
Supplementary information

Meta-analysis reveals global variations in plant diversity effects on productivity

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Supplementary information for
Meta-analysis reveals global variations in plant diversity effects on
productivity

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Supplementary Table 1

The number of observations of different magnitudes of relative complementarity effect

(CE), relative selection effect (SE) and relative net biodiversity effect (NE) across global

plant mixture and diversity experiments. Very negative: ≤ -0.5 ; negative: $> -0.5 \text{ \& } \leq -0.05$;

slightly negative: $> -0.05 \text{ \& } \leq 0$; slightly positive: $> 0 \text{ \& } \leq 0.05$; positive: $> 0.05 \text{ \& } \leq 0.5$; very

positive: > 0.5 .

Number of observations	NE	CE	SE
Very positive	939	706	293
Positive	1947	1871	1609
Slightly positive	345	406	1088
Slightly negative	302	388	756
Negative	1018	1169	735
Very negative	47	58	117

Supplementary Table 2

Exact *P* values for the relationships between diversity effects with potential factors shown in each figure. The relationships are evaluated using mixed-effects meta-regression models followed by robust variance estimation (RVE). See the detailed methods in Data analysis. CE, SE, NE, CE – SE: relative complementarity effect, relative selection effect, relative net biodiversity effect, the difference between relative complementarity effect and relative selection effect; SR: species richness; PD: phylogenetic diversity; Mixing N-fixing: mixing N-fixing and non-N-fixing plants; inequality: species biomass inequality of monocultures; FD: functional diversity; CWM: community-weighted mean; SLA: specific leaf area; MAT: mean annual temperature.

Figure	Dataset	Dependent variable	Factor	<i>F</i> value	<i>P</i> value
Figure 3	Entire dataset (<i>n</i> = 4598)	CE	SR	9.56	0.002
			PD	12.73	< 0.001 (4×10^{-4})
			Mixing N-fixing	29.28	< 0.001 (1×10^{-7})
			Inequality	12.50	< 0.001 (4×10^{-4})
		SE	SR	10.15	0.002
			PD	0.007	0.932
			Mixing N-fixing	0.014	0.907
			Inequality	33.93	< 0.001 (1×10^{-8})
Figure 4	Data with leaf N content (<i>n</i> = 2273)	CE	Leaf N FD	32.20	< 0.001 (5×10^{-8})
			Leaf N CWM	9.60	0.002
		SE	Leaf N FD	0.95	0.331
			Leaf N CWM	0.11	0.738
Figure 5	Entire dataset (<i>n</i> = 4598)	CE	Age	55.98	< 0.001 (4×10^{-13})
			Ecosystem	15.29	< 0.001 (7×10^{-14})
			Plant type	9.58	< 0.001 (8×10^{-5})
		SE	Age	14.20	< 0.001 (2×10^{-4})
			Ecosystem	6.35	< 0.001 (1×10^{-5})
			Plant type	2.45	0.087
Extended Data Fig. 2	Entire dataset (<i>n</i> = 4598)	NE	SR	14.01	< 0.001 (2×10^{-4})
			PD	19.41	< 0.001 (1×10^{-5})
			Inequality	109.93	< 0.001 ($< 1 \times 10^{-16}$)

			Age	22.28	$< 0.001 (3 \times 10^{-6})$
			Mixing N-fixing	50.53	$< 0.001 (5 \times 10^{-12})$
			Ecosystem	16.33	$< 0.001 (8 \times 10^{-15})$
			Plant type	5.45	0.005
		CE - SE	SR	5.56	0.019
			PD	7.08	0.008
			Inequality	2.17	0.141
			Age	55.04	$< 0.001 (6 \times 10^{-13})$
			Mixing N-fixing	9.04	0.003
			Ecosystem	11.99	$< 0.001 (7 \times 10^{-11})$
			Plant type	9.41	$< 0.001 (1 \times 10^{-4})$
Extended Data Fig. 4	Entire dataset ($n = 4598$)	Modified SE	Inequality	12.30	$< 0.001 (5 \times 10^{-4})$
Extended Data Fig. 5	Data with leaf N content ($n = 2273$)	NE	Leaf N FD	5.87	0.016
			Leaf N CWM	13.61	$< 0.001 (3 \times 10^{-4})$
Extended Data Fig. 6	Data with leaf N content and without mixing of N-fixing and non-N-fixing plants ($n = 1398$)	CE	Leaf N FD	6.44	0.012
			Leaf N CWM	0.14	0.704
Extended Data Fig. 7	Data with SLA ($n = 2784$)	CE	SLA FD	2.66	0.104
			SLA CWM	3.10	0.080
		SE	SLA FD	0.23	0.631
			SLA CWM	0.30	0.587
		NE	SLA FD	1.14	0.287
			SLA CWM	2.38	0.125
Extended Data Fig. 8	Data in the field ($n = 3091$)	CE	MAT	0.01	0.928
			Aridity index	2.32	0.129
		SE	MAT	3.00	0.085
			Aridity index	1.83	0.177
		NE	MAT	1.66	0.198
			Aridity index	0.19	0.661

Supplementary Table 3

The effects of realized-biomass-based functional diversity (Rao's *Q*) and community-weighted mean (CWM) of leaf N content (LN) and specific leaf area (SLA) on relative complementarity effect (CE), selection effect (SE), and net biodiversity effect (NE). The relationships are evaluated using two-sided t-tests in mixed-effects meta-regression models followed by robust variance estimation (RVE), based on the datasets of plant mixture observations with leaf N data ($n = 2273$) and SLA data ($n = 2784$). Different from those shown in the main results, Rao's *Q* and CWM here are estimated based on the realized proportion of species biomass in the mixture when conducting biomass measurements.

Dependent variable	Factor	Estimate	CI	<i>P</i> value
CE	LN Rao's <i>Q</i>	0.059	(0.025, 0.093)	< 0.001 (8×10^{-4})
	LN CWM	0.036	(0.008, 0.064)	0.013
	SLA Rao's <i>Q</i>	0.006	(-0.013, 0.024)	0.562
	SLA CWM	-0.012	(-0.033, 0.009)	0.253
SE	LN Rao's <i>Q</i>	-0.046	(-0.077, -0.014)	0.005
	LN CWM	-0.007	(-0.026, 0.013)	0.490
	SLA Rao's <i>Q</i>	-0.023	(-0.044, -0.002)	0.035
	SLA CWM	-0.008	(-0.022, 0.006)	0.251
NE	LN Rao's <i>Q</i>	0.006	(-0.016, 0.028)	0.602
	LN CWM	0.030	(-0.004, 0.064)	0.084
	SLA Rao's <i>Q</i>	-0.018	(-0.029, -0.007)	0.001
	SLA CWM	-0.028	(-0.059, 0.002)	0.070

Supplementary Table 4

The results of the mixed-effect models for relative complementarity effect (CE), selection effect (SE), and net biodiversity effect (NE) by simultaneously examining different potential predictors in a full model. The relationships are evaluated using two-sided t-tests in mixed-effects meta-regression models followed by robust variance estimation (RVE), based on the entire dataset of plant mixture observations ($n = 4598$). CI, bootstrapped confidence interval; SR, species richness; PD, phylogenetic diversity; BiomassCV, biomass coefficient of variance of monoculture biomass indicating inequality; Nfix, mixture with N-fixing species.

Dependent variable	Factor	Estimate	CI	P value
CE	SR	0.038	(0.006, 0.070)	0.022
	PD	0.022	(0.006, 0.038)	0.007
	BiomassCV	0.019	(0.002, 0.037)	0.030
	Nfix	0.152	(0.097, 0.207)	< 0.001 (8.6×10^{-8})
	Age	0.067	(0.040, 0.094)	< 0.001 (2.1×10^{-6})
	Ecosystem type	-	-	< 0.001 (7.2×10^{-6})
	Plant type	-	-	0.893
SE	SR	0.020	(0.005, 0.034)	0.007
	PD	-0.013	(-0.034, 0.008)	0.216
	BiomassCV	0.058	(0.040, 0.076)	< 0.001 (1.4×10^{-9})
	Nfix	-0.012	(-0.062, 0.039)	0.648
	Age	-0.033	(-0.058, -0.009)	0.008
	Ecosystem type	-	-	0.174
	Plant type	-	-	0.697
NE	SR	0.060	(0.014, 0.106)	0.010
	PD	0.006	(-0.023, 0.035)	0.687
	BiomassCV	0.077	(0.061, 0.093)	< 0.001 ($< 1 \times 10^{-16}$)
	Nfix	0.133	(0.096, 0.170)	< 0.001 (8.9×10^{-12})
	Age	0.037	(0.001, 0.072)	0.042
	Ecosystem	-	-	< 0.001 (2.3×10^{-7})
	Plant type	-	-	0.967

50 **Supplementary Table 5**

51 **PRISMA 2020 checklist.** The checklist was originated from <https://www.prisma-statement.org/> (Page *et al.* 2021).

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	<i>Title</i>
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	<i>Summary – completed items 1-10</i>
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	<i>Introduction 1st paragraph</i>
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	<i>Introduction last paragraph</i>
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	<i>Methods-Data collection</i>
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	<i>Methods-Data collection</i>
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	<i>Methods-Data collection</i>
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	<i>Methods-Data collection</i>
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	<i>Methods-Data collection</i>
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	<i>Methods-Data collection</i>
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	<i>Methods-Data collection</i>
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	<i>Methods-Data collection</i>
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	<i>Methods - Diversity effect</i>
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing	<i>Methods -Data</i>

Section and Topic	Item #	Checklist item	Location where item is reported
		against the planned groups for each synthesis (item #5)).	<i>collection</i>
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	<i>Methods - Data collection, Diversity effect</i>
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	<i>Methods -Data analysis</i>
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	<i>Methods -Data analysis</i>
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	<i>Methods -Data analysis</i>
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	<i>Methods -Data analysis</i>
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	<i>Methods -Data analysis</i>
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	<i>Methods -Data analysis</i>
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Extended Data Fig.1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Supplementary Table 7
Study characteristics	17	Cite each included study and present its characteristics.	Supplementary Table 8
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Too large dataset to present risk for each study
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Too large dataset to present risk for each study
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	<i>Methods -Data analysis</i>
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	<i>Results</i>
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	<i>Results</i>
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	<i>Methods -Data</i>

Section and Topic	Item #	Checklist item	Location where item is reported
			<i>analysis</i>
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	<i>Methods -Data analysis</i>
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	<i>Results</i>
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	<i>Discussion</i>
	23b	Discuss any limitations of the evidence included in the review.	<i>Discussion</i>
	23c	Discuss any limitations of the review processes used.	<i>Discussion</i>
	23d	Discuss implications of the results for practice, policy, and future research.	<i>Discussion</i>
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	N/A
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	N/A
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	<i>Acknowledgements</i>
Competing interests	26	Declare any competing interests of review authors.	<i>Competing interests</i>
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	<i>Data availability, Code availability</i>

53 **Supplementary Table 6**

54 **A list of previous syntheses and meta-analyses that were investigated to assist in building the dataset for this study.**

No.	Publications
1	Brisson, J., Rodriguez, M., Martin, C.A. & Proulx, R. (2020) Plant diversity effect on water quality in wetlands: a meta-analysis based on experimental systems. <i>Ecological Applications</i> , 30 , e02074.
2	Cardinale, B.J., Wright, J.P., Cadotte, M.W., Carroll, I.T., Hector, A., Srivastava, D.S., Loreau, M. & Weis, J.J. (2007) Impacts of plant diversity on biomass production increase through time because of species complementarity. <i>Proceedings of the National Academy of Sciences</i> , 104 , 18123-18128.
3	Chen, X. & Chen, H.Y.H. (2019) Plant diversity loss reduces soil respiration across terrestrial ecosystems. <i>Global Change Biology</i> , 25 , 1482-1492.
4	Chen, X., Chen, H.Y.H., Searle, E.B., Chen, C. & Reich, P.B. (2021) Negative to positive shifts in diversity effects on soil nitrogen over time. <i>Nature Sustainability</i> , 4 , 225-232.
5	Feng, Y., Schmid, B., Loreau, M., Forrester, D.I., Fei, S., Zhu, J., Tang, Z., Zhu, J., Hong, P., Ji, C., Shi, Y., Su, H., Xiong, X., Xiao, J., Wang, S. & Fang, J. (2022) Multispecies forest plantations outyield monocultures across a broad range of conditions. <i>Science</i> , 376 , 865-868.
6	Marron, N. & Epron, D. (2019) Are mixed-tree plantations including a nitrogen-fixing species more productive than monocultures? <i>Forest Ecology and Management</i> , 441 , 242-252.
7	Wang, C., Zhang, W., Li, X., Hou, Y. & Wu, J. (2021) A global meta-analysis of the effects of plant diversity on biomass partitioning in grasslands. <i>Environmental Research Letters</i> , 16 , 064083.
8	Zhang, Y., Chen, H.Y.H. & Reich, P.B. (2012) Forest productivity increases with evenness, species richness and trait variation: a global meta-analysis. <i>Journal of Ecology</i> , 100 , 742-749.
9	Zheng, L.-T., Chen, H.Y.H., Biswas, S.R., Bao, D.-F., Fang, X.-C., Abdullah, M. & Yan, E.-R. (2021) Diversity and identity of economics traits determine the extent of tree mixture effects on ecosystem productivity. <i>Journal of Ecology</i> , 109 , 1898-1908.

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56 **Supplementary Table 7**57 **List of publications excluded from the dataset of this study with the reasons of exclusion.**

No.	Publication
Reason: biomass data not available	
1	Adekunle, Y.A. <i>et al.</i> (2014) Mixture productivity of cassava-based cropping system and food security under humid tropical conditions. <i>Food and Energy Security</i> , 3 , 46-60.
2	Adeniyi, O.R. (2001) An economic evaluation of intercropping with tomato and okra in a rain forest zone of Nigeria. <i>The Journal of Horticultural Science and Biotechnology</i> , 76 , 347-349.
3	Aerts, R. <i>et al.</i> (1990) Competition in Heathland along an Experimental Gradient of Nutrient Availability. <i>Oikos</i> , 57 , 310-318.
4	AKEY, W.C., JURIK, T.W. & DEKKER, J. (1990) Competition for light between velvetleaf (<i>Abutilon theophrasti</i>) and soybean (<i>Glycine max</i>). <i>Weed Research</i> , 30 , 403-411.
5	Alberti, G. <i>et al.</i> (2017) Tree functional diversity influences belowground ecosystem functioning. <i>Applied Soil Ecology</i> , 120 , 160-168.
6	Almaz, M. <i>et al.</i> (2017) Integrated application of poultry manure and chemical fertiliser on soil chemical properties and nutrient uptake of maize and soybean. <i>Malaysian Journal of Soil Science</i> , 21 , 13-28.
7	Amoako-Atta, B., Omolo, E.O. & Kidega, E.K. (1983) Influence of Maize, Cowpea and Sorghum Intercropping Systems on Stem-/Pod-Borer Infestations. <i>International Journal of Tropical Insect Science</i> , 4 , 47-57.
8	Ampoorter, E. <i>et al.</i> (2015) Disentangling tree species identity and richness effects on the herb layer: first results from a German tree diversity experiment. <i>Journal of Vegetation Science</i> , 26 , 742-755.
9	Archambault, C. <i>et al.</i> (2019) Evergreenness influences fine root growth more than tree diversity in a common garden experiment. <i>Oecologia</i> , 189 , 1027-1039.
10	Armstrong, R.A. (1985) Field experiments on competition between three foliose lichens using the de Wit experimental design. <i>Environmental and Experimental Botany</i> , 25 , 369-374.
11	Austin, A.N. <i>et al.</i> (2023) Stronger effect of individual species' traits than shading on aquatic plant community productivity and interspecific competition. <i>Aquatic Botany</i> , 103647.
12	Austin, M.N. & Marais, J.N. (1987) Methods of presenting intercropping results and preliminary results with Zea mays and Phaseolus vulgaris. <i>South African Journal of Plant and Soil</i> , 4 , 1-6.
13	Banik, P. (1996) Evaluation of Wheat (<i>Triticum aestivum</i>) and Legume Intercropping Under 1:1 and 2:1 Row-replacement Series System. <i>Journal of Agronomy and Crop Science</i> , 176 , 289-294.
14	Banik, P. <i>et al.</i> (2006) Wheat and chickpea intercropping systems in an additive series experiment: Advantages and weed smothering. <i>European Journal of Agronomy</i> , 24 , 325-332.
15	Barker, J.S.F. (1971) Ecological differences and competitive interaction between <i>Drosophila melanogaster</i> and <i>Drosophila simulans</i> in small laboratory populations. <i>Oecologia</i> , 8 , 139-156.
16	Barrat-Segretain, M.-H. & Elger, A. (2004) Experiments on growth interactions between two invasive macrophyte species. <i>Journal of Vegetation Science</i> , 15 , 109-114.
17	Bauhus, J., Khanna, P.K. & Menden, N. (2000) Aboveground and belowground interactions in mixed plantations of Eucalyptus globulus and Acacia mearnsii. <i>Canadian Journal of Forest Research</i> , 30 , 1886-1894.
18	Bedoussac, L. & Justes, E. (2011) A comparison of commonly used indices for evaluating species interactions and intercrop efficiency: Application to durum wheat–winter pea intercrops. <i>Field Crops Research</i> , 124 , 25-36.
19	Beets, W. (1977) Multiple cropping of maize and soya beans under a high level of crop management. <i>Netherlands Journal of Agricultural Science</i> , 25 , 95-102.
20	Bello, J. <i>et al.</i> (2019) Complementary water uptake depth of Quercus petraea and Pinus sylvestris in mixed stands during an extreme drought. <i>Plant and Soil</i> , 437 , 93-115.
21	Bini, D. <i>et al.</i> (2013) Eucalyptus grandis and Acacia mangium in monoculture and intercropped plantations: Evolution of soil and litter microbial and chemical attributes during early stages of plant development. <i>Applied Soil Ecology</i> , 63 , 57-66.
22	Bissegger, S. <i>et al.</i> (2014) Catabolic profiles of microbial communities in relation to plant identity and diversity in free-floating plant treatment wetland mesocosms. <i>Ecological Engineering</i> , 67 , 190-197.
23	Borken, W. & Beese, F. (2005) Soil respiration in pure and mixed stands of European beech and Norway spruce following removal of organic horizons. <i>Canadian Journal of Forest Research</i> , 35 , 2756-2764.
24	Bu, W. <i>et al.</i> (2017) Interspecific and intraspecific variation in specific root length drives aboveground biodiversity effects in young experimental forest stands. <i>Journal of Plant Ecology</i> , 10 , 158-169.
25	Burdon, J.J. & Whitbread, R. (1979) Rates of Increase of Barley Mildew in Mixed Stands of Barley and Wheat. <i>Journal of Applied Ecology</i> , 16 , 253-258.
26	Burrows, R.L. & Pfleger, F.L. (2002) Arbuscular mycorrhizal fungi respond to increasing plant diversity. <i>Canadian Journal of Botany</i> , 80 , 120-130.
27	Carvalho, L.B.d., Alves, P.L.d.C.A. & Martins, J.V.F. (2011) Effects of plant density and proportion on the interaction between wheat with alexandergrass plants. <i>Bragantia</i> , 70 .
28	Chang, J.F. & Shibles, R.M. (1985) An analysis of competition between intercropped cowpea and maize II. The effect of fertilization and population density. <i>Field Crops Research</i> , 12 , 145-152.
29	Chen, B. <i>et al.</i> (2019) Carbon and nitrogen accumulation and interspecific competition in two algae species, Pyropia haitanensis and Ulva lactuca, under ocean acidification conditions. <i>Aquaculture International</i> , 27 , 721-733.
30	Chen, H. <i>et al.</i> (2017) Root chemistry and soil fauna, but not soil abiotic conditions explain the effects of plant diversity on root decomposition. <i>Oecologia</i> , 185 , 499-511.
31	Chodak, M. & Niklińska, M. (2010) The effect of different tree species on the chemical and microbial properties of reclaimed mine soils. <i>Biology and Fertility of Soils</i> , 46 , 555-566.
32	Choi, H.G. & Norton, T.A. (2005) Competition and facilitation between germlings of Ascophyllum nodosum and Fucus vesiculosus. <i>Marine Biology</i> , 147 , 525-532.
33	Choudhary, V.K. & Choudhury, B.U. (2018) A STAGGERED MAIZE–LEGUME INTERCROP ARRANGEMENT INFLUENCES YIELD, WEED SMOTHERING AND NUTRIENT BALANCE IN THE EASTERN HIMALAYAN REGION OF INDIA. <i>Experimental Agriculture</i> , 54 , 181-200.
34	Clark, E.A. & Francis, C.A. (1985) Transgressive yielding in bean: Maize intercrops; interference in time and space. <i>Field Crops Research</i> , 11 , 37-53.
35	Collins, A.S. <i>et al.</i> (2007) Competitiveness of Three Leguminous Cover Crops with Yellow Nutsedge (Cyperus esculentus) and Smooth Pigweed (Amaranthus hybridus). <i>Weed Science</i> , 55 , 613-618.
36	Cong, W.-F. <i>et al.</i> (2015) Plant species richness leaves a legacy of enhanced root litter-induced decomposition in soil. <i>Soil Biology and Biochemistry</i> , 80 , 341-348.
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Reason: mix and mono not paired

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Reason: not mix or diversity experiment

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59 **Supplementary Table 8**

60 **List of publications and the number of observations extracted from each publication (excluding outliers) included in the**
 61 **dataset of this study.**

Study No.	Publications	Observation No.
1	Agami, M. & Reddy, K.R. (1990) Competition for space between <i>Eichhornia crassipes</i> (Mart.) Solms and <i>Pistia stratiotes</i> L. cultured in nutrient-enriched water. <i>Aquatic Botany</i> , 38 , 195-208.	3
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Supplementary Table 9

Basic statistical summary of continuous variables in different datasets. PD, phylogenetic diversity; Biomass C.V., coefficient of variation of monoculture biomass, indicating inequality; CWM, community weighted mean; MAT, mean annual temperature.

Dataset	Variable	Mean	Standard deviation	Range
Entire dataset ($n = 4598$)	Species richness	2.59	1.32	2–18
	PD	286	195	0–1151
	Biomass C.V.	0.481	0.351	0–1.778
	Age (yr^{-1})	2.66	5.16	0.06–72.00
Dataset with leaf N ($n = 2273$)	Species richness	2.73	1.44	2–12
	PD	320	227	4–1151
	Biomass C.V.	0.465	0.346	0–1.778
	Age (yr^{-1})	3.99	5.87	0.06–72.00
	Leaf N Rao's Q	0.488	0.533	0–3.487
	Leaf N CWM (mg g^{-1})	23.67	6.05	10.40–40.26
Dataset with SLA ($n = 2784$)	Species richness	2.60	1.253	2–12
	PD	300	197	0–940
	Biomass C.V.	0.472	0.346	0–1.778
	Age (yr^{-1})	2.91	4.64	0.06–72.00
	SLA Rao's Q	0.244	0.415	0–3.411
	SLA CWM ($\text{mm}^2 \text{mg}^{-1}$)	21.96	6.61	4.96–50.77
Dataset for field experiments ($n = 3091$)	Species richness	2.83	1.53	2–18
	PD	323	204	0–1151
	Biomass C.V.	0.498	0.348	0–1.778
	Age (yr^{-1})	3.73	6.00	0.13–72.00
	MAT ($^{\circ}\text{C}$)	10.67	4.88	-0.10–27.46
	Aridity index	0.8700	0.4212	0.0931–4.1062

Supplementary Table 10

Mean diversity effects before and after removing outliers, as a test of sensitivity to outliers. The mean relative diversity effect (NE), complementarity effect (CE) and selection effect (SE) are evaluated using two-sided t-tests in mixed-effects meta-regression models followed by robust variance estimation (RVE). The mean and 95% confidence interval (CI) of intercepts indicate their mean effects and uncertainties. *n*, number of observations; Significance, the significance of the mean effects, i.e., intercepts, comparing with 0 (*P* values). As CE, SE, and NE were paired with each other, an observation was removed if any of its CE, SE, and NE was an outlier.

Dataset	Diversity effect measures	Before the exclusion of potential outliers				Potential outlier (<i>n</i>)	After the exclusion of potential outliers			
		<i>n</i>	Mean	CI	<i>P</i> value		<i>n</i>	Mean	CI	<i>P</i> value
Entire dataset	CE	4680	0.117	(0.089, 0.145)	4.5×10^{-15}	82	4598	0.101	(0.077, 0.125)	2.1×10^{-15}
	SE	4680	0.057	(0.040, 0.075)	4.5×10^{-10}	82	4598	0.053	(0.038, 0.069)	2.3×10^{-11}
	NE	4680	0.172	(0.139, 0.206)	$< 1.0 \times 10^{-16}$	82	4598	0.152	(0.128, 0.177)	$< 1.0 \times 10^{-16}$
	lnRR	4680	0.107	(0.085, 0.130)	$< 1.0 \times 10^{-16}$	82	4598	0.100	(0.079, 0.121)	$< 1.0 \times 10^{-16}$
Dataset with leaf N	CE	2341	0.166	(0.121, 0.211)	6.7×10^{-12}	68	2273	0.139	(0.104, 0.175)	3.4×10^{-13}
	SE	2341	0.033	(0.011, 0.055)	3.7×10^{-3}	68	2273	0.036	(0.015, 0.057)	1.1×10^{-3}
	NE	2341	0.198	(0.154, 0.241)	3.0×10^{-16}	68	2273	0.175	(0.139, 0.210)	$< 1.0 \times 10^{-16}$
	lnRR	2341	0.129	(0.099, 0.159)	5.0×10^{-15}	68	2273	0.123	(0.094, 0.152)	1.0×10^{-14}
Dataset with SLA	CE	2857	0.160	(0.120, 0.199)	7.9×10^{-14}	73	2784	0.134	(0.103, 0.166)	3.8×10^{-15}
	SE	2857	0.049	(0.028, 0.071)	8.6×10^{-6}	73	2784	0.050	(0.030, 0.070)	1.7×10^{-6}
	NE	2857	0.207	(0.167, 0.247)	$< 1.0 \times 10^{-16}$	73	2784	0.181	(0.148, 0.214)	$< 1.0 \times 10^{-16}$
	lnRR	2857	0.138	(0.110, 0.166)	$< 1.0 \times 10^{-16}$	73	2784	0.129	(0.102, 0.155)	$< 1.0 \times 10^{-16}$
Dataset for field experiments	CE	3165	0.185	(0.141, 0.228)	6.6×10^{-15}	74	3091	0.163	(0.127, 0.199)	3.0×10^{-16}
	SE	3165	0.049	(0.020, 0.078)	1.1×10^{-3}	74	3091	0.043	(0.022, 0.064)	6.0×10^{-5}
	NE	3165	0.231	(0.175, 0.286)	3.3×10^{-14}	74	3091	0.200	(0.164, 0.236)	$< 1.0 \times 10^{-16}$
	lnRR	3165	0.149	(0.116, 0.183)	8.0×10^{-16}	74	3091	0.138	(0.108, 0.168)	1.0×10^{-16}

Supplementary Table 11

Comparison of different methods for the simulation of sampling variances for the lnRR of plant mixture effects. The ‘corrected $1/W_r$ ’ was based on $1/W_r$ and corrected by its relationship with sampling variance as shown in Data analysis. The different simulation methods were based on Nakagawa *et al.* (2023).

Methods for sampling variances	‘corrected $1/W_r$ ’	‘all cases’ approach	‘multiplicative’ approach
Estimate	0.100	0.096	0.096
SE	0.011	0.011	0.011
CI	(0.079, 0.121)	(0.076, 0.117)	(0.075, 0.117)

References

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