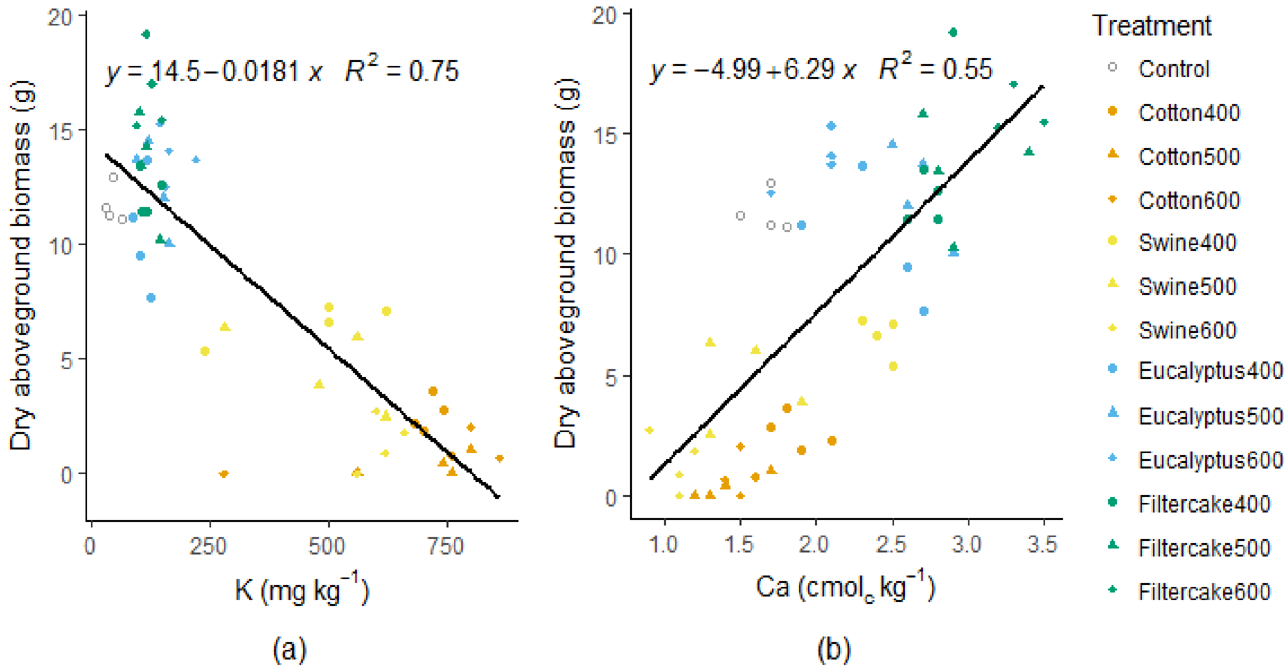

Figure S1. Correlations between dry aboveground biomass (g) and (a) potassium (K; mg kg^{-1}) and (b) calcium (Ca; cmol$_c$ kg^{-1})

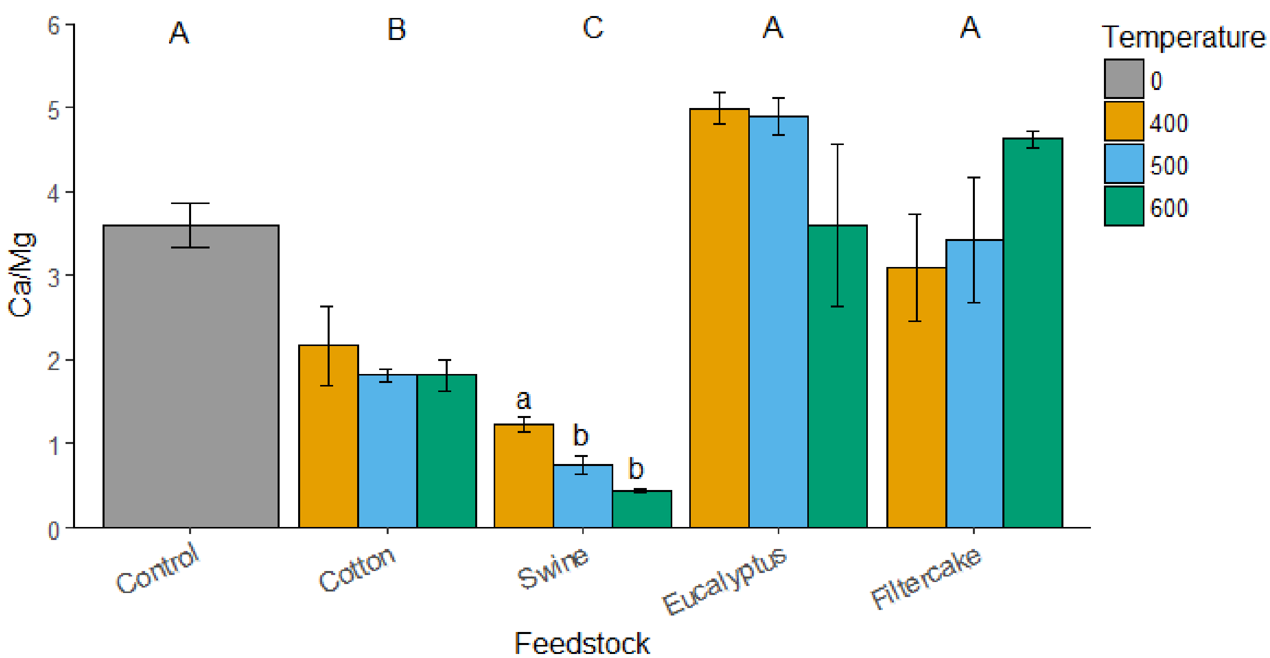

Figure S2. Mean Ca:Mg ratio (n = 4). Capital letters represent significant differences between the feedstocks while lowercase letters represent significant differences between the temperatures (Tukey test; $p < 0.05$).

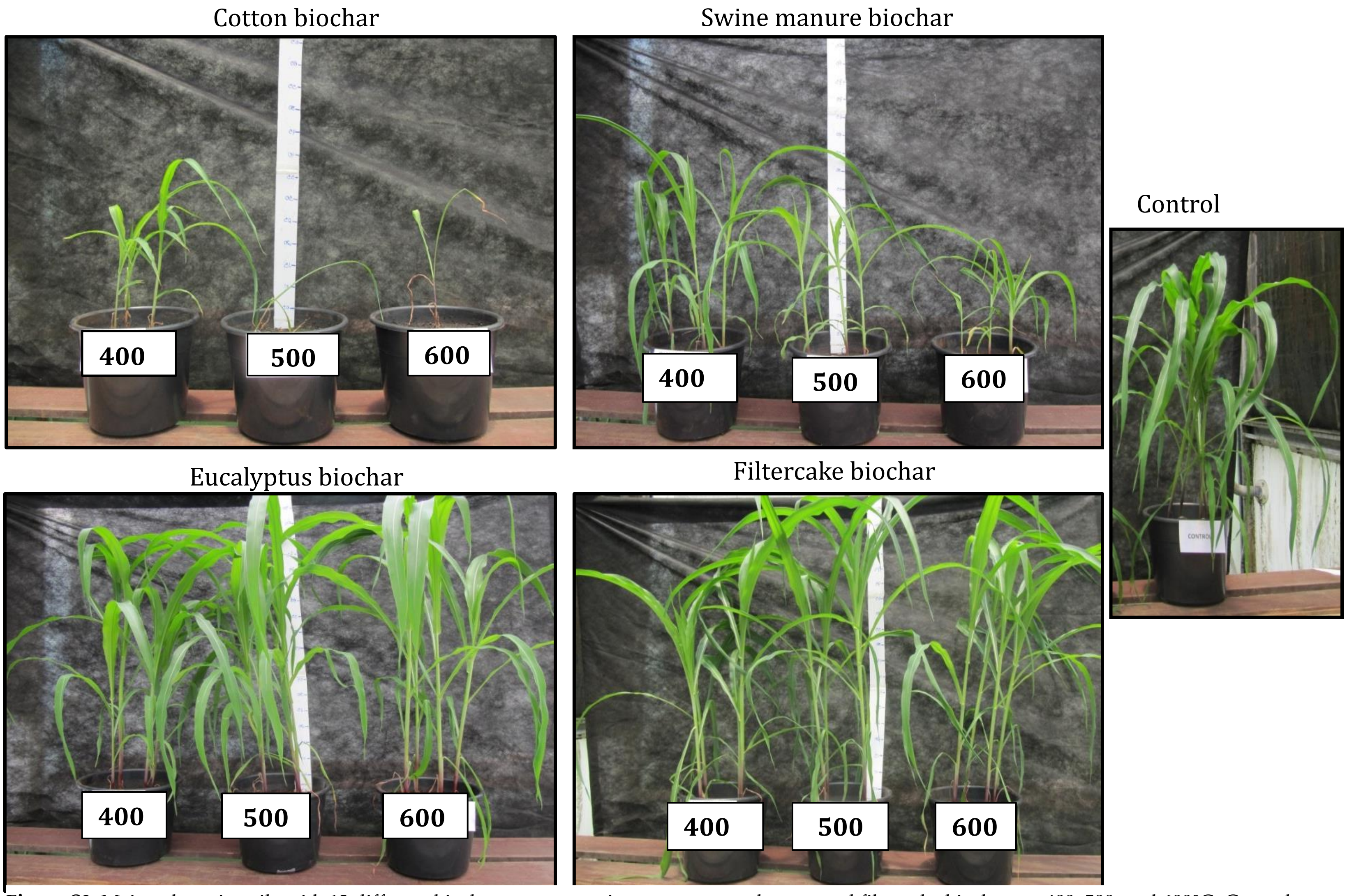

Figure S3. Maize plants in soils with 12 different biochars: cotton, swine manure, eucalyptus, and filtercake biochars at 400, 500, and 600°C. Control treatment did not contain biochar.

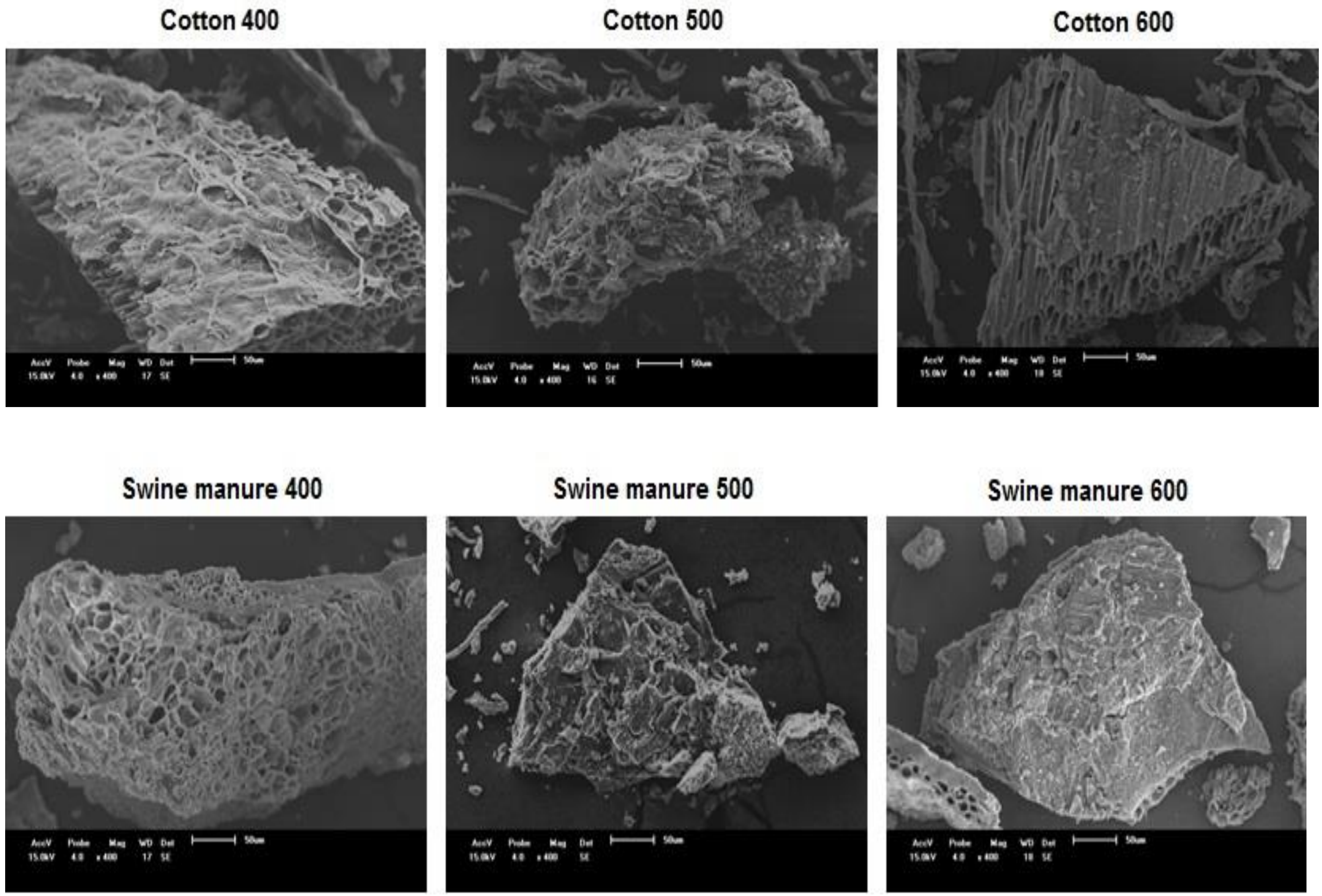

Figure S4. SEM images of cotton and swine manure biochars at 400, 500, and 600°C at x400 magnification (Shimadzu SSX-550 Superscan microscope).

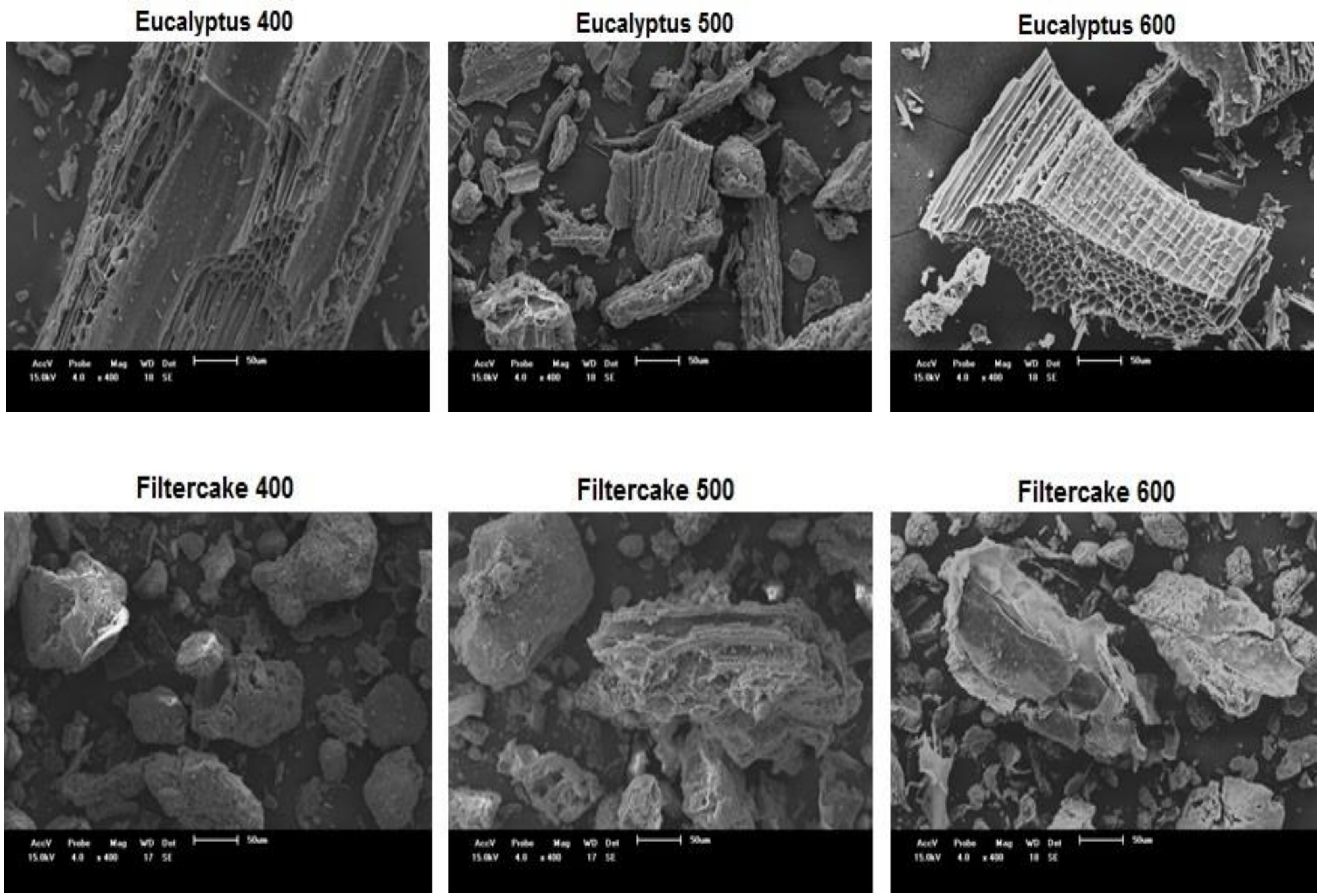

Figure S5. SEM images of eucalyptus and filtercake biochars at 400, 500, and 600°C at x400 magnification (Shimadzu SSX-550 Superscan microscope).

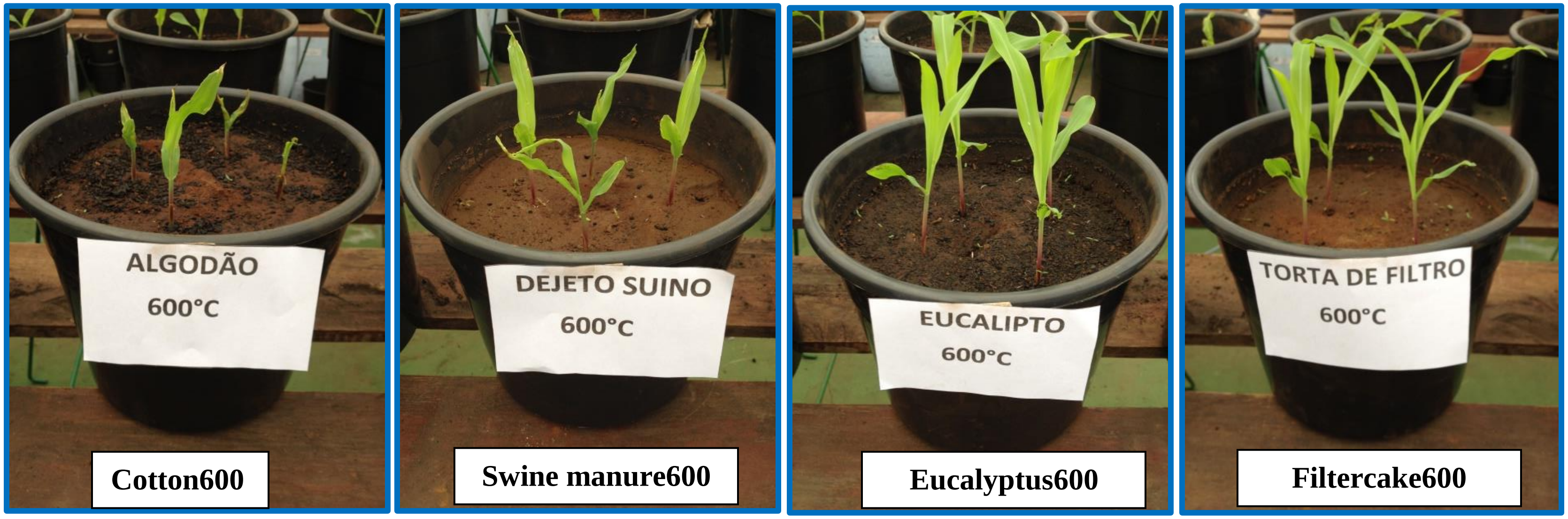

Figure S6. Maize plants in soils with cotton, swine manure, eucalyptus, and filtercake biochars at 600°C in the early stages of the experiment. Biochar is visible on the soil surface for some feedstocks more than the others.

S1.1. Hydraulic conductivity measurements

In addition to the measurements provided by the tension table, pressure chambers, and WP4, saturated and unsaturated hydraulic conductivity (e.g. K(θ)) was determined in the laboratory using the HYPROP® (UMS GmbH, Munich, Germany), which employs the simplified evaporation method [1,2]. The HYPROP® holds two vertically aligned tensiometers (bottom and top) with ceramic cups at the end and takes measurements as the soil water evaporates. An Arenosol (sifted to <2 mm) was mixed dry with each biochar at 5% (w/w), moistened to 20% θ and packed into 250 cm^3 stainless steel cores (8 cm diameter, 5 cm height) to a bulk density of 1.2 g cm^{-3}. A fine mesh was applied at one end and the core placed in a pan of water to saturate for 24 h. The HYPROP® sensor head and tensiometers were refilled with distilled water manually using the syringe method and allowed to sit for 24 hours to degas as much as possible. After 24 hours, two holes for each tensiometer were drilled in the saturated soil sample, the sample placed onto the HYPROP® sensor head with the tensiometers in place, and the HYPROP® with sample was set on a scale. Both the HYPROP® device and the scale were connected to a computer running the tensioView® software (version 1.10, UMS GmbH, Munich, Germany). Weight and tensions (Ψ) were recorded automatically by tensioView® as the soil dried by evaporation in the laboratory environment. Once air entered the ceramic cup of the tensiometers (after 7 days) and the Ψ readings dropped to 0 kPa, the measurement was concluded. The soil was then removed from the core into a dish and placed in the oven to dry at 105°C for 24 hours and weighed.

The soil dry weight was entered in the HYPROP-FIT software to calculate the θ during the measurements. Using HYPROP-FIT, the retention curve, $\theta(\Psi)$, and hydraulic conductivity, K(θ), were determined by fitting the data to the van Genuchten [3] model for the retention curve and the Mualem [4] model for the conductivity curve. The software also provided the quality of the fit to the model by root mean squared error (RMSE) for both θ and the log of hydraulic conductivity, *K*, along with parameter values. This procedure was repeated for the 400 and 600°C biochar-soil mixtures. As measurements for each biochar lasted about a week and could only be measured one sample at a time, it was not feasible to include all 12 biochars with replicates. The HYPROP® results thus serve to provide the potential water retention characteristics and an estimate of the hydraulic conductivity of soil mixed with the biochar feedstocks at a high and low temperature of pyrolysis and compare the results to that of the tension table, pressure chambers, and WP4.

Table S1. Parameter values for water content (θ) and K_s and fit quality of the model measured by root mean square error (RMSE)[a] for each biochar-soil mixture treatment (HYPROP data). θ_s = saturated (wet soil) θ; θ_r = residual (dry soil) θ

	θ			***K_s***	
Treatment	**θ_s (cm^3 cm^{-3})**	**θ_r (cm^3 cm^{-3})**	**$RMSE_\theta$**	**K_s (cm d^{-1})**	**$RMSE_{logK}$**
Control	0.49	0.12	0.01	12.0	0.12
Cotton400	0.57	0.27	0.01	4.31	0.07
Cotton600	0.44	0.17	0.01	0.98	0.13
Swine400	0.46	0.16	0.01	1.22	0.09
Swine600	0.45	0.16	0.01	1.86	0.08
Eucalyptus400	0.41	0.16	0.01	0.70	0.13
Eucalyptus600	0.50	0.18	0.01	7.47	0.04
Filtercake400	0.46	0.16	0.01	2.23	0.06
Filtercake600	0.44	0.17	0.01	2.74	0.06

[a] RMSE values indicate the extent of agreement between the predicted and measured values; the smaller the RMSE, the better the fit between the values [5]

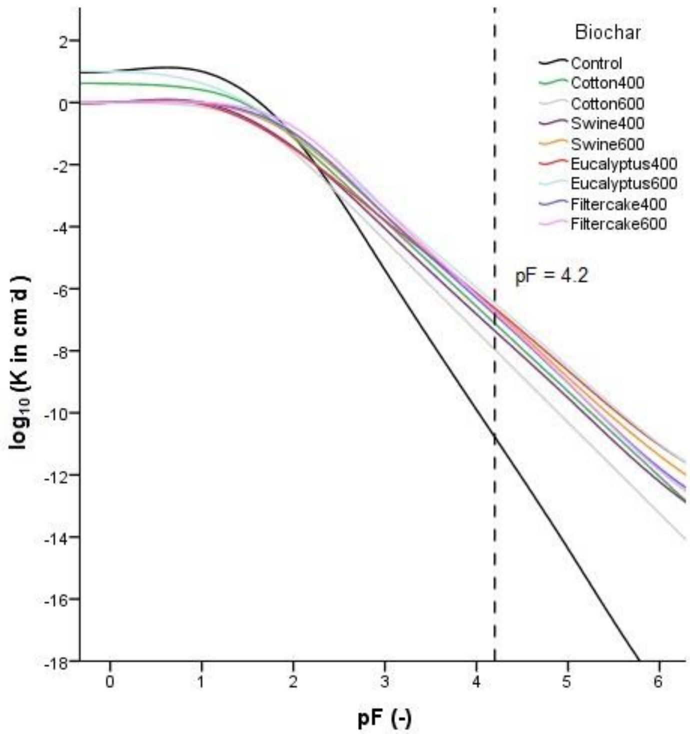

Figure S7. Hydraulic conductivity curves for packed biochar-soil mixtures, low and high temperatures of pyrolysis (HYPROP data; *n*=1). pF 4.2 is the permanent wilting point.

S1.2. HYPROP

Observing the water curves of packed biochar-soil mixtures determined by the HYPROP®, cotton biochar at 400°C had the highest saturated (θ_s) and residual water content (θ_r), followed by eucalyptus biochar at 600°C. All other biochar-soil mixtures had lower θ_s and higher θ_r than the control (Table S1). The control soil had the highest saturated hydraulic conductivity, K_s, (12.0 cm d^{-1}), suggesting water flowed easily through the soil and was poorly retained in soil pores. Eucalyptus biochar at 600°C (7.5 cm d^{-1}) and cotton biochar at 400°C (4.3 cm d^{-1}) also had high K_s, while their counterparts, eucalyptus biochar at 400°C and cotton biochar at 600°C, had much lower K_s. All biochar-soil mixtures except for those with cotton biochar had higher K_s at 600°C than at 400°C (Table S1). The hydraulic conductivity, *K*, of all the biochar-soil mixtures was higher than that of the control soil with no biochar (Figure S6).

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