**SUPPLEMENTAL MATERIAL for “Global response patterns of plant functional traits to combined nitrogen and phosphorus addition are governed by additive interactions”**

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**Table S1** Summary of studies and sites included in the meta-analysis\*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Citation** | **Site name** | **Latitude** | **Longitude** | **Elevation** | ***T*g** | ***AI*g** | ***PAR*g** | **Ecosystem type** | **Experiment type** | **N addition rate (g m-2)** | **P addition rate (g m-2)** |
| (Aerts *et al.*, 2003) | bovenpolder | 51.85 | 5.62 | 6 | 9.6 | 1.56 | 478 | grassland | field | 10 | 5 |
| bethunepolder | 52.07 | 5.58 | 8 | 9.7 | 1.81 | 474 | grassland | field | 10 | 5 |
| (Arens *et al.*, 2008) | pituffik | 76.55 | -68.57 | 229 | 4.2 | 0.25 | 855 | tundra | field | 5 | 2.5 |
| (Augustine *et al.*, 2003) | mpala\_ranch | 0.28 | 37.88 | 1775 | 18.6 | 1.29 | 868 | grassland | field | 40 | 10 |
| (Aydin & Uzun, 2005) | ondokuz | 41.35 | 36.25 | 4 | 14.1 | 0.75 | 698 | grassland | field | 18 | 5.2 |
| (Bennett & Adams, 2001) | hamersley | -22.28 | 117.67 | 606 | 24.5 | 0.13 | 1078 | grassland | field | 5 | 2.5 |
| (Blanke *et al.*, 2012) | alpflix | 46.53 | 9.65 | 2029 | 6.6 | 1.45 | 836 | grassland | field | 5 | 6 |
| (Boeye *et al.*, 1997) | buitengoor | 51.20 | 5.17 | 36 | 10.3 | 1.46 | 481 | wetland | field | 20 | 5 |
| goorken | 51.32 | 5.12 | 27 | 10.1 | 1.51 | 480 | wetland | field | 20 | 5 |
| zwarte\_beek | 51.08 | 5.30 | 56 | 10.1 | 1.55 | 483 | wetland | field | 20 | 5 |
| (Borer *et al.*, 2014) | sedgwick | 34.7 | -119.88 | 1122 | 12.8 | 0.49 | 883 | grassland | field | 10 | 10 |
| (Bowman *et al.*, 1993) | niwot\_ridge | 40.06 | -105.58 | 3471 | 6.1 | 0.40 | 967 | tundra | field | 25 | 25 |
| (Bown *et al.*, 2007) | purokohukohu | NA | NA | NA | NA | NA | NA | NA | pot | 7.14 (mM) | 0.42 (mM) |
| (Cárate-Tandalla *et al.*, 2018) | bombuscaro | -4.12 | -78.97 | 1163 | 22.4 | 1.08 | 651 | forest | field | 5 | 1 |
| cajanuma | -4.12 | -79.18 | 2511 | 14.4 | 1.01 | 684 | forest | field | 5 | 1 |
| sanfrancisco | -3.97 | -79.18 | 2163 | 16.2 | 0.80 | 660 | forest | field | 5 | 1 |
| (Carswell *et al.*, 2005) | okarito | -43.20 | 170.30 | NA | NA | NA | NA | NA | pot | 5 (mM) | 1.33 (mM) |

**Table S1 (cont.)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Citation** | **Site name** | **Latitude** | **Longitude** | **Elevation** | ***T*g** | ***AI*g** | ***PAR*g** | **Ecosystem type** | **Experiment type** | **N addition rate (g m-2)** | **P addition rate (g m-2)** |
| (Cleland *et al.*, 2019) | bldr.us | 39.97 | -105.23 | 1649 | 11.0 | 0.30 | 830 | grassland | field | 10 | 10 |
| bnch.us | 44.28 | -121.97 | 1298 | 7.8 | 1.71 | 770 | grassland | field | 10 | 10 |
| bogong.au | -36.87 | 147.24 | 1567 | 7.3 | 2.09 | 797 | grassland | field | 10 | 10 |
| burrawan.au | -27.73 | 151.14 | 411 | 18.2 | 0.34 | 897 | grassland | field | 10 | 10 |
| cbgb.us | 41.79 | -93.39 | 275 | 14.1 | 0.74 | 785 | grassland | field | 10 | 10 |
| cdcr.us | 45.40 | -93.2 | 282 | 15.1 | 0.67 | 826 | grassland | field | 10 | 10 |
| cdpt.us | 41.2 | -101.63 | 1018 | 13.8 | 0.28 | 874 | grassland | field | 10 | 10 |
| cowi.ca | 48.46 | -123.38 | 24 | 10.5 | 1.91 | 561 | grassland | field | 10 | 10 |
| elliot.us | 32.88 | -117.05 | 256 | 17.7 | 0.25 | 880 | grassland | field | 10 | 10 |
| frue.ch | 47.11 | 8.54 | 972 | 7.8 | 2.13 | 617 | grassland | field | 10 | 10 |
| gilb.za | -29.28 | 30.29 | 1666 | 13.9 | 0.59 | 855 | grassland | field | 10 | 10 |
| hall.us | 36.87 | -86.7 | 201 | 13.7 | 1.27 | 709 | grassland | field | 10 | 10 |
| hart.us | 42.72 | -119.5 | 1513 | 9.5 | 0.20 | 866 | grassland | field | 10 | 10 |
| konz.us | 39.07 | -96.58 | 421 | 15.0 | 0.58 | 817 | grassland | field | 10 | 10 |
| lancaster.uk | 53.99 | -2.63 | 219 | 8.0 | 3.37 | 443 | grassland | field | 10 | 10 |
| look.us | 44.21 | -122.13 | 1481 | 6.1 | 2.72 | 673 | grassland | field | 10 | 10 |
| mtca.au | -31.78 | 117.61 | 297 | 17.7 | 0.24 | 957 | grassland | field | 10 | 10 |
| sage.us | 39.43 | -120.24 | 1968 | 8.5 | 0.53 | 977 | grassland | field | 10 | 10 |
| saline.us | 39.05 | -99.1 | 566 | 14.9 | 0.35 | 858 | grassland | field | 10 | 10 |
| sgs.us | 40.82 | -104.77 | 1654 | 11.2 | 0.22 | 860 | grassland | field | 10 | 10 |
| shps.us | 44.24 | -112.2 | 1667 | 12.2 | 0.15 | 963 | grassland | field | 10 | 10 |
| sier.us | 39.24 | -121.28 | 258 | 16.3 | 1.06 | 820 | grassland | field | 10 | 10 |
| smith.us | 48.21 | -122.62 | 56 | 10.2 | 1.08 | 562 | grassland | field | 10 | 10 |
| spin.us | 38.14 | -84.5 | 284 | 13.6 | 1.07 | 718 | grassland | field | 10 | 10 |
| summ.za | -29.81 | 30.72 | 636 | 18.2 | 0.59 | 810 | grassland | field | 10 | 10 |
| trel.us | 40.08 | -88.83 | 215 | 15.4 | 0.82 | 784 | grassland | field | 10 | 10 |
| ukul.za | -29.67 | 30.4 | 810 | 17.6 | 0.50 | 831 | grassland | field | 10 | 10 |
| unc.us | 36.01 | -79.02 | 147 | 14.9 | 0.94 | 734 | grassland | field | 10 | 10 |
| valm.ch | 46.63 | 10.37 | 2233 | 5.5 | 0.80 | 827 | grassland | field | 10 | 10 |
| (Craft *et al.*, 1995) | everglades | 26.38 | -80.46 | 5 | 23.4 | 0.79 | 860 | grassland | field | 22.4 | 4.8 |
| (Craine *et al.*, 2008) | pretoriuskop | -25.13 | 31.23 | 569 | 20.9 | 0.39 | 861 | grassland | field | 10 | 5 |
| letaba | -23.76 | 31.43 | 270 | 22.7 | 0.24 | 870 | grassland | field | 10 | 5 |
| makhohlola | -25.30 | 31.91 | 198 | 22.3 | 0.33 | 820 | grassland | field | 10 | 5 |
| satara | -24.40 | 31.75 | 299 | 22.0 | 0.31 | 847 | grassland | field | 10 | 5 |
| nwashitsumbe | -22.78 | 31.25 | 386 | 23.1 | 0.25 | 890 | grassland | field | 10 | 5 |
| (Crous *et al.*, 2017) | ANUglass | NA | NA | NA | NA | NA | NA | NA | pot | 3.3 (g yr-1) | 0.153 (g yr-1) |
| (Cunha *et al.*, 2024) | londrina | -23.32 | -51.18 | NA | NA | NA | NA | NA | pot | 8.4 | 4.5 |
| (D’Antonio & Mack, 2006) | volcanoNP | 19.1 | -155.55 | 148 | 22.8 | 0.95 | 860 | forest | field | 10 | 10 |

**Table S1 (cont.)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Citation** | **Site name** | **Latitude** | **Longitude** | **Elevation** | ***T*g** | ***AI*g** | ***PAR*g** | **Ecosystem type** | **Experiment type** | **N addition rate (g m-2)** | **P addition rate (g m-2)** |
| (Davidson *et al.*, 2004) | fazendaVitoria | -2.98 | -47.52 | 136 | 25.9 | 1.62 | 771 | forest | field | 10 | 5 |
| (Dong *et al.*, 2016) | baingoin | 31.43 | 90.03 | 4705 | 6.4 | 0.52 | 931 | grassland | field | 15 | 12.9 |
| (Eller *et al.*, 2017) | flottbek | 53.56 | 9.86 | NA | NA | NA | NA | NA | pot | 1.3 (g pot-1) | 1.3 (g pot-1) |
| (Falk *et al.*, 2010) | luneberg | 53.25 | 9.97 | 118 | 8.5 | 1.76 | 469 | grassland | field | 5 | 2 |
| (Fisher *et al.*, 2013) | tambopata | -12.84 | -69.30 | 198 | 25.3 | 1.83 | 709 | forest | field | 2.5 | 0.5 |
| tono | -12.95 | -71.53 | 805 | 23.1 | 2.04 | 726 | forest | field | 2.5 | 0.5 |
| san\_pedro | -13.05 | -71.54 | 1511 | 20.2 | 1.68 | 674 | forest | field | 2.5 | 0.5 |
| wayqecha | -13.19 | -71.59 | 2989 | 12.9 | 0.29 | 683 | forest | field | 2.5 | 0.5 |
| (Firn *et al.*, 2019) | bogong.au | -36.87 | 147.24 | 1567 | 7.3 | 2.09 | 797 | grassland | field | 10 | 10 |
| burrawan.au | -27.73 | 151.14 | 411 | 18.2 | 0.34 | 897 | grassland | field | 10 | 10 |
| cbgb.us | 41.79 | -93.39 | 275 | 14.1 | 0.74 | 785 | grassland | field | 10 | 10 |
| cowi.ca | 48.46 | -123.38 | 24 | 10.5 | 1.91 | 561 | grassland | field | 10 | 10 |
| elliot.us | 32.88 | -117.05 | 256 | 17.7 | 0.25 | 880 | grassland | field | 10 | 10 |
| frue.ch | 47.11 | 8.54 | 972 | 7.8 | 2.13 | 617 | grassland | field | 10 | 10 |
| gilb.za | -29.28 | 30.29 | 1666 | 13.9 | 0.59 | 855 | grassland | field | 10 | 10 |
| kiny.au | -36.20 | 143.75 | 99 | 15.5 | 0.33 | 809 | grassland | field | 10 | 10 |
| konz.us | 39.07 | -96.58 | 421 | 15.0 | 0.58 | 817 | grassland | field | 10 | 10 |
| lancaster.uk | 53.99 | -2.63 | 219 | 8.0 | 3.37 | 443 | grassland | field | 10 | 10 |
| look.us | 44.21 | -122.13 | 1481 | 6.1 | 2.72 | 673 | grassland | field | 10 | 10 |
| mcla.us | 38.86 | -122.41 | 647 | 14.0 | 1.15 | 803 | grassland | field | 10 | 10 |
| mtca.au | -31.78 | 117.61 | 297 | 17.7 | 0.24 | 957 | grassland | field | 10 | 10 |
| saline.us | 39.05 | -99.10 | 566 | 14.9 | 0.35 | 858 | grassland | field | 10 | 10 |
| sgs.us | 40.82 | -104.77 | 1654 | 11.2 | 0.22 | 860 | grassland | field | 10 | 10 |
| shps.us | 44.24 | -112.2 | 1667 | 12.2 | 0.15 | 963 | grassland | field | 10 | 10 |
| smith.us | 48.21 | -122.62 | 56 | 10.2 | 1.08 | 562 | grassland | field | 10 | 10 |
| summ.za | -29.81 | 30.72 | 636 | 18.2 | 0.59 | 810 | grassland | field | 10 | 10 |
| valm.ch | 46.63 | 10.37 | 2233 | 5.5 | 0.80 | 827 | grassland | field | 10 | 10 |
| (Fornara *et al.*, 2013) | nash | 51.41 | -0.64 | 61 | 10.2 | 1.25 | 478 | grassland | field | 10 | 3.5 |
| (Friedrich *et al.*, 2012) | luneberggh2 | 53.25 | 9.97 | NA | NA | NA | NA | NA | pot | 4.8 | 0.4 |
| (Frost *et al.*, 2009) | hammersmith | 31.30 | -81.28 | 2 | 19.7 | 0.86 | 801 | wetland | field | 50 | 10 |
| (Gough & Hobbie, 2003) | toolik\_nonacidic | 68.63 | -149.72 | 726 | 6.8 | 0.52 | 592 | tundra | field | 10 | 5 |
| (Güsewell *et al.*, 2002) | vechtplassen | 52.50 | 5.70 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| (Güsewell *et al.*, 2003) | gusewellS1 | 51.70 | 3.90 | -2 | 10.2 | 1.42 | 493 | wetland | field | 20 | 5 |
| gusewellS2 | 51.70 | 3.90 | -2 | 10.2 | 1.42 | 493 | wetland | field | 20 | 5 |
| gusewellV1 | 51.7 | 3.9 | -2 | 10.2 | 1.42 | 493 | wetland | field | 20 | 5 |
| gusewellV2 | 51.7 | 3.9 | -2 | 10.2 | 1.42 | 493 | wetland | field | 20 | 5 |
| gusewellV3 | 51.7 | 3.9 | -2 | 10.2 | 1.42 | 493 | wetland | field | 20 | 5 |
| gusewellT1 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| gusewellT2 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |

**Table S1 (cont.)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Citation** | **Site name** | **Latitude** | **Longitude** | **Elevation** | ***T*g** | ***AI*g** | ***PAR*g** | **Ecosystem type** | **Experiment type** | **N addition rate (g m-2)** | **P addition rate (g m-2)** |
| (Güsewell *et al.*, 2003) | gusewellW1 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| gusewellW2 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| gusewellW3 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| gusewellW4 | 52.5 | 5.7 | -5 | 9.8 | 1.58 | 471 | wetland | field | 20 | 5 |
| (Haag, 1974) | tuktoyaktuk | 69.43 | -133.02 | 1 | 7.5 | 0.36 | 712 | tundra | field | 10 | 10 |
| (Han *et al.*, 2011) | seefs\_sunny | 38.79 | 110.35 | 1230 | 14.2 | 0.30 | 948 | grassland | field | 10 | 10 |
| (Harrington *et al.*, 2001) | volcanoNP | 19.10 | -155.55 | 148 | 22.8 | 0.95 | 860 | forest | field | 10 | 10 |
| naPaliKona | 22.13 | -159.63 | 1056 | 15.7 | 1.27 | 879 | forest | field | 10 | 10 |
| (Haubensak & D’Antonio, 2011) | ggnra | 37.87 | -122.52 | 87 | 14.1 | 1.18 | 793 | grassland | field | 10 | 10 |
| (He *et al.*, 2016) | haibei | 37.62 | 101.2 | 3157 | 6.2 | 0.52 | 930 | grassland | field | 10 | 5 |
| (Herbert & Fownes, 1995) | naPaliKona | 22.13 | -159.63 | 1056 | 15.7 | 1.27 | 879 | forest | field | 10 | 10 |
| (Hersch-Green *et al.*, 2024) | kbs.us | 42.41 | -85.39 | 289 | 13.0 | 0.86 | 739 | grassland | field | 10 | 10 |
| konz.us | 39.07 | -96.58 | 421 | 15.0 | 0.58 | 817 | grassland | field | 10 | 10 |
| spin.us | 38.14 | -84.50 | 284 | 13.6 | 1.07 | 718 | grassland | field | 10 | 10 |
| (Huff *et al.*, 2015) | tifft | 42.87 | -78.87 | 178 | 12.5 | 0.97 | 729 | grassland | field | 10 | 8.6 |
| (Iversen *et al.*, 2010) | undercBog | 46 | -89 | 523 | 12.1 | 0.85 | 799 | wetland | field | 6 | 2 |
| undercRichFen | 46 | -89 | 523 | 12.1 | 0.85 | 799 | wetland | field | 6 | 2 |
| (Jing *et al.*, 2016) | haibeiAGERS | 37.6 | 101.32 | 3311 | 5.6 | 0.54 | 927 | grassland | field | 10 | 5 |
| (Ket *et al.*, 2011) | altamaha | 31.33 | -81.47 | 6 | 19.6 | 0.85 | 795 | wetland | field | 50 | 10 |
| (Lawrence, 2001) | kembera | 0.12 | 110.5 | 133 | 26.4 | 2.15 | 773 | forest | field | 54 | 60 |
| (Li *et al.*, 2011) | daqinggou | 42.97 | 122.35 | 249 | 16.8 | 0.41 | 912 | grassland | field | 20 | 10 |
| (Li *et al.*, 2014) | amwelu | 34.92 | 102.88 | 3213 | 7.5 | 0.76 | 822 | grassland | field | 10 | 10 |
| (Ludwig *et al.*, 2001) | tarangire | -3.5 | 36 | 1045 | 22.0 | 0.40 | 792 | grassland | field | 20 | 8 |
| (Lund *et al.*, 2009) | fajemyr | 56.25 | 13.55 | 141 | 8.3 | 2.22 | 544 | wetland | field | 4 | 0.4 |
| (Mayor *et al.*, 2014) | gigante | 9.11 | -79.84 | 83 | 26.4 | 1.38 | 939 | forest | field | 12.5 | 5 |
| (McMaster *et al.*, 1982) | echoValley | 32.9 | 70 | 1472 | 17.2 | 0.31 | 874 | shrubland | field | 4 | 2 |
| (Mo *et al.*, 2019) | xiaolongRS | 21.45 | 110.9 | 27 | 23.3 | 1.11 | 794 | forest | field | 10 | 10 |
| (Mo *et al.*, 2021) | xiaoliangRS | 21.45 | 110.9 | 27 | 23.3 | 1.11 | 794 | forest | field | 10 | 10 |
| (Ngai & Jefferies, 2004) | laPerouse | 58.744 | -93.601 | 6 | 9.8 | 0.69 | 799 | wetland | field | 17 | 12 |
| (Ngatia *et al.*, 2015) | mpala | 0 | 37 | 1852 | 16.5 | 0.52 | 852 | grassland | field | 10 | 5 |
| (Nielsen *et al.*, 2009) | brandbjerg | 55.88 | 11.97 | 9 | 9.7 | 1.67 | 551 | grassland | field | 7.5 | 1 |
| (O’Halloran *et al.*, 2010) | tshane | -24.17 | 21.89 | 1117 | 21.3 | 0.12 | 1067 | grassland | field | 6.7 | 3.3 |
| (Øien, 2004) | solendet | 62.67 | 11.83 | 696 | 7.1 | 1.42 | 631 | wetland | field | 12 | 3 |
| (Prystupa *et al.*, 2004) | uniBueAi | -34.58 | -58.48 | 23 | 17.4 | 0.73 | 777 | cropland | field | 10 | 5.7 |
| (Rejmánková *et al.*, 2008) | belize | 18.83 | -89.12 | 103 | 25.1 | 0.54 | 880 | wetland | field | 20 | 10 |
| (Ren *et al.*, 2010) | lanzhou | 33.97 | 101.88 | 3646 | 5.7 | 0.91 | 805 | grassland | field | 10 | 20 |
| (Ries & Shugart, 2008) | pandamatenga | -18.66 | 25.5 | 1082 | 23.5 | 0.26 | 974 | grassland | field | 20 | 10 |
| (Scott *et al.*, 2015) | ruakura | -37.78 | 175.32 | 46 | 14.2 | 1.35 | 723 | grassland | field | 10 | 3.15 |

**Table S1 (cont.)**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Citation** | **Site name** | **Latitude** | **Longitude** | **Elevation** | ***T*g** | ***AI*g** | ***PAR*g** | **Ecosystem type** | **Experiment type** | **N addition rate (g m-2)** | **P addition rate (g m-2)** |
| (Shaver *et al.*, 1998) | toolik\_inlet | 68.63 | -149.57 | 768 | 6.6 | 0.53 | 590 | tundra | field | 10 |  |
| toolik\_sag | 68.77 | -148.87 | 452 | 7.7 | 0.49 | 592 | tundra | field | 10 |  |
| (Soudzilovskaia *et al.*, 2005) | teberda | 48.45 | 41.7 | 86 | 14.0 | 0.47 | 705 | tundra | field | 9 | 2.5 |
| (Tischer *et al.*, 2015) | cordillera | -3.97 | -70.07 | 127 | 26.5 | 2.53 | 644 | grassland | field | 5 | 1 |
| (van Cleve & Oliver, 1982) | fairbanks | 64.83 | -147.72 | 132 | 12.3 | 0.39 | 688 | forest | field | 11.1 | 5.5 |
| (van der Hoek *et al.*, 2004) | bennekomse | 52.02 | 5.6 | 6 | 9.8 | 1.61 | 473 | grassland | field | 20 | 4 |
| (van der Waal *et al.*, 2011) | klaserie | -24.22 | 31.27 | 402 | 22.3 | 0.31 | 870 | grassland | field | 30 | 25 |
| (van Duren *et al.*, 1997a) | hasselt | 57 | 7 | 32 | 10.6 | 1.41 | 465 | grassland | field | 20 | 8 |
| (van Duren *et al.*, 1997b) | drentsche | 53.08 | 6.67 | 10 | 9.0 | 1.86 | 475 | grassland | field | 20 | 8 |
| (van Wijnen & Bakker, 1999) | schiermonikoog | 53.5 | 6.17 | 6 | 9.0 | 2.08 | 475 | wetland | field | 25 | 10 |
| (Verlinden *et al.*, 2018) | katelijne | 51.08 | 4.53 | NA | NA | NA | NA | NA | mesocosm | 9.5 | 2 |
| (Verryckt *et al.*, 2022) | nouragues | 4.00 | -52.60 | 57 | 25.8 | 2.06 | 887 | forest | field | 12.5 | 5 |
| (Wang *et al.*, 2017) | huitong | 26.67 | 109.43 | 519 | 16.1 | 1.20 | 633 | forest | field | 20 | 5 |
| (Wang *et al.*, 2018) | haibeiAMERS | 37.617 | 101.2 | 3157 | 6.2 | 0.52 | 930 | tundra | field | 10 | 5 |
| (Wang *et al.*, 2019) | qianyanzhou | 26.70 | 105.10 | 1913 | 12.2 | 0.93 | 617 | forest | field | 10 | 5 |
| (Warren & Adams, 2002) | bullsbrook | -31.67 | 116.02 | 40 | 18.8 | 0.51 | 977 | forest | field | 2 (mM) | 0.34 (mM) |
| (Wigand *et al.*, 2004) | nags\_creek | 41.63 | -71.32 | -16 | 12.3 | 1.17 | 710 | wetland | field | 32 | 3.2 |
| (Wright *et al.*, 2011) | barro | 9.12 | -79.85 | 56 | 26.5 | 1.41 | 938 | forest | field | 12.5 | 5 |
| (Yang *et al.*, 2014) | haibei | 38.297 | 101.337 | NA | NA | NA | NA | grassland | field | 10 | 5 |
| (Ye *et al.*, 2022) | jiulianshan\_RS | 24.49 | 114.38 | 624 | 18.1 | 1.49 | 680 | forest | field | 10 | 5 |
| (Ye *et al.*, 2023) | jiulianshan | 24.49 | 114.38 | 624 | 18.1 | 1.49 | 680 | forest | field | 10 | 5 |
| (Yu *et al.*, 2009) | daqinguo | 42.97 | 122.35 | 249 | 16.8 | 0.41 | 912 | grassland | field | 20 | 10 |
| (Yu *et al.*, 2015) | ewenke | 48.5 | 119.7 | 709 | 11.0 | 0.34 | 877 | grassland | field | 10 | 5 |
| (Yu *et al.*, 2022) | primary | 18.73 | 108.90 | 901 | 20.6 | 1.02 | 832 | forest | field | 10 | 10 |
| secondary | 18.74 | 108.86 | 845 | 20.9 | 1.03 | 833 | forest | field | 10 | 10 |
| (Zeng & Wang, 2015) | saihanba | 42.42 | 117.35 | 1684 | 9.7 | 0.46 | 924 | forest | field | 5 | 5 |

**\***Key: *T*g=1970-2000 growing season temperature (°C), *AI*g=growing season aridity index (unitless), *PAR*g=growing season photosynthetically active radiation (μmol m-2 s-1)

**Table S2** Meta-analytic results summarizing the effects of N, P, and N+P on traits related to leaf chemistry

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient addition** | **k** | **Coefficient (±SE)** | **Z-value** | ***p*-value** | **95% CI range** |
| *M*area | N | 113 | **-0.037±0.016** | **-2.318** | **0.020** | **[-0.068, -0.006]** |
| P | -0.015±0.015 | -1.019 | 0.308 | [-0.044, 0.014] |
| N+P | **-0.052±0.018** | **-2.880** | **0.004** | **[-0.088, -0.0167]** |
| *N*mass | N | 139 | **0.124±0.021** | **5.937** | **<0.001** | **[0.083, 0.165]** |
| P | -0.002±0.012 | -0.127 | 0.899 | [-0.025, 0.022] |
| N+P | **0.118±0.021** | **5.462** | **<0.001** | **[0.075, 0.160]** |
| *N*area | N | 84 | **0.125±0.042** | **2.987** | **0.003** | **[0.043, 0.208]** |
| P | 0.026±0.042 | 0.617 | 0.537 | [-0.056, 0.108] |
| N+P | **0.150±0.036** | **4.138** | **<0.001** | **[0.079, 0.221]** |
| *P*mass | N | 133 | **-0.075±0.032** | **-2.365** | **0.018** | **[-0.136, -0.013]** |
| P | **0.449±0.066** | **6.808** | **<0.001** | **[0.320, 0.578]** |
| N+P | **0.366±0.057** | **6.387** | **<0.001** | **[0.253, 0.478]** |
| *P*area | N | 79 | -0.054±0.075 | -0.720 | 0.472 | [-0.201, 0.093] |
| P | **0.530±0.113** | **4.693** | **<0.001** | **[0.309, 0.751]** |
| N+P | **0.383±0.110** | **3.489** | **<0.001** | **[0.168, 0.598]** |

**Table S3** Meta-analytic results summarizing the effects of N, P, and N+P on traits related to leaf photosynthesis

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient addition** | **k** | **Coefficient (±SE)** | **Z-value** | ***p*-value** | **95% CI range** |
| *A*sat | N | 85 | 0.095±0.073 | 1.313 | 0.189 | [-0.047, 0.238] |
| P | 0.083±0.083 | 1.006 | 0.315 | [-0.079, 0.245] |
| N+P | **0.214±0.096** | **2.227** | **0.026** | **[0.026, 0.402]** |
| *V*cmax | N | 42 | 0.007±0.093 | 0.078 | 0.938 | [-0.175, 0.190] |
| P | 0.115±0.072 | 1.607 | 0.108 | [-0.025, 0.256] |
| N+P | *0.164±0.085* | *1.937* | *0.053* | *[-0.002, 0.331]* |
| *J*max | N | 40 | 0.091±0.061 | 1.502 | 0.133 | [-0.028, 0.209] |
| P | **0.177±0.079** | **2.248** | **0.025** | **[0.023, 0.332]** |
| N+P | **0.261±0.027** | **9.601** | **<0.001** | **[0.208, 0.315]** |
| *J*max:*V*cmax | N | 32 | *0.003±0.002* | *1.695* | *0.090* | *[0.000, 0.007]* |
| P | 0.000±0.002 | -0.298 | 0.766 | [-0.004, 0.003] |
| N+P | **0.012±0.002** | **5.291** | **<0.001** | **[0.007, 0.016]** |
| *PNUE* | N | 58 | 0.057±0.118 | 0.483 | 0.629 | [-0.174, 0.287] |
| P | 0.151±0.132 | 1.142 | 0.253 | [-0.108, 0.409] |
| N+P | 0.124±0.189 | 0.656 | 0.512 | [-0.246, 0.494] |
| *PPUE* | N | 59 | 0.194±0.132 | 1.469 | 0.142 | [-0.065, 0.452] |
| P | -0.171±0.182 | 0.939 | 0.348 | [-0.528, 0.186] |
| N+P | -0.053±0.182 | -0.291 | 0.771 | [-0.411, 0.304] |

**Table S4** Meta-analytic results summarizing the effects of N, P, and N+P on whole-plant traits

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient addition** | **k** | **Coefficient (±SE)** | **Z-value** | ***p*-value** | **95% CI range** |
| *Total biomass* | N | 42 | 0.034±0.053 | 0.643 | 0.520 | [-0.070, 0.139] |
| P | **0.155±0.077** | **2.007** | **0.045** | **[0.004, 0.307]** |
| N+P | **0.379±0.078** | **4.871** | **<0.001** | **[0.226, 0.531]** |
| *Aboveground biomass* | N | 125 | **0.326±0.037** | **8.753** | **<0.001** | **[0.253, 0.399]** |
| P | **0.191±0.033** | **5.741** | **<0.001** | **[0.126, 0.257]** |
| N+P | **0.627±0.480** | **13.106** | **<0.001** | **[0.533, 0.721]** |
| *Belowground biomass* | N | 63 | -0.015±0.070 | -0.218 | 0.828 | [-0.151, 0.121] |
| P | 0.032±0.043 | 0.745 | 0.456 | [0.053, 0.117] |
| N+P | 0.101±0.074 | 1.358 | 0.174 | [-0.045, 0.245] |
| *Root mass fraction* | N | 37 | **-0.158±0.047** | **-3.400** | **<0.001** | **[-0.250, -0.067]** |
| P | *-0.070±0.038* | *-1.828* | *0.068* | *[-0.145, 0.005]* |
| N+P | **-0.148±0.046** | **-3.252** | **0.001** | **[-0.237, -0.059]** |
| *Root:shoot ratio* | N | 40 | **-0.341±0.090** | **-3.802** | **<0.001** | **[-0.516, -0.165]** |
| P | **-0.227±0.102** | **-2.226** | **0.026** | **[-0.426, -0.027]** |
| N+P | **-0.401±0.114** | **-3.517** | **<0.001** | **[-0.625, -0.178]** |

**Table S5** Meta-analytic results summarizing the interaction effect on leaf nutrient, leaf photosynthetic, and whole-plant traits

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Trait** | **k** | **Coefficient (±SE)** | **Z-value** | ***p*-value** | **95% CI range** |
| *M*area |  |  |  |  |  |
| *N*mass |  |  |  |  |  |
| *N*area |  |  |  |  |  |
| *P*mass |  |  |  |  |  |
| *P*area |  |  |  |  |  |
| *A*sat |  |  |  |  |  |
| *V*cmax |  |  |  |  |  |
| *J*max |  |  |  |  |  |
| *J*max:*V*cmax |  |  |  |  |  |
| *PNUE* |  |  |  |  |  |
| *PPUE* |  |  |  |  |  |
| *Total biomass* |  |  |  |  |  |
| *Aboveground biomass* |  |  |  |  |  |
| *Belowground biomass* |  |  |  |  |  |
| *Root mass fraction* |  |  |  |  |  |
| *Root:shoot* |  |  |  |  |  |

**Table S6** Climate moderator effects on leaf nutrient responses to nutrient addition\*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef. (±SE)** | **Z-value** | ***p*-value** | **95% CI** |
| *M*area | n | *T*g | 0.0014±0.0030 | 0.464 | 0.643 | [-0.004, 0.007] |
| *AI*g | 0.0374±0.0244 | 1.530 | 0.126 | [-0.011, 0.085] |
| *PAR*g | 0.0000±0.0002 | -0.258 | 0.796 | [0.000, 0.000] |
| p | *T*g | 0.0037±0.0025 | 1.450 | 0.147 | [-0.001, 0.009] |
| ***AI*g** | **0.0488±0.0209** | **2.328** | **0.020** | **[0.008, 0.090]** |
| *PAR*g | 0.0002±0.0001 | 1.476 | 0.140 | [0.000, 0.000] |
| np | *Tg* | *0.0059±0.0031* | *1.873* | *0.061* | *[0.000, 0.012]* |
| ***AI*g** | **0.0762±0.0268** | **2.840** | **0.005** | **[0.024, 0.129]** |
| *PAR*g | 0.0002±0.0002 | 1.211 | 0.226 | [0.000, 0.001] |
| *N*mass | n | ***T*g** | **-0.0067±0.0026** | **-2.536** | **0.011** | **[-0.012, -0.002]** |
| ***AI*g** | **-0.0562±0.0288** | **-1.951** | **0.050** | **[-0.113, 0.000]** |
| *PAR*g | -0.0001±0.0002 | -0.577 | 0.564 | [0.000, 0.000] |
| p | *T*g | 0.0016±0.0022 | 0.721 | 0.471 | [-0.003, 0.006] |
| *AI*g | -0.0206±0.0253 | -0.814 | 0.415 | [-0.070, 0.029] |
| *PAR*g | -0.0001±0.0001 | -0.449 | 0.653 | [0.000, 0.000] |
| np | ***Tg*** | **-0.0069±0.003** | **-2.287** | **0.022** | **[-0.013, -0.001]** |
| *AI*g | -0.0399±0.0331 | -1.204 | 0.229 | [-0.105, 0.025] |
| *PAR*g | -0.0001±0.0002 | -0.740 | 0.459 | [-0.001, 0.000] |
| *N*area | n | *T*g | *-0.0129±0.0067* | *-1.914* | *0.056* | *[-0.026, 0.000]* |
| *AI*g | *-0.1183±0.0675* | *-1.753* | *0.080* | *[-0.251, 0.014]* |
| *PAR*g | 0.0000±0.0004 | 0.020 | 0.984 | [-0.001, 0.001] |
| p | *T*g | 0.0010±0.0052 | 0.193 | 0.847 | [-0.009, 0.011] |
| *AI*g | 0.0274±0.0453 | 0.605 | 0.545 | [-0.061, 0.116] |
| *PAR*g | 0.0001±0.0003 | 0.408 | 0.684 | [0.000, 0.001] |
| np | *Tg* | -0.0036±0.0048 | -0.746 | 0.455 | [-0.013, 0.006] |
| *AI*g | -0.0221±0.0406 | -0.543 | 0.587 | [-0.102, 0.057] |
| *PAR*g | 0.0002±0.0003 | 0.591 | 0.554 | [0.000, 0.001] |
| *P*mass | n | *T*g | 0.0046±0.0050 | 0.916 | 0.360 | [-0.005, 0.014] |
| *AI*g | 0.0374±0.0527 | 0.710 | 0.478 | [-0.066, 0.141] |
| *PAR*g | -0.0005±0.0003 | -1.616 | 0.106 | [-0.001, 0.000] |
| p | *T*g | **-0.0215±0.0105** | **-2.053** | **0.040** | **[-0.042, -0.001]** |
| *AI*g | *-0.1794±0.1044* | *-1.717* | *0.086* | *[-0.384, 0.025]* |
| *PAR*g | 0.0010±0.0006 | 1.629 | 0.103 | [0.000, 0.002] |
| np | *Tg* | -0.0195±0.4826 | -0.040 | 0.968 | [-0.965, 0.926] |
| *AI*g | **-0.0231±0.0094** | **-2.454** | **0.014** | **[-0.042, -0.005]** |
| *PAR*g | -0.0879±0.0931 | -0.944 | 0.345 | [-0.270, 0.095] |

**Table S6 (cont.)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef. (±SE)** | **Z-value** | ***p*-value** | **95% CI** |
| *P*area | n | *T*g | 0.0080±0.0089 | 0.896 | 0.370 | [-0.010, 0.026] |
| *AI*g | -0.0582±0.0768 | -0.758 | 0.448 | [-0.209, 0.092] |
| *PAR*g | -0.0008±0.0005 | -1.595 | 0.111 | [-0.002, 0.000] |
| p | *T*g | *-0.0299±0.0163* | *-1.829* | *0.067* | *[-0.062, 0.002]* |
| *AI*g | -0.1855±0.1290 | -1.438 | 0.150 | [-0.438, 0.067] |
| *PAR*g | 0.0013±0.0009 | 1.503 | 0.133 | [0.000, 0.003] |
| np | *Tg* | -0.0178±0.0187 | -0.950 | 0.342 | [-0.054, 0.019] |
| *AI*g | -0.1663±0.1495 | -1.112 | 0.266 | [-0.459, 0.127] |
| *PAR*g | **0.0020±0.0010** | **1.991** | **0.046** | **[0.000, 0.004]** |

\*Trait acronyms are as defined in Fig. 2. Rows where *p*-values are less than 0.05 are noted in bold font and *p*-values where 0.5<*p*<0.1 are noted in italic font. Key: *T*g=mean growing season temperature (°C), *AI*g=mean growing season aridity index (unitless), *PAR*g=mean growing season photosynthetically active radiation (μmol m-2 s-1).

**Table S7** Climate moderator effects on whole-plant responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef. (±SE)** | **Z-value** | ***p*-value** | **95% CI** |
| *Total biomass* | n | *Tg* | *-0.0267±0.0138* | *-1.927* | *0.054* | *[-0.054, 0.000]* |
| *AI*g | 0.0118±0.0924 | 0.128 | 0.899 | [-0.169, 0.193] |
| *PAR*g | 0.0005±0.0005 | 0.989 | 0.323 | [0.000, 0.001] |
| p | *Tg* | *-0.0218±0.0126* | *-1.730* | *0.084* | *[-0.046, 0.003]* |
| *AI*g | -0.0497±0.0819 | -0.607 | 0.544 | [-0.210, 0.111] |
| *PAR*g | 0.0004±0.0005 | 0.744 | 0.457 | [-0.001, 0.001] |
| np | *Tg* | *-0.0283±0.0156* | *-1.813* | *0.070* | *[-0.059, 0.002]* |
| *AI*g | -0.1616±0.1220 | -1.325 | 0.185 | [-0.401, 0.077] |
| *PAR*g | 0.0000±0.0006 | -0.072 | 0.943 | [-0.001, 0.001] |
| *Aboveground biomass* | n | *T*g | -0.0036±0.0065 | -0.560 | 0.576 | [-0.016, 0.009] |
| *AI*g | 0.0819±0.0701 | 1.168 | 0.243 | [-0.056, 0.219] |
| *PAR*g | 0.0002±0.0003 | 0.569 | 0.569 | [0.000, 0.001] |
| p | *T*g | -0.0013±0.0071 | -0.189 | 0.850 | [-0.015, 0.013] |
| *AIg* | *0.1392±0.0748* | *1.860* | *0.063* | *[-0.007, 0.286]* |
| *PAR*g | 0.0004±0.0003 | 1.330 | 0.184 | [0.000, 0.001] |
| np | *Tg* | -0.0126±0.0097 | -1.299 | 0.194 | [-0.032, 0.006] |
| *AI*g | -0.0795±0.1058 | -0.751 | 0.453 | [-0.287, 0.128] |
| *PAR*g | -0.0003±0.0004 | -0.697 | 0.486 | [-0.001, 0.001] |
| *Belowground biomass* | n | *T*g | -0.0030±0.0090 | -0.328 | 0.743 | [-0.021, 0.015] |
| *AI*g | 0.1623±0.1021 | 1.590 | 0.112 | [-0.038, 0.362] |
| *PAR*g | 0.0007±0.0005 | 1.443 | 0.149 | [0.000, 0.002] |
| p | *T*g | 0.0005±0.0077 | 0.069 | 0.945 | [-0.015, 0.016] |
| *AI*g | -0.0293±0.0846 | -0.346 | 0.729 | [-0.195, 0.136] |
| *PAR*g | 0.0003±0.0004 | 0.610 | 0.542 | [-0.001, 0.001] |
| np | *Tg* | -0.0092±0.0101 | -0.912 | 0.362 | [-0.029, 0.011] |
| *AI*g | 0.1430±0.1150 | 1.244 | 0.214 | [-0.082, 0.368] |
| ***PAR*g** | **0.0012±0.0006** | **2.202** | **0.028** | **[0.000, 0.002]** |
| *Root mass fraction* | n | *T*g | -0.0064±0.0136 | -0.469 | 0.639 | [-0.033, 0.020] |
| *AI*g | 0.1145±0.1062 | 1.078 | 0.281 | [-0.094, 0.323] |
| *PARg* | *0.0012±0.0006* | *1.889* | *0.059* | *[0.000, 0.002]* |
| p | *T*g | -0.0097±0.0104 | -0.930 | 0.353 | [-0.030, 0.011] |
| *AI*g | -0.0835±0.0835 | -1.000 | 0.317 | [-0.247, 0.080] |
| *PAR*g | 0.0003±0.0005 | 0.540 | 0.589 | [-0.001, 0.001] |
| np | *Tg* | 0.0012±0.0138 | 0.089 | 0.929 | [-0.026, 0.028] |
| *AI*g | 0.1242±0.1083 | 1.146 | 0.252 | [-0.088, 0.336] |
| *PAR*g | 0.0008±0.0006 | 1.328 | 0.184 | [0.000, 0.002] |

**Table S7 (cont.)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef. (±SE)** | **Z-value** | ***p*-value** | **95% CI** |
| *Root:shoot* | n | *T*g | -0.0103±0.0278 | -0.371 | 0.711 | [-0.065, 0.044] |
| *AI*g | 0.0359±0.2472 | 0.145 | 0.885 | [-0.449, 0.520] |
| *PAR*g | 0.0011±0.0013 | 0.841 | 0.401 | [-0.001, 0.004] |
| p | *T*g | -0.0405±0.0285 | -1.422 | 0.155 | [-0.096, 0.015] |
| ***AI*g** | **-0.5298±0.2457** | **-2.156** | **0.031** | **[-1.011, -0.048]** |
| *PAR*g | -0.0008±0.0014 | -0.602 | 0.547 | [-0.004, 0.002] |
| np | *Tg* | -0.0042±0.0362 | -0.116 | 0.908 | [-0.075, 0.067] |
| *AI*g | -0.0062±0.3200 | -0.019 | 0.985 | [-0.633, 0.621] |
| *PAR*g | 0.0004±0.0017 | 0.227 | 0.821 | [-0.003, 0.004] |

**Table S8** Photosynthetic pathway moderator effects on leaf nutrient responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *M*area | n | *C3* | **-0.009** | **-3.662** | **<0.001** | **[-0.043, 0.025]** |
| *C4* | **-0.126** | **[-0.183, -0.069]** |
| p | *C3* | -0.023 | 1.628 | 0.104 | [-0.055, 0.010] |
| *C4* | 0.019 | [-0.031, 0.069] |
| np | *C3* | **-0.019** | **-4.699** | **<0.001** | **[-0.061, 0.022]** |
| *C4* | **-0.172** | **[-0.237, -0.106]** |
| *N*mass | n | *C3* | **0.118** | **2.643** | **0.008** | **[0.071, 0.166]** |
| *C4* | **0.243** | **[0.153, 0.334]** |
| p | *C3* | 0.000 | 1.645 | 0.100 | [-0.024, 0.024] |
| *C4* | 0.054 | [-0.008, 0.115] |
| np | *C3* | **0.108** | **3.123** | **0.002** | **[0.059, 0.157]** |
| *C4* | **0.247** | **[0.159, 0.335]** |
| *N*area | n | *C3* | **0.156** | **-2.661** | **0.008** | **[0.066, 0.247]** |
| *C4* | **0.021** | **[-0.096, 0.138]** |
| p | *C3* | 0.029 | -0.285 | 0.776 | [-0.056, 0.114] |
| *C4* | 0.015 | [-0.095, 0.125] |
| np | *C3* | **0.189** | **-5.865** | **<0.001** | **[0.098, 0.280]** |
| *C4* | **-0.053** | **[-0.165, 0.058]** |
| *P*mass | n | *C3* | -0.095 | 1.260 | 0.208 | [-0.170, -0.021] |
| *C4* | 0.016 | [-0.155, 0.187] |
| p | *C3* | **0.511** | **-2.884** | **0.004** | **[0.355, 0.667]** |
| *C4* | **0.178** | **[-0.075, 0.430]** |
| np | *C3* | 0.367 | 0.124 | 0.901 | [0.239, 0.495] |
| *C4* | 0.381 | [0.147, 0.615] |
| *P*area | n | *C3* | -0.069 | 1.032 | 0.302 | [-0.220, 0.082] |
| *C4* | 0.038 | [-0.191, 0.267] |
| p | *C3* | 0.559 | -1.584 | 0.113 | [0.323, 0.794] |
| *C4* | 0.373 | [0.068, 0.677] |
| np | *C3* | 0.411 | -1.590 | 0.112 | [0.182, 0.641] |
| *C4* | 0.225 | [-0.075, 0.524] |

**Table S9** Photosynthetic pathway moderator effects on leaf photosynthetic responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *A*sat | n | *C3* | 0.072 | 0.949 | 0.343 | [-0.074, 0.217] |
| *C4* | 0.185 | [-0.080, 0.450] |
| p | *C3* | *0.089* | *-1.646* | *0.100* | *[-0.085, 0.263]* |
| *C4* | *-0.067* | *[-0.312, 0.179]* |
| np | *C3* | 0.214 | 0.153 | 0.879 | [0.015, 0.413] |
| *C4* | 0.224 | [-0.007, 0.455] |
| *V*cmax | n | *C3* | 0.007 | 0.464 | 0.643 | [-0.176, 0.189] |
| *C4* | 0.082 | [-0.283, 0.447] |
| p | *C3* | 0.117 | -1.365 | 0.172 | [-0.021, 0.256] |
| *C4* | -0.023 | [-0.264, 0.218] |
| np | *C3* | 0.165 | -0.058 | 0.954 | [-0.002, 0.331] |
| *C4* | 0.160 | [-0.060, 0.380] |
| *J*max | n | *C3* | 0.091 | 0.145 | 0.885 | [-0.028, 0.209] |
| *C4* | 0.117 | [-0.255, 0.488] |
| p | *C3* | 0.179 | -1.509 | 0.131 | [0.027, 0.331] |
| *C4* | 0.014 | [-0.245, 0.274] |
| np | *C3* | 0.256 | -0.220 | 0.826 | [0.190, 0.322] |
| *C4* | 0.237 | [0.065, 0.409] |
| *PNUE* | n | *C3* | 0.056 | 0.831 | 0.406 | [-0.175, 0.287] |
| *C4* | 0.168 | [-0.181, 0.517] |
| p | *C3* | *0.152* | *-1.897* | *0.058* | *[-0.106, 0.410]* |
| *C4* | *-0.044* | *[-0.370, 0.283]* |
| np | *C3* | *0.121* | *1.834* | *0.067* | *[-0.251, 0.492]* |
| *C4* | *0.257* | *[-0.141, 0.655]* |
| *PPUE* | n | *C3* | 0.196 | -0.912 | 0.362 | [-0.065, 0.457] |
| *C4* | 0.102 | [-0.224, 0.428] |
| p | *C3* | -0.172 | 0.507 | 0.612 | [-0.531, 0.187] |
| *C4* | -0.097 | [-0.555, 0.362] |
| np | *C3* | **-0.057** | **2.638** | **0.008** | **[-0.417, 0.303]** |
| *C4* | **0.384** | **[-0.101, 0.869]** |

**Table S10** Photosynthetic pathway moderator effects on leaf photosynthetic responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *Total biomass* | n | *C3* | 0.209 | -0.970 | 0.332 | [-0.532, 0.951] |
| *C4* | -0.402 | [-1.389, 0.586] |
| p | *C3* | **0.012** | **8.491** | **<0.001** | **[-0.299, 0.323]** |
| *C4* | **1.687** | **[1.457, 1.917]** |
| np | *C3* | 0.576 | 1.639 | 0.101 | [-0.206, 1.358] |
| *C4* | 1.621 | [0.647, 2.595] |
| *Aboveground biomass* | n | *C3* | 0.472 | -0.328 | 0.743 | [0.155, 0.788] |
| *C4* | 0.338 | [-0.398, 1.074] |
| p | *C3* | 0.177 | -0.051 | 0.960 | [-0.094, 0.448] |
| *C4* | 0.160 | [-0.470, 0.789] |
| np | *C3* | 0.658 | -0.079 | 0.937 | [0.237, 1.079] |
| *C4* | 0.616 | [-0.338, 1.571] |
| *Belowground biomass* | n | *C3* | 0.167 | 0.267 | 0.790 | [-0.356, 0.691] |
| *C4* | 0.296 | [-0.489, 1.081] |
| p | *C3* | -0.115 | 2.096 | 0.960 | [-0.314, 0.084] |
| *C4* | 0.252 | [-0.027, 0.531] |
| np | *C3* | 0.036 | 0.661 | 0.509 | [-0.589, 0.661] |
| *C4* | 0.421 | [-0.533, 1.375] |

**Table S11** N2-fixer moderator effects on leaf nutrient responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *M*area | n | *non-fixer* | **-0.044** | **3.508** | **<0.001** | **[-0.082, -0.007]** |
| *N2-fixer* | **0.126** | **[0.027, 0.224]** |
| p | *non-fixer* | **-0.007** | **-4.584** | **<0.001** | **[-0.043, 0.028]** |
| *N2-fixer* | **-0.171** | **[-0.247, -0.095]** |
| np | *non-fixer* | **-0.051** | **3.015** | **0.003** | **[-0.084, -0.019]** |
| *N2-fixer* | **0.074** | **[-0.010, 0.158]** |
| *N*mass | n | *non-fixer* | **0.153** | **-4.498** | **<0.001** | **[0.106, 0.199]** |
| *N2-fixer* | **-0.031** | **[-0.119, 0.056]** |
| p | *non-fixer* | **-0.006** | **3.454** | **0.001** | **[-0.032, 0.020]** |
| *N2-fixer* | **0.115** | **[0.048, 0.181]** |
| np | *non-fixer* | **0.137** | **-2.258** | **0.024** | **[0.089, 0.185]** |
| *N2-fixer* | **0.025** | **[-0.076, 0.127]** |
| *N*area | n | *non-fixer* | 0.124 | 0.625 | 0.532 | [0.041, 0.207] |
| *N2-fixer* | 0.159 | [0.026, 0.292] |
| p | *non-fixer* | 0.021 | 1.236 | 0.217 | [-0.062, 0.104] |
| *N2-fixer* | 0.094 | [-0.042, 0.231] |
| np | *non-fixer* | 0.150 | -0.116 | 0.908 | [0.079, 0.221] |
| *N2-fixer* | 0.143 | [0.010, 0.276] |
| *P*mass | n | *non-fixer* | **-0.094** | **2.595** | **0.009** | **[-0.162, -0.026]** |
| *N2-fixer* | **0.041** | **[-0.074, 0.157]** |
| p | *non-fixer* | **0.444** | **5.376** | **<0.001** | **[0.298, 0.589]** |
| *N2-fixer* | **0.698** | **[0.531, 0.865]** |
| np | *non-fixer* | **0.359** | **2.021** | **0.043** | **[0.231, 0.486]** |
| *N2-fixer* | **0.514** | **[0.324, 0.704]** |
| *P*area | n | *non-fixer* | **-0.073** | **7.261** | **<0.001** | **[-0.226, 0.080]** |
| *N2-fixer* | **0.335** | **[0.150, 0.521]** |
| p | *non-fixer* | **0.512** | **4.506** | **<0.001** | **[0.289, 0.735]** |
| *N2-fixer* | **0.776** | **[0.529, 1.023]** |
| np | *non-fixer* | **0.376** | **3.292** | **0.001** | **[0.161, 0.592]** |
| *N2-fixer* | **0.628** | **[0.368, 0.889]** |

**Table S12** N2-fixer moderator effects on leaf photosynthetic responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *A*sat | n | *non-fixer* | **0.084** | **-2.900** | **0.004** | **[-0.060, 0.229]** |
| *N2-fixer* | **-0.281** | **[-0.563, 0.001]** |
| p | *non-fixer* | 0.079 | 0.083 | 0.934 | [-0.095, 0.252] |
| *N2-fixer* | 0.088 | [-0.179, 0.354] |
| np | *non-fixer* | **0.221** | **-4.135** | **<0.001** | **[0.023, 0.420]** |
| *N2-fixer* | **-0.275** | **[-0.58, 0.031]** |
| *V*cmax | n | *non-fixer* | **0.069** | **-3.879** | **<0.001** | **[-0.047, 0.184]** |
| *N2-fixer* | **-0.291** | **[-0.478, -0.105]** |
| p | *non-fixer* | **0.143** | **-2.309** | **0.021** | **[0.013, 0.274]** |
| *N2-fixer* | **-0.057** | **[-0.25, 0.135]** |
| np | *non-fixer* | **0.251** | **-4.918** | **<0.001** | **[0.137, 0.366]** |
| *N2-fixer* | **-0.194** | **[-0.378, -0.010]** |
| *J*max | n | *non-fixer* | **0.123** | **-2.001** | **0.045** | **[0.028, 0.219]** |
| *N2-fixer* | **-0.039** | **[-0.191, 0.114]** |
| p | *non-fixer* | 0.175 | 0.218 | 0.828 | [0.017, 0.333] |
| *N2-fixer* | 0.195 | [-0.027, 0.417] |
| np | *non-fixer* | **0.294** | **-4.209** | **<0.001** | **[0.244, 0.344]** |
| *N2-fixer* | **-0.095** | **[-0.270, 0.079]** |
| *PNUE* | n | *non-fixer* | 0.056 | 0.740 | 0.459 | [-0.175, 0.287] |
| *N2-fixer* | 0.166 | [-0.204, 0.536] |
| p | *non-fixer* | 0.150 | 1.037 | 0.300 | [-0.109, 0.408] |
| *N2-fixer* | 0.284 | [-0.077, 0.646] |
| np | *non-fixer* | 0.124 | -0.113 | 0.910 | [-0.246, 0.494] |
| *N2-fixer* | 0.108 | [-0.347, 0.564] |
| *PPUE* | n | *non-fixer* | **0.206** | **-5.627** | **<0.001** | **[-0.064, 0.475]** |
| *N2-fixer* | **-0.491** | **[-0.852, -0.131]** |
| p | *non-fixer* | -0.169 | -1.038 | 0.299 | [-0.523, 0.185] |
| *N2-fixer* | -0.318 | [-0.766, 0.131] |
| np | *non-fixer* | **-0.044** | **-4.961** | **<0.001** | **[-0.397, 0.309]** |
| *N2-fixer* | **-0.808** | **[-1.270, -0.346]** |

**Table S13** Mycorrhizal acquisition strategy moderator effects on leaf nutrient responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *M*area | n | *mining* | **0.011** | **-2.472** | **0.013** | **[-0.040, 0.061]** |
| *scavenging* | **-0.046** | **[-0.080, -0.011]** |
| p | *mining* | 0.003 | -1.026 | 0.305 | [-0.042, 0.049] |
| *scavenging* | -0.018 | [-0.050, 0.014] |
| np | *mining* | **-0.161** | **4.265** | **<0.001** | **[-0.227, -0.094]** |
| *scavenging* | **-0.030** | **[-0.072, 0.012]** |
| *N*mass | n | *mining* | 0.149 | -0.561 | 0.575 | [0.088, 0.211] |
| *scavenging* | 0.137 | [0.091, 0.183] |
| p | *mining* | -0.017 | 1.077 | 0.281 | [-0.065, 0.032] |
| *scavenging* | 0.008 | [-0.017, 0.033] |
| np | *mining* | 0.158 | -1.041 | 0.298 | [0.086, 0.230] |
| *scavenging* | 0.126 | [0.080, 0.173] |
| *N*area | n | *mining* | **0.042** | **2.236** | **0.025** | **[-0.069, 0.153]** |
| *scavenging* | **0.133** | **[0.050, 0.217]** |
| p | *mining* | 0.040 | -0.402 | 0.688 | [-0.066, 0.146] |
| *scavenging* | 0.024 | [-0.057, 0.105] |
| np | *mining* | 0.155 | -0.150 | 0.881 | [0.055, 0.256] |
| *scavenging* | 0.149 | [0.077, 0.221] |
| *P*mass | n | *mining* | **-0.227** | **6.069** | **<0.001** | **[-0.305, -0.149]** |
| *scavenging* | **-0.066** | **[-0.129, -0.003]** |
| p | *mining* | **0.805** | **-6.408** | **<0.001** | **[0.637, 0.972]** |
| *scavenging* | **0.435** | **[0.303, 0.567]** |
| np | *mining* | **0.261** | **3.544** | **<0.001** | **[0.119, 0.403]** |
| *scavenging* | **0.381** | **[0.252, 0.510]** |
| *P*area | n | *mining* | -0.048 | -0.087 | 0.931 | [-0.242, 0.145] |
| *scavenging* | -0.055 | [-0.202, 0.093] |
| p | *mining* | **1.071** | **-8.600** | **<0.001** | **[0.796, 1.346]** |
| *scavenging* | **0.459** | **[0.213, 0.706]** |
| np | *mining* | 0.401 | -0.284 | 0.777 | [0.153, 0.649] |
| *scavenging* | 0.380 | [0.165, 0.595] |

**Table S14** Mycorrhizal acquisition strategy moderator effects on leaf nutrient responses to nutrient addition

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trait** | **Nutrient** | **Moderator** | **Coef.** | **Z-value** | ***p*-value** | **95% CI** |
| *A*sat | n | *mining* | **-0.142** | **4.899** | **<0.001** | **[-0.336, 0.052]** |
| *scavenging* | **0.138** | **[-0.037, 0.313]** |
| p | *mining* | 0.091 | -0.264 | 0.792 | [-0.101, 0.283] |
| *scavenging* | 0.076 | [-0.098, 0.250] |
| np | *mining* | **0.056** | **3.583** | **<0.001** | **[-0.170, 0.283]** |
| *scavenging* | **0.256** | **[0.045, 0.466]** |
| *V*cmax | n | *mining* | **-0.199** | **5.064** | **<0.001** | **[-0.433, 0.036]** |
| *scavenging* | **0.090** | **[-0.132, 0.313]** |
| p | *mining* | 0.120 | -0.108 | 0.914 | [-0.043, 0.283] |
| *scavenging* | 0.114 | [-0.031, 0.259] |
| np | *mining* | **0.026** | **3.199** | **0.001** | **[-0.198, 0.251]** |
| *scavenging* | **0.207** | **[-0.003, 0.417]** |
| *J*max | n | *mining* | **-0.056** | **4.278** | **<0.001** | **[-0.222, 0.110]** |
| *scavenging* | **0.179** | **[0.024, 0.334]** |
| p | *mining* | 0.185 | -0.171 | 0.864 | [0.008, 0.361] |
| *scavenging* | 0.175 | [0.015, 0.336] |
| np | *mining* | **0.096** | **3.302** | **0.001** | **[-0.072, 0.264]** |
| *scavenging* | **0.283** | **[0.129, 0.436]** |
| *PNUE* | n | *mining* | **-0.123** | **3.706** | **<0.001** | **[-0.382, 0.136]** |
| *scavenging* | **0.095** | **[-0.146, 0.337]** |
| p | *mining* | 0.147 | 0.087 | 0.931 | [-0.126, 0.420] |
| *scavenging* | 0.151 | [-0.109, 0.412] |
| np | *mining* | 0.157 | -0.681 | 0.496 | [-0.226, 0.540] |
| *scavenging* | 0.118 | [-0.253, 0.489] |
| *PPUE* | n | *mining* | **-0.018** | **3.001** | **0.003** | **[-0.335, 0.298]** |
| *scavenging* | **0.223** | **[-0.062, 0.508]** |
| p | *mining* | **-0.583** | **5.158** | **<0.001** | **[-1.012, -0.154]** |
| *scavenging* | **-0.094** | **[-0.494, 0.306]** |
| np | *mining* | **-0.229** | **2.184** | **0.029** | **[-0.629, 0.171]** |
| *scavenging* | **-0.026** | **[-0.394, 0.342]** |