^{\frac{1}{c}}$ where $R_{max}$ is the estimated total amount of

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
				roots, $R_{Smax}$ is the total amount of roots in sampled profile, and C is a dimensionless shape parameter.
F00958	Rooting depth_Interpolated 95 percent rooting depth	m		Depth which includes 95% of roots in profile, calculated by fitting logistic dose-response curve to cumulative root profile and interpolating to maximum sampling depth, using the equation $D_{S95} = D_{50} * (\frac{R_{max}}{0.95R_{Smax}} - 1)^{\frac{1}{c}}$ .
F00963	Rooting depth_Fraction roots in soil depth increment	percent	SD [F00964]	Proportion of observed roots (quantified by parameter in column F00961, "Notes_Rooting depth measurement") contained in depth interval.
F00956	Rooting depth_Active	cm		Depth where most of the root activity of interest occurs.
F00961	Notes_Rooting depth measurement	"length", "mass", "number", "surface", "unknown"		Measurement used to determine 50% and 95% rooting depth (e.g., mass, number, length).
F00962	Notes_Sampled to maximum rooting depth (yes, no)	Yes or No		Whether sampling depth exceeds maximum rooting depth.
F00885	Belowground biomass per ground area	g/m <sup>2</sup>	n [F00886] SE [F00887] SD [F00888] Median [F00889] Upper quartile [F00890] Lower quartile [F00891] Min [F00892] Max [F00893] 5 <sup>th</sup> percentile [F00894]	Root mass per square meter for the specified depth increment.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
			95 <sup>th</sup> percentile [F00895]	
<b>F00898</b>	Belowground biomass per plant	g/plant	n [F00899] SE [F00900] Min [F00901] Max [F00902]	Total root mass for the entire plant.
<b>F00896</b>	Belowground biomass per soil volume	kg/m <sup>3</sup>	n [F00897]	Kilograms of root mass per cubic meter of soil.
<b>F00917</b>	Belowground necromass per ground area	g/m <sup>2</sup>	n [F00918] SE [F00919] SD [F00920]	Dead root mass per square meter for the specified depth increment.
<b>F00909</b>	Root C content per ground area	kg/ha	n [F00910] SE [F00911] SD [F00912]	Total mass of root carbon per ground area.
<b>F00913</b>	Max_Root annual C content per ground area	Mg/ha	SE [F00914]	Maximum value of root carbon stock measured per year, in mass of carbon per ground area for the specified depth increment.
<b>F00915</b>	Min_Root annual C content per ground area	Mg/ha	SE [F00916]	Minimum value of root carbon stock per year, in mass of carbon per ground area.
<b>F00906</b>	Root C content per soil mass	mg/g	SE [F00908]	Mass of root carbon per gram of soil.
<b>F00196</b>	Root intact branch length	cm	n [F00197] SE [F00198]	Total root length contained within an intact root branch.
<b>F00934</b>	Root length density (RLD)_Root length per ground area	m/m <sup>2</sup>	n [F00935] SE [F00936] SD [F00937]	Root length divided by soil core cross-sectional area.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00938	Root length density (RLD)_Root length per soil volume	cm/cm <sup>3</sup>	n [F00939] SE [F00940] SD [F00941] Median [F01353] Min [F01354] Max [F01355] Upper quartile [F01356] Lower quartile [F01357]	Root length divided by the sampled soil volume.
F00930	Root length per minirhizotron frame	mm/frame	SE [F00932]	Total root length observed per minirhizotron frame.
F00944	Root length per minirhizotron surface area	m/m <sup>2</sup>	SE [F00945]	Meters of root length visible per square meter of minirhizotron surface.
F00942	Root length per plant	m/plant	n [F00943]	Total length of all roots for an entire plant.
F00927	Root length ratio (RLR)	m/g	n [F00928] SE [F00929]	Root length per gram of plant mass.
F00933	Root length_Fraction per species	percent		Percentage of total root length belonging to an individual species.
F00921	Root N content per ground area	kg/ha	n [F00922] SE [F00923]	Total mass of root nitrogen per ground area for the specified depth increment.
F00924	Root N_Root N mass per soil mass	mg/g	SE [F00926]	Mass of root nitrogen per gram of soil.
F00878	Root surface area per ground area	m <sup>2</sup> /m <sup>2</sup>	n [F00879] SE [F00880]	Total surface area of roots per square meter of ground area.
F00946	Root volume per ground area	cm <sup>3</sup> /m <sup>2</sup>	n [F00947] SE [F00948]	Total volume of roots per square meter of ground area for the specified depth increment.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F00661	Soil microbes_Fungal/bacterial rRNA copy number ratio	ratio	n [F00662] SE [F00663]	Ratio of fungal rRNA gene copy number to bacterial rRNA gene copy number ratio from DNA extraction and PCR runs from soil.
F00664	Soil microbes_Ergosterol content	mg/kg	SE [F00666]	Mass of ergosterol per gram of soil or growth medium.
F00667	Soil microbes_PLFA proxy for fungal mass per soil mass	nmol/g	SE [F00668]	Amount of phospholipid fatty acid 18:2 $\omega$ 6.9 lost during soil incubation, used as an indicator of fungal biomass in the soil.
F01335	Soil microbes_PFLA 18: 2 $\omega$ 6.9 mass per soil mass_indicator for soil fungus	$\mu$ g/g		Concentration by mass of phospholipid-derived fatty acid 18:2 $\omega$ 6.9 in soil, used as an indicator for soil fungal content.
F01336	Soil microbes_PLFA 18: 2 $\omega$ 6.9 molar concentration per soil mass_indicator for soil fungus	nmol/g		Nanomoles of phospholipid-derived fatty acid 18:2 $\omega$ 6.9 in soil per soil mass, used as an indicator for soil fungal content. This value can be multiplied by 2 to serve as a proxy for soil fungal mass in milligrams.
F01337	Soil microbes_PLFA molar concentration per soil mass_indicator for soil microbes	nmol/g		Nanomoles in soil of a phospholipid-derived fatty acid used as an indicator for soil microbes (i15:0, a15:0, i16:0, 16:1 $\omega$ 9, 16:1 $\omega$ 7c, 10Me16:0, cy17:0, i17:0, a17:0, 18:1 $\omega$ 7, or cy19:0) per gram of soil.
F00980	Soil pH_water		SE [F00981]	Mean pH of soil at data collection location, measured in water.
F01402	Notes_Soil pH_Water			Notes pertaining to data in column F00980 (Soil pH_water). "Method unspecified" means that the data in column F00980 are not confirmed in the source to have been measured in water. "Direct measure of liquid media" means that the plants grew in a liquid medium, such as Hoagland's solution, which could be measured directly without dilution.
F01400	Soil pH_Salt			Mean pH of soil at data collection location, measured in a salt solution.



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01403	Notes_Soil pH_Salt			The type of salt used to measure the data in "Soil pH_Salt" [F01400].
F00983	Notes_Soil type			Name of soil in sampling area, as described in original data source.
F00984	Soil horizon			Soil horizon from which sample is taken.
F00985	Soil depth	cm		Depth of soil profile.
F00982	Soil texture			Textural class of soil in sampling area.
F00986	Soil texture_Fraction sand	percent		Mean percentage of sand (particles 0.05-2 mm) in the sampled soil.
F00987	Soil texture_Fraction silt	percent		Mean percentage of silt (particles 0.002-0.05 mm) in the sampled soil.
F00988	Soil texture_Fraction clay	percent		Mean percentage of clay (particles less than 0.002 mm) in the sampled soil.
F00989	Soil organic matter content	percent	SE [F00990]	Percentage of organic matter in the sampled soil.
F00991	Soil bulk density	g/cm <sup>3</sup>	SE [F00992]	M/V where M is the mass of the soil sample under field conditions and V is the volume of the soil sample.
F00993	Soil bulk density_Isolated aggregates	g/cm <sup>3</sup>	SE [F00994]	Bulk density of isolated soil aggregates (clods).
F00998	Soil organic C content	mg/g		Amount of organic carbon per mass of soil.
F00999	Soil N content	mg/g	SE [F01000] SD [F01001]	Nitrogen concentration in soil as determined by soil test.
F01002	Soil N_Mineral N content	mg/kg		Mineral nitrogen concentration in soil.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F01003</b>	Soil N_NH4 content	mg/kg	SE [F01004] Min [F01005] Max [F01006]	Concentration of NH <sub>4</sub> <sup>+</sup> in soil, extracted by solution or method named in “Notes_Soil NH4 extraction method” column [F00080].
<b>F01007-F01008</b>	Soil N_NO3 content	mg/kg	Min [F1007] Max [F1008]	Concentration of NO <sub>3</sub> <sup>-</sup> in soil, extracted by solution or method named in “Notes_Soil NO3 extraction method” column [F00081].
<b>F00080</b>	Notes_Soil NH4 extraction method			Extractive solution or method used to extract soil NH <sub>4</sub> .
<b>F00081</b>	Notes_Soil NO3 extraction method			Extractive solution or method used to extract soil NO <sub>3</sub> .
<b>F00082</b>	Notes_Soil PO4 extraction method			Extractive solution or method used to extract soil PO <sub>4</sub> .
<b>F00083</b>	Notes_Soil P extraction method			Extractive solution or method used to extract soil P.
<b>F00084</b>	Notes_Soil K extraction method			Extractive solution or method used to extract soil K.
<b>F01012</b>	Soil nonpolar extractable content	percent		Percentage of soil that consists of fats, oils, and waxes.
<b>F01013</b>	Soil water soluble sugar fraction	percent		Percentage of soil that consists of water-soluble sugars, as determined by a phenol-sulfuric acid assay.
<b>F01014</b>	Soil water soluble phenol fraction	percent		Percentage of soil that consists of water-soluble phenols.
<b>F01017</b>	Soil N_Hydrolytic content	mg/kg		Concentration of hydrolytic nitrogen in soil.
<b>F01018</b>	Soil P content	mg/g	SE [F01019] SD [F01020]	Concentration of phosphorus in the soil
<b>F01021</b>	Soil P_Resin-extractable P	mg/kg		Resin-extractable soil phosphorus per kg of soil.
<b>F01023</b>	Soil Fe content	mg/kg		Concentration of iron in soil.
<b>F01024</b>	Soil Mg content	mg/kg		Concentration of magnesium in soil.
<b>F01025</b>	Soil Ca content	mg/kg		Concentration of calcium in soil.

<b>Column ID</b>	<b>Column name</b>	<b>Units / Format</b>	<b>Associated statistical metrics [Column ID]</b>	<b>Description</b>
<b>F01026</b>	Soil P_Inorganic P content_HCl extraction	mg/kg		Concentration of soil inorganic P extractable by diluted HCl. See Ushio et al. 2015 (DOI: 10.1111/1365-2435.12424) for further information.
<b>F01027</b>	Soil P_Inorganic P content_NaHCO3 extraction	mg/kg		Concentration of soil inorganic P extractable by NaHCO <sub>3</sub> .
<b>F01028</b>	Soil P_Al and Fe bound inorganic P content	mg/kg		Concentration of soil inorganic P loosely bound to aluminum and iron. See Ushio et al. 2015 (DOI: 10.1111/1365-2435.12424) for further information.
<b>F01029</b>	Soil P_Occluded inorganic P content	mg/kg		Concentration of occluded inorganic phosphorus in soil.
<b>F01030</b>	Soil P_Organic P content_NaHCO3 extraction	mg/kg		Concentration of soil organic P extractable by NaHCO <sub>3</sub> .
<b>F01031</b>	Soil P_Organic P content_NaOH extraction	mg/kg		Concentration of organic phosphorus extractable by NaOH. See Ushio et al. 2015 (DOI: 10.1111/1365-2435.12424) for further information.
<b>F01032</b>	Soil P_Organic P content_HCl extraction	mg/kg		Concentration of soil organic phosphorus extractable by concentrated hot HCl. See Ushio et al. 2015 (DOI: 10.1111/1365-2435.12424) for further information.
<b>F01033</b>	Soil P_Total extractable content	mg/kg		Total concentration of soil phosphorus yielded by the extraction method named in “Notes_Soil P extraction method” column [F00083].
<b>F01034</b>	Notes_Soil solution P concentration for P uptake	μmol		Molar concentration of phosphorus in solution used for determining phosphorus uptake.
<b>F01035</b>	Soil K_Extractable K content	mg/kg	SE [F01036]	Concentration of potassium in soil extractable by method named in “Notes_Soil K extraction method” column [F00084].

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F01037</b>	Soil K content	mg/g	SD [F01038]	Potassium concentration of soil as determined by soil test.
<b>F01039</b>	Soil Zn content	mg/g		Concentration of zinc in soil.
<b>F01040</b>	Soil Ca <sup>2+</sup> content	mg/kg		Concentration of calcium 2+ ion in soil.
<b>F01041</b>	Soil Mg <sup>2+</sup> content	mg/kg		Concentration of magnesium 2+ ion in soil.
<b>F01046</b>	Soil N content per ground area	Mg/ha	n [F01047] SE [F01048]	Megagrams of nitrogen in soil per hectare.
<b>F01049</b>	Soil P content per ground area	Mg/ha	n [F01050] SE [F01051]	Megagrams of phosphorus in soil per hectare.
<b>F01052</b>	Soil Ca_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable calcium per kilogram of soil.
<b>F01053</b>	Soil Mg_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable magnesium per kilogram of soil.
<b>F01054</b>	Soil K_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable potassium per kilogram of soil.
<b>F01055</b>	Soil Fe_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable iron per kilogram of soil.
<b>F01056</b>	Soil Mn_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable manganese per kilogram of soil.
<b>F01057</b>	Soil Na_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable sodium per kilogram of soil.
<b>F01059</b>	Soil cation exchange capacity (CEC)	cmol <sub>c</sub> /kg		Exchangeable cations that can be absorbed by soil.
<b>F01060</b>	Soil effective cation exchange capacity (ECEC)	cmol <sub>c</sub> /kg		The total basic and acidic cations in the soil, extracted with an unbuffered salt.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01068	Soil Ca_Exchangeable Ca <sup>2+</sup> mass	mg/kg	SE [F01069]	Concentration of exchangeable Ca <sup>2+</sup> ions in soil.
F01070	Soil K_Exchangeable K <sup>+</sup> mass	mg/kg	SE [F01071]	Concentration of exchangeable K <sup>+</sup> ions in soil.
F01072	Soil Mg_Exchangeable Mg <sup>2+</sup> mass	mg/kg	SE [F01073]	Concentration of exchangeable Mg <sup>2+</sup> ions in soil.
F01074	Soil Na_Exchangeable Na <sup>+</sup> mass	mg/kg	SE [F01075]	Concentration of exchangeable Na <sup>+</sup> ions in soil.
F01076	Soil N_Exchangeable NH <sub>4</sub> <sup>+</sup> mass	mg/kg	SE [F01077]	Concentration of exchangeable NH <sub>4</sub> <sup>+</sup> ions in soil.
F01078	Soil N_Exchangeable NO <sub>3</sub> <sup>-</sup> mass	mg/kg	SE [F01079]	Concentration of exchangeable NO <sub>3</sub> <sup>-</sup> ions in soil.
F01080	Soil P_Exchangeable PO <sub>4</sub> <sup>3-</sup> mass	mg/kg	SE [F01081]	Concentration of exchangeable PO <sub>4</sub> <sup>3-</sup> ions in soil.
F01082	Soil N_Annual available N per ground area	kg/ha/yr		Annual amount of N available in soil per hectare.
F01083	Soil N_Available N content	mg/kg		Concentration of plant-available nitrogen in soil.
F01084	Soil P_Available P content	mg/kg		Concentration of plant-available phosphorus in soil.
F01086	Soil P_Available P per ground area	kg/ha		Kilograms of plant-available phosphorus per hectare soil.
F01087	Soil redox potential	mV		Redox potential of soil.
F01098	Soil temperature	degrees_C		Mean temperature of soil at data collection site.
F01136	Soil water_Gravimetric water content	percent		Percentage of bulk soil mass that consists of water under field conditions.
F01099	Soil water_Volumetric content	percent	n [F01100] SE [F01101]	Percentage of bulk soil volume that consists of water under field conditions.
F01102	Soil water_Potential (SWP)	bars		Soil water potential, measured with a tensiometer and/or psychrometer.
F01103	Soil water_Matric potential	-cbars		Matric potential of soil.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01104	Soil water_Available soil water at field capacity	cm		Plant-available water in soil at field capacity.
F01105	Soil water_Storage capacity	mm/120cm		Water storage capacity of soil in mm per 120 cm depth. Based on amount of water retained in the soil at matric potentials > -1.5 MPa and < -300 hPa.
F01107	Soil aggregate stability in sodium oxalate fraction	percent fine particles in aggregate		Aggregate stability in sodium oxalate in percent fine particles in aggregate, determined by method described in: Strickland TC et al. 1988. <i>Soil Sci. Soc. Am. J.</i> 52: 829-833. DOI: 10.2136/sssaj1988.03615995005200030041x
F01106	Soil aggregate stability in water fraction	percent fine particles in aggregate		Aggregate stability in water in percent fine particles in aggregate, determined by method described in: Strickland TC et al. 1988. <i>Soil Sci. Soc. Am. J.</i> 52: 829-833.
F01016	Soil acid insoluble (lignin) fraction	percent		Percentage of soil that consists of acid-insoluble lignin.
F01015	Soil acid soluble cellulose and hemicellulose fraction	percent		Percentage of soil that consists of acid-soluble cellulose and hemicellulose.
F01022	Soil Al content	mg/kg		Concentration of aluminum in soil.
F01066	Soil Al_Exchangeable Al <sup>3+</sup> mass	mg/kg	SE [F01067]	Concentration of exchangeable Al <sup>3+</sup> ions in soil.
F01058	Soil Al_Exchangeable charge	mmol <sub>c</sub> /kg		Millimoles of charge of exchangeable aluminum per kilogram of soil.
F01061	Soil Al_saturation	percent		Proportion of soil adsorption complex saturated with Al cations.
F01042	Soil Al/Ca ratio	ratio		Ratio of aluminum to calcium in soil.
F01062	Soil base cation saturation	percent	n [F01063] SE [F01064]	Proportion of soil adsorption complex saturated with exchangeable cations.

<b>Column ID</b>	<b>Column name</b>	<b>Units / Format</b>	<b>Associated statistical metrics [Column ID]</b>	<b>Description</b>
<b>F01065</b>	Soil base cation saturation_ECEC	percent		Base cation saturation calculated based on effective cation exchange capacity (CEC).
<b>F00995</b>	Soil C content	mg/g	n [F00996] SE [F00997]	Carbon content of soil as determined by soil test or elemental analyzer.
<b>F01043</b>	Soil C content per ground area	Mg/ha	n [F01044] SE [F01045]	Megagrams of carbon in soil per hectare.
<b>F01009</b>	Soil C/N ratio	ratio	n [F01010] SE [F01011]	Carbon-to-nitrogen ratio of soil.
<b>F01108</b>	Soil microbes_Microbial biomass C content in soil	mg/kg		Mass of carbon from microbial biomass per gram of soil, measured by fumigation extraction.
<b>F01109</b>	Soil microbes_Microbial biomass N content in soil	mg/kg		Mass of nitrogen from microbial biomass per gram of soil, measured by fumigation extraction.
<b>F01110</b>	Soil microbes_Microbial biomass C/N ratio	ratio		Ratio of carbon to nitrogen in microbial biomass measured by fumigation extraction.
<b>F01111</b>	Soil microbes_Microbial biomass C content_Initial	mg/kg		Microbial biomass carbon concentration, measured by fumigation extraction, prior to the sowing of the studied plant.
<b>F01112</b>	Soil microbes_Microbial biomass N content_Initial	mg/kg		Microbial biomass nitrogen concentration, measured by fumigation extraction, prior to the sowing of the studied plant.
<b>F01113</b>	Soil microbes_Microbial biomass C/N ratio_Initial	ratio		Microbial biomass carbon-to-nitrogen ratio, measured by fumigation extraction, prior to the sowing of the studied plant.
<b>F01114</b>	Soil ergosterol content	mg/kg	n [F01115]	Concentration of ergosterol in soil, measured with HPLC (high-performance liquid chromatography).

<b>Column ID</b>	<b>Column name</b>	<b>Units / Format</b>	<b>Associated statistical metrics [Column ID]</b>	<b>Description</b>
<b>F01117</b>	Soil ergosterol C/microbial biomass C ratio	percent		Proportion of soil ergosterol carbon to soil microbial biomass carbon, expressed as a percentage.
<b>F01118</b>	Soil ergosterol content_Initial	mg/kg		Ergosterol concentration of soil prior to the sowing of the studied plant.
<b>F01119</b>	Soil ergosterol C/microbial biomass C ratio_Initial soil	percent		Ratio of ergosterol to microbial biomass C in soil prior to the sowing of the studied plant.
<b>F01120</b>	Rhizosphere soil_Glucosamine content	mg/g		Concentration of glucosamine measured in rhizosphere soil.
<b>F01121</b>	Rhizosphere soil_Muramic acid content	mg/kg		Concentration of muramic acid measured in rhizosphere soil.
<b>F01122</b>	Rhizosphere soil_Fungal C content	mg/g		Concentration of fungal organic carbon in rhizosphere soil, estimated based on calculated mean conversion factor of glucosamine to fungal C.
<b>F01123</b>	Rhizosphere soil_Bacterial C content	mg/g		Concentration of bacterial carbon in rhizosphere soil, estimated based on calculated mean conversion factor of muramic acid to fungal C.
<b>F01124</b>	Rhizosphere soil_Fungal C/bacterial C ratio	ratio		Ratio of rhizosphere soil fungal carbon to rhizosphere soil bacterial carbon.
<b>F01128</b>	Soil N_Daily net soil N mineralization_Lower bound	mg/kg/d		Lower net nitrogen mineralization per unit soil mass per day.
<b>F01129</b>	Soil N_Daily net soil N mineralization_Upper bound	mg/kg/d		Upper net nitrogen mineralization per unit soil mass per day.
<b>F01130</b>	Soil N_Gross N mineralization rate per ground area	mg/m <sup>2</sup> /d	n [F01131] SE [F01132]	Milligrams of soil nitrogen mineralized per square meter of ground area per day.
<b>F01133</b>	Soil N_Gross nitrification rate per ground area	mg/m <sup>2</sup> /d	n [F01134] SE [F01135]	Milligrams of soil mass nitrified per square meter of ground area per day.



Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01165	Stand age	yr		Time since establishment of tree stand or plantation.
F01166	Plant age_days	d		Age of plant in days.
F01167	Plant age_y	yr		Age of plant in years.
F01168	Plant age interval_Lower bound_d	d		The minimum plant age when plant age is presented as an interval.
F01169	Plant age interval_Upper bound_d	d		The maximum plant age when plant age is presented as an interval.
F01170	Stem diameter at breast height (DBH)	cm	n [F01171] SE [F01172] Min [F01173] Max [F01174]	Mean diameter of plant at breast height.
F01175	Stand canopy height	m	n [F01176] SE [F01177] Min [F01178] Max [F01179]	Mean height of canopy at measurement site.
F01185	Latitude_Main	decimal_degrees		The single latitude value that best describes the data collection location. This is, in order of priority: a single latitude reported in the original study; the average of a minimum and maximum latitude reported in the original study; or an estimated latitude based on the study location.
F01186	Longitude_Main	decimal_degrees		The single longitude value that best describes the collection location. This is, in order of priority: a single latitude reported in the original study; the average of a minimum and maximum latitude reported in the original study; or an estimated latitude based on the study location.
F01187	Latitude	decimal_degrees		Decimal degrees latitude of data collection location as reported in the original study.

<b>Column ID</b>	<b>Column name</b>	<b>Units / Format</b>	<b>Associated statistical metrics [Column ID]</b>	<b>Description</b>
<b>F01188</b>	Longitude	decimal_degrees		Decimal degrees longitude of data collection location as reported in the original study.
<b>F01189</b>	Latitude_Estimated	decimal_degrees		When original source does not specify coordinates, latitude estimated using available location description.
<b>F01190</b>	Longitude_Estimated	decimal_degrees		When original source does not specify coordinates, longitude estimated using available location description.
<b>F01191</b>	Min_Latitude	decimal_degrees		Minimum latitude of data collection location when a range of locations is listed in original source.
<b>F01192</b>	Max_Latitude	decimal_degrees		Maximum latitude of data collection location when a range of locations is listed in original source.
<b>F01193</b>	Min_Longitude	decimal_degrees		Minimum longitude of data collection location when a range of locations is listed in original source.
<b>F01194</b>	Max_Longitude	decimal_degrees		Maximum longitude of data collection location when a range of locations is listed in original source.
<b>F01221</b>	Notes_Location			Miscellaneous information about data collection location, given in original data source.
<b>F01156</b>	Notes_In situ, pot, or hydroponic	“in situ”, “pot”, “hydroponic”		Whether plant was studied in field or grown under controlled conditions.
<b>F01158</b>	Notes_Indoor or outdoor	Indoors or Outdoors		Whether data were collected indoors or outdoors.
<b>F01146</b>	Sample collection_Measurement year			Year of sample collection.
<b>F01147</b>	Sample collection_Measurement month			Month of sample collection.
<b>F01148</b>	Sample collection_Measurement day			Day of sample collection.

<b>Column ID</b>	<b>Column name</b>	<b>Units / Format</b>	<b>Associated statistical metrics [Column ID]</b>	<b>Description</b>
<b>F01149</b>	Sample collection_Year beginning collection			The first year of sample collection for data collected over multiple years.
<b>F01150</b>	Sample collection_Month beginning collection			The first month of sample collection for data collected over multiple months.
<b>F01151</b>	Sample collection_Day beginning collection			The first day of sample collection for data collected over multiple days.
<b>F01152</b>	Sample collection_Year ending collection			The final year of sample collection for data collected over multiple years.
<b>F01153</b>	Sample collection_Month ending collection			The final month of sample collection for data collected over multiple months.
<b>F01154</b>	Sample collection_Day ending collection			The final day of sample collection for data collected over multiple days.
<b>F01159</b>	Notes_Treatment types			Broad description of the type of experimental manipulation involved. This column differs from Notes_Treatments [F01160] in that the latter is a non-standardized description of the treatment in the original data source, whereas “Notes_Treatment types” attempts to group treatments together into standardized types.
<b>F01160</b>	Notes_Treatments			Experimental treatment group of data in row.
<b>F01161</b>	Notes_Treatment extent	numeral		Amount or extent of treatment applied
<b>F01162</b>	Notes_Units for extent of treatment			Unit for value in “extent of treatment”.
<b>F01219</b>	Climate_PFT_Biome equivalent_Poulter			Whether the data collection location is tropical, arid, temperate, boreal, or polar, based on Köppen-Geiger designation and Table 3 from the following paper: Poulter B, Ciais P, Hodson E., Lischke H., Maignan F., Plummer S, Zimmermann N.E. 2011. Plant functional type mapping for

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
				earth system models. <i>Geoscientific Model Development</i> 4: 993-1010. DOI: 10.5194/gmd-4-993-2011.
F01227	Climate			Climate category of sample collection location as described in original data source.
F01220	Climate_Koeppen-Geiger classification			Three-letter Köppen-Geiger climate designation, according to the main latitude and longitude and referenced against classifications from Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: <u>World Map of the Köppen-Geiger climate classification updated</u> . <i>Meteorol. Z.</i> , <b>15</b> , 259-263. DOI: 10.1127/0941-2948/2006/0130.
F01235	Elevation	m		Elevation of data collection location.
F01228	Mean annual precipitation (MAP)	mm		Mean annual precipitation of sample collection location.
F01230	Air temperature_Coldest month	degrees_C		Mean monthly air temperature for coldest month of year at collection location.
F01229	Air temperature_Warmest month	degrees_C		Mean monthly air temperature for warmest month of year at collection location.
F01231	Mean annual air temperature (MAT)	degrees_C		Mean annual air temperature of collection location.
F01236	Slope	degrees		Slope of data collection location.
F01237	Soil water_Water table depth	m	Min [F01411] Max [F01412]	Depth of water table below soil surface at sampling time.
F01232	Chamber_Photoperiod	h		Daily number of hours of light in growth chamber.
F01233	Chamber_Temperature_day	degrees_C		Maximum daytime temperature in controlled growing environment.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01234	Chamber_Temperature_night	degrees_C		Minimum nighttime temperature in controlled growing environment.
F00071	Notes_Collection method			Method used to collect data (e.g. minirhizotron, root excavation, sequential coring).
F00079	Notes_Miscellaneous notes			Miscellaneous information about data in row. Notes pertaining specifically to location or soil may be located in Notes_Location [F01221] or Notes_Soil type [F00983] instead.
F00085	Notes_Root decomposition_Litterbag mesh size	mm		Size of mesh used for litterbags or in-growth cores.
F00078	Notes_Root dynamics calculation method			Method used to calculate root dynamics data, such as production, mortality, or turnover.
F00590	Notes_Root turnover formula			Formula used to determine root turnover.
F00810	Notes_Temperature of respiration chamber	degrees_C		Temperature at which reported respiration rate occurs (i.e., temperature of respiration chamber during observation period).
F01294	Exposition period_main	d		In-growth duration, production duration, or decomposition duration in days. If exposition period is presented in months, period in days is estimated.
F00076	Notes_Ingrowth duration_d	d		Number of days between installation and collection of in-growth core or mesh bag.
F01283	Notes_Ingrowth duration_mo	mo		Number of months between installation and collection of in-growth core or mesh bag.
F01284	Notes_Production duration_d	d		Number of days during which production has been observed.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
F01280	Notes_Production duration_mo	mo		Number of months during which production has been observed.
F00077	Root decomposition duration_d	d		Number of days roots had been decomposing at time of collection.
F01285	Root decomposition duration_mo	mo		Number of months dead roots had been decomposing at time of collection.
F01243	Stand density_Stem number per ground area	stems/ha	n [F01244] SE [F01245]	Number of stems per hectare for a given stand of trees
F01246	Stand density_Stem number per species per ground area	stems/ha		Proportion of sampling environment occupied by stems of a particular species of tree.
F01247	Basal area_Stem area per species per ground area	m <sup>2</sup> /ha	n [F01248] SE [F01249]	Proportion of sampling environment ground area occupied by plant stems of a specific species.
F01250	Basal area_Stem area per ground area	m <sup>2</sup> /ha	n [F01251] SE [F01252]	Area of plant stems per unit ground area.
F01254	Leaf area index (LAI)_Per ground area	m <sup>2</sup> /m <sup>2</sup>		Leaf area per unit ground area.
F01256	Leaf area index (LAI)_Fraction of peak	unitless	SE [F01257]	Leaf area index (LAI) at a specific time divided by the maximum LAI observed during the entire observation period.
F01258	Stand fertilizer use efficiency (FUE)	ratio	SE [F01260]	Amount of nitrogen acquired by the plants per unit nitrogen available.
F01261	Photosynthesis per leaf area	μmol_CO <sub>2</sub> /m <sup>2</sup> /s	n [F01262] SE [F01263]	Mean net photosynthetic rate at light saturation.
F01264	Leaf N retranslocation	g_N/m <sup>2</sup> /yr	n [F01265] SE [F01266]	Rate of retranslocation of nitrogen before abscission of leaves.

Column ID	Column name	Units / Format	Associated statistical metrics [Column ID]	Description
<b>F01267</b>	Aboveground biomass per ground area	g/m <sup>2</sup>	SE [F01268]	Total biomass of aboveground plant parts, not including inflorescences, per square meter of ground area.
<b>F01269</b>	Aboveground biomass per plant	g/plant		Total aboveground mass of an individual plant.
<b>F01270</b>	Stem mass per plant	g/plant		Total mass of individual plant stem.
<b>F01271</b>	Leaf mass per plant	g/plant		Total mass of leaves for an individual plant.
<b>F01272</b>	Leaf mass ratio (LMR, LWR)	ratio		Leaf mass divided by whole plant weight. Also sometimes referred to as leaf weight ratio.
<b>F01273</b>	Aboveground growth_Annual net primary production per ground area	g/m <sup>2</sup> /yr	n [F01274] SE [F01275]	Aboveground plant biomass produced in one year per ground area.
<b>F01279</b>	Aboveground annual C production	Mg_C/ha/yr		Amount of aboveground plant carbon per ground area produced in one year.

## 7. References:

More details about *FRED* and the motivation for undertaking this monumental data compilation can be found in:

Iversen CM, McCormack ML, Powell AS, Blackwood CB, Freschet GT, Kattge J, Roumet C, Stover DB, Soudzilovskaia NA, Valverde-Barrantes OJ, van Bodegom PM, Violle C. 2017. Viewpoints: A global Fine-Root Ecology Database to address belowground challenges in plant ecology. *New Phytologist* 215: 15-26. <https://doi.org/10.1111/nph.14486>.

McCormack ML, Powell AS, Iversen CM. 2018. Letter: The Fine-Root Ecology Database version 2 - bigger, better, and free. *Eos, in press*.

## 8. Data Sources for FRED 2.0:

Please download associated file, **FRED2\_Data Sources\_20180518.pdf**, for full citations of each original data source; data sources followed by an asterisk were added between FRED 1.0 and FRED 2.0. In FRED 2.0, columns F00003, F00004, and F00005 also have the abbreviated and full citations, respectively, as well as a digital object identifier (DOI) for each data source.

## 9. Data Access:

FRED 2.0 is freely available to the public with unrestricted access. The data and companion files are available for download at <http://roots.ornl.gov/public-release>.



## **10. Changes from FRED 1.0 to 2.0:**

Compared to FRED 1.0, FRED 2.0 features a total increase of approximately 35,000 root trait observations, collected from over 400 additional sources.

### **Overview**

We have added 7950 new rows to FRED since version 1. However, some of the original rows of data from FRED 1.0 have been removed due to redundancy or poor data; for this reason, the highest Row ID (35475) exceeds the total number of rows in the dataset (35211). Data are unique to FRED 2.0 for all rows where “2” appears in column F00001 (Version\_FRED version number).

Rows 35446 to 35459 are attributed to FRED 1.0 in column F00001, although these rows are not present in FRED 1.0. This is because the data in these rows were moved from their original position (listed as covariate with a less-specific pool of roots) to new columns for the sake of greater clarity.

### **Plant Taxa Verification**

While FRED 1.0 used the Catalogue of Life ([www.catalogueoflife.org](http://www.catalogueoflife.org)) to verify accepted genus and species, those in FRED 2.0 were verified against The Plant List ([www.theplantlist.org](http://www.theplantlist.org)).

### **Quality Changes**

FRED 1.0 contained some erroneous or incomplete data which we corrected before releasing FRED 2.0. Some data which did not stand out during the quality-checking process for FRED 1.0 became more apparent when compared to a larger data pool for FRED 2.0. Other erroneous or incomplete data were reported by users or noticed in the process of entering new data. Users are encouraged to reach out to us through the contact page at [roots.ornl.gov/contact](http://roots.ornl.gov/contact) to report suspicious or erroneous data.

Table 5 lists corrections made between FRED 1.0 and FRED 2.0.

### **New Traits and Metrics – New Columns**

Our focus during the expansion from FRED 1.0 to FRED 2.0 was to fill existing columns rather than add columns for new traits. However, we did add new columns if we deemed them particularly useful or if new statistical metrics, such as n, SE, or SD, were available for existing values.

Table 6 lists new columns present in FRED 2.0 that were not present in FRED 1.0.

### **Removal of Columns**

We most often removed columns because we considered them redundant with other columns, as with columns F00015 (Plant taxonomy\_Group, redundant with F01291, Plant taxonomy\_Group\_TPL) and F00190 (Root tips per root mass, redundant with F00192, Specific root tip abundance (SRTA)), or because they were empty or underpopulated, as with columns F00098 (n\_Root aerenchyma porosity fraction) and F00363 (Root lipid content per root C content).

Table 7 lists columns which were present in FRED 1.0 but removed from FRED 2.0.

### **Renaming of Columns**

We renamed columns for further clarity, as in column F00582 (Root turnover\_Annual root system replacement, formerly Root turnover\_Mass per year), or to reflect a slight change or correction in the column's function or content, as in columns F00980 (Soil pH\_Water, formerly Soil pH) and F001156 (Notes\_In situ, pot, or hydroponic; formerly Notes\_In situ or pot).

Table 8 lists columns which were present in FRED 1.0 but renamed for FRED 2.0.

**Table 5:** Corrections made between FRED 1.0 and FRED 2.0. Correction numbers 40-55 are instances where we added or clarified data, but an error was not present.

Correction no.	Column IDs	Row IDs	Correction needed
1	F00703	25460 - 25487	Erroneous data corrected.
2	F00705	25460 - 25487	Erroneous data corrected.
3	F00705	858	SE was filled even though F00703 was blank.
4	F01161	4151, 4152, 4153	Treatment amounts were incorrect.
5	F01234	14180-14261	Corrected night temperature
6	F01234, F01231	17095-17507, 17601-18262, 18278-18292, 18673-18688, 18767-19179, 19273-19878, 19921-19935, 20277-20292, 20368-20780, 20874-21535, 21551-21565, 21946-21961	Corrected MAT values that had been mistakenly reported as nighttime chamber temperature.
7	F00950, F01292, F01293, F01295, F01296	25806-25838	Data had been ordered improperly, describing the wrong species.
8	F00679, F00681	14817-14841	Diameter values corrected.
9	F00679	3598-3621	Values incorrectly presumed to be mean root diameter deleted.
10	F00679	908	Root diameter corrected.
11	F00289, F00291, F00413, F00415	7275-7290	Data reported in source in incorrect units corrected.
12	F00802, F00803, F00804		Name, unit, and definitions should be per dry mass, not fresh mass.
13	F00799	15809-15821	Erroneous data corrected.
14	F00709	15821	Suspicious value corrected
15	F00277, F00279	1622-1661	Root P content and SE multiplied by 100 to correct for mis-labeled scale in source.
16	F00005	1842-1849	DOI corrected.
17	F00078, F00079	4342-4349, 4361-4368, 25337-25342	Notes intended for column F00079 had been erroneously added to F00078.
18	F01166	17046-17072	Corrected erroneous data.

19	F00017	2832-2836	Corrected misspelled family name.
20	F00980, F00981	9845-9997	Moved erroneously added values from column F00980 to column F00981.
21	F00964, F00980, F00981	26771-26778	Improperly-entered data in F00964 and F00980 moved to F00980 and F00981, respectively.
22	F01159	7775	Corrected "Nitrogen" to "nitrogen addition"
23	F01287	9787	Corrected erroneous data.
24	F00097	5397	Corrected erroneous data.
25	F00537	6250	Corrected erroneous data.
26	F00722, F00723, F00724, F00725, F00726	7318-7320	Data had been entered into wrong columns; had to be rearranged.
27	F00889, F00890, F00891, F00892, F00893	6559-6633	Data had been entered into wrong columns; had to be rearranged
28	F00953	26480-26481	Impossibly negative digitized values changed to zero.
29	F00980	25348-25351	Corrected erroneous data.
30	F01003, F01004	25003-25018	Corrected erroneous data.
31	F01295	8865-8876	Data had been entered in wrong rows; moved from 8865-8874 to 8867-8876.
32	F01156	5796-5805	Corrected from "pot" to " <i>in situ</i> ".
33	F00134, F00136		Corrected mislabeled units.
34	F00055	15056-15111	Changed belowground part to FR.
35	F00055	15020-15037	Changed belowground part to FR.
36	F00249, F00251	19-30, 43-54	Moved root Ca and SE from rows 43-54 to rows 19-30; data had been mislabeled in source.
37	F00413	19-30, 43-54	Moved root C/N from rows 43-54 to rows 19-30; data had been mislabeled in source.
38	F00179, F00182	8552-8563	Moved data from F00179 to F00182
39	F00004	4866-4867	Corrected long-form citation for San Jose and Miragaya 1981.

40	F00068, F00069, F00070	24163-24193	Added missed or neglected data from initial entry.
41	F01233	14180-14261	Filled day temperature
42	F00055	24763-25018	Empty or ambiguous data filled or clarified.
43	F00261, F00358	15770-15808	Added missed or neglected data from initial entry.
44	F00003, F00004	17018-17072	Updated citation for article that was added prior to publishing.
45	F00004	24005-24092	Updated citation for article that was added prior to publishing.
46	F00004	26576-26583	Updated citation for article that was added prior to publishing.
47	F00980	14690	Added soil pH value.
48	F00003	18347-18672, 19990- 20276, 21620-21945	Abbreviated citation corrected.
49	F01159		Changed all capitalized treatment types to lowercase in accordance with FRED's standards.
50	F00190, F00191, F00192, F00194	7577-7600, 7679-7680	Moved values from columns F00190 and F00191 to columns F00192 and F00194 after converting them accordingly.
51	F00961	2417	Removed "section" from rooting depth measurement column; unable to make sense of it.
52	F00638, F00639, F00640	908-917, 934-936, 9517-9522, 14968- 14980, 25575-25598	Copied data from F00622 and F00626 to F00638 wherever applicable.
53	F00568, F00569		Changed data in F00568 and F00569 from growth per 20cm of coarse root to growth per cm of coarse root, in the interest of standardization. Added note to that effect to miscellaneous notes column.
54	F00043, F00079		Changed plant photosynthetic pathway to a single designation wherever TRY categorical traits package had presented two. Reason supporting the chosen designation was added to miscellaneous notes column.
55		14436-14607	Removed Bohning and Lusanandana 1952 because it was deemed too specific.

**Table 6:** Columns added between FRED 1.0 and FRED 2.0.

<b>Column ID</b>	<b>Column name</b>
<b>F01239</b>	n_Root phenols content
<b>F01310</b>	n_Root dry matter content (RDMC)
<b>F01311</b>	Root xylem cross-sectional area
<b>F01312</b>	n_root xylem cross-sectional area
<b>F01313</b>	Root number of vessels
<b>F01314</b>	n_Root number of vessels
<b>F01315</b>	Root xylem cross-sectional fraction
<b>F01316</b>	n_Root xylem cross-sectional fraction
<b>F01317</b>	Root cross-sectional area
<b>F01318</b>	n_root cross-sectional area
<b>F01319</b>	Root vessel cross-sectional area
<b>F01320</b>	n_Root vessel cross-sectional area
<b>F01321</b>	Root vessel number per root cross-sectional area
<b>F01322</b>	n_Root vessel number per root cross-sectional area
<b>F01323</b>	SE_Root cross-sectional area
<b>F01324</b>	Root stele cross-sectional area
<b>F01325</b>	SE_Root stele cross-sectional area
<b>F01326</b>	SE_Root vessel cross-sectional area
<b>F01327</b>	SE_Root number of vessels
<b>F01328</b>	Root phenols_chlorogenic acid molarity per root mass
<b>F01329</b>	Root starch fraction
<b>F01330</b>	Root condensed tannins
<b>F01331</b>	n_Root condensed tannins
<b>F01332</b>	SE_Root condensed tannins
<b>F01333</b>	Mycorrhiza_PLFA proxy for mycorrhizal hyphal C per soil mass
<b>F01334</b>	SE_Mycorrhiza_PLFA proxy for mycorrhizal hyphal C per soil mass
<b>F01335</b>	Soil microbes_PLFA 18: 2w6.9 mass per soil mass_indicator for soil fungus
<b>F01336</b>	Soil microbes_PLFA 18: 2w6.9 molar concentration per soil mass_indicator for soil fungus
<b>F01337</b>	Soil microbes_PLFA molar concentration per soil mass_indicator for soil microbes
<b>F01338</b>	n_Root Al content
<b>F01339</b>	Root branching intensity_root tips per total root length
<b>F01340</b>	n_Root branching intensity_root tips per total root length
<b>F01341</b>	SE_Root branching intensity_root tips per total root length
<b>F01342</b>	Min_Root branching intensity_root tips per total root length

<b>F01343</b>	Max_Root branching intensity_root tips per total root length
<b>F01344</b>	Accepted subspecies_TPL
<b>F01345</b>	Median_Specific root length (SRL)
<b>F01346</b>	Upper quartile_Specific Root Length
<b>F01347</b>	Lower quartile_Specific root length
<b>F01348</b>	Median_Root mass fraction per root diameter class
<b>F01349</b>	Upper quartile_Root mass fraction per root diameter class
<b>F01350</b>	Lower quartile_Root mass fraction per root diameter class
<b>F01351</b>	Min_Root mass fraction per root diameter class
<b>F01352</b>	Max_Root mass fraction per root diameter class
<b>F01353</b>	Median_Root length density (RLD)_Root length per soil volume
<b>F01354</b>	Min_Root length density (RLD)_Root length per soil volume
<b>F01355</b>	Max_Root length density (RLD)_Root length per soil volume
<b>F01356</b>	Upper quartile_Root length density (RLD)_Root length per soil volume
<b>F01357</b>	Lower quartile_Root length density (RLD)_Root length per soil volume
<b>F01358</b>	SE_Root growth_Annual surface area production per ground area
<b>F01359</b>	Median_Root turnover_Mass per year
<b>F01360</b>	Max_Root turnover_Mass per year
<b>F01361</b>	Upper quartile_Root turnover_Mass per year
<b>F01362</b>	Lower quartile_Root turnover_Mass per year
<b>F01363</b>	Min_Root turnover_Mass per year
<b>F01364</b>	Root decomposition_Fraction C remaining
<b>F01365</b>	SE_Root decomposition_Fraction C remaining
<b>F01366</b>	Median_Root relative growth rate (RGR)_Root length
<b>F01367</b>	Max_Root relative growth rate (RGR)_Root length
<b>F01368</b>	Upper quartile_Root relative growth rate (RGR)_Root length
<b>F01369</b>	Lower quartile_Root relative growth rate (RGR)_Root length
<b>F01370</b>	Min_Root relative growth rate (RGR)_Root length
<b>F01371</b>	Median_Root branching intensity_root tips per higher order root length
<b>F01372</b>	Upper quartile_Root branching intensity_root tips per higher order root length
<b>F01373</b>	Lower quartile_Root branching intensity_root tips per higher order root length
<b>F01374</b>	Median_Root porosity fraction
<b>F01375</b>	Min_Root porosity fraction
<b>F01376</b>	Max_Root porosity fraction
<b>F01377</b>	Upper quartile_root porosity fraction
<b>F01378</b>	Lower quartile_Root porosity fraction
<b>F01379</b>	Min_Root/shoot ratio
<b>F01380</b>	Max_Root/shoot ratio

<b>F01381</b>	Median_Root/shoot ratio
<b>F01382</b>	Upper quartile_Root/shoot ratio
<b>F01383</b>	Lower quartile_Root/shoot ratio
<b>F01384</b>	Median_Root mass fraction (RMF)
<b>F01385</b>	Upper quartile_Root mass fraction (RMF)
<b>F01386</b>	Lower quartile_Root mass fraction (RMF)
<b>F01387</b>	SE_Root lipid content
<b>F01388</b>	SE_Root Na content
<b>F01389</b>	n_Root hemicellulose content per root mass
<b>F01390</b>	n_Root lignin/N ratio
<b>F01391</b>	n_Root lipid content
<b>F01392</b>	Plant N uptake_daily uptake of molar 15NH <sub>4</sub> <sup>+</sup> per shoot dry mass
<b>F01393</b>	SE_Plant N uptake_daily uptake of molar 15NH <sub>4</sub> <sup>+</sup> per shoot dry mass
<b>F01394</b>	Plant N uptake_daily uptake of molar 15NO <sub>3</sub> <sup>-</sup> per shoot dry mass
<b>F01395</b>	SE_Plant N uptake_daily uptake of molar 15NO <sub>3</sub> <sup>-</sup> per Shoot dry mass
<b>F01396</b>	Plant N uptake_daily uptake of molar 15N-Glycine per shoot dry mass
<b>F01397</b>	SE_Plant N uptake_daily uptake of molar 15N-Glycine per shoot dry mass
<b>F01398</b>	Plant N uptake_daily uptake of molar total 15N per shoot dry mass
<b>F01399</b>	SE_Plant N uptake_daily uptake of molar total 15N per shoot dry mass
<b>F01400</b>	Soil pH_Salt
<b>F01402</b>	Notes_Soil pH_Water
<b>F01403</b>	Notes_Soil pH_Salt
<b>F01404</b>	Root exudation_molar C exudation rate per root area
<b>F01405</b>	Root N uptake_molar inorganic N uptake per root area
<b>F01406</b>	Root N uptake_molar NH <sub>4</sub> <sup>+</sup> uptake per root area
<b>F01407</b>	Root N uptake_molar NO <sub>3</sub> <sup>-</sup> uptake per root area
<b>F01408</b>	Root N uptake_molar organic N uptake per root area
<b>F01409</b>	Rooting depth_min
<b>F01410</b>	Rooting depth_max
<b>F01411</b>	Min_Soil water_Water Table depth
<b>F01412</b>	Max_Soil water_Water Table depth
<b>F01413</b>	Species name unresolved
<b>F01414</b>	Root forks per root length



**Table 7:** Columns removed between FRED 1.0 and FRED 2.0.

<b>Column ID</b>	<b>Column name</b>
F00015	Plant taxonomy_Group
F00016	Plant taxonomy_Order
F00021	Accepted genus_CoL
F00022	Accepted species_CoL
F00023	Accepted subspecies_CoL
F00033	Plant growth form_Graminoid
F00034	Plant growth form_Succulent
F00035	Plant growth form_Climber
F00036	Plant growth form_Parasitic
F00037	Plant growth form_Aquatic
F00038	Plant growth form_Epiphyte
F00039	Plant growth form_Crop
F00040	Plant growth form_Palmoid
F00045	Plant growth form_Woodiness detail
F00046	Growth form_Leaf compoundness
F00047	Growth form_Number of leaflets
F00070	Notes_Minirhizotron depth of field
F00098	n_Root aerenchyma porosity fraction
F00099	SE_Root aerenchyma porosity fraction
F00127	SE_Root stele/root cortex ratio
F00158	n_Root phellem
F00159	SD_Root phellem
F00183	n_Root branching intensity_root tips per higher order root length
F00188	n_Root branching architecture_Root length per higher order root length
F00189	SE_Root branching architecture_Root length per higher order root length
F00190	Root tips per root mass
F00191	SE_Root tips per root mass
F00200	n_Root fractal dimension
F00201	SE_Root fractal dimension
F00202	SD_Root fractal dimension
F00217	n_Root tips per minirhizotron frame
F00241	SE_Root cellulose content per root C content
F00274	n_Root 15N content
F00275	SE_Root 15N content
F00309	n_Root Cl- ion content
F00332	n_Root Na+ content
F00341	SE_Root ash C content per root C content

<b>F00363</b>	Root lipid content per root C content
<b>F00372</b>	SD_Root acid insoluble fraction (AIF)
<b>F00440</b>	Root non-structural carbohydrate content per root C content
<b>F00494</b>	n_Root mortality_Cumulative root length mortality per minirhizotron frame
<b>F00512</b>	SE_Root growth_Annual net new length production per ground area
<b>F00516</b>	n_Root relative growth rate (RGR)_Root length
<b>F00530</b>	n_Root growth_Daily mass production per ground area
<b>F00541</b>	n_Root growth_Length production per minirhizotron frame
<b>F00555</b>	Root growth_Annual length production per minirhizotron or rhizotron surface
<b>F00614</b>	SE_Mycorrhiza_Fraction medium-distance exploration mycorrhizae
<b>F00618</b>	SE_Mycorrhiza_Fraction mycorrhizal root tips that are living
<b>F00627</b>	n_Mycorrhiza_Fraction root length colonized by EM mycorrhizae
<b>F00634</b>	SD_Mycorrhiza_Visual estimate of root colonization intensity
<b>F00647</b>	n_Root nodules_Nodule mass on living roots per ground area
<b>F00650</b>	n_Root nodules_Nodule mass on dead roots per ground area
<b>F00665</b>	n_Soil egosterol content
<b>F00767</b>	Root Ca turnover_Annual turnover per ground area
<b>F00768</b>	Root Mg_Annual turnover per ground area
<b>F00783</b>	Root P turnover_Annual turnover per ground area
<b>F00790</b>	Root K_Annual turnover per ground area
<b>F00793</b>	n_Root Rb uptake_Hourly uptake of molar Rb <sup>+</sup> per root fresh mass
<b>F00797</b>	n_Root Rb uptake_Hourly Rb uptake per root mass
<b>F00811</b>	Root temperature
<b>F00814</b>	Root water uptake_Treatment/control ratio
<b>F00821</b>	SE_Root water uptake per root length
<b>F00820</b>	n_Root water uptake per root length
<b>F00845</b>	n_Fine root C/leaf C ratio
<b>F00856</b>	n_Root mass fraction per root diameter class
<b>F00861</b>	Root mass fraction per root functional class
<b>F00862</b>	n_Root mass fraction per root functional class
<b>F00863</b>	SE_Root mass fraction per root functional class
<b>F00873</b>	n_Root surface area fraction per root order class
<b>F00904</b>	n_Root growth_Number of roots per area of ingrowth screen
<b>F00907</b>	n_Root C content per soil mass
<b>F00925</b>	n_Root N_Root N mass per soil mass
<b>F00931</b>	n_Root length per minirhizotron frame
<b>F01116</b>	SE_Soil egosterol content
<b>F01155</b>	Notes_Growing season (yes/no)

<b>F01157</b>	Notes_Level of artificiality
<b>F01253</b>	Vegetation species richness
<b>F01259</b>	n_Stand fertilizer use efficiency (FUE)
<b>F01277</b>	n_Belowground biomass production per plant per growing season
<b>F01278</b>	SE_Belowground biomass production per plant per growing season

**Table 8:** Columns renamed between FRED 1.0 and FRED 2.0.

<b>Column ID</b>	<b>Name in FRED 1.0</b>	<b>Name in FRED 2.0</b>
<b>F00100</b>	Root aerenchyma fraction of crosssection	Root aerenchyma fraction of cross section
<b>F00101</b>	n_Root aerenchyma fraction of crosssection	n_Root aerenchyma fraction of cross section
<b>F00102</b>	SE_Root aerenchyma fraction of crosssection	SE_Root aerenchyma fraction of cross section
<b>F00134</b>	Root conduit density	Root conduit number per root stele area
<b>F00135</b>	n_Root conduit density	n_Root conduit number per root stele area
<b>F00136</b>	SE_Root conduit density	SE_Root conduit number per root stele area
<b>F00582</b>	Root turnover_Mass per year	Root turnover_Annual root system replacement
<b>F00583</b>	n_Root turnover_Mass per year	n_Root turnover_Annual root system replacement
<b>F00584</b>	SE_Root turnover_Mass per year	SE_Root turnover_Annual root system replacement
<b>F00769</b>	Root N turnover_Annual turnover per ground area	Root N_Annual turnover per ground area
<b>F00799</b>	Root respiration rate per root fresh mass_O2 uptake	Root respiration rate per root dry mass_O2 uptake
<b>F00800</b>	n_Root respiration rate per root fresh mass_O2 uptake	n_Root respiration rate per root dry mass_O2 uptake
<b>F00801</b>	SE_Root respiration rate per root fresh mass_O2 uptake	SE_Root respiration rate per root dry mass_O2 uptake
<b>F00802</b>	Root respiration rate per root fresh mass_CO2 release	Root respiration rate per root dry mass_CO2 release
<b>F00803</b>	n_Root respiration rate per root fresh mass_CO2 release	n_Root respiration rate per root dry mass_CO2 release
<b>F00804</b>	SE_Root respiration rate per root fresh mass_CO2 release	SE_Root respiration rate per root dry mass_CO2 release
<b>F00956</b>	Rooting depth_Main	Rooting depth_Active
<b>F00980</b>	Soil pH	Soil pH_Water
<b>F00981</b>	SE_Soil pH	SE_Soil pH_Water
<b>F01108</b>	Soil microbes_Microbial biomass C content	Soil microbes_Microbial biomass C content in soil
<b>F01109</b>	Soil microbes_Microbial biomass N content	Soil microbes_Microbial biomass N content in soil
<b>F01156</b>	Notes_In situ or pot	Notes_In situ, pot, or hydroponic
<b>F01272</b>	Leaf weight ratio (LWR, LMR)	Leaf mass ratio (LMR, LWR)

<b>F01276</b>	Belowground biomass production per plant per growing season	Root growth_Mass production per plant per growing season
<b>F01290</b>	Plant taxonomy_Order_TPL	Plant taxonomy_Order_APW

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### **11. Contact Us:**

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