**Supplementary material**

**Material and Methods**

**Phospholipid fatty acid analysis (PLFA)**

Phospholipids were extracted from freeze-dried soil (10 g) with 15.2 mL Bligh and Dyer mixture of chloroform: methanol: phosphate buffer (1:2:0.8, v/v/v) on a Multi Reax vortex mixer at room temperature for 2 h, at 1500 rpm. After centrifugation for 20 min at 2500 rpm, the supernatant was transferred to a borosilicate glass tube and the soil residue was re-extracted for 30 min with 7.6 mL of Bligh and Dyer extractant. The combined supernatant was split into two phases by adding 3.1 mL chloroform and 3.1 mL phosphate buffer and left overnight to separate. The organic layer at the bottom was then transferred to a vial and evaporated to dryness under N2 at 37°C. Phospholipids were separated from neutral lipids and glycolipids on a solid phase extraction (SPE) Si column Bond Elut. The column was first conditioned with CHCl3 (5 ml). The lipids were then transferred into the column with CHCl3 (500 µL, then 3×250 μl). Neutral lipids and glycolipids were eluted with 6 ml chloroform and 6 ml acetone. Phospholipids were obtained from methanol elution (3x3 ml) and evaporated to dryness under N2 at 37°C. Lipidic extracts were redissolved in 2 x 500 µL methanol: toluene (1: 1, v : v), transferred to a glass centrifuge tube, and 500 µL C19 at 76 nmol mL-1 was then added as an internal standard. The polar lipids were trans-esterified to the fatty acid methyl esters (FAMEs) by a mild alkaline methanolysis (Guckert et al., 1985) with a methanol: toluene (1 ml) and potassium hydroxide methanol solution (0.2 M, 1 ml) in the glass centrifuge tube and incubated at 37 °C for 30 min. After methylation, acetic acid (0.3 ml) and H2O (2 ml) were added. FAMEs were extracted in 2x2 mL hexane: chloroform (4:1, v/v) and dried under N2. Samples were then dissolved in hexane (200 μL) with C13 at 47.73 nmol/mL and transferred to a GC vial insert and analysed in a Varian CP 3800 Gas Chromatograph fitted with a flam ionisation detector. The column was a Thermo Scientific 260 M 142 P (30 m x 0.25 mm x 0.25 µm capillary column. Helium was the carrier gas. The GC temperature progression was set at 100 °C to 165 °C (5 °C/min) to 183 °C (2 °C/min) to 240 °C (5 °C/min) and after 20 min to 240 °C. The fatty acid 19:0 was added as an internal standard before methylation and 13:0 before analysis in GC. FAMEs were identified using relative retention times; the peaks having previously been identified by GC/MS and BAME 26 standards Sigma-Aldritch.

**Enzymatic activities**

Beta-glucosidase was evaluated by Eivazi and Tabatabai’s method (1988), using the *p*-nitrophenyl-beta-glucopyranoside (*p*NPG) as a substrate. 1 g of wet soil was weighed in duplicate and each sample was incubated for 2 hours at 25 °C. and stirred with 1 ml substrate (5 nM pNPG) and 4 ml universal buffer solution adjusted to pH 6.0. The reaction was terminated by adding 1 ml of 0.5 mol L-1 CaCl2 and 4 ml of 0.5 molar L-1 NaOH. The mixture was vortexed and centrifuged for 3 minutes at 9000 rpm. The beta-glucosidase activity was based on the level of *p*-nitrophenol released during the incubation, which was determined by spectrophotometry (410 nm). The standard curve was measured with p-nitrophenol (50 μg mL-1) at concentrations of 0, 25, 50, 100, 150, and 200 μg, respectively. The data were expressed in µg pNPg-1 dry soil h-1.

Urease activity, an enzyme linked to the conversion of the amine (NH2) to ammonium (NH4 +), was measured by determining the amount of ammonium released during incubation (2 hours at 37 °C) (Kandeler and Gerber, 1988). Moist soil (2 g) was weighed (two replicates per sample) and incubated with 2 mL of urea (1 replicate) and 2 mL of milli Q water (control samples). Ammonium was extracted from soil using KCl 2 mol L-1 measured by spectrophotometry (690 nm) using the acid-salicylic method (Bundy and Meisinger, 1994). The standard curve was measured with NH4Cl solution at concentrations of 0, 0.56, 1.11, 2.23, 5.57, 8.9, 13.38, 17.85, and 22.31 μmol L-1 NH4+, respectively. The data were expressed in µg N-NH4 g-1 dry soil h-1.

The FDA activity proposed by Schnurer and Rosswall (1982) was measured on 2 g of moist soil in the presence of 15 ml of 60 nM potassium phosphate buffer and 200 μL of substrate (solution of 1000 μg mL-1 of FDA). The samples were incubated for 20 min at 30 °C with shaking, the reaction was then quenched by adding 15 mL of a chloroform/methanol mixture (2:1, v:v). The control samples did not receive any substrate prior to incubation after adding chloroform/methanol. All samples were centrifuged at 2000 rpm for 3 minutes and the fluorescein was read at 490 nm by spectrophotometry. The standard curve was measured using a fluorescein solution (20 μg mL-1) at concentrations of 0, 10, 20, 30, 40, 50, 60, 70, 80, 90, and 100 μg, respectively. The data were expressed in µg fluorescein g-1 dry soil h-1.

References

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