Calcium-based biochar loading *Paenibacillus mucilaginosus* an eco-friendly strategy to enhance soil nutrients and plant biomass with biochar-based fertilizers

**Supplementary tables:**

**Table S1.** Soil physical and chemical properties.

**Table S2.** BCEKH physical and chemical properties.

**Table S3.** Coefficients of determination (R2) and rate constants (b) for the kinetic model of phosphorus release from biochar in soil.

**Table S4.** Coefficients of determination (R2) and rate constants (b) for kinetic models of potassium release from biochar in soil.

**Table S5.** Coefficient of determination (R2) and rate constant (b) for a kinetic model of potassium release from biochar in soil.

**Table S1**

Soil physical and chemical properties.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Property | pH | EC  (ms·cm-1) | Total  Calcium  (mg·kg-1) | Active Phosphorus (mg·kg-1) | Active  Potassium  (mg·kg-1) | Organic matter (%) | Moisture content (%) |
| Value | 8.51 | 1.151 | 1800 | 44.57 | 225.41 | 17.79 | 13.15 |

**Table S2**

BCEKH physical and chemical properties.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Property | pH | EC  (ds·m-1) | Total  Calcium  (g·kg-1) | Total Phosphorus (g·kg-1) | Total  Potassium  (g·kg-1) | Surface Area  (m2·g-1) | Pore Volume  (cm3·g-1) | Pore Size  (nm) |
| Value | 7.79 | 8.07 | 126.10 | 188.93 | 159.88 | 73.92 | 0.06 | 5.48 |

**Table S3**

Coefficient of determination (R2) and slope (K) for a kinetic model of phosphorus release from experimental groups

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| P soil | The zero order (linear) | | pseudo-first  order | | pseudo-second order | | Elovich | | parabolic diffusion  model | | power  function | |
| R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 |
| CS | 0.992 | 0.020 | 0.907 | 0.055 | 0.920 | 0.036 | 0.935 | 2.674 | 0.992 | 0.040 | 0.978 | 0.140 |
| T | 0.996 | 1.959 | 0.998 | -0.008 | 0.995 | 0.000 | 0.995 | 0.000 | 0.996 | 3.918 | 0.998 | 1.433 |
| J | 0.998 | 0.171 | 0.956 | 0.037 | 0.960 | 0.028 | 0.964 | 0.204 | 0.998 | 0.343 | 0.986 | 0.759 |
| 10TJ | 0.994 | 2.290 | 0.997 | -0.009 | 0.993 | 0.000 | 0.993 | 0.000 | 0.994 | 4.580 | 0.997 | 1.545 |
| 20TJ | 0.997 | 2.148 | 0.998 | -0.004 | 0.997 | 0.000 | 0.997 | 0.000 | 0.997 | 4.295 | 0.997 | 1.900 |
| 30TJ | 0.998 | 2.499 | 0.998 | -0.002 | 0.997 | 0.000 | 0.998 | 0.000 | 0.998 | 4.998 | 0.998 | 2.275 |

**Table S4**

Coefficient of determination (R2) and slope (K) for a kinetic model of potassium release from experimental groups

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| K soil | The zero order (linear) | | pseudo-first  order | | pseudo-second order | | Elovich | | parabolic diffusion  model | | power  function | |
| R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 |
| CS | 0.998 | 0.024 | 0.844 | 0.065 | 0.865 | 0.063 | 0.896 | 2.799 | 0.998 | 0.047 | 0.963 | 0.216 |
| T | 0.998 | 2.327 | 0.971 | 0.000 | 0.980 | 0.008 | 0.981 | 0.006 | 0.998 | 4.655 | 0.987 | 4.894 |
| J | 1.000 | 0.195 | 0.956 | 0.030 | 0.959 | 0.020 | 0.961 | 0.146 | 1.000 | 0.391 | 0.981 | 0.731 |
| 10TJ | 0.996 | 2.826 | 0.972 | 0.000 | 0.977 | 0.005 | 0.977 | 0.003 | 0.996 | 5.651 | 0.983 | 5.321 |
| 20TJ | 0.995 | 2.983 | 0.975 | 0.000 | 0.976 | 0.003 | 0.976 | 0.002 | 0.994 | 5.966 | 0.981 | 5.000 |
| 30TJ | 0.989 | 3.104 | 0.969 | -0.001 | 0.962 | 0.001 | 0.969 | 0.001 | 0.989 | 6.207 | 0.972 | 4.700 |

**Table S5**

Coefficient of determination (R2) and slope (K) for a kinetic model of calcium release from experimental groups

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ca soil | The zero order (linear) | | pseudo-first  order | | pseudo-second order | | Elovich | | parabolic diffusion  model | | power  function | |
| R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 | R2 | K1 |
| CS | 0.989 | 0.027 | 0.975 | 0.000 | 0.975 | 0.001 | 0.975 | 0.031 | 0.989 | 0.055 | 0.978 | 0.041 |
| T | 0.992 | 1.112 | 0.998 | -0.012 | 0.991 | 0.000 | 0.991 | 1.093 | 0.991 | 2.223 | 0.996 | 0.717 |
| J | 0.998 | 0.024 | 0.984 | 0.025 | 0.985 | 0.016 | 0.985 | 0.043 | 0.998 | 0.049 | 0.993 | 0.068 |
| 10TJ | 0.985 | 1.113 | 0.997 | -0.017 | 0.984 | 0.000 | 0.984 | 1.085 | 0.985 | 2.226 | 0.994 | 0.578 |
| 20TJ | 0.992 | 1.215 | 0.998 | -0.013 | 0.991 | 0.000 | 0.991 | 1.189 | 0.992 | 2.430 | 0.997 | 0.754 |
| 30TJ | 0.991 | 1.203 | 0.997 | -0.012 | 0.991 | 0.000 | 0.991 | 0.001 | 0.991 | 2.406 | 0.996 | 0.782 |