#### **Table S1:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for gravimetric water content. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 15.62 | 2 | ***< 0.001*** |
| Irrigation | 30.06 | 1 | ***< 0.001*** |
| Crop rotation | 18.83 | 1 | ***< 0.001*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Clay | 100.9 | 1 | ***< 0.001*** |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 15.96 | 2 | ***< 0.001*** |
| Irrigation | 24.89 | 1 | ***< 0.001*** |
| Crop types | 43.31 | 5 | ***< 0.001*** |
| Cover crop | 3.22 | 1 | 0.073 |

#### **Table S2:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for total available nitrogen. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Irrigation | 3.32 | 1 | 0.068 |
| Fertilizer | 4.31 | 1 | ***0.038*** |
| Residue | 12.76 | 1 | ***< 0.001*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Organic matter | 21.01 | 1 | ***< 0.001*** |
| Gravimetric water content | 0.49 | 1 | 0.48 |
|  |  |  |  |

#### **Table S3:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for total available phosphorus. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 19.99 | 2 | ***< 0.001*** |
| Irrigation | 11.97 | 1 | ***< 0.001*** |
| Fertilizer | 17.64 | 1 | ***< 0.001*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Organic matter | 10.27 | 1 | ***< 0.001*** |
| Gravimetric water content | 5.58 | 1 | 0.018 |

#### **Table S4:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for soil organic matter. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 12.41 | 2 | ***0.002*** |
| Irrigation | 4.34 | 1 | ***0.037*** |
| Crop rotation | 4.38 | 1 | ***0.036*** |
| Residue | 2.31 | 1 | 0.123 |
| Cover Crops | 13.14 | 1 | ***< 0.001*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| clay | 194.30 | 1 | ***< 0.001*** |
| Gravimetric water content | 9.91 | 1 | ***< 0.001*** |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 17.28 | 2 | ***< 0.001*** |
| Residue | 4.93 | 1 | ***0.026*** |
| Crop types | 42.75 | 5 | ***< 0.001*** |
| Cover crops | 14.06 | 1 | ***0.009*** |

#### **Table S5:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for dissolved organic carbon. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 4.93 | 2 | 0.085 |
| Irrigation | 27.15 | 1 | ***< 0.001*** |
| Residue | 14.64 | 1 | ***< 0.001*** |
| Cover Crops | 2.51 | 1 | 0.112 |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| clay | 6.65 | 1 | ***0.009*** |
| Gravimetric water content | 0.29 | 1 | 0.58 |

#### **Table S6:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for microbial biomass carbon. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 10.02 | 2 | ***0.0067*** |
| Fertilizer | 24.413 | 1 | ***< 0.001*** |
| Residue | 9.22 | 1 | ***0.0024*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| clay | 14.17 | 1 | ***< 0.001*** |
| Gravimetric water content | 75.17 | 1 | ***< 0.001*** |
| Total nitrogen | 4.48 | 1 | ***0.034*** |
| PC1 | 16.25 | 1 | ***< 0.001*** |
| PC2 | 5.46 | 1 | ***0.019*** |

#### **Table S7:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for microbial biomass carbon to organic carbon ratio. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Fertilizer | 23.23 | 1 | ***< 0.001*** |
| Cover Crops | 12.70 | 1 | ***< 0.001*** |
| Residue | 12.42 | 1 | ***< 0.001*** |
| Clay | 49.24 | 1 | ***< 0.001*** |

#### **Table S8:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for total FAME biomarker level. The bolded and italicized values are significant at P < 0.05.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 8.78 | 2 | ***0.012*** |
| Irrigation | 16.75 | 1 | ***< 0.001*** |
| Crop rotation | 3.91 | 1 | ***0.048*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Clay | 3.33 | 1 | 0.067 |
| Organic matter | 19.77 | 1 | ***< 0.001*** |
| Gravimetric water content | 4.54 | 1 | ***0.033*** |
| Total nitrogen | 2.86 | 1 | 0.090 |
| PC2 | 22.39 | 1 | ***< 0.001*** |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 10.25 | 2 | ***0.006*** |
| Irrigation | 16.13 | 1 | ***< 0.001*** |
| Crop types | 20.13 | 4 | ***< 0.001*** |

#### **Table S9:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for bacterial FAME biomarker level. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 13.93 | 2 | ***< 0.001*** |
| Irrigation | 9.18 | 1 | ***0.002*** |
| Crop rotation | 9.31 | 1 | ***0.002*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Clay | 3.12 | 1 | 0.078 |
| Organic matter | 31.71 | 1 | ***< 0.001*** |
| Gravimetric water content | 2.13 | 1 | ***0.144*** |
| PC2 | 14.71 | 1 | ***< 0.001*** |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 25.03 | 2 | ***< 0.001*** |
| Irrigation | 12.25 | 1 | ***< 0.001*** |
| Crop types | 37.78 | 4 | ***< 0.001*** |

#### **Table S10:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for fungal FAME biomarker level. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 8.72 | 2 | ***0.012*** |
| Irrigation | 20.73 | 1 | ***< 0.001*** |
| Crop rotation | 8.83 | 1 | ***0.003*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Organic matter | 61.48 | 1 | ***< 0.001*** |
| Gravimetric water content | 7.50 | 1 | ***0.006*** |
| Soil pH | 3.90 | 1 | ***0.048*** |
| Total nitrogen | 2.79 | 1 | 0.09 |
| PC2 | 17.71 | 1 | ***< 0.001*** |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 15.62 | 2 | ***< 0.001*** |
| Irrigation | 24.13 | 1 | ***< 0.001*** |
| Crop types | 34.50 | 4 | ***< 0.001*** |

#### **Table S10:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for Arbuscular Mycorrhizal Fungi (AMF) FAME biomarker level. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 8.88 | 2 | ***0.012*** |
| Irrigation | 30.27 | 1 | ***< 0.001*** |
| Crop rotation | 4.17 | 1 | ***0.041*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Clay | 2.62 | 1 | 0.105 |
| Organic matter | 5.39 | 1 | ***0.020*** |
| Gravimetric water content | 6.26 | 1 | ***0.012*** |
| Soil pH | 4.41 | 1 | ***0.035*** |
| Total nitrogen | 10.65 | 1 | ***0.001*** |
| PC2 | 3.75 | 1 | 0.053 |

1. The model results from post-hoc analysis with crop types as predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 6.04 | 2 | ***0.048*** |
| Irrigation | 35.38 | 1 | ***< 0.001*** |
| Residue | 6.09 | 1 | ***0.014*** |

#### **Table S11:** Type II ANOVA showing χ2, degree of freedom, and p-values from mixed effects model for fungi to bacteria (FB) ratio. The bolded and italicized values are significant at P < 0.05. The automated model selection procedure was performed to avoid model overfitting, and AIC was used as the model selection criteria. The table shows only the predictors retained in the best-fit model.

1. The model results with categorical predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Tillage | 7.83 | 2 | ***0.019*** |
| Irrigation | 20.03 | 1 | ***< 0.001*** |
| Crop rotation | 2.74 | 1 | ***0.097*** |

1. The model results with continuous predictors.

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | χ2 | df | *P* |
| Soil pH | 11.12 | 1 | ***< 0.001*** |
| Total nitrogen | 7.92 | 1 | ***0.005*** |
| PC2 | 10.48 | 1 | ***0.001*** |