nature portfolio

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Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed
☐	☒ The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒ The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒ A description of all covariates tested
☐	☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒ For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☐	☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☐	☒ Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	GetData Graph Digitizer v.2.24
Data analysis	"metafor" package, "glmulti" package, "lmer" package in R version 4.0.4, Excel 2021

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our policy

The data generated or analyzed in this study are included in this article and its supplementary information files. The dataset of this study is publicly accessible on Figshare (https://doi.org/10.6084/m9.figshare.21656219.v1)

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	This study does not involve this information.
Population characteristics	This study does not involve this information.
Recruitment	This study does not involve this information.
Ethics oversight	This study does not involve this information.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	This study compiled a database of carbon-degrading extracellular enzyme (C-EEAs) activities under experimental nitrogen addition in global natural terrestrial ecosystems. We document the mycorrhizal type of each study site based on the site-specific dominant plant species. The aim is to explore the underlying mechanisms associated with the responses of C-EEAs to nitrogen addition. Our global analyses, for the first time, discovered the importance of mycorrhizal associations in predicting C-EEAs under N addition.
Research sample	In total, we collected 59 published articles, including 84 independent field experimental observations under N addition.
Sampling strategy	Based on the original dataset from Chen et al. (2018b), we updated this dataset by April 2022 by searching for peer-reviewed articles from Web of Science (http://apps.webofknowledge.com/), Google Scholar (http://scholar.google.com/), and China National Knowledge Infrastructure (http://www.cnki.net/). The keywords and phrases used for the article selection were: (a) "nitrogen addition" or "nitrogen fertilizer" or "nitrogen amendment" or "nitrogen enrichment" or "nitrogen elevated" or "nitrogen deposition"; (b) "glucosidase" or "cellobiosidase" or "xylosidase" or "cellulase"; (c) "peroxidase" or "phenol oxidase" or "polyphenol oxidase" or "lignin modifying enzymes"; (d) "terrestrial" or "soil" or "land". A PRISMA flow diagram (in Supplementary) shows the procedures we used for the article selection.
Data collection	Yuanliu Hu, Ji Chen, Guoying Chen and Qi Deng collected all the data. The PRISMA flow diagram (in Supplementary) showed the procedure we used for the selection of studies.
Timing and spatial scale	Timing scale: data published before April 2022, as early as data published in June 2004. Spatial scale: global natural terrestrial ecosystems, which were then classified into forest and grassland.
Data exclusions	Observations were not included in our dataset if they met any of the following exclusion criteria: (1) duplicate reports of the same studies, ensuring the independence of each study; (2) C-EEAs observations with soil sampling depth below 20 cm, because the strongest interaction between plants and microorganisms generally occurs in the topsoil; (3) N addition studies with inputs of other nutrients (e.g., P, K, Ca, compost or slurry additions) or other global change treatments (e.g., CO2, warming or precipitation change).
Reproducibility	Most of the experiments in the database reported the number of replicate and the standard deviation/error. Each step of statistical analysis is described. The dataset of this study is publicly accessible on Figshare (https://doi.org/10.6084/m9.figshare.21656219.v1)
Randomization	Samples were grouped by locations, climate conditions, fertilization regimes, and ecosystem types, as described in detail in the Methods section.
Blinding	We are blinded to group allocation mainly through three ways. Firstly, we set explicit article selection rules before compiling the data from the published studies, as stated clearly in the Method section. Secondly, our database includes data from all published studies that fulfilled our rules of including experiments. For statistical analyses, observations are grouped by established and commonly used methods (e.g., the mycorrhizal type of each ecosystem is identified based on the site-specific dominant plant species).

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging