****

**Fig. S1.** The plausible interaction pathways in the structural equation model.

**Table S1**

Pearson’s correlation coefficients of wheat yield and AMF alpha diversity to soil properties.

| **Soil properties** |  | **AMF richness** | **OTUs1 detected** | **Phylogenetic diversity** | **WY** |
| --- | --- | --- | --- | --- | --- |
| **pH** | *R**P* | **0.575**0.025 | **0.597**0.019 | 0.5000.058 | **−0.551**0.033 |
| **AK** | *R**P* | 0.4080.131 | 0.4110.128 | 0.3490.203 | −0.4150.124 |
| **AP** | *R**P* | **−0.772**0.001 | **−0.714**0.003 | **−0.724**0.002 | **0.663**0.007 |
| **NO3−-N** | *R**P* | −0.2580.354 | −0.2200.430 | −0.1130.689 | 0.0920.745 |
| **NH4+-N** | *R**P* | −0.3700.175 | −0.3040.270 | −0.2480.373 | 0.1790.523 |
| **TN** | *R**P* | −0.0620.827 | −0.0720.798 | 0.0470.869 | −0.0890.754 |
| **TOC** | *R**P* | −0.1880.501 | −0.3340.224 | −0.2570.355 | 0.4790.071 |
| **C:N** | *R**P* | −0.0510.858 | −0.1330.637 | −0.2000.474 | 0.3620.185 |
| **C:P** | *R**P* | **0.835**0.000 | **0.838**0.000 | **0.808**0.000 | **−0.740**0.002 |

1OTUs: operational taxonomic units (97% similarity).

Fertilizer regimes: CK (without fertilizer), N1 (150 kg N ha−1), N1P1 (150 kg N ha−1 plus 75 kg P ha−1), N2 (300 kg N ha−1) and N2P2 (300 kg N ha−1plus 150 kg P ha−1).

Soil properties indicated include AP (available P), AK (available K), TOC (total organic carbon), TN (total N), C:N (TOC:TN), C:P (TOC:AP) and WY (wheat yield).

Bold values are significant at *P* < 0.05

**Table S2.**

Results of structural equation modeling of responses of AMF structure on soil properties and plant shown in Fig. 5.

|  |  |  | Estimate | Std Error | z value | P |
| --- | --- | --- | --- | --- | --- | --- |
| pH | <--- | Fertilization | -0.330 | 0.017 | -19.088 | **<0.001** |
| NO3−-N | <--- | Fertilization | 0.423 | 1.419 | 0.298 | 0.766 |
| NO3−-N | <--- | pH | -3.230 | 4.217 | -0.766 | 0.444 |
| C: P ratio | <--- | Fertilization | -2711.631 | 476.537 | -5.690 | **<0.001** |
| C: P ratio | <--- | pH | -5141.340 | 1441.320 | -3.567 | **<0.001** |
| C: P ratio | <--- | NO3−-N | 281.223 | 89.496 | 3.142 | **0.002** |
| Wheat yield | <--- | C: P ratio | -0.257 | 0.103 | -2.490 | **0.013** |
| Wheat yield | <--- | NO3−-N | -280.204 | 67.396 | -4.158 | **<0.001** |
| Wheat yield | <--- | pH | -1752.170 | 431.089 | -4.065 | **<0.001** |
| AMF composition | <--- | C: P ratio | 0.000 | 0.000 | -.282 | 0.778 |
| AMF composition | <--- | pH | 1.119 | 0.460 | 2.434 | **0.015** |
| AMF composition | <--- | NO3−-N | -0.086 | 0.073 | -1.184 | 0.237 |
| AMF composition | <--- | Wheat yield | 0.000 | 0.000 | -0.386 | 0.699 |
| AMF diversity | <--- | pH | -0.031 | 0.613 | -0.050 | 0.960 |
| AMF diversity | <--- | Wheat yield | -0.001 | 0.000 | -3.427 | **<0.001** |
| AMF diversity | <--- | composition | -0.228 | 0.299 | -0.763 | 0.445 |
| AMF diversity | <--- | NO3−-N | -0.043 | 0.085 | -0.500 | 0.617 |
| AMF diversity | <--- | C: P ratio | 0.000 | 0.000 | 2.129 | **0.033** |

Boldface indicates significant level for the regression weight.