**Table S1.** Two-way ANOVA of vegetation characteristics under different fertilization treatments. Values shown as 0.000 represent p-values smaller than 0.001 due to rounding by the statistical software, the same below.

| Treatment | *df* | Vegetation height(cm) | | Vegetation coverage(%) | | Vegetation density(plants·m$^{-2}$) | | Above-ground biomass(g·m$^{-2}$) | |
|---|---|---|---|---|---|---|---|---|---|
| | | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** |
| S | 2 | 12.209 | 0.000 | 50.818 | 0.000 | 10.462 | 0.001 | 13.317 | 0.000 |
| F | 2 | 8.686 | 0.002 | 10.886 | 0.001 | 4.761 | 0.022 | 2.022 | 0.161 |
| S*F | 4 | 10.503 | 0.000 | 5.908 | 0.003 | 2.550 | 0.075 | 2.166 | 0.114 |

**Table S2.** Two-way ANOVA of soil physicochemical properties under different fertilization.

| Indicators | *df* | S | F | S*F |
|---|---|---|---|---|
| | | **2** | **2** | **4** |
| Moisture content/( g·cm$^{-3}$) | *F* | 321.725 | 12.073 | 9.407 |
| | *P* | 0.000 | 0.000 | 0.000 |
| Bluk density/( g·cm$^{-3}$) | *F* | 783.981 | 80.695 | 98.075 |
| | *P* | 0.000 | 0.000 | 0.000 |
| pH | *F* | 25.087 | 9.494 | 2.786 |
| | *P* | 0.000 | 0.002 | 0.058 |
| Available nitrogen/(mg·kg$^{-1}$) | *F* | 40.184 | 3.587 | 1.968 |
| | *P* | 0.000 | 0.049 | 0.143 |
| Available phosphorus/(mg·kg$^{-1}$) | *F* | 74.325 | 22.195 | 4.196 |
| | *P* | 0.000 | 0.000 | 0.014 |
| Total nitrogen/(g·kg$^{-1}$) | *F* | 70.160 | 5.049 | 0.605 |
| | *P* | 0.000 | 0.018 | 0.664 |
| Total phosphorus/(g·kg$^{-1}$) | *F* | 50.930 | 3.058 | 1.807 |
| | *P* | 0.000 | 0.072 | 0.171 |
| Organic matter/(g·kg$^{-1}$) | *F* | 38.474 | 3.771 | 0.813 |
| | *P* | 0.000 | 0.043 | 0.533 |

**Table S3.** Two-way ANOVA of soil microbial biomass carbon, nitrogen, phosphorus, and their stoichiometric ratios under different fertilization treatments.

| Treatment | *df* | MBC | | MBN | | MBP | | MBC/MBN | | MBC/MBP | | MBN/MBP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** | ***F*** | ***P*** |
| S | 2 | 2075.819 | 0.000 | 369.641 | 0.000 | 496.969 | 0.000 | 8.509 | 0.003 | 2.768 | 0.001 | 2.662 | 0.097 |
| F | 2 | 82.352 | 0.000 | 7.298 | 0.005 | 31.787 | 0.000 | 1.669 | 0.216 | 0.147 | 0.090 | 0.185 | 0.833 |
| S*F | 4 | 22.799 | 0.000 | 2.161 | 0.115 | 12.896 | 0.000 | 6.907 | 0.001 | 0.930 | 0.864 | 2.994 | 0.047 |