Supporting online material

Partitioning the contributions of biochar properties to enhanced biological nitrogen fixation in common bean (*Phaseolus vulgaris*)

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Table S1. Properties of biochar produced from seven feedstocks, at two pyrolysis temperatures with four post-pyrolysis treatments.

Feedstock	Temp. (°C)	Treatment	C (%)	N (%)	O (%)	H (%)	Volatile matter (%)	Ash (%)	Fixed Carbon (%)	Volatile matter (% ash free)	Fixed Carbon (% ash free)	C:N (w/w)	H/C (mol mol^{-1})	O:C (mol mol^{-1})
Rice	350	None	41.31	0.50	15.18	2.52	24.10	40.49	35.42	31.02	68.98	82.62	0.73	0.28
		Acetone	40.02	0.40	17.95	2.52	24.81	39.11	36.08	33.35	66.65	100.05	0.76	0.34
		HCl	40.48	0.45	18.28	2.67	25.55	38.12	36.33	37.25	62.75	89.96	0.79	0.34
		Steam	40.39	0.48	16.00	1.11	21.60	42.02	36.38	41.29	58.71	84.15	0.33	0.30
	550	None	42.00	0.52	5.42	3.30	8.51	48.75	42.74	13.71	86.29	80.77	0.94	0.10
		Acetone	42.61	0.36	8.77	1.27	8.30	46.99	44.71	14.75	85.25	118.36	0.36	0.15
		HCl	39.05	0.37	11.00	1.48	7.93	48.09	43.98	12.54	87.46	105.54	0.45	0.21
		Steam	41.38	0.31	5.58	1.38	7.30	51.36	41.34	13.94	86.06	133.48	0.40	0.10
Bagasse	350	None	56.56	0.33	11.73	3.01	26.54	28.38	45.07	36.31	63.69	171.39	0.64	0.16
		Acetone	54.74	0.30	16.64	2.61	26.56	25.71	47.73	35.75	64.25	182.47	0.57	0.23
		HCl	50.03	0.29	18.04	3.20	24.34	28.44	47.22	39.06	60.94	172.52	0.77	0.27
		Steam	62.53	0.34	6.70	2.08	27.98	28.35	43.67	34.02	65.98	183.91	0.40	0.08
	550	None	62.64	0.25	7.53	1.96	10.51	27.62	51.74	16.76	83.24	250.56	0.38	0.09
		Acetone	68.53	0.21	2.65	1.71	12.57	26.91	60.53	17.19	82.81	326.33	0.30	0.03
		HCl	70.60	0.26	2.44	1.69	11.09	25.01	63.90	13.91	86.09	271.54	0.29	0.03
		Steam	61.33	0.27	13.02	1.52	10.59	23.87	65.54	14.79	85.21	227.15	0.30	0.16
Maize stover	350	None	67.14	0.78	14.02	3.51	31.03	14.55	54.42	40.49	59.51	85.53	0.63	0.16
		Acetone	57.26	0.72	24.95	3.85	32.53	13.22	54.25	37.49	62.51	79.53	0.81	0.33
		HCl	62.92	0.65	17.55	3.58	34.97	15.31	49.73	36.43	63.57	96.80	0.68	0.21
		Steam	57.52	0.71	26.57	3.63	32.21	11.58	56.21	41.29	58.71	81.01	0.76	0.35
	550	None	67.73	0.51	14.00	1.94	14.11	15.83	70.06	16.60	83.40	132.80	0.34	0.16
		Acetone	68.54	1.02	14.35	3.32	13.61	12.78	73.61	15.61	84.39	67.20	0.58	0.16
		HCl	71.19	0.40	17.63	1.85	13.80	8.93	77.27	13.39	86.61	177.98	0.31	0.19
		Steam	78.97	0.58	6.37	3.86	12.02	10.22	77.76	15.15	84.85	136.16	0.59	0.06
Maize cobs	350	None	71.37	0.80	18.61	3.97	29.39	5.25	65.36	37.06	62.94	89.21	0.67	0.20
		Acetone	68.36	0.76	22.48	3.58	31.74	4.82	63.44	33.35	66.65	89.95	0.63	0.25
		HCl	66.09	0.73	26.53	3.64	32.85	3.01	64.14	30.72	69.28	90.53	0.66	0.30
		Steam	71.53	0.82	17.52	3.60	28.71	6.53	64.76	33.87	66.13	87.23	0.60	0.18
	550	None	82.90	0.43	6.95	2.04	12.66	7.69	79.66	16.89	83.11	192.79	0.30	0.06
		Acetone	80.92	0.43	12.11	2.18	14.10	4.35	81.55	14.75	85.25	188.19	0.32	0.11
		HCl	82.64	0.44	12.83	2.02	13.65	2.07	84.28	12.54	87.46	187.82	0.29	0.12
		Steam	81.73	0.50	10.16	1.95	11.83	5.66	82.51	13.94	86.06	163.46	0.29	0.09

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Eucalyptus	350	None	67.08	0.23	27.12	3.84	35.08	1.72	63.19	35.70	64.30	291.65	0.69	0.30
		Acetone	67.86	0.19	26.50	3.76	36.39	1.69	61.93	37.01	62.99	357.16	0.66	0.29
		HCl	69.08	0.21	25.98	3.79	35.22	0.94	63.84	35.34	64.66	328.95	0.66	0.28
		Steam	61.59	0.22	32.26	3.71	34.55	2.22	63.22	35.56	64.44	279.95	0.72	0.39
	550	None	83.18	0.19	10.81	2.37	12.24	3.45	84.31	12.67	87.33	437.79	0.34	0.10
		Acetone	86.58	0.17	8.61	2.32	12.92	2.32	84.76	13.23	86.77	509.29	0.32	0.07
		HCl	81.25	0.17	14.81	2.22	13.25	1.56	85.19	11.80	88.20	477.94	0.33	0.14
		Steam	87.67	0.13	7.32	2.45	11.51	2.43	86.06	13.46	86.54	674.38	0.34	0.06
Delonix	350	None	69.89	1.93	18.19	3.53	31.61	6.46	61.94	33.79	66.21	36.21	0.61	0.20
		Acetone	65.12	1.95	22.53	3.49	32.13	6.91	60.95	34.52	65.48	33.39	0.64	0.26
		HCl	75.08	2.01	16.51	3.64	33.18	2.76	64.05	33.87	66.13	37.35	0.58	0.16
		Steam	73.99	1.93	13.42	3.31	31.39	7.34	61.27	34.13	65.87	38.34	0.54	0.14
	550	None	75.41	1.74	11.81	1.92	11.93	9.13	78.94	13.13	86.87	43.34	0.31	0.12
		Acetone	75.46	1.29	12.42	1.96	14.71	8.86	76.43	16.14	83.86	58.50	0.31	0.12
		HCl	77.14	1.64	16.40	2.17	14.15	2.64	83.20	13.70	86.30	47.04	0.34	0.16
		Steam	75.13	1.29	12.43	1.71	12.40	9.44	78.15	14.54	85.46	58.24	0.27	0.12
Tea	350	None	65.19	1.05	26.26	1.96	31.97	5.53	62.50	33.84	66.16	62.09	0.36	0.30
		Acetone	67.38	0.92	23.56	3.42	33.01	4.72	62.27	34.64	65.36	73.24	0.61	0.26
		HCl	70.93	0.74	24.96	1.78	30.38	1.59	68.03	35.32	64.68	95.85	0.30	0.26
		Steam	71.11	1.00	19.55	3.63	33.66	4.70	61.64	30.87	69.13	71.11	0.61	0.21
	550	None	77.78	0.59	13.47	2.10	10.62	6.06	83.32	11.31	88.69	131.83	0.32	0.13
		Acetone	76.62	0.71	14.23	2.16	12.07	6.28	81.66	12.88	87.12	107.92	0.34	0.14
		HCl	81.99	0.54	13.09	2.20	12.77	2.17	85.06	15.15	84.85	151.83	0.32	0.12
		Steam	71.93	0.91	17.07	1.85	13.90	8.24	77.86	13.05	86.95	79.04	0.31	0.18

Table S2. pH and nutrient content of biochar produced from seven feedstocks, at two temperatures, and four post-treatments.

Feedstock	Temperature (°C)	Treatment	pH (H_2O)	P	K	Ca	S	Mg	Fe (mg g^{-1})	Mn	Cu	Zn	B	Na	Mo
Rice	350	None	8.06	0.46	6.72	1.31	0.20	0.66	0.20	0.27	<det	0.11	0.04	0.43	<det
		Acetone	7.58	0.31	5.93	1.03	0.16	0.43	0.09	0.17	<det	0.08	0.01	0.40	<det
		HCl	8.19	0.03	0.22	0.13	0.09	0.06	0.01	0.01	<det	0.13	<det	2.76	<det
		Steam	8.17	0.75	5.57	1.17	0.27	0.52	0.46	0.24	0.01	0.15	<det	0.80	<det
	550	None	9.95	0.75	4.43	1.09	0.14	0.45	0.27	0.16	<det	0.32	0.01	1.21	<det
		Acetone	9.98	0.58	5.13	1.17	0.14	0.41	0.10	0.10	<det	0.20	<det	0.90	<det
		HCl	5.35	0.22	0.61	0.27	0.08	0.28	0.06	0.10	0.01	0.30	<det	1.15	<det
		Steam	9.47	0.80	4.99	1.28	0.10	0.54	0.10	0.11	<det	0.11	<det	1.06	<det
Bagasse	350	None	7.75	0.60	4.45	1.70	0.26	0.74	9.89	0.74	0.04	0.54	0.01	1.06	<det
		Acetone	6.96	0.63	4.72	2.23	0.26	0.85	10.10	0.75	0.03	0.56	0.01	0.95	<det
		HCl	6.58	0.42	3.24	1.15	0.17	0.62	6.33	0.32	0.03	0.13	0.01	13.28	<det
		Steam	7.15	0.67	4.86	1.89	0.28	0.81	10.27	0.67	0.03	0.19	0.01	0.91	<det
	550	None	9.58	0.78	5.66	2.31	0.27	0.95	12.49	1.21	0.01	0.23	<det	1.77	<det
		Acetone	8.89	0.65	5.15	2.12	0.24	0.90	8.05	0.99	0.02	0.17	<det	1.38	<det
		HCl	5.03	0.52	1.76	1.26	0.14	0.71	4.66	0.35	0.02	0.07	<det	1.24	<det
		Steam	9.94	0.75	5.13	2.16	0.22	0.93	9.42	1.69	0.04	0.17	<det	1.27	<det
Maize stover	350	None	9.25	1.90	25.44	4.84	0.72	2.55	3.02	0.19	0.08	0.09	<det	1.09	<det
		Acetone	8.48	1.78	24.94	3.86	0.74	2.28	1.48	0.12	0.02	0.29	0.01	1.97	<det
		HCl	6.49	0.91	5.45	1.23	0.31	1.11	1.50	0.04	0.01	0.50	<det	10.13	<det
		Steam	9.29	2.70	27.78	4.34	0.84	2.58	3.31	0.17	0.03	0.21	0.01	0.63	<det
	550	None	10.04	3.22	39.70	6.57	0.90	3.29	4.86	0.25	0.06	0.11	0.01	0.45	<det
		Acetone	4.81	2.82	20.17	12.15	0.81	7.54	1.08	0.16	0.06	0.31	<det	0.33	<det
		HCl	10.00	0.80	5.08	4.08	0.37	2.69	0.46	0.09	0.12	0.25	<det	4.74	<det
		Steam	10.03	2.96	14.53	12.05	0.59	5.62	0.26	0.09	0.12	0.06	<det	1.17	<det
Maize cobs	350	None	9.45	1.01	15.17	0.67	0.56	0.66	0.75	0.03	0.01	0.20	0.01	2.52	<det
		Acetone	8.92	1.04	12.71	0.62	0.27	0.57	0.95	0.03	0.01	0.54	0.02	2.74	<det
		HCl	3.34	0.58	3.44	0.48	1.19	0.45	0.55	0.01	0.02	0.06	<det	1.48	<det
		Steam	9.38	1.03	15.31	0.90	0.42	0.80	0.60	0.03	0.01	0.35	0.04	2.75	<det
	550	None	9.67	1.42	21.86	1.26	0.32	1.10	1.48	0.07	0.03	0.31	0.04	1.82	<det
		Acetone	9.44	1.50	23.02	0.87	0.33	0.82	1.70	0.04	0.01	0.27	0.04	2.91	<det
		HCl	2.97	0.86	0.50	0.48	0.11	0.51	0.52	0.00	<det	0.07	0.01	2.29	<det
		Steam	9.64	1.53	20.08	0.75	0.21	0.73	0.48	0.02	0.02	0.13	0.04	3.05	<det

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Eucalyptus	350	None	7.52	0.14	0.88	4.72	0.08	1.12	0.00	0.20	0.02	0.14	0.03	1.68	<det
		Acetone	6.67	0.15	2.96	5.38	0.09	1.28	0.04	0.21	0.02	0.02	<det	1.34	<det
		HCl	4.69	0.08	0.08	1.41	0.06	0.82	0.49	0.13	0.01	0.79	0.07	2.15	<det
		Steam	6.98	0.11	1.09	4.49	0.05	1.29	0.42	0.26	0.02	0.25	0.02	1.91	<det
	550	None	9.53	0.21	3.44	6.03	0.09	1.88	0.06	0.36	0.15	0.07	0.03	2.05	<det
		Acetone	9.61	0.24	2.37	6.63	0.08	1.88	0.11	0.36	0.06	0.17	0.02	2.48	<det
		HCl	4.69	0.20	0.13	2.13	0.05	1.52	0.32	0.30	0.11	0.03	<det	2.49	<det
		Steam	10.20	0.34	4.44	6.59	0.07	1.94	0.11	0.40	0.11	0.04	0.01	1.95	<det
Delonix	350	None	8.57	4.93	9.89	9.42	1.78	4.86	0.42	0.04	0.02	0.39	0.01	1.89	<det
		Acetone	8.11	3.71	8.48	8.09	1.46	4.46	0.26	0.01	0.02	0.64	0.02	2.29	<det
		HCl	3.13	1.34	0.78	2.64	0.17	1.30	0.07	0.00	0.01	0.01	<det	3.15	<det
		Steam	8.59	5.69	11.25	11.98	2.31	5.50	1.02	0.03	0.03	1.36	0.02	1.45	<det
	550	None	10.29	6.12	12.93	13.74	2.44	6.67	0.69	0.04	0.11	0.38	0.02	3.06	<det
		Acetone	10.30	6.19	14.05	11.98	2.22	6.44	0.39	0.04	0.05	0.19	0.02	1.95	<det
		HCl	4.09	2.16	0.60	3.33	0.91	2.71	0.21	0.01	0.01	0.19	0.01	1.75	<det
		Steam	10.93	7.05	16.79	21.28	2.69	8.43	0.98	0.06	0.07	0.13	0.04	3.10	<det
Tea	350	None	8.34	1.06	10.20	7.86	0.82	1.62	1.19	1.20	0.03	0.28	0.01	0.84	<det
		Acetone	7.91	0.78	8.83	4.76	0.83	1.14	0.54	0.65	0.04	0.13	0.01	1.07	<det
		HCl	3.49	0.22	5.28	2.76	0.40	1.00	0.15	0.49	0.10	0.00	<det	1.41	<det
		Steam	8.24	1.17	10.28	5.92	0.92	1.32	0.72	0.90	0.02	0.14	<det	0.58	<det
	550	None	9.84	0.28	12.89	6.31	0.72	1.57	0.15	0.87	0.11	0.01	<det	0.77	<det
		Acetone	10.15	1.25	11.63	7.14	0.99	1.58	0.48	1.04	0.11	0.36	0.02	1.22	<det
		HCl	3.55	0.86	0.51	2.76	0.55	1.33	0.14	0.57	0.02	0.29	<det	0.22	<det
		Steam	8.72	1.06	17.52	12.18	0.99	2.43	0.62	1.72	0.05	0.02	<det	0.88	<det

<det represents values below the method detection limit.

Table S3. Soil and biochar pH used in Experiment 2. Biochar pH was measured in 1:20 (w/v) H_2O, soil pH was measures in 1:2 (w/v) H_2O (*n*=5). Values followed by the same letter are not significantly different; feedstock. Letters are not shown when differences are not significant.

	Biochar pH	Soil pH
Delonix	10.43	6.18 ± 0.03 ab
Delonix HCl – high pH	10.47	6.39 ± 0.03 a
Delonix HCl – low pH	4.37	5.91 ± 0.03 cd
Eucalyptus	8.27	6.14 ± 0.03 b
Eucalyptus HCl – high pH	8.35	5.94 ± 0.03 c
Eucalyptus HCl – low pH	4.99	5.82 ± 0.03 cde
Fertilizer	-	5.69 ± 0.03 e
No fertilizer	-	5.79 ± 0.03 de
P-value	-	<0.001

Table S4**.** Bean shoot biomass, root biomass, nodule biomass, number of nodules, plant nutrient content and uptake following applications of biochar prepared from seven feedstocks, at two production temperatures, with four post-pyrolysis treatments. Error is standard deviation (*n*=4).

Feedstock	Temp. (°C)	Treatment	Shoot biomass (g pot^{-1})	Root biomass (g pot^{-1})	Nodule biomass (g pot^{-1})	Nodules (number)	Ndfa (%)	Ndfa (mg plant^{-1})	Foliar P (mg g^{-1})	Plant P uptake (mg plant^{-1})	Foliar Ca (mg g^{-1})	Plant Ca uptake (mg plant^{-1})	Foliar Mn (mg g^{-1})	Plant Mn uptake (mg plant^{-1})
Rice	350	None	1.58±0.34	0.45±0.15	0.13±0.04	133±39	43.21±8.80	29.51±12.71	2.32±0.19	3.63±0.51	22.23±1.05	35.10±6.75	0.40±0.05	0.42±0.10
		Acetone	1.72±0.81	0.48±0.13	0.15±0.06	151±57	47.81±18.69	32.54±24.53	1.91±0.51	3.12±1.11	18.66±1.50	32.03±15.21	0.24±0.17	0.35±0.28
		HCl	2.19±0.63	0.47±0.07	0.14±0.06	128±56	39.41±18.81	27.21±19.20	1.22±0.15	2.70±0.98	23.98±1.86	52.10±12.65	0.20±0.02	0.05±0.02
		Steam	2.25±0.36	0.57±0.14	0.19±0.07	172±41	40.83±14.48	36.11±15.97	1.53±0.19	3.43±0.63	20.91±1.72	46.64±4.98	0.38±0.12	0.22±0.11
	550	None	2.18±0.76	0.48±0.17	0.17±0.05	136±41	53.19±11.33	43.16±19.43	2.24±0.23	4.80±1.45	18.07±6.79	38.89±20.56	0.40±0.21	0.31+0.13
		Acetone	2.33±0.20	0.45±0.06	0.18±0.06	171±43	57.04±6.37	55.56±11.96	1.82±0.08	4.22±0.20	17.63±2.04	40.99±5.49	0.08±0.03	0.16±0.04
		HCl	2.09±0.31	0.55±0.14	0.13±0.05	128±51	43.35±13.06	25.22±9.45	1.48±0.15	3.09±0.53	20.42±3.17	42.54±8.58	0.16±0.09	0.14±0.10
		Steam	2.21±0.47	0.55±0.25	0.17±0.03	150±27	41.84±4.13	28.04±8.35	1.71±0.12	3.76±0.50	15.02±6.18	32.42±11.74	0.08±0.03	0.11±0.05
Bagasse	350	None	2.13±0.39	0.57±0.13	0.16±0.05	257±54	44.63±17.40	27.71±14.52	3.64±0.69	7.95±2.68	26.27±2.87	55.45±9.41	0.65±0.16	0.30±0.03
		Acetone	1.92±0.57	0.49±0.15	0.16±0.04	167±51	47.86±15.08	31.20±16.32	3.96±0.64	7.04±1.84	24.07±6.76	47.53±23.37	0.46±0.11	0.24±0.05
		HCl	1.86±0.70	0.51±0.12	0.08±0.06	122±56	13.16±10.57	6.74±6.02	3.01±0.16	5.67±2.27	3.85±2.13	57.35±22.02	0.73±0.49	0.50±0.15
		Steam	1.71±0.24	0.44±0.12	0.14±0.03	122±42	37.99±2.72	18.96±2.85	2.97±0.18	5.06±0.47	30.34±2.27	51.69±5.63	0.36±0.13	0.18±0.03
	550	None	1.71±0.77	0.37±0.07	0.13±0.08	91±30	36.38±19.87	23.54±15.25	5.53±0.45	9.60±4.37	24.02±3.24	40.42±15.90	0.43±0.18	0.25±0.01
		Acetone	2.23±0.56	0.59±0.22	0.20±0.07	171±61	55.04±0.80	43.41±17.11	4.18±0.54	9.23±2.28	32.06±4.28	71.35±20.34	0.42±0.09	0.19±0.02
		HCl	1.24±0.36	0.41±0.14	0.11±0.09	105±59	32.71±11.85	13.97±9.76	3.68±0.32	4.62±1.57	30.59±1.46	38.21±12.22	0.55±0.54	0.25±0.02
		Steam	2.01±0.88	0.46±0.12	0.18±0.05	192±36	56.85±6.88	38.89±20.12	3.97±0.62	7.73±2.80	30.04±3.15	61.12±28.47	0.33±0.14	0.18±0.01
Maize stover	350	None	1.64±0.29	0.43±0.16	0.11≠0.04	85±30	31.53±2.54	14.60±3.82	3.45±0.20	5.68±1.23	18.28±1.30	30.18±7.18	0.34±0.17	0.33±0.09
		Acetone	2.05±0.22	0.61±0.09	0.21±0.05	172±21	48.87±8.08	38.72±16.51	3.31±0.19	6.76±0.52	15.40±1.43	31.36±2.42	0.36±0.05	0.29±0.04
		HCl	1.67±0.27	0.35±0.08	0.02±0.02	42±20	0.00±4.72	0.00±5.95	2.96±0.28	4.96±0.96	28.70±1.73	47.88±7.51	1.09±0.20	0.58±0.24
		Steam	1.82±0.31	0.71±0.18	0.10±0.07	94±24	17.89±10.36	8.96±6.88	3.20±0.04	5.83±1.06	17.64±1.42	31.97±4.52	0.38±0.10	0.42±0.14
	550	None	1.11±0.39	0.44±0.10	0.07±0.01	82±18	26.96±1.72	7.79±3.76	3.71±0.82	4.12±1.65	16.66±1.63	18.30±5.53	0.26±0.10	0.33±0.08
		Acetone	1.88±0.96	0.50±0.12	0.16±0.07	181±72	59.31±8.72	36.62±22.96	3.33±0.51	6.39±3.28	16.55±2.66	29.29±10.59	0.37±0.16	0.57±0.33
		HCl	1.77±0.44	0.48±0.13	0.13±0.08	159±104	26.97±13.52	14.55±9.76	3.31±0.16	5.91±1.63	26.26±2.45	46.41±15.59	0.67±0.20	0.33±0.09
		Steam	1.47±0.45	0.46±0.15	0.09±0.04	107±32	34.20±14.93	17.27±10.51	4.12±0.42	6.17±2.30	17.31±2.67	25.45±8.80	0.34±0.12	0.42±0.10
Maize cobs	350	None	1.65±0.77	0.48±0.13	0.08±0.07	78±47	26.99±17.01	11.45±9.98	2.66±0.59	4.62±2.50	19.25±1.45	31.95±14.53	0.43±0.31	0.46±0.08
		Acetone	1.89±0.43	0.33±0.11	0.16±0.06	123±35	55.96±12.90	31.81±13.64	3.67±0.37	6.37±1.45	18.40±0.38	34.83±7.79	0.36±0.06	0.31±0.08
		HCl	1.79±0.23	0.54±0.07	0.08±0.04	88±15	22.07±9.95	10.05±4.13	3.01±0.11	5.38±0.57	26.06±1.50	46.72±5.90	0.59±0.11	0.26±0.03
		Steam	1.41±0.75	0.36±0.08	0.10±0.08	107±69	30.73±18.57	12.12±11.55	2.67±0.16	4.75±0.79	18.24±0.76	32.44±5.21	0.14±0.06	0.15±0.04
	550	None	1.58±0.12	0.39±0.08	0.12±0.04	90±20	38.37±12.88	16.96±10.86	2.80±1.87	4.31±2.88	13.35±8.90	20.62±13.87	0.25±0.17	0.32±0.22
		Acetone	2.31±0.24	0.38±0.08	0.19±0.03	177±37	41.74±24.53	23.19±16.47	3.75±0.30	8.62±0.52	15.91±1.24	36.73±5.18	0.40±0.10	0.31±0.12
		HCl	1.43±0.27	0.51±0.09	0.08±0.05	89±46	21.84±7.07	9.11±5.58	3.39±0.34	4.84±0.95	25.86±2.82	36.70±5.62	0.46±0.15	0.48±0.17
		Steam	1.67±0.58	0.46±0.12	0.14±0.13	81±93	39.57±10.04	21.93±2.07	3.41±0.51	5.74±2.23	18.96±2.63	30.96±8.38	0.31±0.09	0.34±0.08
Eucalyptus	350	None	2.09±0.46	0.33±0.07	0.17±0.05	175±47	34.92±5.44	22.57±9.21	2.76±0.25	5.74±1.00	18.42±0.32	38.54±8.05	0.38±0.06	0.37±0.02
		Acetone	2.19±0.52	0.31±0.12	0.15±0.02	169±20	37.97±15.00	26.05±12.60	3.00±0.36	6.46±1.00	17.82±0.60	38.69±8.69	0.31±0.09	0.31±0.11
		HCl	1.85±0.12	0.60±0.22	0.13±0.03	174±49	21.87±7.22	11.19±5.15	2.57±0.12	4.76±0.38	23.81±1.76	44.29±5.68	0.69±0.11	0.34±0.08
		Steam	1.96±0.69	0.45±0.03	0.06±0.04	71±42	17.84±17.33	11.22±13.78	2.94±0.06	5.75±1.96	18.75±0.91	36.79±13.15	0.31±0.11	0.31±0.11
	550	None	1.98±0.38	0.35±0.08	0.12±0.06	143±81	47.95±`0.23	35.16±16.38	4.37±0.49	8.60±1.33	17.94±1.33	35.24±4.27	0.32±0.07	0.52±0.27
		Acetone	1.10±0.41	0.29±0.12	0.09±0.05	183±96	58.24±6.95	21.05±9.71	2.80±0.73	3.14±1.64	13.78±4.23	15.39±8.04	0.19±0.11	0.45±0.26
		HCl	1.60±0.40	0.33±0.04	0.07±0.05	100±81	15.65±9.73	6.50±4.55	3.45±0.17	5.56±1.51	29.98±4.44	46.93±6.30	0.48±0.10	0.44±0.20
		Steam	1.08±0.57	0.36±0.08	0.05±0.06	70±59	9.11±10.95	2.07±4.10	2.99±1.33	3.74±3.34	18.88±2.84	20.40±10.65	0.17±0.08	0.40±0.10

Delonix	350	None	1.82±0.79	0.35±0.20	0.14±0.10	110±71	23.01±14.00	14.39±13.81	3.17±0.29	5.89±2.73	19.62±2.86	34.04±11.81	0.35±0.16	0.35±0.10
		Acetone	1.61±0.95	0.54±0.29	0.11±0.09	134±81	23.45±12.91	13.84±13.55	3.20±0.53	5.48±3.75	20.61±2.18	31.81±17.33	0.39±0.22	0.54±0.19
		HCl	1.74 ±0.18	0.52±0.09	0.11±0.04	120±26	16.23±8.61	7.91±4.97	3.09±0.12	5.39±0.66	25.77±2.24	44.96±6.59	0.73±0.19	0.33±0.06
		Steam	2.36±0.60	0.52±0.23	0.21±0.05	186±76	34.19±6.19	24.13±3.20	3.43±0.35	8.00±1.56	20.35±1.68	47.56±9.79	0.52±0.08	0.51±0.16
	550	None	2.20±0.20	0.37±0.08	0.20±0.03	216±70	50.30±1.70	38.78±9.33	4.04±0.32	8.87±0.41	14.76±1.64	32.36±2.52	0.43±0.04	0.39±0.15
		Acetone	2.55±0.63	0.51±0.12	0.25±0.06	251±46	52.17±2.67	39.98±10.64	3.96±0.27	10.01±2.57	15.99±0.82	40.04±8.94	0.44±0.09	0.35±0.06
		HCl	2.19±0.55	0.40±0.03	0.35±0.38	174±65	40.67±4.27	23.38±14.72	3.91±0.22	8.46±1.72	25.90±2.78	55.45±7.53	0.56±0.03	0.43±0.10
		Steam	1.53±0.78	0.53±0.12	0.15±0.02	190±63	39.35±9.00	19.96±15.38	4.15±0.26	7.55±2.11	17.06±1.02	30.88±8.01	0.47±0.07	1.07±0.76
Tea	350	None	2.36±0.78	0.55±0.15	0.17±0.06	139±60	43.90±8.08	27.92±10.44	2.97±0.04	7.02±2.28	18.11±0.20	42.67±13.81	0.47±0.19	0.39±0.05
		Acetone	2.07±0.60	0.40±0.13	0.19±0.08	176±68	52.41±11.42	35.86±17.51	3.62±0.34	7.41±1.76	17.64±1.07	36.88±11.86	0.39±0.12	0.35±0.07
		HCl	1.49±0.23	0.40±0.73	0.11±0.01	117±25	17.77±7.20	6.97±2.50	3.36±0.17	4.97±0.57	25.82±2.44	38.25±6.15	0.48±0.11	0.39±0.03
		Steam	1.67±0.76	0.59±0.10	0.26±0.05	219±34	42.42±8.90	18.80±7.58	3.16±0.09	5.33±2.49	19.82±0.78	33.37±16.00	0.31±0.14	0.38±0.08
	550	None	2.09±0.59	0.38±0.18	0.20±0.06	226±43	52.41±4.22	36.50±14.11	4.43±0.35	8.54±2.65	16.94±1.61	32.83±11.39	0.39±0.14	0.39±0.10
		Acetone	1.86±0.34	0.43±0.05	0.181±0.05	228±53	48.83±5.30	30.98±5.54	4.11±0.14	7.64±1.50	14.99±0.74	28.06±6.22	0.38±0.04	0.46±0.18
		HCl	1.80±0.12	0.42±0.14	0.27±0.28	225±115	45.75±2.76	22.16±3.01	4.57±0.28	8.23±1.08	25.40±1.96	45.79±6.36	0.52±0.11	0.76±0.60
		Steam	1.67±0.75	0.20±0.03	0.13 ±0.03	160±37	44.04±8.28	24.72±12.73	4.51±0.24	7.42±2/92	16.66±1.32	27.36±10.49	0.32±0.15	0.55±0.28
Control			0.71±0.37	0.28±0.02	0.00±0.00	22±18	3.14±2.06	1.12±1.24	1.85±0.15	1.35±0.80	24.26±6.58	15.73±4.07	0.17±0.10	0.48±0.09

Table S5. Soil pH from Experiment 1. pH measured in 1:2 (w/v) H_2O. Values followed by the same letter are not significantly different; feedstock: Tukey's HSD, $P<0.05$, $n=32$ within biochar; linear contrast between all biochar and the control, $P<0.05$, $n=4$; temperature: Tukey's HSD, $P<0.05$, $n=112$; treatment: Tukey's HSD, $P<0.05$, $n=56$. Letters are not shown when differences are not significant.

Feedstock	pH (H_2O)
Rice	5.61 ± 0.02 cd
Bagasse	5.66 ± 0.02 bc
Maize Stover	5.75 ± 0.02 ab
Maize cobs	5.73 ± 0.02 ab
Eucalyptus	5.79 ± 0.02 a
Delonix	5.79 ± 0.02 a
Tea	5.81 ± 0.02 a
Control	5.40 ± 0.07 d
P-value	<0.0001
Temperature	
350˚C	5.72 ± 0.01 a
550˚C	5.75 ± 0.01 a
P-value	<0.0001
Treatment	
None	5.78 ± 0.01 a
Acetone	5.79 ± 0.01 a
HCl	5.59 ± 0.01 b
Steam	5.78 ± 0.01 a
P-value	<0.0001

Table S6. Loadings for the first two principal components of Figure 1.

Variable	Component 1	Component 2
Number of nodules	0.707	0.202
Nodule biomass	0.732	0.202
Ndfa	0.646	0.105
VM	-0.250	0.123
Foliar P	0.480	0.336
Plant P uptake	0.753	0.510
Foliar Ca	-0.450	0.740
Plant Ca uptake	0.115	0.795
Foliar Mn	-0.360	0.640
Plant Mn uptake	-0.072	0.789
Biochar P	0.503	-0.173
Biochar Ca	0.629	-0.221
Biochar Mn	0.285	0.284
Soil pH	0.652	-0.304