

Supplementary Materials: Biochar Application in Malaysian Sandy and Acid Sulphate Soils: Soil Amelioration Effects and Improved Crop Production over Two Cropping Seasons

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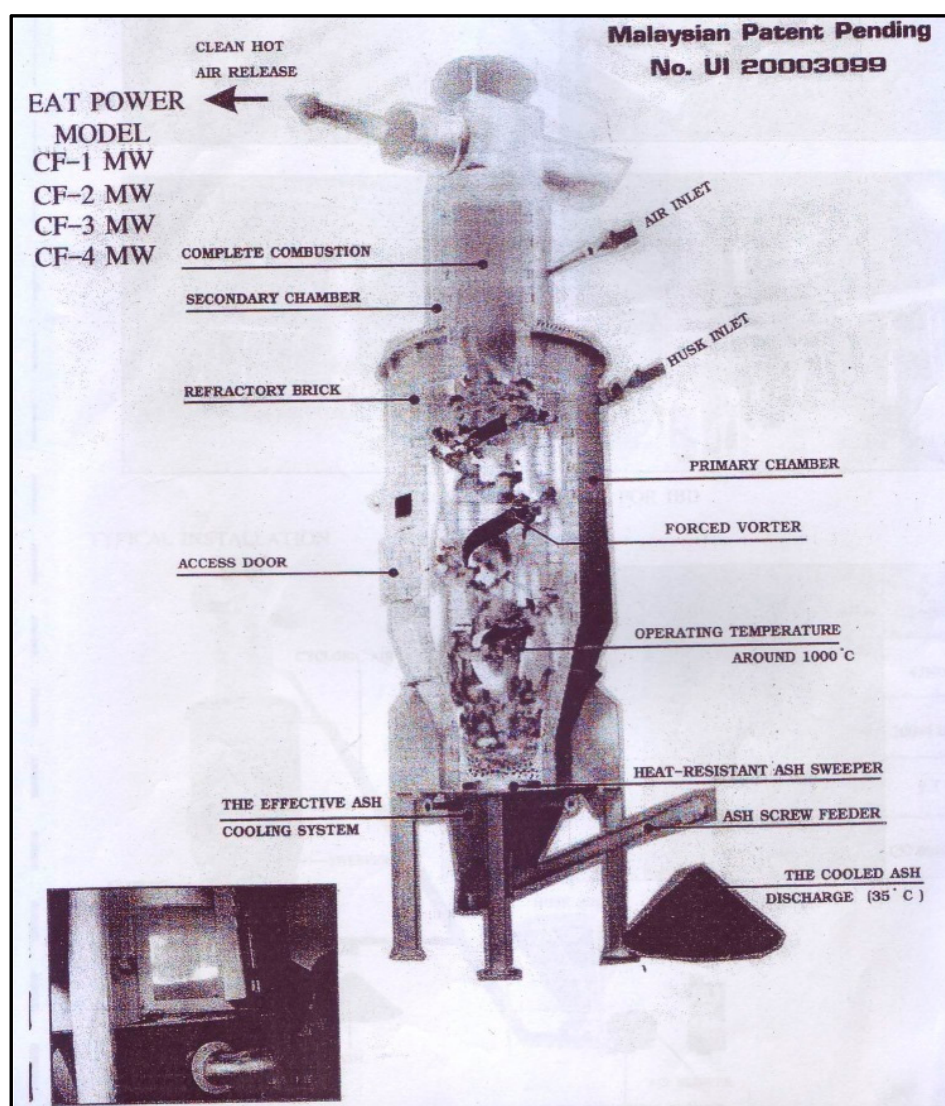


Figure S1. Schematic diagram of cyclonic furnace in rice processing mill BERNAS Peringat, Kelantan.

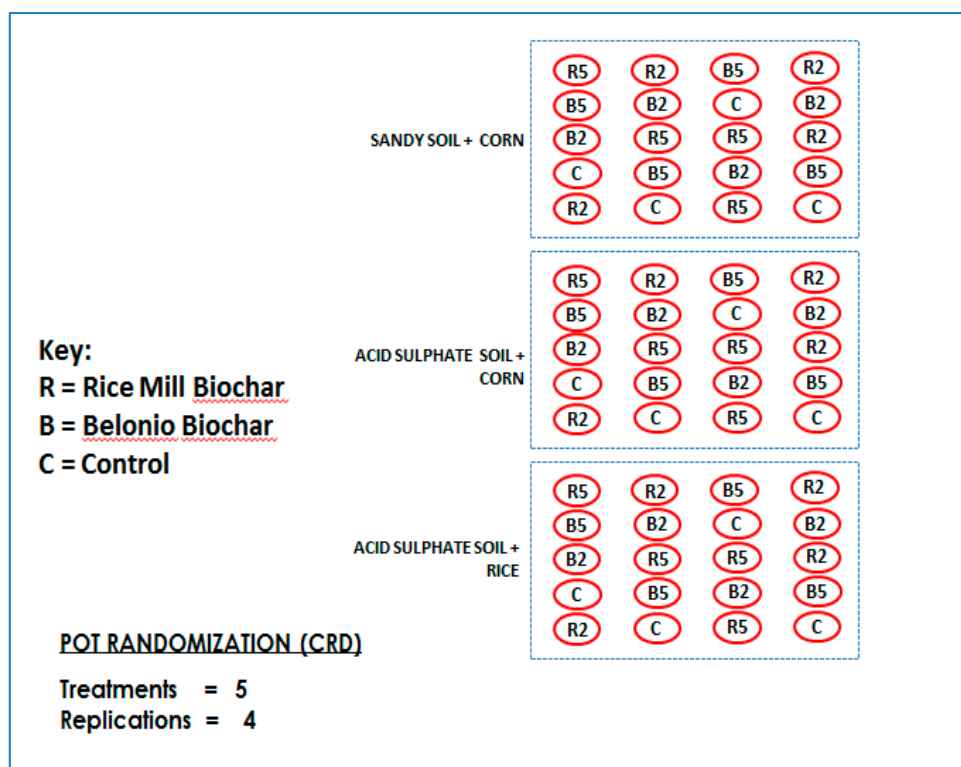


Figure S2. Complete randomized design for pot trials.

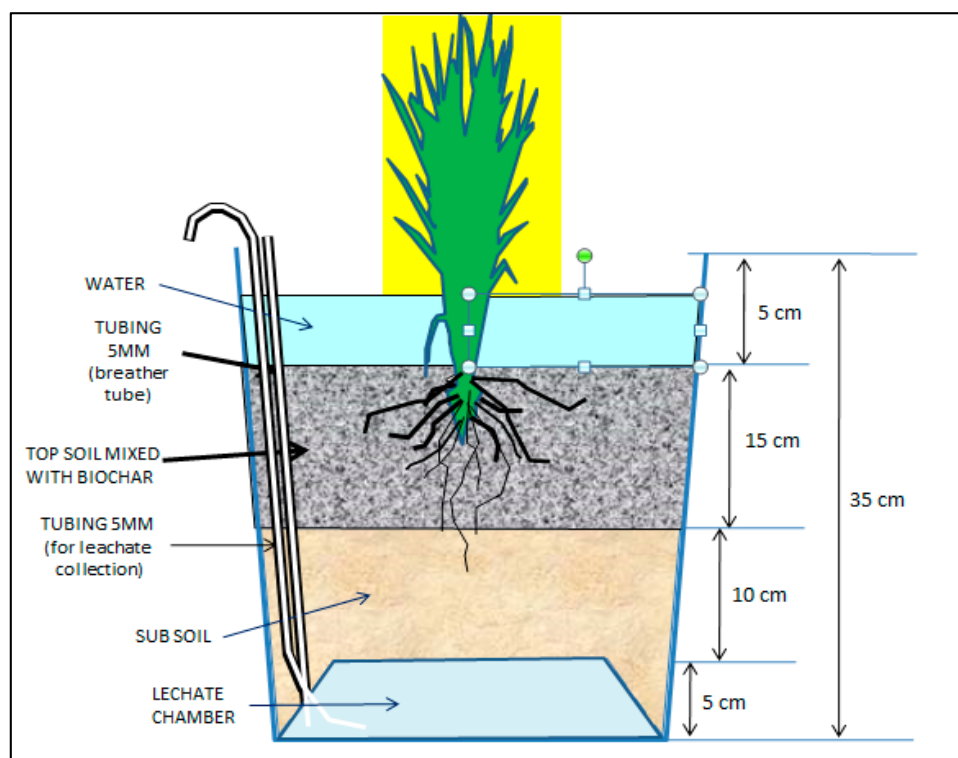


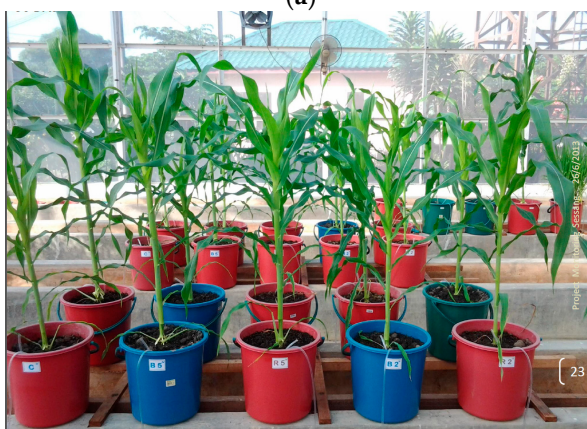
Figure S3. Schematic of pot set up.



Figure S4. Leachate chamber designed at inner bottom of pot.



(a)



(b)



(c)

Figure S5. Photographs of pot trials. (a) sandy soil and corn; (b) acid sulphate soil and corn; (c) acid sulphate soil and rice.

In some of the pots (as can be seen on the figure) the leaves turned yellow. This was not investigated further as it did not lead to mortality, however it may have been related to an nitrogen deficiency.

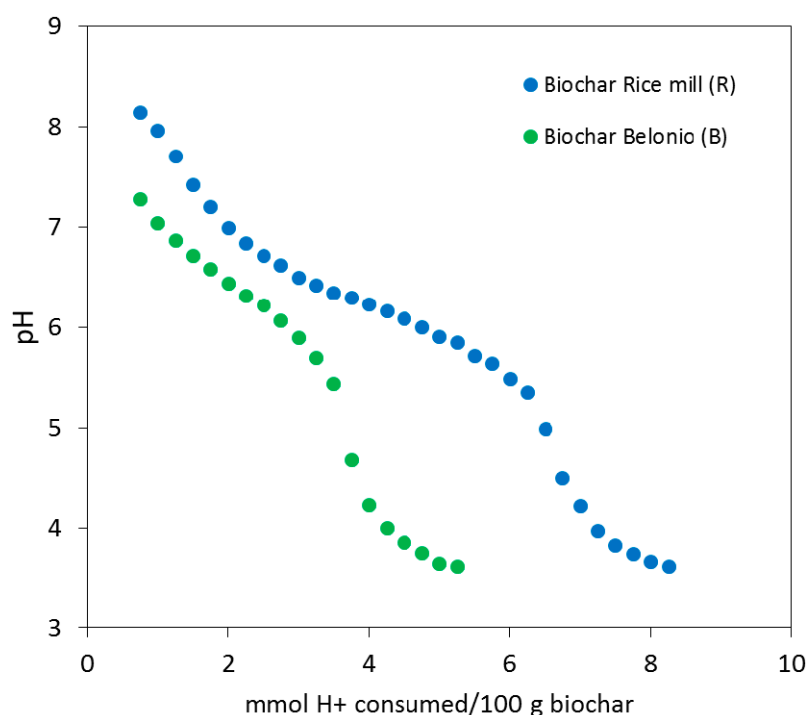


Figure S6. Acid neutralizing capacity of the two rice husk biochars.

Table S1. Standard fertilizer types and rates used for acid sulphate and sandy soil for corn and rice.

Rice and Acid Sulphate Soil (N:P ₂ O ₅ :K ₂ O 160:61:110 KG/HA)		
DATE	FERTILIZER TYPES	g/pot
12	NPK Compound 17:20:10	1.003
25	NPK Compound 17:20:10	0.716
	Urea	0.716
45	NPK Compound 17:3:20:2:0.8 s	2.006
65	NPK Compound 17:3:20:2:0.8 s	1.074
Corn and acid sulphate soil (N:P ₂ O ₅ :K ₂ O 149:61:67 KG/HA)		
DATE	FERTILIZER TYPES	g/pot
15	NPK Compound 17:20:10	4.500
25	NPK Compound 17:20:10	5.625
	Urea	5.625
46	NPK Compound 17:3:20:2:0.8 s	7.500
Corn and sandy soil (N:P ₂ O ₅ :K ₂ O 157:70:72 KG/HA)		
DATE	FERTILIZER TYPES	g/pot
15	NPK Compound 17:20:10	4.50
25	NPK Compound 17:20:10	7.50
	Urea	5.63
46	NPK Compound 17:3:20:2:0.8 s	7.50

Table S2. Soil exchangeable bases at harvest.

Crop/Soil	trt	Pot Trial Season 1 (meq/kg)						Pot tRial Season 2 (meq/kg)					
		K ⁺	Mg ²⁺	Na ⁺	Ca ²⁺	Al ³⁺	Ca/Al (Molar Ratio)	K ⁺	Mg ²⁺	Na ⁺	Ca ²⁺	Al ³⁺	Ca/Al (Molar Ratio)
Corn/ Acid Sulphate	C	3.4 ^c	8.6 ^c	5.0 ^b	1.9 ^c	3.2 ^a	0.9 ^b	2.0 ^c	1.9 ^b	2.7 ^b	2.1 ^c	1.9 ^a	1.7 ^c
	B2	4.7 ^b	8.6 ^c	4.8 ^b	2.5 ^b	3.1 ^a	1.2 ^b	2.8 ^b	2.4 ^b	2.6 ^b	2.8 ^b	1.2 ^b	3.3 ^b
	B5	6.7 ^{a,b}	16.4 ^{a,b}	5.9 ^a	3.5 ^a	2.2 ^b	2.4 ^a	2.9 ^b	3.4 ^{a,b}	2.9 ^{a,b}	3.2 ^b	1.0 ^b	4.7 ^{a,b}
	R2	5.1 ^b	7.8 ^c	5.0 ^b	1.9 ^c	2.7 ^a	1.1 ^b	2.9 ^b	2.4 ^b	3.0 ^{a,b}	2.6 ^b	1.3 ^b	3.1 ^b
	R5	8.1 ^a	10.7 ^b	5.9 ^a	2.3 ^b	2.2 ^b	1.6 ^{a,b}	3.4 ^a	3.1 ^a	3.3 ^a	3.9 ^a	1.4 ^b	4.3 ^{a,b}
Corn/ Sandy	C	3.3 ^c	1.4 ^c	2.0 ^{a,b}	7.2 ^c	1.2 ^a	8.6 ^b	1.6 ^b	0.4 ^c	3.6 ^b	5.0 ^b	1.0 ^a	7.3 ^c
	B2	3.8 ^b	1.7 ^b	2.2 ^{a,b}	10.6 ^b	1.3 ^a	12.2 ^b	2.0 ^a	0.5 ^c	4.1 ^b	6.1 ^{a,b}	0.6 ^{a,b}	14.2 ^b
	B5	6.5 ^a	2.8 ^b	2.1 ^{a,b}	16.5 ^a	1.1 ^b	23.5 ^a	2.3 ^a	1.3 ^b	5.7 ^{a,b}	7.8 ^a	0.7 ^{a,b}	17.8 ^{a,b}
	R2	3.3 ^b	2.5 ^b	1.9 ^b	6.2 ^c	1.2 ^{a,b}	8.0 ^b	1.7 ^b	0.9 ^b	6.0 ^a	5.4 ^{a,b}	0.6 ^{a,b}	14.7 ^b
	R5	6.7 ^a	25.9 ^a	2.5 ^{a,b}	14.5 ^{a,b}	1.1 ^b	20.7 ^a	2.7 ^a	3.3 ^a	7.3 ^a	6.6 ^{a,b}	0.3 ^b	29.6 ^a
Rice/ Acid Sulphate	C	3.9 ^b	9.1 ^b	5.5 ^a	3.6 ^b	3.5 ^a	1.5 ^b	2.4 ^a	3.2 ^b	3.2 ^b	2.3 ^b	2.0 ^a	1.7 ^b
	B2	4.3 ^{a,b}	8.9 ^b	5.6 ^a	3.9 ^b	3.4 ^a	1.8 ^b	2.4 ^a	3.6 ^a	3.2 ^b	2.9 ^{a,b}	2.0 ^a	2.1 ^{a,b}
	B5	4.3 ^{a,b}	10.4 ^a	5.9 ^a	6.6 ^a	2.8 ^a	3.5 ^a	2.5 ^a	4.0 ^a	3.4 ^{a,b}	3.3 ^a	1.7 ^a	2.8 ^a
	R2	4.4 ^a	9.2 ^{a,b}	5.5 ^a	1.8 ^b	3.4 ^a	0.8 ^b	2.5 ^a	3.8 ^a	3.3 ^b	2.4 ^b	1.9 ^a	2.0 ^b
	R5	4.4 ^a	10.7 ^a	5.9 ^a	6.4 ^a	2.7 ^a	3.5 ^a	2.6 ^a	4.1 ^a	3.7 ^a	3.5 ^a	1.7 ^a	3.1 ^a

Means within the same column in each crop set followed by same letters (a, b, c) are not significantly different at $p < 0.05$.

Table S3. Yields of corn cropped under acid sulphate and sandy soil, and rice cropped under acid sulphate soil (t/ha) including the standard deviation of 4 measurements.

	Corn t/ha				Rice t/ha	
	Acid Sulphate		Sandy		Acid Sulphate	
	Season 1	Season 2	Season 1	Season 2	Season1	Season 2
C	0.18 ± 0.004	0.14 ± 0.07	0.02 ± 0.004	0.20 ± 0.02	4.18 ± 0.53	4.65 ± 0.39
B2	0.21 ± 0.02	0.13 ± 0.02	0.11 ± 0.01	0.20 ± 0.02	4.13 ± 0.43	5.63 ± 0.28
B5	0.26 ± 0.02	0.28 ± 0.009	0.12 ± 0.01	0.24 ± 0.01	5.07 ± 0.25	4.08 ± 0.18
R2	0.26 ± 0.02	0.21 ± 0.02	0.16 ± 0.006	0.21 ± 0.05	4.59 ± 0.42	5.15 ± 0.81
R5	0.28 ± 0.01	0.23 ± 0.02	0.19 ± 0.02	0.27 ± 0.03	4.81 ± 0.18	4.95 ± 0.17