**Supplement Table S1: Characteristics of the research sites in the high-P (HP, Bad Brückenau) and the low-P forest (LP Luess).** Data were compiled from publications (Haußmann and Lux, 1997; Lang et al., 2017). The parameters age, height and diameter refer to beech trees. Extractable P was determined with the resin method (Lang et al. 2017).

| Parameters | HP | LP |
|---|---|---|
| **Location** | | |
| Gauss-Krüger coordinates | R: 3566195 E<br>H: 5579975 N | R: 3585473 E<br>H: 5857057 N |
| Altitude (m a.s.l.) | 809 | 115 |
| **Climate** | | |
| Mean annual temperature (°C) | 5.8 | 8.0 |
| Sum of annual precipitation (mm) | 1031 | 779 |
| **Stand characteristics** | | |
| Potential natural vegetation | Hordelymo-Fagetum | Luzulo-Fagetum |
| Tree species composition (%) | *Fagus sylvatica* (99)<br>*Acer pseudoplatanus* (1) | *Fagus sylvatica* (91)<br>*Quercus petraea* (9) |
| Age (a) | 137 | 132 |
| Height (mean tree) (m) | 26.8 | 27.3 |
| Diameter at breast height (cm) | 36.8 | 27.5 |
| Number of trees ($ha^{-1}$) | 335 | 480 |
| Basal area ($m^2\ ha^{-1}$) | 35.6 | 36.7 |
| Standing volume ($m^3\ ha^{-1}$) | 495 | 529 |
| **Soil characteristics** | | |
| Soil type | Dystric skeletic cambisol | Hyperdystric folic cambisol |
| Parent material | Basalt | Sandy till |
| Humus form | Mull-like Moder | Mor-like Moder |
| Texture (topsoil) | Silty clay loam | Loamy sand |
| Texture (subsoil) | Loam | Sand |
| **Soil chemistry (A horizon 0 to 5 cm)** | | |
| pH ($H_20$) | 3.8 | 3.5 |
| Total P ($mg\ kg^{-1}$) | 2966 | 195 |
| Extractable P ($mg\ kg^{-1}$) | 116 | 11 |
| P in leaf litter ($g\ m^{-2}\ a^{-1}$) | 0.229 | 0.156 |
| P in leaves ($mg\ g^{-1}$ dry mass) | 1.41 | 1.21 |

**Supplement Table S2: Compilation of data for the amount of soil, plant, and residual materials (g soil core$^{-1}$), number of root tips (number g$^{-1}$ fresh mass of fine roots), P (mg g$^{-1}$ dry mass) and $^{33}$P concentrations (Bq g$^{-1}$ dry mass) in the organic layer (OL) and the mineral topsoil (ML) of a P-rich (HP) and P-poor (LP) beech forest.** Data indicate means (n = 5 ± SE). For coarse roots or other roots occasionally only one sample was available and therefore no SE calculated. Statistical analyses: Comparison of forest type was done by general linear models with OL and ML as random factor. Student's t-test was performed to compare the means for parameters measured in OL in HP and LP or the means for ML. Bold letters indicate significant differences at $p \leq 0.05$. Table S1 continues on the next page.

| | Forest Treatment | HP OL | HP ML | LP OL | LP ML | Forest F | *p* | OL t | *p* | ML t | *p* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fresh mass** | Soil | 244.06 ± 22.70 | 767.34 ± 78.40 | 452.72 ± 35.81 | 1555.82 ± 94.73 | 27.85 | **<0.001** | 4.92 | **<0.001** | 6.41 | **<0.001** |
| | Rhizosphere | 17.18 ± 2.32 | 47.57 ± 6.56 | 39.95 ± 1.55 | 40.87 ± 5.15 | 2.08 | 0.167 | 8.16 | **<0.001** | 0.81 | 0.445 |
| | Coarse roots | 0.30 ± 0.08 | 3.73 ± 2.39 | 2.21 ± 1.11 | 1.35 ± 0.29 | 0.028 | 0.870 | 1.72 | 0.124 | 0.98 | 0.354 |
| | Fine roots | 2.04 ± 0.63 | 5.57 ± 0.81 | 8.61 ± 1.15 | 4.13 ± 0.59 | 4.35 | 0.052 | 5.00 | **0.001** | 1.44 | 0.189 |
| | Other roots | 6.82 ± 3.40 | 1.29 ± 0.46 | 0.58 ± 0.26 | 0.40 | 4.88 | **0.041** | 1.97 | 0.084 | 2.61 | **0.031** |
| | Rest | 106.86 ± 16.11 | 293.34 ± 36.19 | 8.66 ± 0.93 | 42.42 ± 13.57 | 40.32 | **<0.001** | 6.09 | **<0.001** | 6.49 | **<0.001** |
| **Dry mass** | Soil | 143.17 ± 14.38 | 514.88 ± 64.39 | 265.77 ± 21.69 | 1283.62 ± 109.83 | 19.64 | **<0.001** | 4.71 | **0.002** | 6.04 | **<0.001** |
| | Rhizosphere | 10.44 ± 1.55 | 30.11 ± 4.24 | 19.20 ± 2.88 | 33.59 ± 4.32 | 3.24 | 0.089 | 2.68 | **0.028** | 0.57 | 0.581 |
| | Coarse roots | 0.15 ± 0.04 | 1.80 ± 1.22 | 0.84 ± 0.45 | 0.50 ± 0.11 | 0.21 | 0.655 | 1.52 | 0.166 | 0.75 | 0.478 |
| | Fine roots | 1.02 ± 0.18 | 2.35 ± 0.39 | 2.89 ± 0.32 | 1.74 ± 0.30 | 2.82 | 0.11 | 5.07 | **<0.001** | 1.24 | 0.25 |
| | Other roots | 2.36 ± 1.12 | 0.51 ± 0.16 | 0.04 ± 0.04 | 0.01 ± 0.01 | 5.61 | **0.029** | 2.06 | 0.074 | 3.03 | **0.016** |
| | Rest | 96.84 ± 14.91 | 272.42 ± 34.16 | 4.55 ± 0.56 | 40.91 ± 13.18 | 40.15 | **<0.001** | 6.18 | **<0.001** | 6.32 | **<0.001** |
| **Root tips** | EMF[#] | 1008.7 ± 271.3 | 609.7 ± 81.2 | 649.1 ± 155.9 | 468.2 ± 127.0 | 2.16 | 0.160 | 1.15 | 0.284 | 1.22 | 0.256 |
| | Dry[#] | 106.9 ± 35.5 | 115.6 ± 18.8 | 75.3 ± 17.5 | 80.5 ± 14.3 | 2.33 | 0.144 | 0.79 | 0.449 | 1.54 | 0.161 |
| | NM[#] | 44.8 ± 19.5 | 31.2 ± 9.4 | 15.4 ± 8.1 | 14.0 ± 2.9 | 4.69 | **0.044** | 1.39 | 0.201 | 2.13 | 0.066 |
| **$P_{total}$** | Soil | 1.54 ± 0.04 | 1.49 ± 0.05 | 0.28 ± 0.03 | 0.10 ± 0.004 | 1371.9 | **<0.001** | 28.69 | **<0.001** | 28.43 | **<0.001** |
| | Rhizosphere | 1.52 ± 0.03 | 1.47 ± 0.03 | 0.41 ± 0.05 | 0.10 ± 0.01 | 784.24 | **<0.001** | 19.63 | **<0.001** | 40.57 | **<0.001** |
| | Coarse roots | 0.76 ± 0.18 | 1.05 ± 0.17 | 0.36 ± 0.10 | 0.29 ± 0.02 | 19.43 | **<0.001** | 2.71 | **0.027** | 7.55 | **<0.001** |
| | Fine roots | 1.40 ± 0.03 | 1.13 ± 0.15 | 0.60 ± 0.07 | 0.42 ± 0.03 | 89.27 | **<0.001** | 10.66 | **<0.001** | 4.62 | **0.002** |
| | Other roots | 1.76 ± 0.13 | 1.34 ± 0.14 | 0.25 | 1.11 | 79.61 | **<0.001** | 12.52 | **0.001** | 4.27 | **0.003** |
| | Rest | 0.81 ± 0.08 | na. | 0.35 ± 0.03 | na. | 27.44 | **<0.001** | 5.24 | **<0.001** | na. | |
| | EMF | 1.014 ± 0.103 | 0.956 ± 0.062 | 2.046 ± 0.464 | 1.120 ± 0.193 | 4.84 | **0.042** | 2.17 | 0.062 | 0.81 | 0.441 |
| | Dry | 0.892 ± 0.113 | 0.778 ± 0.010 | 1.572 ± 0.287 | 0.351 ± 0.044 | 2.82 | 0.112 | 1.71 | 0.137 | 7.15 | **<0.001** |
| | NM | 1.403 ± 0.422 | 1.169 ± 0.167 | 0.188 ± 0.074 | 0.195 ± 0.118 | 12.94 | **0.002** | 3.06 | **0.018** | 3.22 | **0.032** |

[#]EMF: mycorrhizal root tips, Dry: dry root tips, NM = non-mycorrhizal root tips, [##] mic = microbial P in soil

**Supplement Table S2 (continued)**

| | Forest Treatment | HP OL | HP ML | LP OL | LP ML | Forest F | *p* | OL t | *p* | ML t | *p* |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $P_{sol}$ | Soil | 0.23 ± 0.039 | 0.05 ± 0.005 | 0.01 ± 0.001 | 0.002 ± 0.0001 | 9.863 | **0.005** | 2.60 | **0.032** | 5.87 | **<0.001** |
| | Rhizosphere | 0.22 ± 0.03 | 0.16 ± 0.01 | 0.04 ± 0.005 | 0.02 ± 0.003 | 85.73 | **<0.001** | 5.82 | **<0.001** | 9.89 | **<0.001** |
| | Coarse roots | 0.21 ± 0.09 | 0.47 ± 0.04 | 0.08 ± 0.01 | 0.09 ± 0.01 | 18.28 | **<0.001** | 1.27 | 0.252 | 9.92 | **<0.001** |
| | Fine roots | 0.50 ± 0.05 | 0.48 ± 0.05 | 0.15 ± 0.03 | 0.09 ± 0.01 | 90.42 | **<0.001** | 5.75 | **<0.001** | 7.46 | **<0.001** |
| | Other roots | 1.04 ± 0.11 | 0.50 ± 0.10 | 0.04 | na. | 26.08 | **<0.001** | 9.83 | **<0.001** | na. | |
| | Rest | 0.22 ± 0.03 | na. | 0.04 ± 0.004 | na. | 28.76 | **<0.001** | 5.36 | **<0.001** | na. | |
| $P_{mic}$ | Soil[##] | 0.03 ± 0.003 | 0.004 ± 0.001 | 0.02 ± 0.002 | 0.006 ± 0.001 | 0.17 | 0.682 | 1.44 | 0.189 | 1.42 | 0.193 |
| $^{33}P_{total}$ | Soil | 5.25 ± 0.52 | 1.00 ± 0.12 | 6.04 ± 0.52 | 0.03 ± 0.01 | 0.05 | 0.821 | 1.17 | 0.275 | 8.03 | **<0.001** |
| | Rhizosphere | 4.01 ± 0.61 | 0.55 ± 0.14 | 9.38 ± 1.95 | 0.005 ± 0.004 | 3.88 | 0.065 | 2.63 | **0.003** | 4.02 | **0.004** |
| | Coarse roots | 2.23 ± 1.23 | 1.41 ± 1.11 | 0.36 ± 0.18 | 0.004 ± 0.003 | 4.08 | 0.059 | 1.94 | 0.089 | 2.98 | **0.031** |
| | Fine roots | 8.38 ± 1.54 | 1.46 ± 0.19 | 11.05 ± 2.54 | 0.03 ± 0.01 | 0.17 | 0.687 | 0.90 | 0.394 | 18.44 | **<0.001** |
| | Other roots | 5.23 ± 2.01 | 2.42 ± 0.83 | 0.18 | 0.01 | 11.78 | **0.003** | 2.58 | **0.033** | 2.92 | **0.019** |
| | Rest | 5.53 ± 2.33 | na. | 15.36 ± 1.40 | na. | 13.03 | **0.007** | 3.61 | **0.007** | na. | |
| | EMF | 5.222 ± 1.771 | 2.557 ± 0.614 | 10.758 ± 3.178 | 0.009 ± 0.007 | 0.54 | 0.474 | 1.52 | 0.167 | 4.15 | **0.003** |
| | Dry | 1.412 ± 0.407 | 0.490 ± 0.314 | 3.874 ± 1.191 | 0.013 ± 0.012 | 3.38 | 0.084 | 1.51 | 0.182 | 1.40 | 0.219 |
| | NM | 2.575 ± 0.374 | 1.100 ± 0.983 | 1.588 ± 0.370 | 0.000 | 11.73 | **0.004** | 2.68 | **0.032** | 2.05 | 0.096 |
| $^{33}P_{sol}$ | Soil | 0.18 ± 0.02 | 0.01 ± 0.002 | 0.32 ± 0.02 | 0.001 ± 0.0004 | 6.74 | **0.018** | 4.22 | **0.003** | 7.25 | **<0.001** |
| | Rhizosphere | 1.33 ± 0.17 | 0.21 ± 0.04 | 2.02 ± 0.44 | 0.003 ± 0.001 | 0.92 | 0.351 | 1.48 | 0.176 | 5.03 | **0.001** |
| | Coarse roots | 0.80 ± 0.57 | 0.67 ± 0.55 | 0.20 ± 0.10 | 0.004 ± 0.001 | 2.62 | 0.124 | 1.09 | 0.308 | 5.38 | **0.001** |
| | Fine roots | 4.71 ± 0.25 | 1.30 ± 0.25 | 3.60 ± 0.83 | 0.01 ± 0.001 | 6.71 | **0.019** | 1.13 | 0.295 | 20.06 | **<0.001** |
| | Other roots | 1.42 ± 0.62 | 0.38 ± 0.18 | 0.04 | na. | 7.03 | **0.017** | 2.27 | 0.053 | na. | |
| | Rest | 1.81 ± 0.53 | na. | 2.89 ± 0.48 | na. | 2.83 | 0.131 | 1.68 | 0.131 | na. | |
| $^{33}P_{mic}$ | Soil | 0.16 ± 0.01 | 0.007 ± 0.002 | 0.65 ± 0.05 | 0.001 ± 0.001 | 14.11 | **0.001** | 10.30 | **<0.001** | 2.61 | **0.031** |

[#]EMF: mycorrhizal root tips, Dry: dry root tips, NM = non-mycorrhizal root tips, [##] mic = microbial P in soil

**Supplement Table S3: Compilation of data for the number of root tips, and the total amounts P (mg) and $^{33}$P (Bq) in the organic layer (OL) and the mineral topsoil (ML) of a P-rich (HP) and P-poor (LP) beech forest.** All data are expressed per soil core (diameter 0.12, height 0.2m). Data indicate means (n = 5 ± SE). For coarse roots or other roots occasionally only one sample was available and therefore no SE calculated. Statistical analyses: Comparison of forest type was done by general linear models with OL and ML as random factor. Student's t-test was performed to compare the means for parameters measured in OL in HP and LP or the means for ML. Bold letters indicate significant differences at $p \leq 0.05$. na. = not available

| | **Forest Layer** | **HP OL** | **HP ML** | **LP OL** | **LP ML** | **Forest F** | ***p*** | **OL t** | ***p*** | **ML t** | ***p*** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number of root tips** | EMF | 2701.1 ± 1095.2 | 3287.1 ± 562.5 | 5324.9 ± 1150.0 | 1783.0 ± 393.1 | 0.33 | 0.575 | 1.65 | 0.137 | 2.39 | **0.044** |
| | Dry | 301.8 ± 136.8 | 615.2 ± 102.5 | 635.3 ± 164.5 | 317.1 ± 52.1 | 0.16 | 0.899 | 1.56 | 0.158 | 2.59 | **0.032** |
| | NM | 11.3 ± 68.0 | 160.7 ± 39.7 | 119.2 ± 55.2 | 56.6 ± 12.3 | 1.28 | 0.272 | 0.53 | 0.609 | 2.50 | **0.037** |
| **$P_{total}$** | Soil | 221.94 ± 25.94 | 762.89 ± 92.22 | 73.62 ± 5.51 | 122.14 ± 11.98 | 26.99 | **<0.001** | 7.77 | **<0.001** | 6.89 | **<0.001** |
| | Rhizosphere | 15.77 ± 2.26 | 44.09 ± 6.27 | 7.54 ± 0.96 | 3.52 ± 0.48 | 22.81 | **<0.001** | 3.35 | **0.001** | 12.80 | **<0.001** |
| | Coarse roots | 0.11 ± 0.03 | 1.54 ± 0.90 | 0.21 ± 0.10 | 0.14 ± 0.02 | 4.51 | **0.048** | 0.68 | 0.522 | 2.61 | **0.031** |
| | Fine roots | 1.13 ± 0.36 | 2.60 ± 0.72 | 1.74 ± 0.31 | 0.72 ± 0.09 | 1.56 | 0.228 | 1.30 | 0.231 | 4.49 | **0.003** |
| | Other roots | 3.83 ± 1.88 | 0.70 ± 0.23 | 0.05 | 0.04 | 9.86 | **0.011** | 2.03 | 0.077 | 2.96 | **0.018** |
| | Rest | 75.38 ± 8.97 | na. | 1.53 ± 0.17 | na. | 13.75 | **0.001** | 22.25 | **<0.001** | na. | |
| **$P_{sol}$** | Soil | 34.27 ± 8.90 | 26.09 ± 3.97 | 3.29 ± 0.35 | 2.58 ± 0.17 | 32.26 | **<0.001** | 3.48 | **0.008** | 5.91 | **<0.001** |
| | Rhizosphere | 2.13 ± 0.30 | 4.69 ± 0.74 | 0.79 ± 0.07 | 0.80 ± 0.13 | 27.31 | **<0.001** | 5.69 | **<0.001** | 8.30 | **<0.001** |
| | Coarse roots | 0.03 ± 0.01 | 0.87 ± 0.60 | 0.06 ± 0.03 | 0.04 ± 0.01 | 2.09 | 0.171 | 1.14 | 0.298 | 4.82 | **0.001** |
| | Fine roots | 0.39 ± 0.12 | 1.09 ± 0.16 | 0.46 ± 0.13 | 0.16 ± 0.03 | 10.91 | **0.004** | 0.54 | 0.605 | 8.93 | **<0.001** |
| | Other roots | 2.68 ± 1.42 | 0.24 ± 0.15 | 0.01 | na. | 5.79 | **0.029** | 2.36 | 0.05 | na. | |
| | Rest | 20.51 ± 2.61 | na. | 0.18 ± 0.01 | na. | 13.45 | **0.001** | 27.78 | **<0.001** | na. | |
| **$P_{mic}$** | Soil | 3.75 ± 0.83 | 1.98 ± 0.33 | 5.13 ± 0.40 | 7.87 ± 1.37 | 14.24 | **0.001** | 1.77 | 0.114 | 4.17 | **0.003** |
| **$^{33}P_{total}$** | Soil | 730.54 ± 49.01 | 514.60 ± 93.27 | 1564.66 ± 47.39 | 33.73 ± 11.25 | 1.09 | 0.311 | 12.23 | **<0.001** | 6.00 | **<0.001** |
| | Rhizosphere | 40.19 ± 7.76 | 17.31 ± 5.28 | 170.42 ± 35.15 | 0.21 ± 0.17 | 5.07 | **0.037** | 4.68 | **0.002** | 4.82 | **0.005** |
| | Coarse roots | 0.30 ± 0.20 | 0.89 ± 0.65 | 0.24 ± 0.10 | 0.001 ± 0.001 | 2.40 | 0.139 | 0.85 | 0.42 | 4.58 | **0.006** |
| | Fine roots | 8.30 ± 2.96 | 3.41 ± 0.68 | 31.01 ± 7.14 | 0.06 ± 0.01 | 3.87 | 0.066 | 2.94 | **0.019** | 16.15 | **<0.001** |
| | Other roots | 6.95 ± 2.65 | 0.84 ± 0.17 | 0.04 | 0.0002 | 24.30 | **<0.001** | 2.62 | **0.031** | 5.03 | **0.001** |
| | Rest | 595.26 ± 299.62 | na. | 69.40 ± 10.53 | na. | 7.51 | **0.025** | 2.74 | **0.025** | na. | |
| **$^{33}P_{sol}$** | Soil | 25.36 ± 4.33 | 6.70 ± 0.96 | 83.69 ± 6.45 | 0.81 ± 0.48 | 9.15 | **0.007** | 7.51 | **<0.001** | 5.46 | **<0.001** |
| | Rhizosphere | 13.75 ± 2.63 | 6.72 ± 2.00 | 37.69 ± 8.37 | 0.10 ± 0.05 | 2.28 | 0.149 | 2.73 | **0.026** | 7.00 | **<0.001** |
| | Coarse roots | 0.13 ± 0.10 | 0.48 ± 0.31 | 0.10 ± 0.04 | 0.002 ± 0.001 | 8.69 | **0.009** | 0.36 | 0.733 | 11.46 | **<0.001** |
| | Fine roots | 4.66 ± 1.13 | 2.94 ± 0.61 | 10.50 ± 2.88 | 0.02 ± 0.004 | 0.42 | 0.524 | 1.75 | 0.124 | 16.04 | **<0.001** |
| | Other roots | 3.47 ± 1.61 | 0.31 ± 0.19 | 0.01 | na. | 7.19 | **0.017** | 2.81 | **0.026** | na. | |
| | Rest | 188.64 ± 62.67 | na. | 13.30 ± 3.05 | na. | 19.18 | **0.002** | 4.38 | **0.002** | na. | |
| **$^{33}P_{mic}$** | Soil | 23.04 ± 2.67 | 3.17 ± 0.80 | 172.95 ± 16.43 | 1.53 ± 0.89 | 13.63 | **0.001** | 9.01 | <0.001 | 1.38 | 0.205 |

**Supplement Table S4: Molecular identification of ectomycorrhizal fungal species colonizing beech (*Fagus sylvatica*) root tips.** Best match indicates the accession number in the NCBI database, obtained by BLAST of the nucleotide sequence. SI = percent sequence identity, Score = sequence similarity independent of query sequence length and database size, normalized based on the raw pairwise alignment score, BP = number of base pairs, NCBI accession number is the number under which the sequences can be accessed in the NCBI Genbank.

| **Ectomycorrhizal fungal species** | **Best match In NCBI** | **SI** | **Score** | **BP** | **NCBI accession number** |
|---|---|---|---|---|---|
| *Cenococcum geophilum* | MH038069.1 | 100 | 904 | 507 | MN959775 |
| *Clavulina cristata* | HQ336681.1 | 99 | 1066 | 585 | MN959776 |
| *Genea hispidula* | HM189754.1 | 99 | 1221 | 668 | MN959778 |
| *Heliotales spec.* | HM190117.1 | 100 | 1247 | 680 | MN959779 |
| *Hyaloscyphaceae* | JF519606.1 | 97 | 848 | 553 | MN959780 |
| *Hygrophorus discoxanthus* | HF675300.1 | 99 | 682 | 384 | MN959781 |
| *Inocybe cookei* | JF908173.1 | 97 | 715 | 417 | MN959782 |
| *Inocybe maculata* | AM882957.2 | 99 | 1086 | 607 | MN959783 |
| *Lactarius blennius* | AY606944.1 | 99 | 1280 | 707 | MN959785 |
| *Lactarius subdulcis* | MG820044.1 | 100 | 1304 | 709 | MN959786 |
| *Lactarius tabidus* | KT165310.1 | 100 | 1277 | 699 | MN959787 |
| *MT10* | Not available | | | | |
| *MT11* | Not available | | | | |
| *MT26* | Not available | | | | |
| *Rhizodermea veluwensis* | LC151458.1 | 99 | 955 | 548 | MN959790 |
| *Russula integra* | HM189839.1 | 99 | 1262 | 694 | MN959792 |
| *Russula ochroleuca* | HM189931.1 | 99 | 1251 | 685 | MN959793 |
| *Skleroderma spec.* | KX545378.1 | 97 | 359 | 131 | MN959794 |
| *Tuber puberulum* | AJ969625.1 | 97 | 798 | 531 | MN959795 |
| *Tylospora asterophora* | JN943924.1 | 99 | 1109 | 608 | MN959796 |
| *Unk. Agaricales* | HM240534.1 | 98 | 1162 | 659 | MN959788 |
| *Xerocomus cisalpinus* | HM190066.1 | 100 | 1328 | 734 | MN959797 |
| *Xerocomus pruinatus* | HM190093.1 | 100 | 1360 | 739 | MN959798 |

MT: unidentified morphotypes, unk = unknown