**Supplemental Material**

Table S1. Mean of soil parameters in the top 30 cm of three soils with different initial P concentrations namely very low, low and optimal PCAL concentrations after harvest in 2013. Measurements were conducted before the set-up of the present experiment and previously published by Panten and Leinweber (2020).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Soil parameter** | **Very low P** | **Low P** | **Optimal P** |  |
| PCAL [mg kg-1] | 11.2 (6.9-17.8) | 20.7 (16.5-25.1) | 47.2 (41.4-53.0) |  |
| Pwater [mg kg-1] | 2.8 (2.0-3.9) | 4.4 (3.5-5.5) | 9.4 (8.0-10.5) |  |
| Total P [mg kg-1] | 217 (204-241) | 273 (230-324) | 399 (378-424) |  |
| Total C [%] | 1.3 (1.2-1.4) | 1.4 (1.3-1.5) | 1.4 (1.4-1.4) |  |
| Total N [%] | 0.10 (0.09-0.10) | 0.10 (0.10-0.11) | 0.10 (0.10-0.11) |  |
| pH | 5.1 (5.0-5.2)  | 5.2 (5.0-5.2) | 5.2 (5.1-5.3) |  |
|  |  |  |  |  |

**Table S2.** Mean values and standard deviation of the potential alkaline (ALP) and acid (ACP) phosphatase activity, dissolved organic carbon (DOC) and nitrogen (DON), microbial biomass carbon (Cmic) and the pH. Samples were taken and analyzed from three field replicates.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Sampling Date** | **Initial P** | **Treatment** | **ALP** | **ACP** | **DOC**  | **DON** | **Cmic** | **pH** |
|  [µg p-NP g-1 dwt h-1] | [µg g-1 dwt] |   |   |   |
| Stem elongation | very low | Control | 69.4 | ± | 13 | 285.1 | ± | 24.1 | 21.4 | ± | 13.5 | 24.5 | ± | 20.6 | 242.5 | ± | 125.5 | 5.0 | ± | 0.2 |
|  |  | TSP | 69.2 | ± | 14.3 | 248.0 | ± | 27.8 | 22.7 | ± | 11 | 10.5 | ± | 4.4 | 201.7 | ± | 87.1 | 5.1 | ± | 0.2 |
|  |  | BC | 73.7 | ± | 10 | 301.3 | ± | 28.1 | 24.1 | ± | 9.7 | 20.0 | ± | 6.2 | 243.9 | ± | 37.8 | 5.0 | ± | 0.1 |
|  |  | BCplus | 56.9 | ± | 12.4 | 254.4 | ± | 39.3 | 91.6 | ± | 115\* | 16.9 | ± | 21.0 | 244.6 | ± | 130.9 | 5.2 | ± | 0.1 |
|  | low | Control | 75.6 | ± | 19 | 266.0 | ± | 32.1 | 16.1 | ± | 2.1 | 7.7 | ± | 5.6 | 225.8 | ± | 64.2 | 5.1 | ± | 0.0 |
|  |  | TSP | 54.8 | ± | 2.5 | 267.5 | ± | 13.7 | 14.3 | ± | 3.3 | 2.2 | ± | 1.1 | 271.8 | ± | 155.3 | 5.1 | ± | 0.1 |
|  |  | BC | 64.3 | ± | 11.8 | 283.6 | ± | 21.4 | 15.7 | ± | 0.7 | 10.3 | ± | 5.8 | 210.4 | ± | 48.2 | 5.1 | ± | 0.2 |
|  |  | BCplus | 68.3 | ± | 13.4 | 265.0 | ± | 1.6 | 237.8 | ± | 382# | 6.3 | ± | 4.8 | 163.5 | ± | 75.3 | 5.1 | ± | 0.1 |
|  | optimal | Control | 70.4 | ± | 14.3 | 268.9 | ± | 21.2 | 20.1 | ± | 8.8 | 4.8 | ± | 4.9 | 210.6 | ± | 25.7 | 5.1 | ± | 0.1 |
|  |  | TSP | 67.9 | ± | 5.1 | 260.0 | ± | 16.6 | 23.6 | ± | 11.3 | 7.0 | ± | 1.9 | 251.3 | ± | 48.4 | 5.2 | ± | 0.0 |
|  |  | BC | 69.9 | ± | 7.3 | 262.6 | ± | 29.2 | 16.9 | ± | 5.6 | 3.1 | ± | 1.3 | 167.4 | ± | 51.8 | 5.2 | ± | 0.0 |
|   |   | BCplus | 71.9 | ± | 23.1 | 283.5 | ± | 38.3 | 92.5 | ± | 47.2 | 4.0 | ± | 4.0 | 260.3 | ± | 94.1 | 5.1 | ± | 0.1 |
| Heading | very low | Control | 81.3 | ± | 33.5 | 328.6 | ± | 43 | 25.8 | ± | 8.9 | 12.6 | ± | 6.3 | 225.6 | ± | 31.2 | 5.1 | ± | 0.2 |
|  |  | TSP | 74.8 | ± | 13.5 | 320.5 | ± | 42 | 23.6 | ± | 4.25 | 8.5 | ± | 3.1 | 258.9 | ± | 31.7 | 5.2 | ± | 0.1 |
|  |  | BC | 69.4 | ± | 17.8 | 324.4 | ± | 33.7 | 23.9 | ± | 4.95 | 9.2 | ± | 1.7 | 259.2 | ± | 56.9 | 5.2 | ± | 0.2 |
|  |  | BCplus | 75.0 | ± | 5.4 | 314.3 | ± | 28.2 | 20.2 | ± | 0.58 | 7.2 | ± | 1.4 | 242.5 | ± | 72.5 | 5.2 | ± | 0.1 |
|  | low | Control | 86.2 | ± | 9.9 | 318.0 | ± | 6.4 | 23.8 | ± | 4.85 | 8.2 | ± | 1.1 | 251.8 | ± | 36.1 | 5.2 | ± | 0.1 |
|  |  | TSP | 80.1 | ± | 17.8 | 313.2 | ± | 28.9 | 24.4 | ± | 1.68 | 7.2 | ± | 1.1 | 231.1 | ± | 33.9 | 5.1 | ± | 0.1 |
|  |  | BC | 77.4 | ± | 10.9 | 332.9 | ± | 60.9 | 21.5 | ± | 5.82 | 7.0 | ± | 0.4 | 211.8 | ± | 53.2 | 5.2 | ± | 0.1 |
|  |  | BCplus | 83.7 | ± | 18.3 | 333.6 | ± | 41.7 | 18.4 | ± | 2.79 | 8.5 | ± | 0.7 | 273.9 | ± | 78.9 | 5.2 | ± | 0.1 |
|  | optimal | Control | 74.9 | ± | 14 | 328.0 | ± | 29.3 | 22.2 | ± | 6.8 | 7.5 | ± | 1.7 | 247.7 | ± | 59.6 | 5.1 | ± | 0.1 |
|  |  | TSP | 77.2 | ± | 1.7 | 301.8 | ± | 43.6 | 21.2 | ± | 1.71 | 8.0 | ± | 1.3 | 270.2 | ± | 41.3 | 5.2 | ± | 0.0 |
|  |  | BC | 78.2 | ± | 9.6 | 322.6 | ± | 32.7 | 18.5 | ± | 4.95 | 6.9 | ± | 1.2 | 229.2 | ± | 11.2 | 5.2 | ± | 0.0 |
|   |   | BCplus | 65.3 | ± | 15.3 | 293.1 | ± | 25.5 | 20.1 | ± | 1.62 | 6.1 | ± | 1.1 | 255.4 | ± | 35.0 | 5.2 | ± | 0.1 |
| Ripening | very low | Control | 66.9 | ± | 4.4 | 321.7 | ± | 67.6 | 31.2 | ± | 13.9 | 5.8 | ± | 0.5 | 249.6 | ± | 67.7 | 5.2 | ± | 0.4 |
|  |  | TSP | 73.8 | ± | 4.2 | 285.9 | ± | 1.3 | 23.9 | ± | 8.07 | 5.7 | ± | 1.4 | 276.6 | ± | 18.1 | 5.4 | ± | 0.3 |
|  |  | BC | 67.9 | ± | 2.2 | 329.0 | ± | 52.2 | 25.1 | ± | 1.59 | 6.6 | ± | 0.8 | 270.0 | ± | 41.0 | 5.6 | ± | 0.6 |
|  |  | BCplus | 81.7 | ± | 8 | 316.6 | ± | 27.5 | 23.7 | ± | 1.35 | 6.3 | ± | 0.7 | 283.4 | ± | 44.1 | 5.2 | ± | 0.2 |
|  | low | Control | 83.9 | ± | 8.1 | 294.0 | ± | 42.5 | 46.4 | ± | 34 | 8.7 | ± | 2.9 | 255.7 | ± | 57.3 | 5.2 | ± | 0.0 |
|  |  | TSP | 67.7 | ± | 13.7 | 308.6 | ± | 13.6 | 21.1 | ± | 3.1 | 6.6 | ± | 1.3 | 282.3 | ± | 81.8 | 5.1 | ± | 0.2 |
|  |  | BC | 73.7 | ± | 14.9 | 328.0 | ± | 15.1 | 30.6 | ± | 13.4 | 6.3 | ± | 1.5 | 268.1 | ± | 65.2 | 5.1 | ± | 0.2 |
|  |  | BCplus | 69.3 | ± | 7.2 | 308.0 | ± | 39.6 | 29.6 | ± | 12.6 | 7.1 | ± | 1.9 | 244.5 | ± | 52.4 | 5.2 | ± | 0.1 |
|  | optimal | Control | 64.7 | ± | 11.1 | 303.9 | ± | 21.2 | 23.7 | ± | 4.99 | 5.1 | ± | 0.7 | 266.9 | ± | 35.6 | 5.1 | ± | 0.3 |
|  |  | TSP | 73.4 | ± | 3.7 | 297.4 | ± | 30.5 | 29.4 | ± | 5.82 | 7.0 | ± | 0.9 | 280.1 | ± | 68.8 | 5.2 | ± | 0.1 |
|  |  | BC | 72.5 | ± | 8.1 | 300.4 | ± | 11.6 | 26.3 | ± | 4.18 | 6.4 | ± | 0.9 | 278.9 | ± | 72.4 | 5.3 | ± | 0.1 |
|   |   | BCplus | 62.9 | ± | 14.7 | 290.0 | ± | 21 | 30.7 | ± | 9.13 | 6.6 | ± | 2.3 | 260.0 | ± | 50.8 | 5.1 | ± | 0.2 |

DOC values excluding outlier replicates (n=2): \*25.6 µg g-1 dwt, # 17.5 µg g-1 dwt

**Table S3.** p values of significant (p < 0.05) pairwise comparisons based on a Tukey Post hoc test.

|  |  |  |  |
| --- | --- | --- | --- |
| **Sampling Date** | **Contrast (initial P, Treatment)** | **p Value** | **Test Variable** |
|
| Stem elongation | very low, BC - optimal, BC | 0.002 | Pwater |
|  | very low, TSP - optimal, TSP | 0.023 | Pwater |
|  | very low, BC - optimal, BC | 0.005 | PCAL |
|  | very low, Control - optimal, Control | 0.031 | PCAL |
|   | very low, TSP - optimal, TSP | 0.028 | PCAL |
| Heading | optimal, BC - optimal, Control | 0.027 | *pstS* |
|  | low, BCplus - low, TSP | 0.033 | *phoD* |
|  | optimal, BC - optimal, BCplus | 0.012 | *gcd* |
|  | very low, BCplus - optimal, BCplus | 0.019 | *gcd* |
|  | optimal, BCplus - optimal, TSP | 0.019 | *gcd* |
|  | very low, BC - optimal, BC | 0.000 | Pwater |
|  | very low, BC - A, TSP | 0.028 | Pwater |
|  | low, BC - optimal, BC | 0.010 | Pwater |
|  | low, BC - low, TSP | 0.006 | Pwater |
|  | very low, Control - optimal, Control | 0.027 | Pwater |
|  | low, Control - low, TSP | 0.037 | Pwater |
|  | very low, TSP - optimal, TSP | 0.004 | Pwater |
|  | very low, BC - optimal, BC | 0.000 | PCAL |
|  | low, BC - low, TSP | 0.007 | PCAL |
|  | very low, Control - optimal, Control | 0.013 | PCAL |
|  | very low, TSP - low, TSP | 0.011 | PCAL |
|   | very low, TSP - optimal, TSP | 0.002 | PCAL |
| Ripening | very low, BC - optimal, BC | 0.000 | Pwater |
|  | low, BC - optimal, BC | 0.005 | Pwater |
|  | low, BC - low, TSP | 0.014 | Pwater |
|  | very low, Control - optimal, Control | 0.004 | Pwater |
|  | very low, TSP - optimal, TSP | 0.001 | Pwater |
|  | very low, BC - optimal, BC | 0.001 | PCAL |
|  | very low, Control - optimal, Control | 0.009 | PCAL |
|   | very low, TSP - optimal, TSP | 0.002 | PCAL |