*Table S1. Effects of drought (irrigation), cropping system, and sampling date (date) on the ammonium (NH4+), nitrate (NO3+), and total mineral N contents in bulk soil assessed by linear mixed model*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Ammonium (NH4+) | | Nitrate (NO3+) | | Total Mineral N | |
| F | P-value | F | P-value | F | P-value |
| Irrigation |  |  |  |  |  |  |
| Cropping System |  |  |  |  |  |  |
| Date |  |  |  |  |  |  |
| Irrigation x Cropping System |  |  |  |  |  |  |
| Irrigation x Date |  |  |  |  |  |  |
| Cropping System x Date |  |  |  |  |  |  |
| Irrigation x Cropping System x Date |  |  |  |  |  |  |

*Table S2. Effects of drought (irrigation), cropping system, and sampling date (date) on the alpha diversity (Observed Richness and Shannon Diversity Index) of ammonia-oxidizing communities assessed by linear mixed model*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Observed Richness | AOB | | | | AOA | | | | Comammox | | | |
| Bulk Soil | | Rhizosphere | | Bulk Soil | | Rhizosphere | | Bulk soil | | Rhizosphere | |
| F | P-value | F | P-value | F | P-value | F | P-value | F | P-value | F | P-value |
| Irrigation | 0.52 | 0.47 | 0.18 | 0.67 | 0.02 | 0.89 | 0.94 | 0.34 | 4.28 | **0.04** | 0.72 | 0.4 |
| Cropping System | 28.53 | **<0.0001** | 18.42 | **<0.0001** | 7.45 | **0.001** | 9.47 | **0.0008** | 20.39 | **<0.0001** | 15.87 | **<0.0001** |
| Date | 4.73 | **0.002** | 1.2 | 0.32 | 0.44 | 0.78 | 0.19 | 0.82 | 0.13 | 0.97 | 1.31 | 0.29 |
| Irrigation x Cropping System | 0.74 | 0.48 | 0.82 | 0.45 | 1.33 | 0.27 | 0.66 | 0.52 | 2.32 | 0.11 | 1.89 | 0.17 |
| Irrigation x Date | 0.52 | 0.72 | 1.46 | 0.25 | 0.33 | 0.85 | 0.03 | 0.97 | 1.02 | 0.41 | 0.21 | 0.81 |
| Cropping System x Date | 0.6 | 0.77 | 0.06 | 0.99 | 0.08 | 0.99 | 0.05 | 0.99 | 0.14 | 0.99 | 0.23 | 0.92 |
| Irrigation x Cropping System x Date | 0.34 | 0.95 | 0.12 | 0.98 | 0.2 | 0.99 | 0.08 | 0.99 | 0,.47 | 0.87 | 0.44 | 0.78 |
| Shannon Diversity Index | AOB | | | | AOA | | | | Comammox | | | |
| Bulk Soil | | Rhizosphere | | Bulk Soil | | Rhizosphere | | Bulk soil | | Rhizosphere | |
| F | P-value | F | P-value | F | P-value | F | P-value | F | P-value | F | P-value |
| Irrigation | 0.83 | 0.36 | 0.13 | 0.72 | 0.17 | 0.68 | 0.39 | 0.54 | 1.06 | 0.31 | 0.59 | 0.45 |
| Cropping System | 22.22 | **<0.0001** | 23.71 | **<0.0001** | 16.93 | **<0.0001** | 11.74 | **0.0002** | 32.87 | **<0.0001** | 21.09 | **<0.0001** |
| Date | 1.84 | 0.13 | 0.49 | 0.62 | 0.16 | 0.96 | 0.05 | 0.95 | 0.25 | 0.91 | 0.41 | 0.67 |
| Irrigation x Cropping System | 0.16 | 0.86 | 1.12 | 0.34 | 1.21 | 0.31 | 0.63 | 0.54 | 2.05 | 0.14 | 0.92 | 0.41 |
| Irrigation x Date | 0.3 | 0.87 | 1.18 | 0.32 | 0.25 | 0.91 | 0.02 | 0.98 | 0.98 | 0.43 | 0.21 | 0.81 |
| Cropping System x Date | 0.35 | 0.95 | 0.19 | 0.94 | 0.04 | 1 | 0.002 | 0.99 | 0.09 | 0.99 | 0.03 | 0.99 |
| Irrigation x Cropping System x Date | 0.58 | 0.79 | 0.28 | 0.89 | 0.21 | 0.99 | 0.04 | 0.99 | 0.27 | 0.97 | 0.4 | 0.81 |

*Table S3. Effects of drought (irrigation), cropping system, and sampling date (date) on the beta diversity (Bray-curtis and Weighted Unifrac distances) of ammonia-oxidizing communities assessed by PERMANOVA.*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bray-Curtis | AOB | | | | | | AOA | | | | | | Comammox | | | | | |
| Bulk Soil | | | Rhizosphere | | | Bulk Soil | | | Rhizosphere | | | Bulk soil | | | Rhizosphere | | |
| R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P |
| Irrigation (with restricted permutation using ‘block’ as strata) | 0.009 | 1.03 | **0.02** | 0.02 | 1.03 | **0.007** | 0.004 | 0.46 | 0.08 | 0.007 | 0.46 | 0.08 | 0.004 | 0.43 | **0.042** | 0.02 | 1.22 | **0.001** |
| Cropping System | 0.23 | 16.31 | **0.001** | 0.29 | 13.02 | **0.001** | 0.33 | 23.88 | **0.001** | 0.33 | 14.25 | **0.001** | 0.49 | 46.26 | **0.001** | 0.49 | **28.15** | **0.001** |
| Date | 0.03 | 1.12 | 0.26 |  |  |  | 0.008 | 0.27 | 1 | 0.002 | 0.09 | 1 |  |  |  |  |  |  |
| Irrigation x Cropping System | 0.02 | 1.09 | 0.29 |  |  |  | 0.009 | 0.71 | 0.58 | 0.008 | 0.34 | 0.93 |  |  |  |  |  |  |
| Irrigation x Date | 0.02 | 0.77 | 0.88 |  |  |  | 0.004 | 0.13 | 1 | 0.002 | 0.08 | 1 |  |  |  |  |  |  |
| Cropping System x Date | 0.04 | 0.74 | 0.98 |  |  |  | 0.008 | 0.14 | 1 | 0.002 | 0.05 | 1 |  |  |  |  |  |  |
| Irrigation x Cropping System x Date | 0.03 | 0.61 | 1 |  |  |  | 0.007 | 0.12 | 1 | 0.004 | 0.09 | 1 |  |  |  |  |  |  |
| Weighted UniFrac | AOB | | | | | | AOA | | | | | | Comammox | | | | | |
| Bulk Soil | | | Rhizosphere | | | Bulk Soil | | | Rhizosphere | | | Bulk soil | | | Rhizosphere | | |
| R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P | R2 | F | P |
| Irrigation (restricted permutation using ‘block’ as strata) | 0.007 | 0.87 | 0.21 | 0.03 | 1.85 | **0.008** | 0.005 | 0.63 | **0.02** | 0.007 | 0.49 | **0.04** | 0.0007 | 0.08 | 0.89 | 0.006 | 0.42 | **0.01** |
| Cropping System |  |  |  |  |  |  | 0.32 | 23.58 | **0.001** | 0.33 | 13.89 | **0.001** |  |  |  |  |  |  |
| Date |  |  |  |  |  |  | 0.03 | 1.23 | 0.29 | 0.001 | 0.04 | 0.99 |  |  |  |  |  |  |
| Irrigation x Cropping System |  |  |  |  |  |  | 0.005 | 0.34 | 0.87 | 0.006 | 0.24 | 0.92 |  |  |  |  |  |  |
| Irrigation x Date |  |  |  |  |  |  | 0.004 | 0.15 | 0.99 | 0.002 | 0.06 | 0.99 |  |  |  |  |  |  |
| Cropping System x Date |  |  |  |  |  |  | 0.006 | 0.11 | 1 | 0.002 | 0.035 | 1 |  |  |  |  |  |  |
| Irrigation x Cropping System x Date |  |  |  |  |  |  | 0.005 | 0.07 | 1 | 0.002 | 0.04 | 1 |  |  |  |  |  |  |

*Table S4. Effects of drought (irrigation), cropping system, and sampling date (date) on the ammonia-oxidizers abundance assessed by linear mixed model*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Total abundance (16S) | | | | AOB:16S Ratio | | | | AOA:16S Ratio | | | |
| Bulk Soil | | Rhizosphere | | Bulk Soil | | Rhizosphere | | Bulk soil | | Rhizosphere | |
| F | P-value | F | P-value | F | P-value | F | P-value | F | P-value | F | P-value |
| Irrigation | 0.59 | 0.45 | 0.23 | 0.64 | 10.32 | **0.002** | 2.21 | 0.15 | 0.05 | 0.83 | 22.53 | **<0.0001** |
| Cropping System | 7.65 | **0.001** | 1.42 | 0.29 | 7.62 | **0.001** | 10.18 | **0.0005** | 11.09 | **0.0001** | 9.26 | **0.0009** |
| Date | 35.83 | **<0.0001** | 0.38 | 0.69 | 1.32 | 0.28 | 0.64 | 0.54 | 29.58 | **<0.0001** | 1.84 | 0.18 |
| Irrigation x Cropping System | 12.05 | **<0.0001** | 1.38 | 0.27 | 0.06 | 0.94 | 0.99 | 0.38 | 3.83 | **0.03** | 1.25 | 0.3 |
| Irrigation x Date | 1.27 | 0.29 | 0.93 | 0.4 | 0.89 | 0.48 | 2.97 | 0.07 | 0.24 | 0.91 | 0.21 | 0.81 |
| Cropping System x Date | 0.22 | 0.98 | 0.37 | 0.82 | 0.35 | 0.94 | 0.14 | 0.97 | 0.47 | 0.87 | 0.54 | 0.71 |
| Irrigation x Cropping System x Date | 3.66 | **0.002** | 0.91 | 0.47 | 1.74 | 0.11 | 1.81 | 0.16 | 2.93 | **0.01** | 0.14 | 0.97 |
|  | | Comammox A:16S Ratio | | | | Comammox B:16S Ratio | | | | AOA:AOB Ratio | | | |
| Bulk Soil | | Rhizosphere | | Bulk Soil | | Rhizosphere | | Bulk soil | | Rhizosphere | |
| F | P-value | F | P-value | F | P-value | F | P-value | F | P-value | F | P-value |
| Irrigation | | 2.79 | 0.1 | 0.7 | 0.41 | 57.99 | **<0.0001** | 0.67 | 0.42 | 6.87 | **0.01** | 7.34 | **0.01** |
| Cropping System | | 0.92 | 0.41 | 0.35 | 0.71 | 12.07 | **<0.0001** | 11.25 | **0.0003** | 13.78 | **<0.0001** | 14.68 | **<0.0001** |
| Date | | 1.66 | 0.18 | 1.08 | 0.35 | 3.94 | **0.008** | 1.65 | 0.21 | 17.65 | **<0.0001** | 0.51 | 0.6 |
| Irrigation x Cropping System | | 3.82 | **0.03** | 1.22 | 0.31 | 6.75 | **0.003** | 2.29 | 0.12 | 1.38 | 0.26 | 2.25 | 0.13 |
| Irrigation x Date | | 1.11 | 0.36 | 0.18 | 0.83 | 1.19 | 0.33 | 0.69 | 0.51 | 1.4 | 0.25 | 1.76 | 0.19 |
| Cropping System x Date | | 0.14 | 0.99 | 0.03 | 0.99 | 0.63 | 0.75 | 1.72 | 0.17 | 0.27 | 0.97 | 0.34 | 0.85 |
| Irrigation x Cropping System x Date | | 1.49 | 0.19 | 1.13 | 0.36 | 3.77 | **0.002** | 0.32 | 0.86 | 0.54 | 0.82 | 0.88 | 0.49 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Comammox A:Comammox B Ratio | | | |
| Bulk Soil | | Rhizosphere | |
| F | P-value | F | P-value |
| Irrigation | 23.96 | **<0.0001** | 3.29 | 0.08 |
| Cropping System | 1.99 | 0.15 | 1.31 | 0.29 |
| Date | 1.81 | 0.14 | 0.5 | 0.61 |
| Irrigation x Cropping System | 1.31 | 0.28 | 2.49 | 0.1 |
| Irrigation x Date | 3.69 | **0.01** | 2.1 | 0.14 |
| Cropping System x Date | 0.21 | 0.99 | 1.03 | 0.41 |
| Irrigation x Cropping System x Date | 0.82 | 0.59 | 2.29 | 0.08 |