**Supplementary table：**

Table S1. Fit of the neutral model for the abundant and rare bacterial subcommunities in different P fertilizer input treatments from the maize and wheat fields. *m* indicates the estimated migration rate; *R2* indicates the fit to the neutral model and *nm* indicates the metacommunity size times immigration.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Habitats** |  | **P0** | | |  | **P70** | | |  | **P120** | | |
| *m* | *nm* | *R2* |  | *m* | *nm* | *R2* |  | *m* | *nm* | *R2* |
| Maize | Abundant | 0.0426 | 842 | 0.4200 |  | 0.0388 | 797 | 0.5839 |  | 0.0403 | 752 | 0.4941 |
| Rare | 0.7650 | 5885 | 0.7584 |  | 0.7400 | 5837 | 0.7313 |  | 0.8841 | 6963 | 0.7211 |
| Wheat | Abundant | 0.0199 | 349 | 0.6750 |  | 0.0208 | 395 | 0.6187 |  | 0.0184 | 355 | 0.6948 |
| Rare | 0.1755 | 905 | 0.0717 |  | 0.1966 | 931 | 0.1346 |  | 0.1648 | 805 | 0.1090 |

Table S2. The topological features of co-occurrence networks for the different groups of microbial taxa in maize and wheat field soils.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Node | Edge | Average degree | Clustering coefficient | Average path length | Diameter | Graph density |
| Maize | 1833 | 3654 | 3.987 | 0.367 | 7.417 | 19.89 | 0.002 |
| Wheat | 2441 | 4666 | 3.823 | 0.477 | 16.406 | 34.54 | 0.001 |

Table S3. The topological parameters of co-occurrence networks of different P fertilizer input treatments.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Node | Edge | Average degree | Clustering coefficient | Average path length | Diameter | Graph density |
| P0 | 4051 | 9714 | 4.796 | 0.898 | 2.966 | 10.84 | 0.001 |
| P70 | 4615 | 11533 | 4.998 | 0.807 | 2.176 | 12.78 | 0.001 |
| P120 | 4088 | 9808 | 4.798 | 0.861 | 3.405 | 16.72 | 0.001 |

Table S4. Spearman correlations between βNTI of abundant and rare bacterial subcommunities and changes of subcommunity α-diversity and soil nutrients (based on Euclidean Distance) in maize and wheat field soils.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Maize | | Wheat | |
|  | Abundant-βNTI | Rare-βNTI | Abundant-βNTI | Rare-βNTI |
| Abundant-Shannon | 0.090 | 0.047 | **-0.079\*** | **-0.083\*** |
| Rare-Shannon | 0.038 | 0.039 | **0.123\*\*** | **-0.145\*\*\*** |
| Abundant-Richness | 0.038 | 0.078 | 0.035 | -0.017 |
| Rare-Richness | 0.086 | 0.052 | **0.114\*\*** | **-0.163\*\*\*** |
| pH | -0.081 | **-0.155\*\*\*** | **0.177\*\*\*** | **-0.210\*\*\*** |
| NO3-N | 0.004 | -0.054 | **0.149\*\*\*** | **-0.342\*\*\*** |
| NH4-N | 0.080 | -0.081 | 0.010 | **-0.105\*\*** |
| AP | **0.269\*\*\*** | **-0.264\*\*\*** | 0.063 | **0.098\*** |
| ALP | **0.212\*\*\*** | **-0.223\*\*\*** | **-0.264\*\*\*** | -0.021 |

Table S5. PERMANOVA analysis (based on OTU relative abundance matrix) for the abundant and rare bacterial subcommunity compositions in different P fertilizer input treatments.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **PERMANOVA** | Maize | | Wheat | |
|  | F | *p* | F | *p* |
| Abundant |  |  |  |  |
| P70 VS. P0 | 0.967 | 0.392 | 4.342 | 0.001\*\*\* |
| P120 VS. P0 | 0.826 | 0.483 | 4.339 | 0.004\*\* |
| Rare |  |  |  |  |
| P70 VS. P0 | 1.091 | 0.252 | 1.880 | 0.001\*\*\* |
| P120 VS. P0 | 1.052 | 0.338 | 1.850 | 0.001\*\*\* |

Table S6. ANOSIM analysis (based on OTU relative abundance matrix) for the abundant and rare bacterial subcommunity compositions in different P fertilizer input treatments.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **ANOSIM** | Maize | | Wheat | |
|  | R | *p* | R | *p* |
| Abundant |  |  |  |  |
| P70 VS. P0 | -0.053 | 0.757 | 0.289 | 0.001\*\*\* |
| P120 VS. P0 | -0.019 | 0.449 | 0.287 | 0.001\*\*\* |
| Rare |  |  |  |  |
| P70 VS. P0 | -0.031 | 0.618 | 0.369 | 0.001\*\*\* |
| P120 VS. P0 | -0.0003 | 0.365 | 0.373 | 0.001\*\*\* |