Biochar use, market and legislation in Europe

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ithaka institute for organic carbon cycling, Switzerland

E2BEBIS

CENTRAL EUROPE
COOPERATING FOR SUCCESS.

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

cost

eBRN

EBC foundation | certificate

ithaka institute

Biochar Production in EU

Germany	5000 t (EBC certified)
Austria	500 t (EBC certified)
Switzerland	700 t (EBC certified)
UK	500 t
all other EU countries	< 50 t

Gazifier char-ash:	ca. 50.000 t

Germany‘s Charcoal Import 2009

Länder	import: weight	import value	price	total value
	t	kEUR	Euro/t	k US $
2009				
Belgien (ab 1999)	695,8	483	694	656
Frankreich	8766,6	2857	326	3895
Litauen (ab 1992)	2608,5	355	136	510
Niederlande	11585,3	5993	517	8214
Österreich	2620,0	1380	527	1849
Polen	17453,4	7632	437	10392
Spanien	1877,9	760	405	1019
Tschechische Republik (ab 1993)	762,3	237	311	328
Bosnien und Herzegowina (ab 1993)	3421,3	1227	359	1736
Serbien (ab 06/05)	926,8	344	371	472
Ukraine (ab 05/92)	5515,0	1991	361	2793
Ägypten	244,9	111	453	152
Namibia	5282,8	1248	236	1804
Nigeria	14362,8	3991	278	5472
Argentinien	27164,5	8912	328	12074
Brasilien	1595,7	379	238	515
Paraguay	51205,3	17277	337	23450
Indonesien	9115,4	2632	289	3684
Malaysia	4523,7	1315	291	1737
Philippinen	3599,9	991	275	1347
Singapur	1748,4	459	263	622
Summe	325.803			82.721
Average price			**354 €**	**115.295 €**

Biochar Definition

Biochar is a charcoal-like substance that is pyrolysed from sustainably obtained biomass under controlled conditions with clean technology and which is used for any purpose which does not involve its rapid mineralisation to CO_2. **(EBC)**

Biochar is a name for charcoal when it is used for particular purposes, especially as a soil amendment (Wikipedia)

legislation - a linguistic problem?

- in all except 4 EU countries, **charcoal** can be used as soil amendment, compost additive, fertilizer support
- **vegetal carbon** (E 153) is legal in EU as feed and as food additive

- Charcoal = Holzkohle = charbon de bois etc.
- vegetal carbon = Pflanzenkohle = charbon vegetal etc.
- biochar = charcoal = vegetal carbon

- biochar is legal if you call it charcoal or vegetal carbon without any environmental limits
- the same material is illegal even when it complies with the most sever thresholds it you call it biochar

So what's the difference?

Biochar is a charcoal-like substance that is pyrolysed from sustainably obtained biomass under controlled conditions with clean technology and which is used for any purpose which does not involve its rapid mineralisation to CO_2. **(EBC)**

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55 Uses of Biochar

farming

Soil amendment

7. Carbon fertiliser, 8. Compost, 9. Substitute for peat in potting soil, 10. Plant protection, 11. Compensatory fertiliser for trace elements

Livestock farming

1. Silage agent, 2. Feed additive / supplement, 3. Litter additive, 4. Slurry treatment, 5. Manure composting, 6. Water treatment in fish farming

Biogas produktion

21. Biomass additive, 22. Biogas slurry treatment

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decontamination

Decontamination of soil and natural water

17. Soil additive for soil remediation, 18. highly adsorbing, plantable soil substrates *19. A barrier preventing pesticides getting into surface water 20. Treating pond and lake water*

2.6 Waste water and sewage treatment

23. Active carbon filter, 24. Pre-rinsing additive, 25. Soil substrate for organic plant beds, 26. Composting toilets

2.7 Treatment of drinking water

27. Micro-filters, 28. Macro-filters in developing countries

2.8 Exhaust filter

29. Controlling emissions, 30. Room air filters

55 Uses of Biochar

industry

Building material

12. Insulation, 13. Air decontamination, 14. Decontamination of earth foundations, 15. Humidity regulation, 16. Protection against electromagnetic radiation (“electrosmog”)

Textile industry

45. Fabric additive for functional underwear, 46. Thermal insulation for functional clothing, 47. Deodorant for shoe soles

Food industry

48. Conservation of food 49. Digesting helper

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Wellness
48. Filling for mattresses, 49. filling for pillows

Radio protection
*50. Shield against electromagnetic radiation (*microwaves, TV, Netzgeräte, computer)

Further uses
Industrial materials (31. carbon fibres, 32. plastics)
Electronics (33. semiconductors, 34. batteries)
Metallurgy (35. metal reduction)
Cosmetics (36. soaps, 37. skin-cream, 38. therapeutic bath additives)
Paints and colouring (39. food colorants, 40. industrial paints)
Energy production (41. pellets, 42. substitute for lignite)
Medicines (43. detoxification, 44. carrier for active pharmaceutical ingredients)

Cascading use of biochar

Use it nine times – pay it only once

silage

feed additive

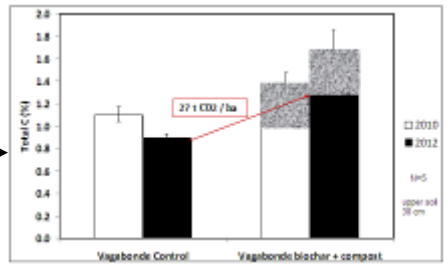
litter additive

liquid manure treatment

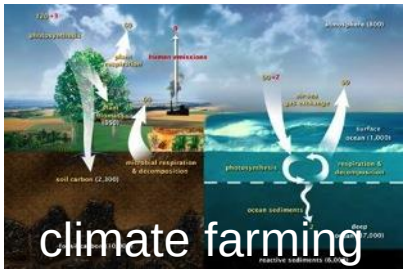
composting

urban soil substrate

soil amendment



humus increase



climate farming

ithaka institute

1. Silage

Cascading use of biochar

1.

Charging biochar with malolactic bacteria and add

1 % BC to silage

reducing mycotoxins and butyric acid, adsorption of pesticides and herbicides

2. Feed additive

Cascading use of biochar

2.

1 % BC for feeding

Carbon-Feed

increases energy efficiency of digestion, decreases milk cells, adsorption of gram positive bacteria (botulisme), pesticides, herbicides, reducing odors, fixation of nutrients, improvement of barn climate

CarbonFeed

- **Ingredients:** Wheat bran (40 %), biochar (15 %), sugar cane molasses, linseed, alpine herbs, corn flakes, wheat flakes, barley flakes, minerals

- Water 43 %, raw proteins 7.5 %, raw ash 5.2 %, raw fibre 4.7 %, raw fat 1.7 %, sodium 0.03 %, calcium 0.08 %, phosphorous 0.5 %, magnesium 0.2 %, lysine 2.7 g/kg, methionine 1.0 g/kg

For cows, horses, chicken, pigs, sheep – dogs, cats …

Reduction of methane emission caused by rumination

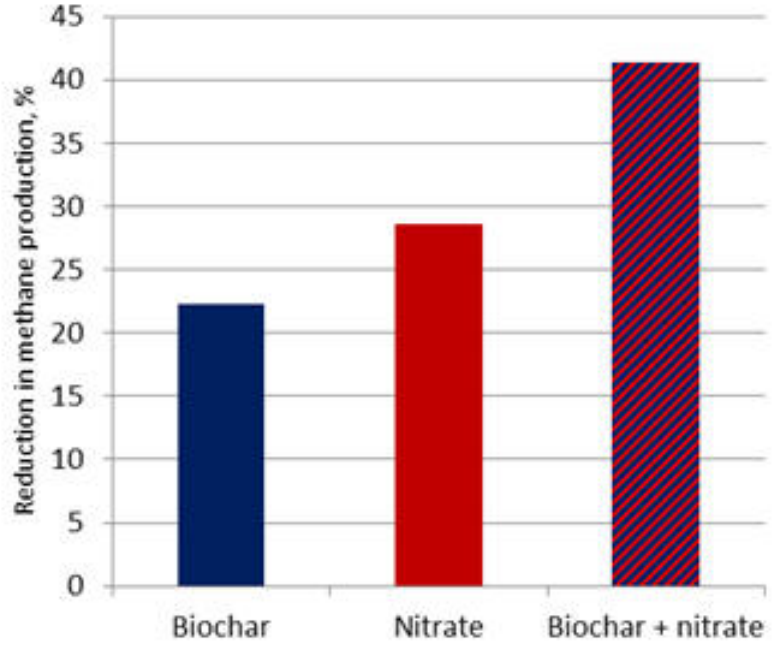


Figure 4. Reduction in methane due to biochar and nitrate in local "Yellow" cattle fed cassava root and cassava foliage supplemented or not with biochar and with urea or potassium nitrate as NPN source

http://www.lrrd.org/lrrd24/11/leng24199.htm for full details

BC – Biochar
KN – form of potassium nitrate

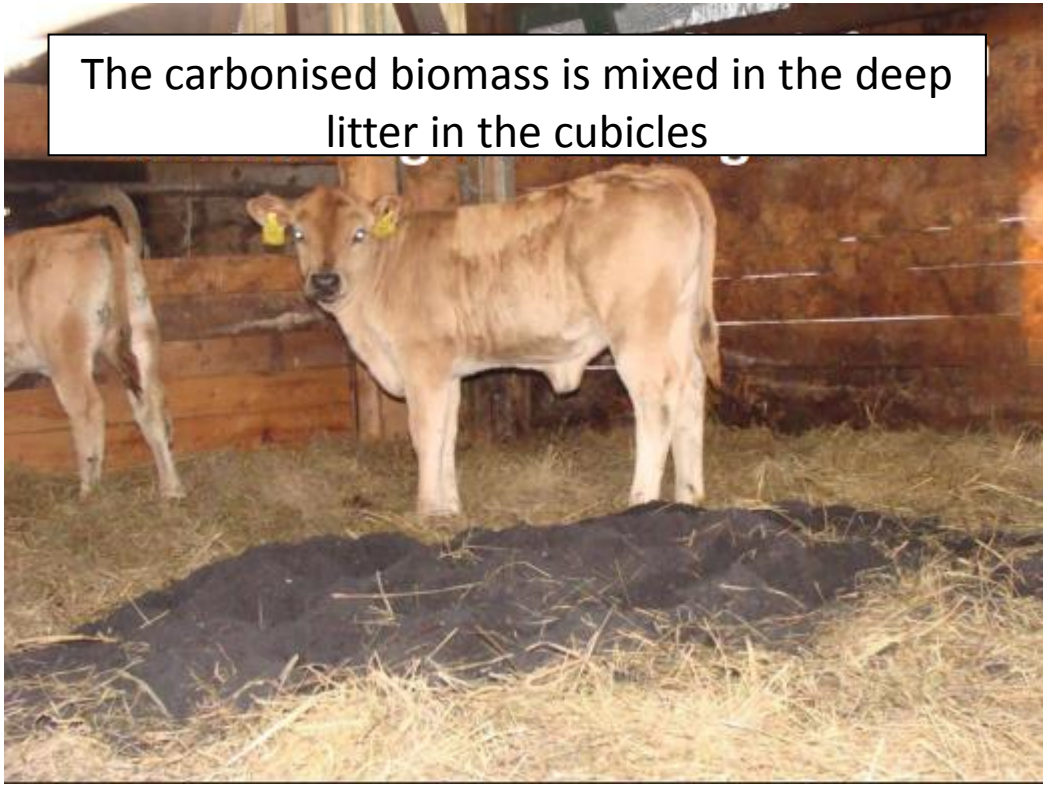
Leng et al 2012, Biochar reduces enteric methane and improves growth and feed conversion in local "Yellow" cattle fed cassava root chips and fresh cassava foliage

3. Litter Amendment

Cascading use of biochar

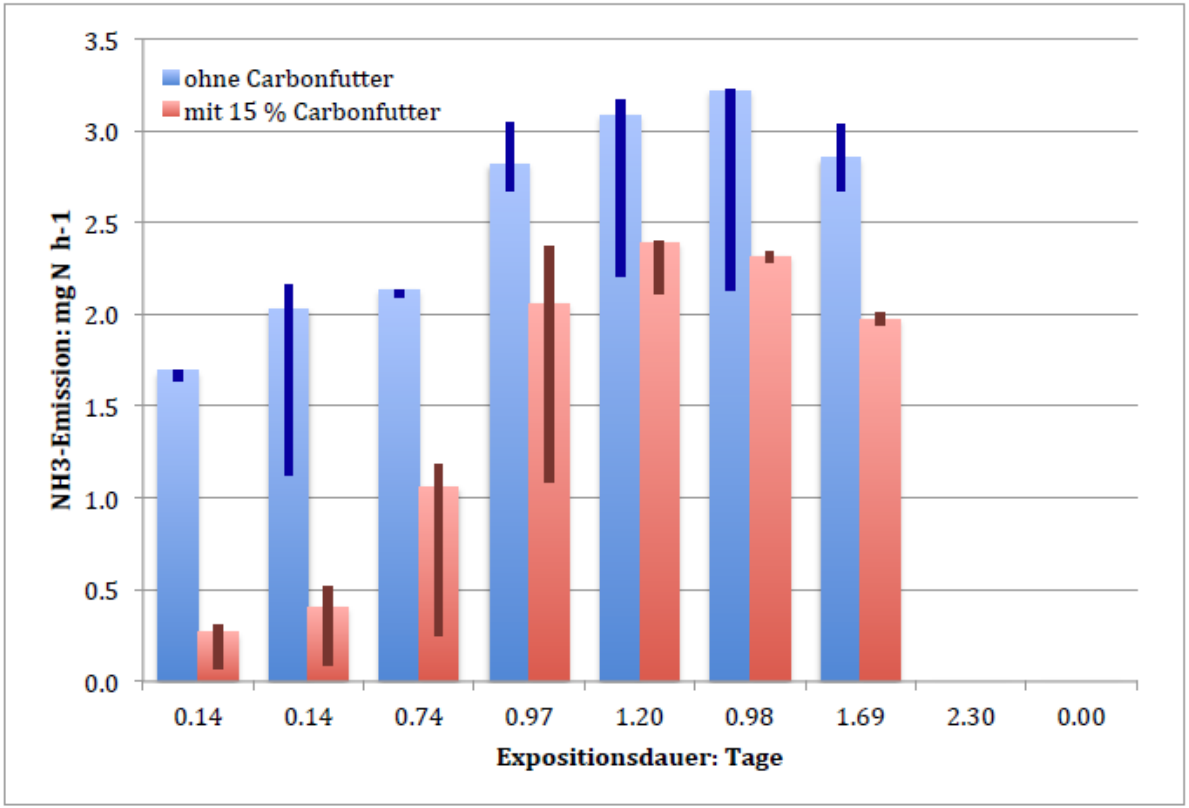
3.

5 - 10 % BC in litter



reducing humidity and odors, fixation of nutrients, reducing NH3 and CH4 emissions, ameliorates hygiene, hoof infections

Biochar induced ammonia reduction in chicken farm



4. Liquid manure additive

Cascading use of biochar

4.

1- 1,5 % BC

in liquid manure

Reducing NH3-losses, methane emissions, increases plant nutrient efficiency, decreases nutrient leaching and odors

5. Composting the manure

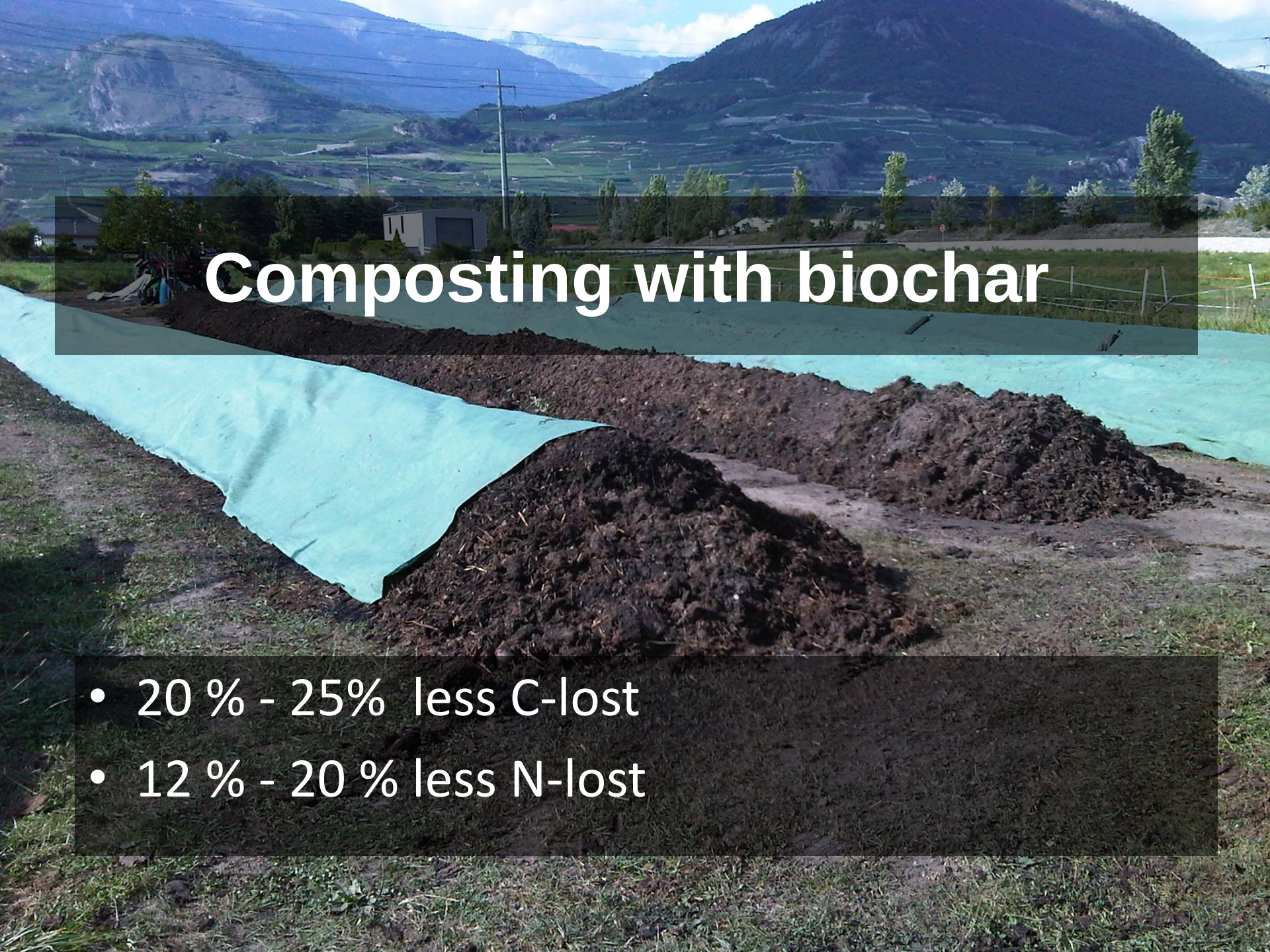
Cascading use of biochar

5.

Composting the carbon manure + the separated solids of the liquid manure

10 – 20% BC

Terra Preta



Composting with biochar

- 20 % - 25% less C-lost
- 12 % - 20 % less N-lost

reduction of GHG during composting

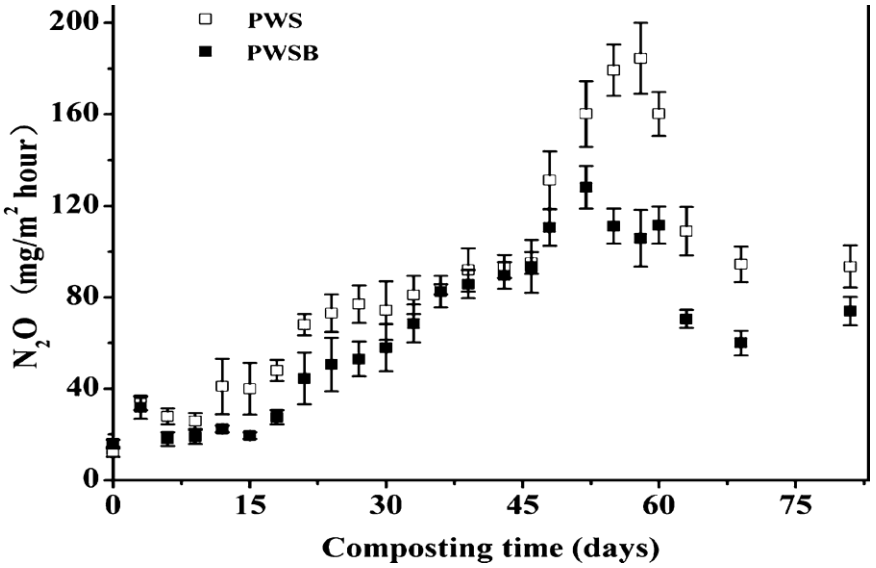


Figure 2. Changes in N2O emission rate during pig manure composting.

Wang et al. 2012: dx.doi.org/10.1021/es305293h | Environ. Sci. Technol.

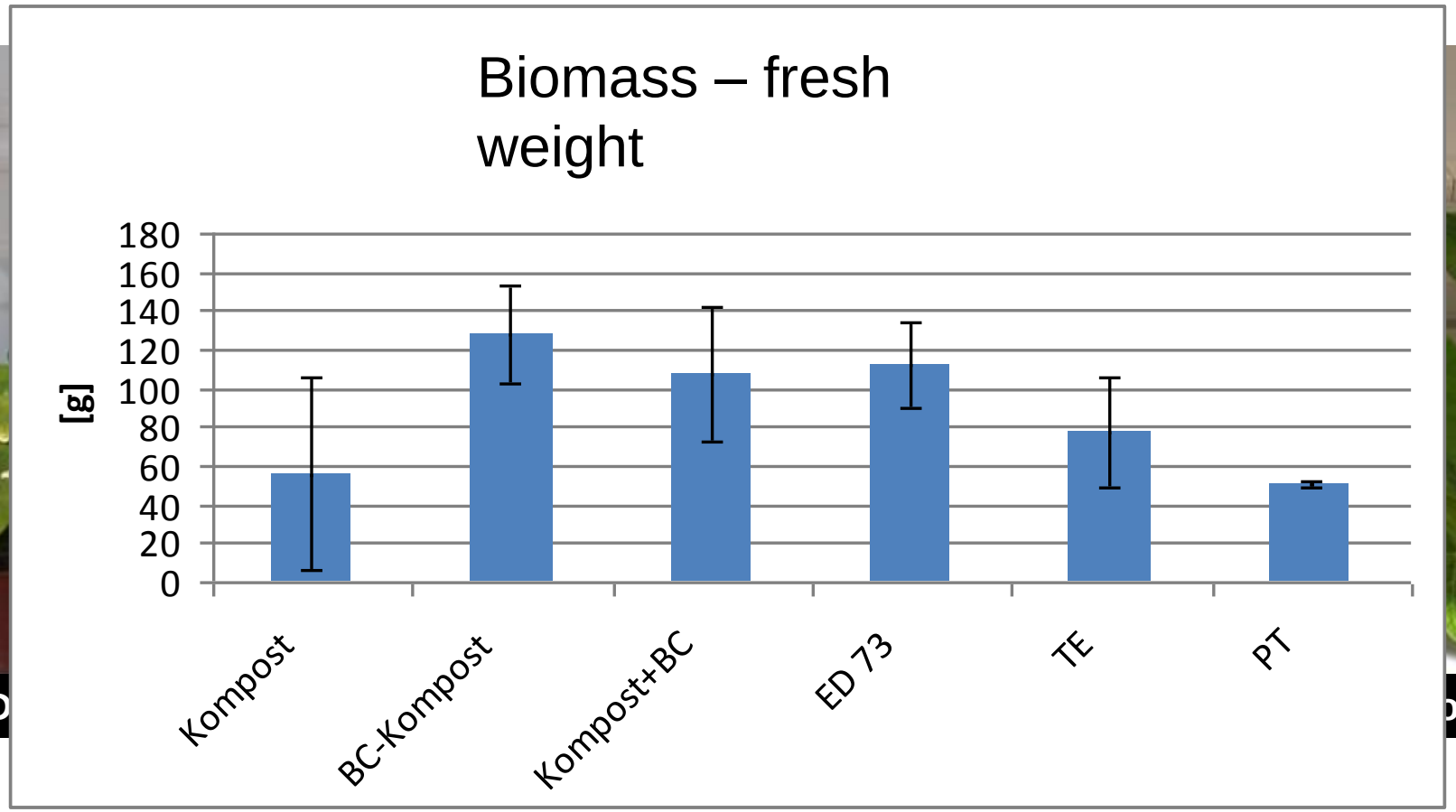
Chen et al. 2010, Chemosphere 78:
up to 65% reduced N loss (total Kjeldahl N)
with up to 9% bamboo biochar addition
(pig manure + sawdust +/- BC (pH 8.8)

Peat substrate vs BC-compost pumpkin

peat ED73 **peat substitute** **soil** **compost** **BC-compost**

Peat substrate vs BC-compost pumpkin

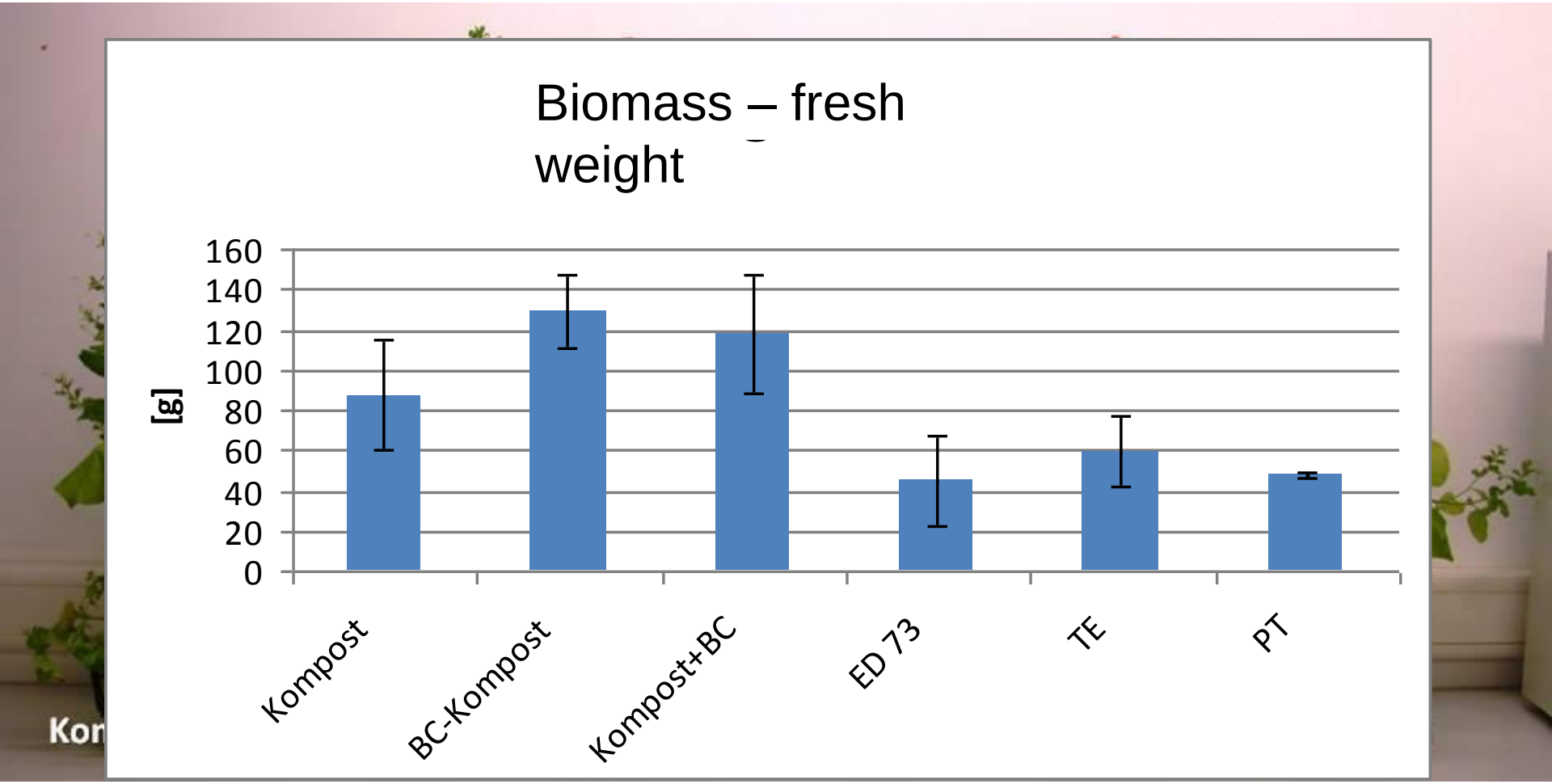
peat ED



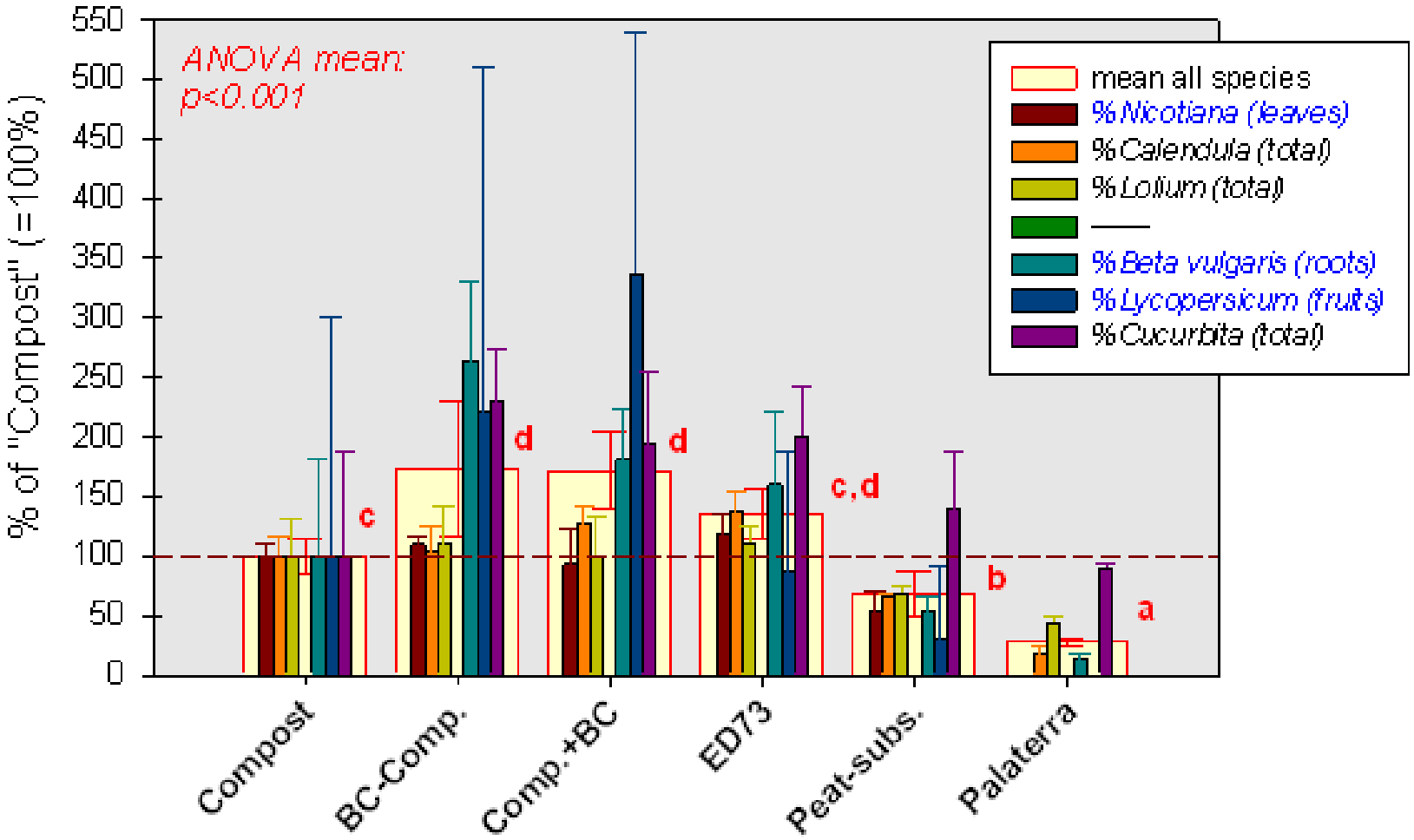
ost

Nicotina benthamiana

Nicotina benthamiana



Summary – biomass yield changes

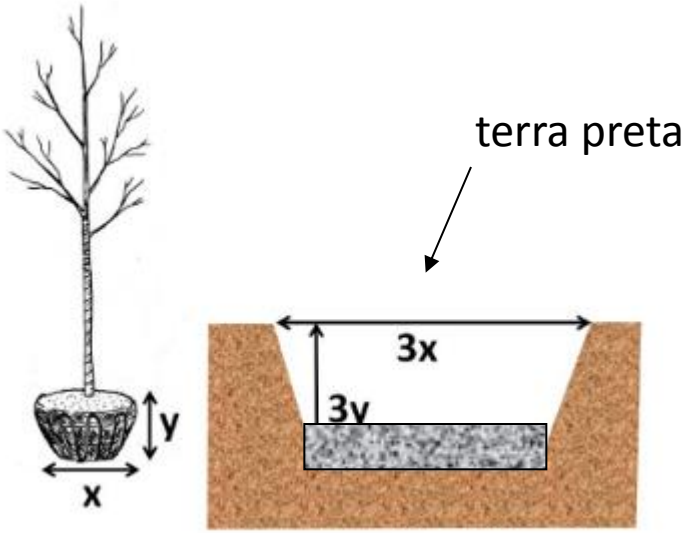


Swiss Terra Preta

greenhouse substrates, urban farming, pot substrates, special cultures, tree nurcery

Corresponding to 1000 t biochar / ha

Planting trees with terra preta



Highly concentrated hotspots close to the roots

under the roots: biochar substrates

7. Soil Amendment

Cascading use of biochar

7.

Soil amendment

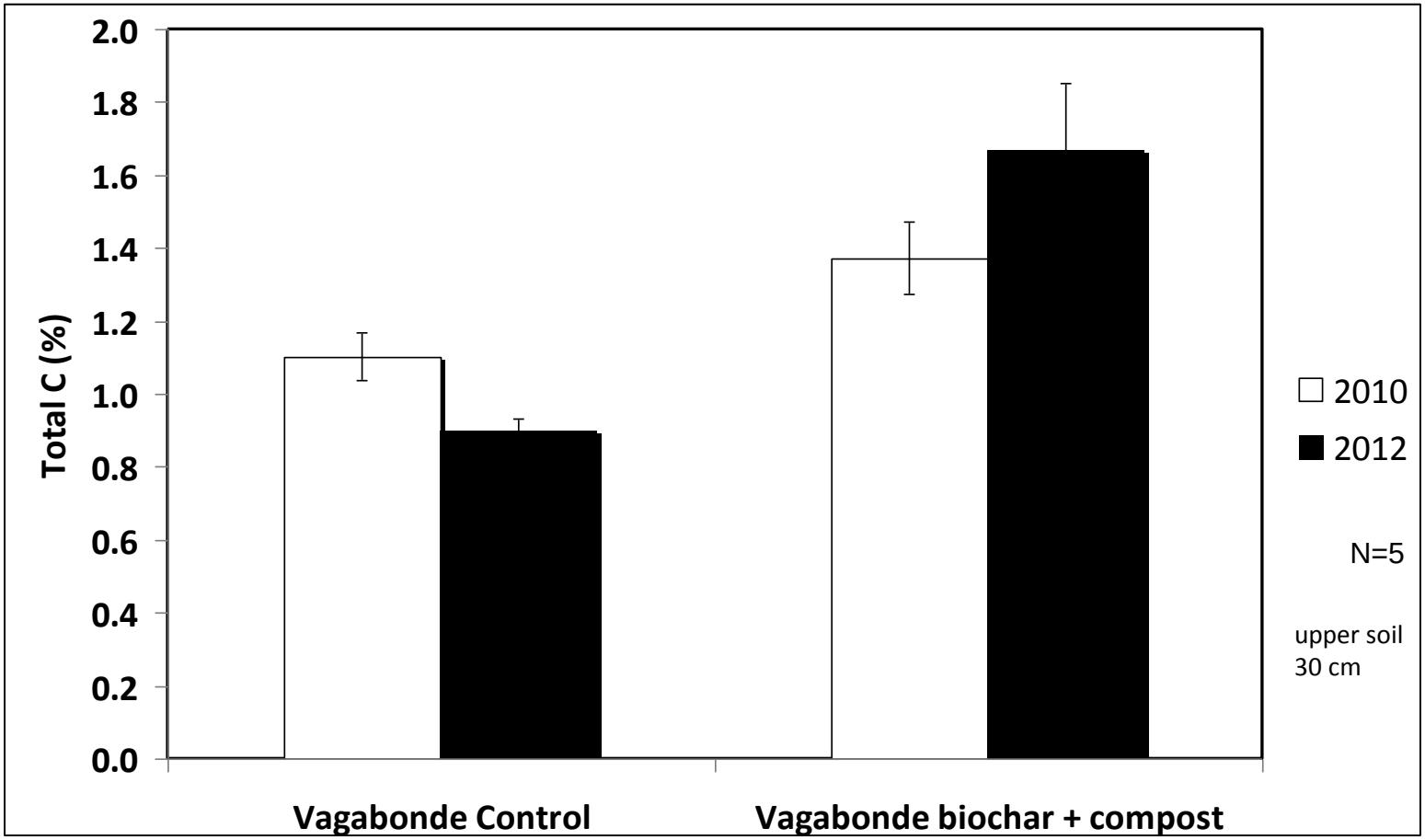
Fixation of nutrients

Increase of SOM

8. Increase of humus (SOC)

Cascading use of biochar

10 t BC / ha
= ca. 0,5%
total C in
upper soil



Data from a vineyard field trial in Valais

8. Increase of humus (SOC)

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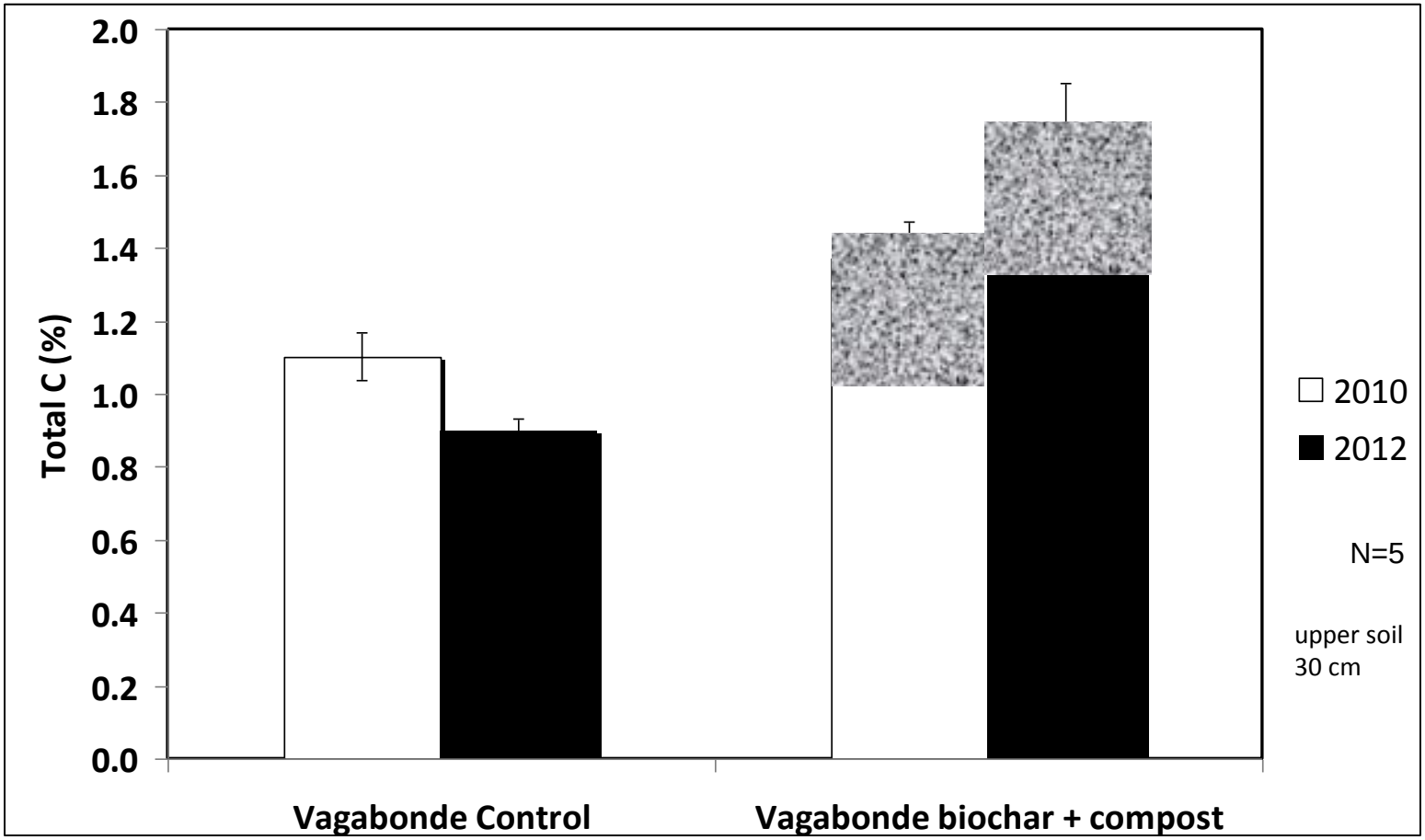

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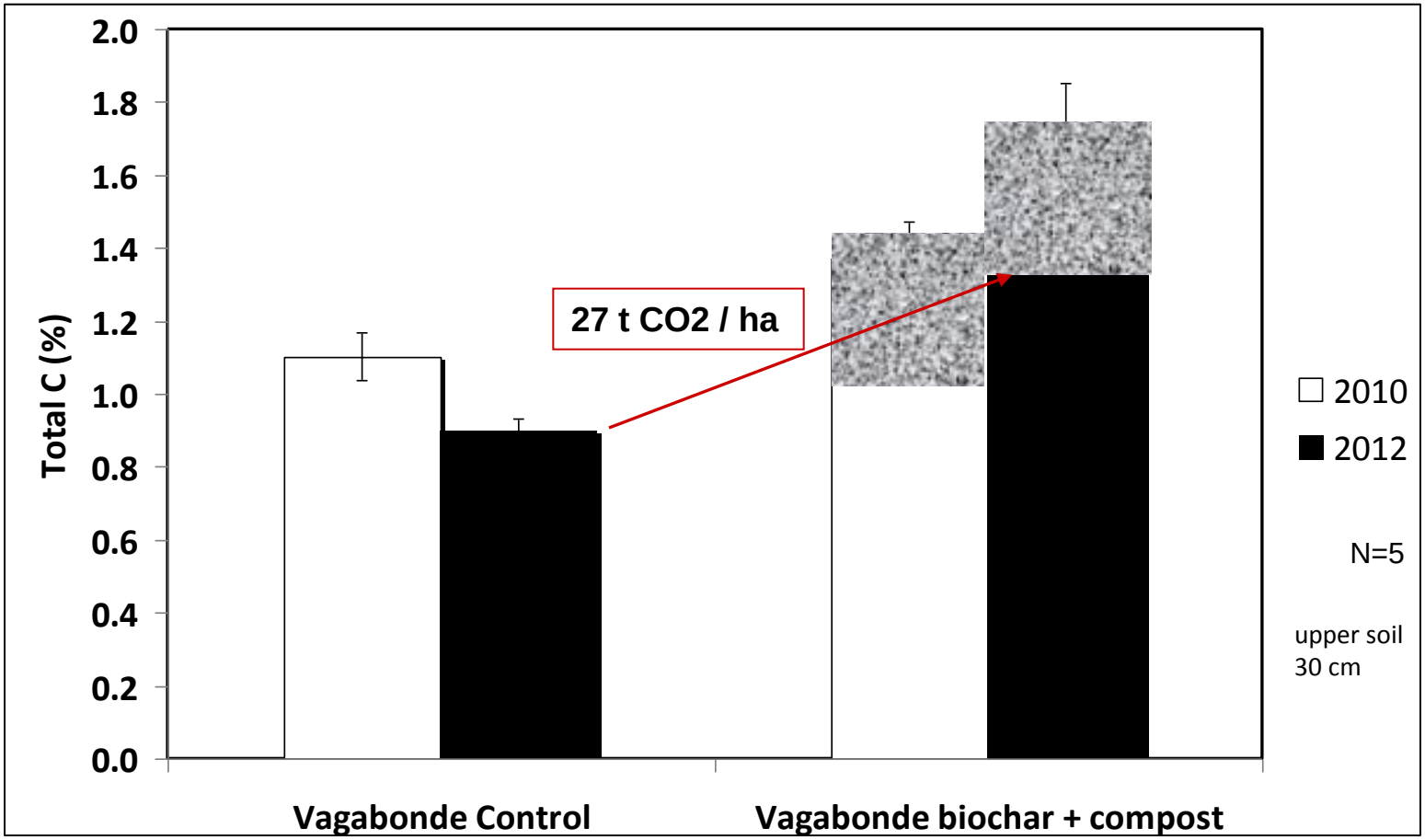


Data from a vineyard field trial in Valais

9. Carbon sequestration

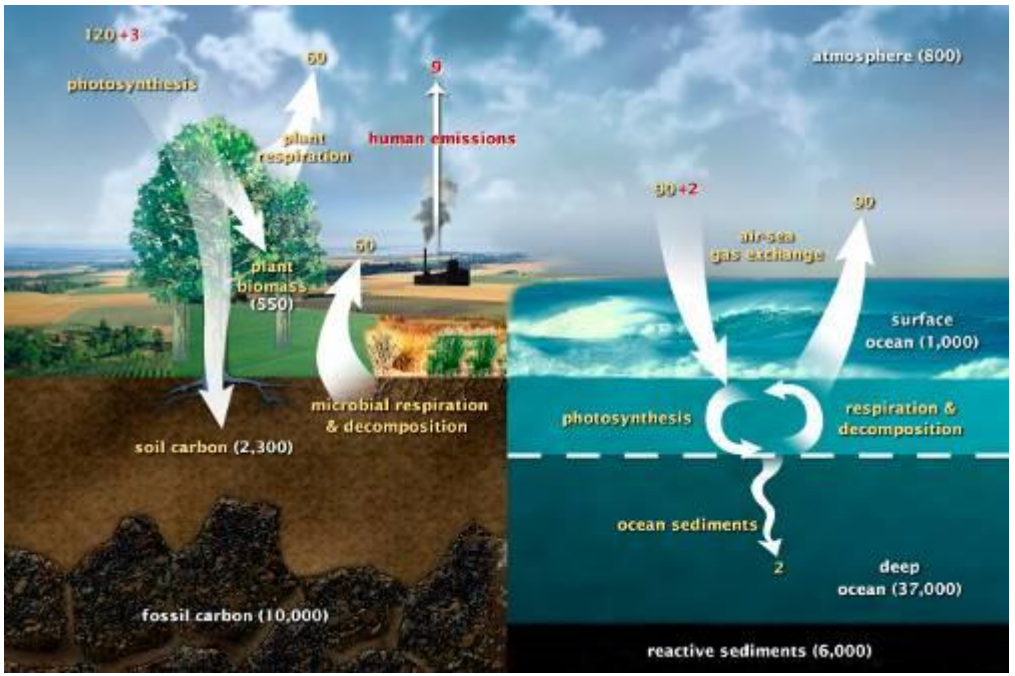
Cascading use of biochar

9.

Carbon sequestration:

SOM, BC

Reducing NH_3, CH_4, N_20



CO2-certificates?

Ecosystem Service Certificate

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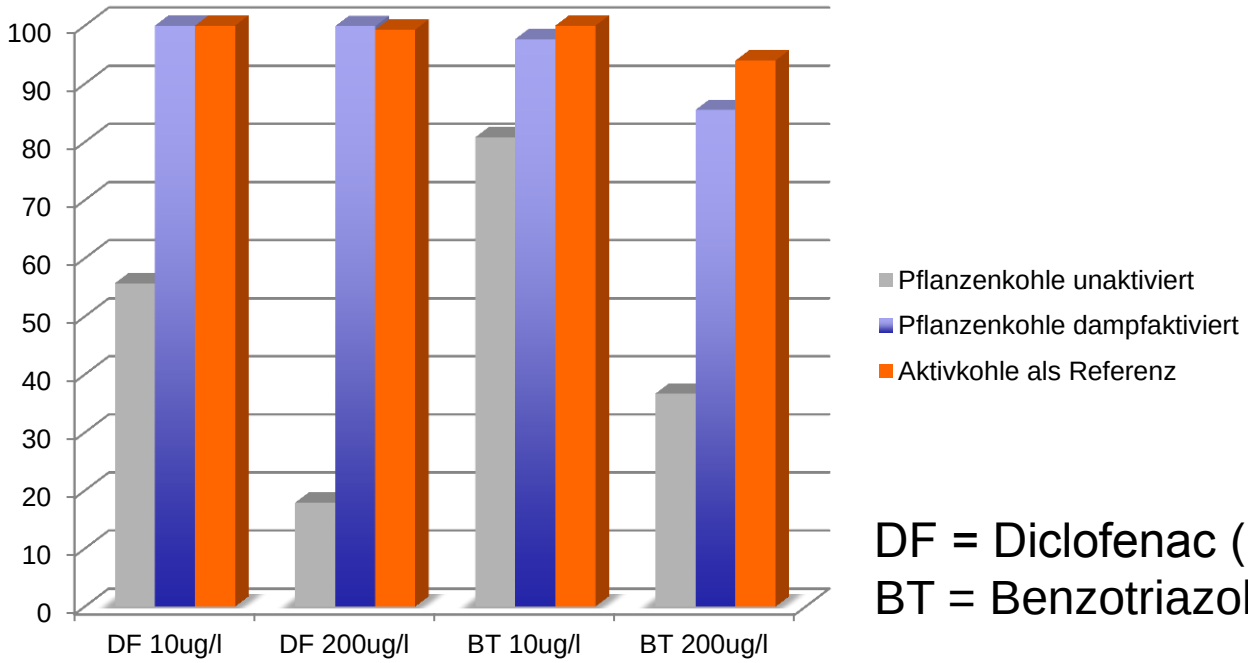
A Biochar Cascade

Adding complexity to multiply yields

Albert Bates
Global Village Institute
for Appropriate Technology

Decontamination of waste water

Adsorption of contaminents by activated biochar



DF = Diclofenac (Entzündungshemmer)
BT = Benzotriazole (Rostschutzmittel)

Magnetic charging of biochar

Biochar

Ferrous sulfate

55 Uses of Biochar

Building material
12. Insulation, 13. Air decontamination, 14. Decontamination of earth foundations, 15. Humidity regulation, 16. Protection against electromagnetic radiation ("electrosmog")

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Biochar in Textile Industry

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30% bambou-char

Conservation of Food

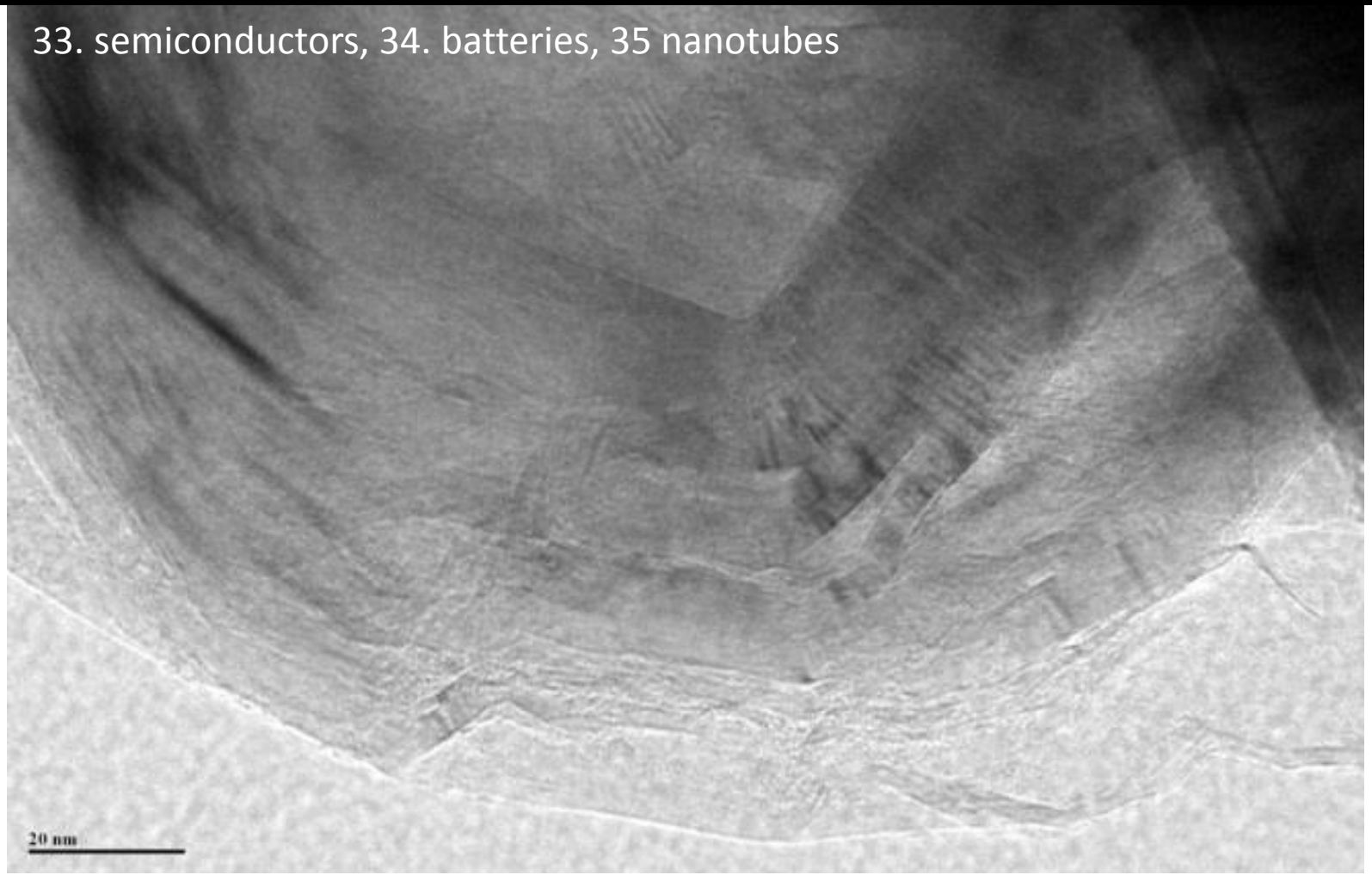
Regulation of humidity, anti-bacteriologic,
adsorption of ethylen

Cosmetics

36. soaps, 37. skin-cream, 38. therapeutic bath additives)

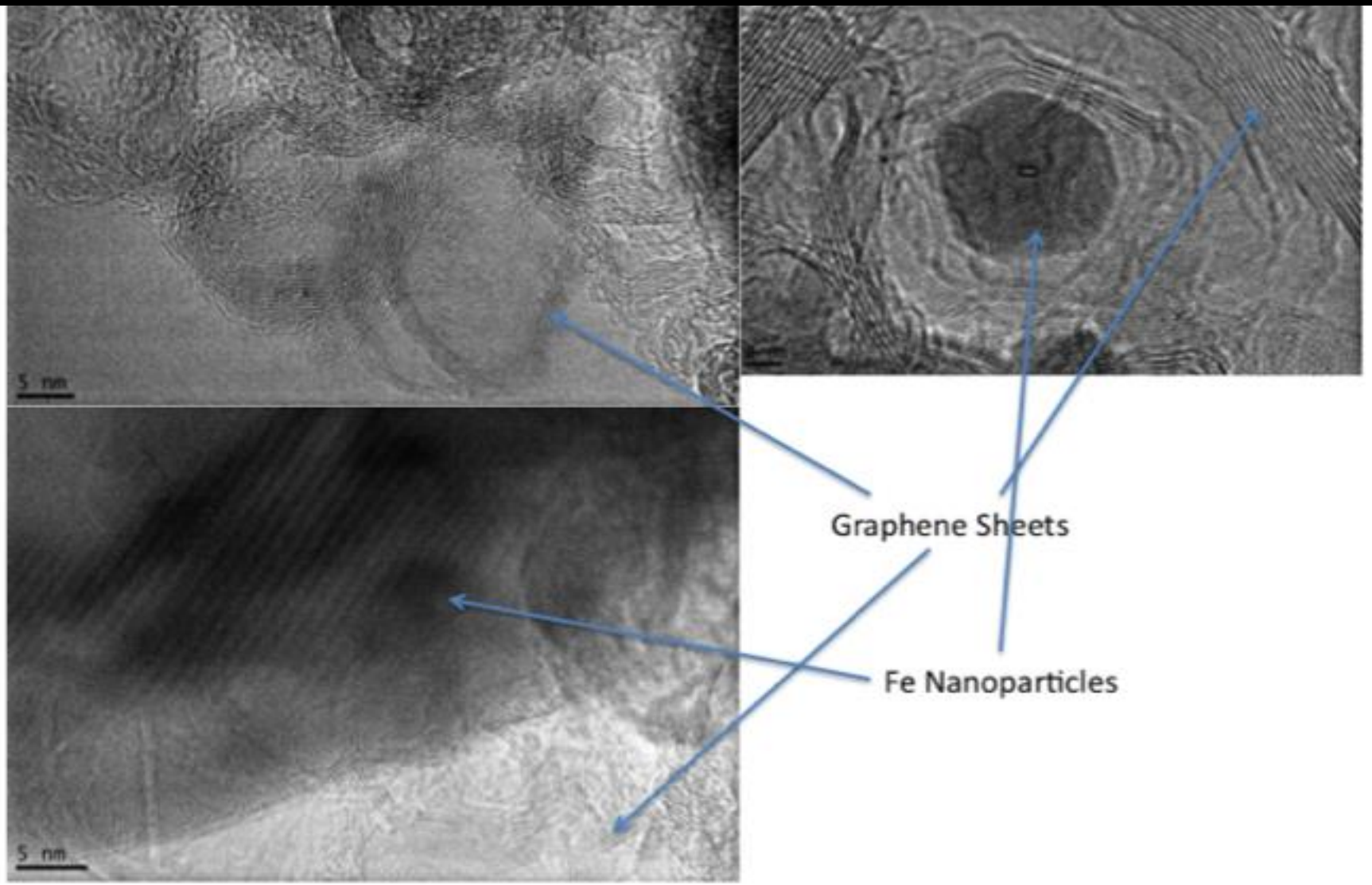
Biochar Food

Graphen



Zhengrong Gu,, 2013. American Transactions on Engineering & Applied Sciences. Volume 2 No.1 ISSN 2229-1652
TEM of Activated carbon from DDGS biochar (KOH 0.075 1050 °C). TEM at 20 nm,

Graphen



Forest Waste for Supercapacitors

https://www.pddnet.com/news/2013/10/forest-waste-cheaper-greener-supercapacitors#!

Biochar-Clay-Plaster for optimal indoor climate

humidity control, thermal insulation, toxin fixation, electro-magnetic shielding

50% Biochar

Biochar for habitats

Effects of Biochar-Plaster

- Regulation / buffering of humidity
- Insulation
- Noise protection
- Toxin binding (solvents, VOC)
- Blocking of high frequency radiation
- Low electrostatic charging of air
- Conservation of wood
- Reduction of dust (mites!)

Effects of Biochar-Plaster

- Deodorising
- aesthetic
- Anti-bacteriological, fungicide (repellent)
- Air cleaning
- Increase of redox potential
- Emission of far-infrared radiation

Ithaka Institute‘s conferencing room

Ithaka Institute‘s conferencing room

Painted with with Claycolour

Ithaka Institute‘s Office


carbon recycling is the key for the sustainable development of the human civilisation
At least 4 Gt C would have to be fixated by biomass recycling while reducing the human emissions by at least 5 Gt C.
ithaka institute

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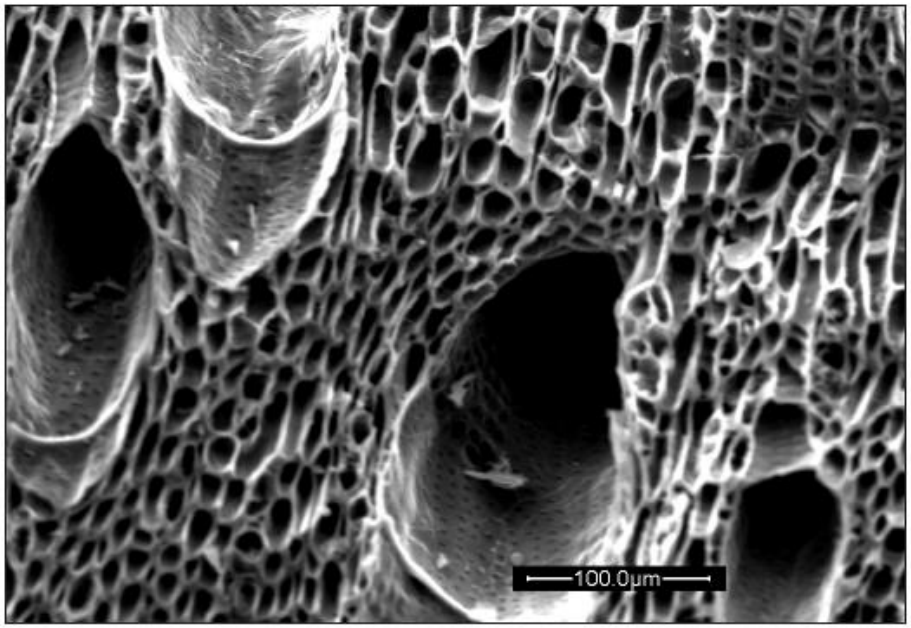
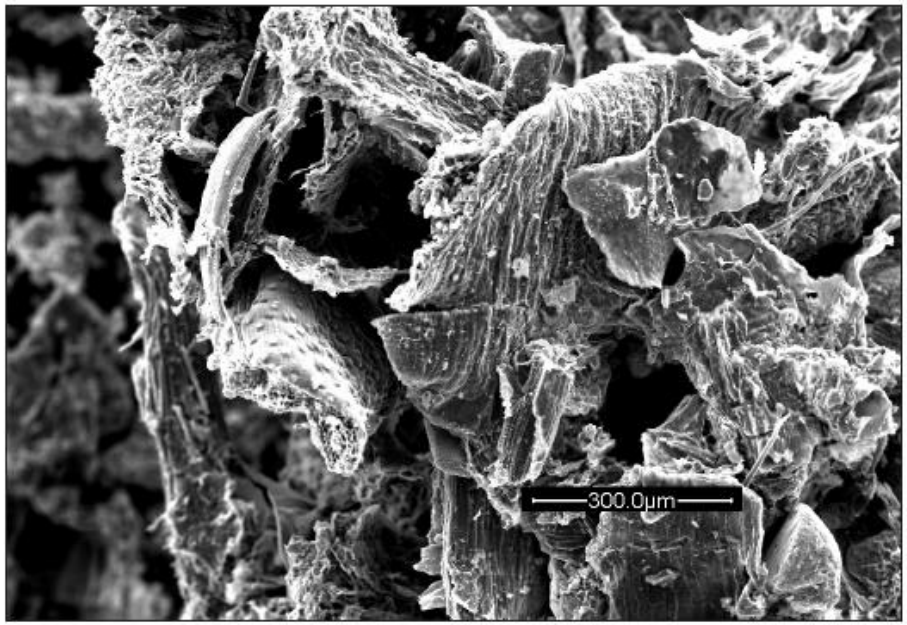
Who knows what biochar is?

Probe		Probe A, Biochen 28.06.12 Pflanzenkohle		Grenzwerte gemäß Richtlinie European Biochar Certificate für die Produktion von Pflanzenkohle	
Labor-Nr.:		112037219			
Parameter	Einheit	anl	wf = TM	Qualitätsstufe basic	Qualitätsstufe premium
Schüttdichte	kg/m^3	552	-		
Wasser gesamt	Ma.-%	73,2	-		
Asche 550°C	Ma.-%	5,0	18,6		
Brennwert (Ho,V)	kJ/kg	7185	26808		
Heizwert (Hu,p)	kJ/kg	5371	26704		
Wasserstoff	Ma.-%	0,12	0,47		
Kohlenstoff	Ma.-%	20,1	75,0	> 50	> 50
Stickstoff	Ma.-%	0,48	1,80		
Sauerstoff (Differenz) [berechnet]	Ma.-%	1,1	4,1		
H/C-Verhältnis (molar)		0,074	0,074	< 0,6	< 0,6
O/C-Verhältnis (molar)		0,041	0,041	< 0,4	< 0,4
Schwefel ges.	Ma.-%	< 0,03	< 0,03		
Carbonat CO_2	Ma.-%	1,09	4,07		
pH-Wert		10,1	-	≤ 10	≤ 10
el. Leitfähigkeit	µS/cm	3000	-		

	Einheit	Wert i.d.OS	Wert i.d.TS	Faktor	TE	1992	Methode
Physikalisch-chemische Parameter							
pH-Wert		**9,2**					DIN EN 12176
Trockenrückstand	%	**99,0**					DIN 38414-S2
Wassergehalt	%	**1,0**					berechnet
Glühverlust (org.Substanz)	%	**12,0**	**12,1**				DIN 38414-S3
organischer Kohlenstoff (TOC)	%	**12,0**	**12,1**				n. Dumas
Pflanzennährstoffe							
Gesamtstickstoff (N)	%	**0,35**	**0,35**				DIN ISO 13878
Ammoniumstickstoff (NH4-N)	%	**<0,05**	**<0,05**				DIN 38406-E5
Phosphat ges. (als P2O5)	%	**15,5**	**15,7**				DIN EN ISO 11885
Kalium ges. (als K2O)	%	**0,990**	**1,00**				DIN EN ISO 11885
Calcium ges. (als CaO)	%	**9,03**	**9,12**				DIN EN ISO 11885
basisch wirksame Stoffe (CaO)	%	**5,70**	**5,76**				AbfKlärV 1992
Magnesium ges. (als MgO)	%	**2,40**	**2,42**				DIN EN ISO 11885
Kobalt (Co)	mg/kg		**28,2**				DIN EN ISO 11885
Mangan (Mn) gesamt	mg/kg	**418**	**422**				DIN EN ISO 11885
Selen (Se)	mg/kg	**<1,9800**	**<2,00**				DIN EN ISO 11885

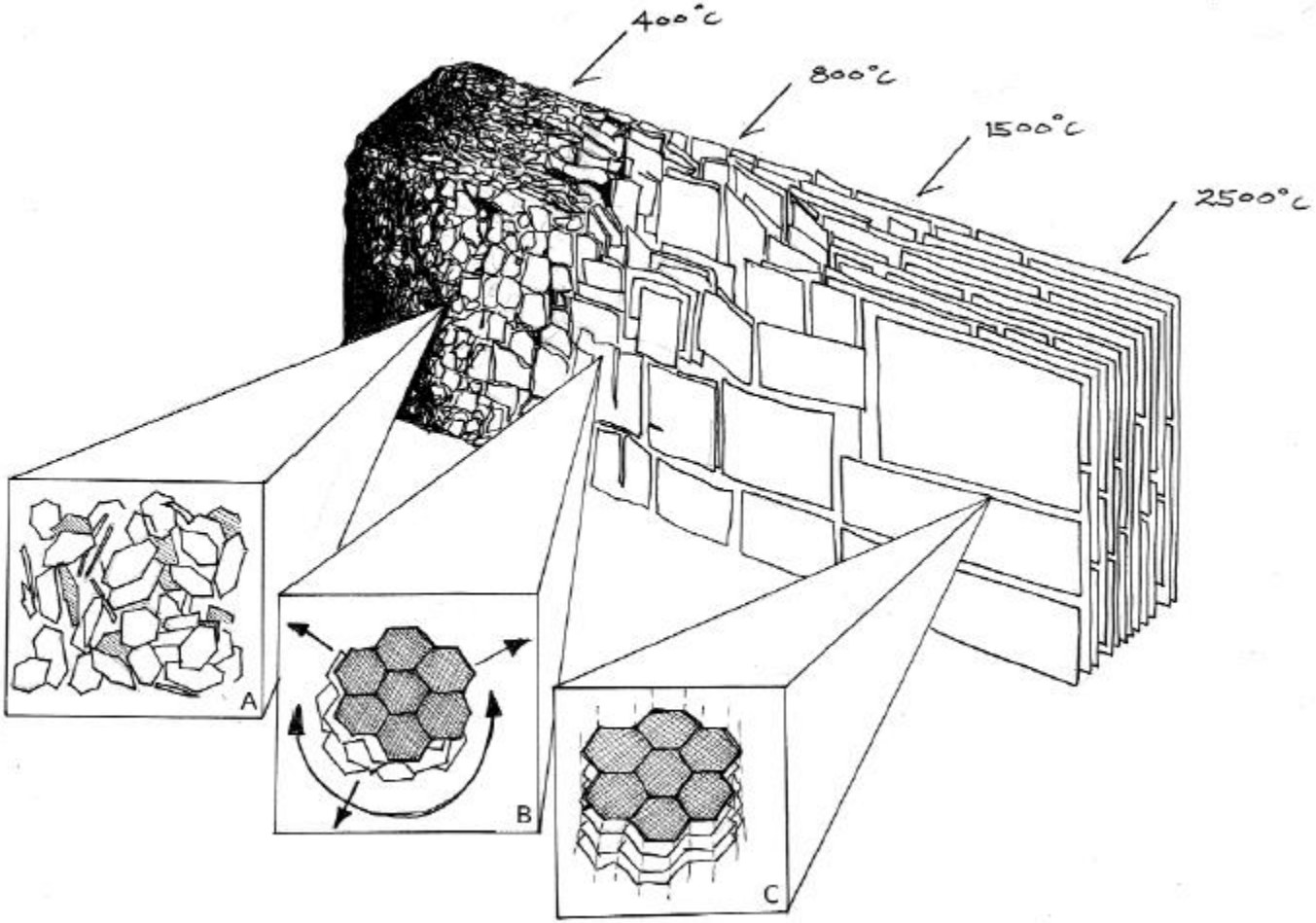
Different feed stock different char





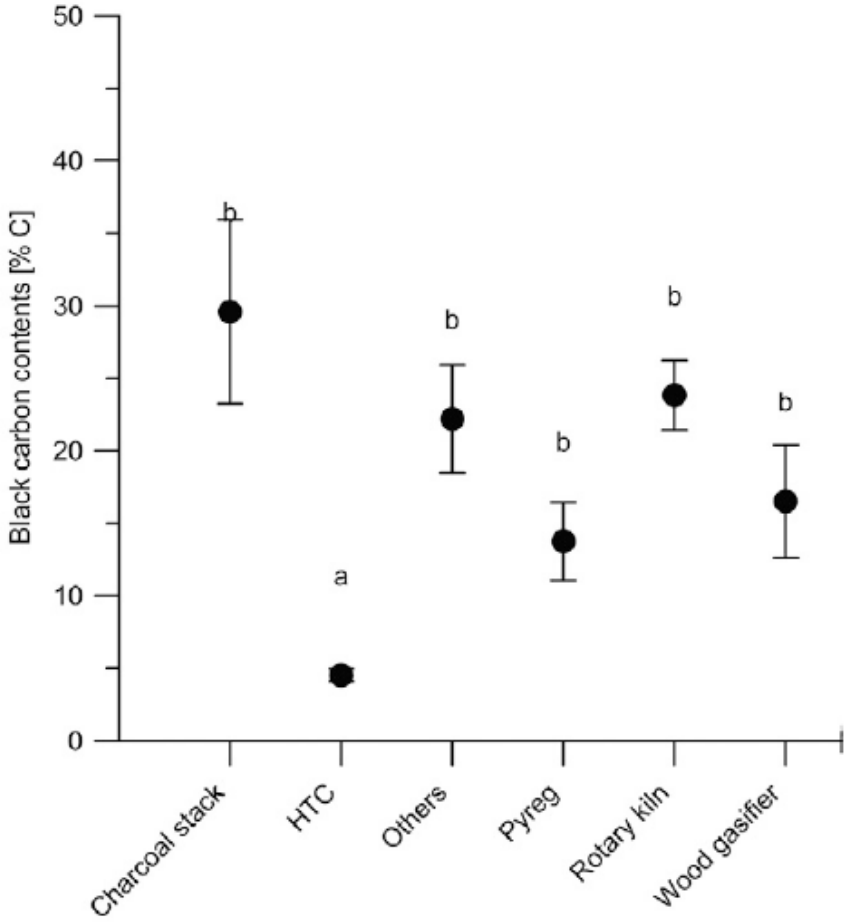
Adriana Downie,Alan Crosky and Paul Munroe (2009)

Different temperature different char



Adriana Downie,Alan Crosky and Paul Munroe (2009)

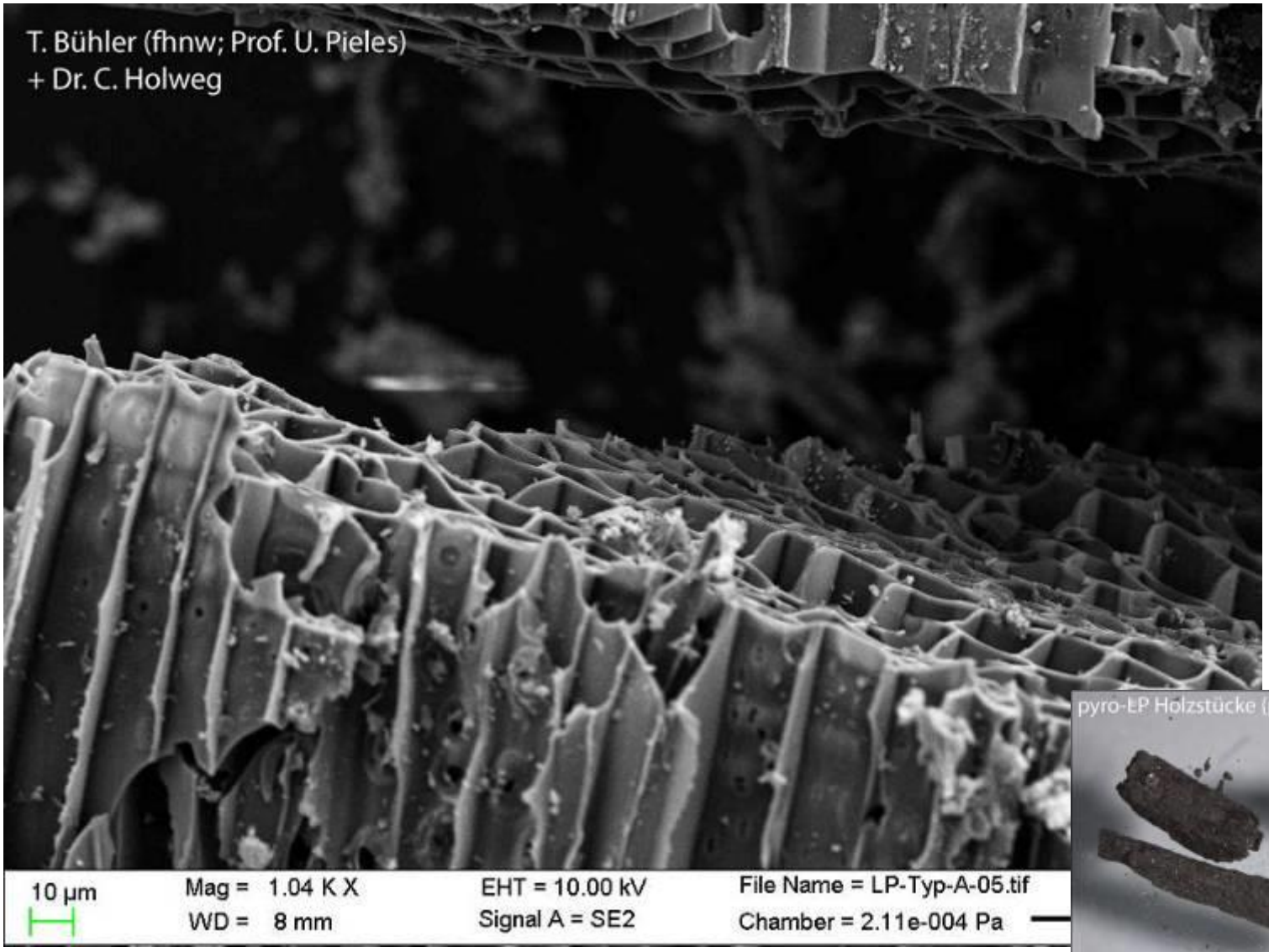
Stable Carbon (fixed, laticed carbon) Carbon Backbone

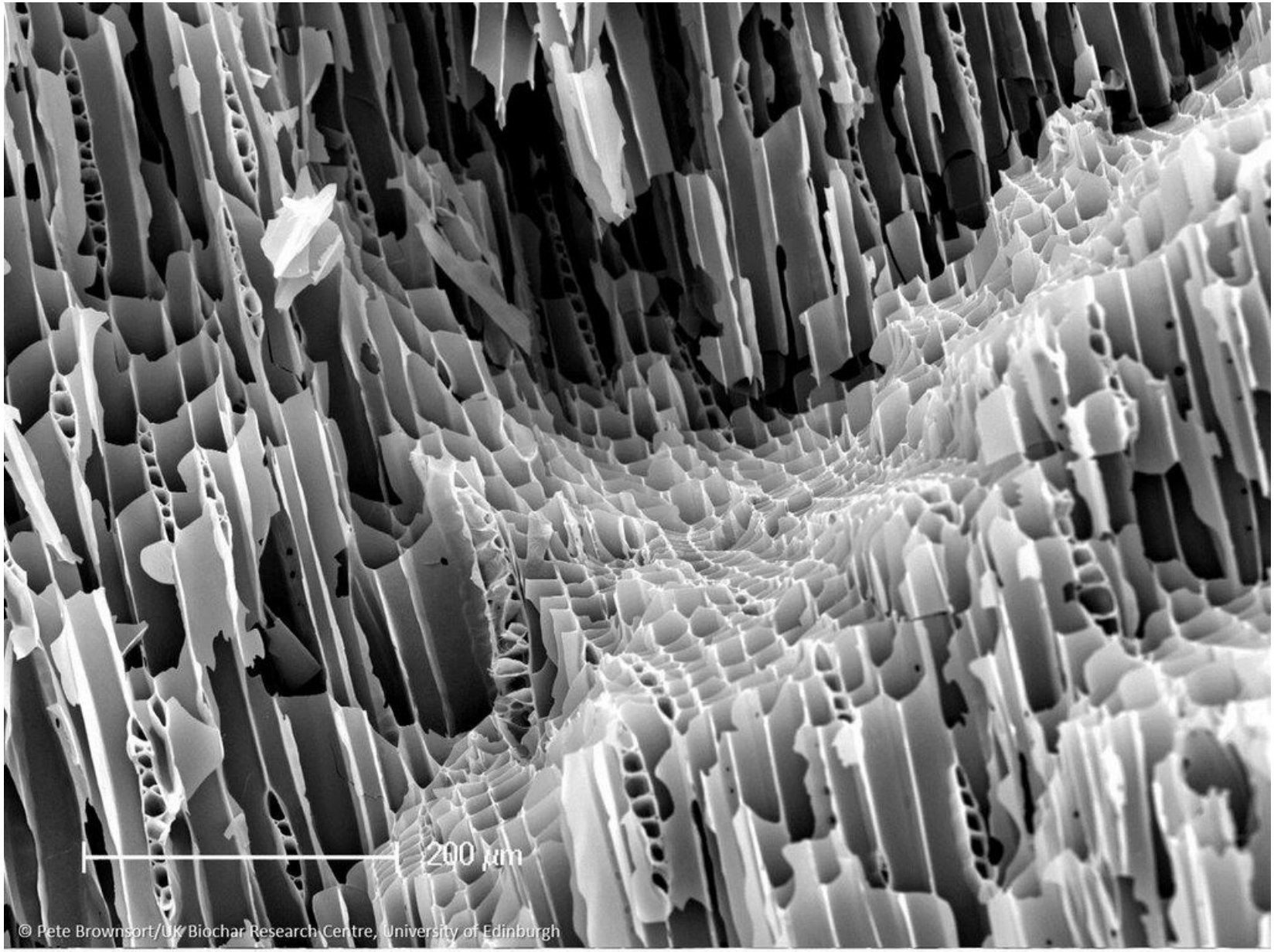


Schimmelpfennig & Glaser 2012

REM-picture of a fraction of biochar

Biomasse: green clipings – Swiss Biochar




200 µm
© Pete Brownsort/UK Biochar Research Centre, University of Edinburgh

Volatile Organic Carbon (10min at 150°C)

BC#	Parent material	Unit	PT (°C)	pH	SA ($m^2\ g^{-1}$)	C	N	O	H	H_2O	VM	Ash
Fast pyrolysis biochar												
1	Macadamia shells	F1	n/a	6.2	6.9	84.3	0.6	1.5	2.3	9.5	15.2	1.7
2	Oak hardwood sawdust	F2	500	8.0	46	61.8	0.21	2.3	0.6	80.7	5.0	15.8
3	Macadamia shells	F3	650	6.9	0.45	71.0	0.88	1.2	2.5	5.0	19.5	20.4
Slow pyrolysis biochar												
4	Corn stover	SP1	515	9.5	4.4	45.0	0.5	1.0	1.7	11.5	30.9	55.0
5	Pine wood chip	SP2	465	6.8	0.1	75.0	0.3	9.0	3.4	55.0	34.9	6.0
6	Peanut hulls	SP2	481	8.0	1.0	59.0	2.7	12.0	2.3	72.0	5.3	15.0
7	Corn stover	SP3	500	8.9	4.2	25.0	0.6	5.0	1.1	9.1	41.3	69.0
8	Corn stover	SP2	410	n/a	2.2	42.0	1.0	11.0	1.8	4.1	n/a	54.0
9	Pine wood chip	SP2	465	6.8	0.2	71.0	0.2	11.0	3.3	12.0	72.3	9.0
10	Peanut hulls	SP2	481	5.1	286	60.0	0.9	10	1.1	5.2	n/a	15.0
11	Corn stover	SP4	505	10.0	17.3	46.0	1.2	4.0	1.5	28.0	13.8	54.0
12	Coconut shell	SP1	550	8.9	15.1	80.1	0.5	2.5	n/a	12.4	8.7	n/a
13	Distillers grain	SP5	350	6.8	0.3	67.4	7.4	6.5	4.7	1.8	43.9	11.3
14	Distillers grain	SP5	400	6.9	0.3	68.1	7.3	5.9	4.2	2.0	36.9	11.7
15	Corn cob	SP5	350	8.7	<0.1	76.5	0.7	12.9	4.2	2.9	32.2	2.8
16	Corn cob	SP5	400	9.0	<0.1	80.1	0.6	8.8	3.7	3.1	24	3.7
17	Wood waste	SP6	400	6.9	3.5	76.9	0.8	11.5	3.6	3.7	25.8	3.5
18	Wood waste	SP6	450	8.4	26.8	77.9	0.7	11	3.1	3.6	22.8	3.6
19	Wood waste + composting	SP7	465	8.6	63.5	43.0	2.2	n/a	n/a	11.4	32.3	n/a
20	Wood chip (pellet)	SP8	650	9.8	177.2	69.3	0.2	17.7	1.2	5.6	11.7	6.0
21	Oak hardwood	SP9	538	9.8	33.7	53.4	0.4	9.8	2.6	6.3	32.5	27.1
22	Wood waste	SP10	500	5.0	66.3	68.7	0.1	19.9	3.3	3.3	33.6	4.6
23	Oak hardwood	SP11	540	6.6	n/a	73.3	0.3	n/a	n/a	1.7	n/a	2.4
24	Oak hardwood	SP12	n/a	8.5	106.3	90.1	0.3	4.5	2.8	1.3	15	1.0
25	Pine wood chip	SP13	500	7.2	n/a	87.2	0.43	6.44	3.6	3.24	45.8	2.3
26	Sugar cane bagasse	SP15	350	5.0	n/a	75.2	0.66	15.8	4.6	3.42	39.2	3.6
27	Pine wood chip	SP15	350	4.6	n/a	74.7	0.45	18.4	5.0	2.74	45.2	1.5
28	Swine manure	SP15	350	8.1	0.92	50.8	3.74	6.64	5.0	2.31	46.2	32.3

Spokas et al. 2011

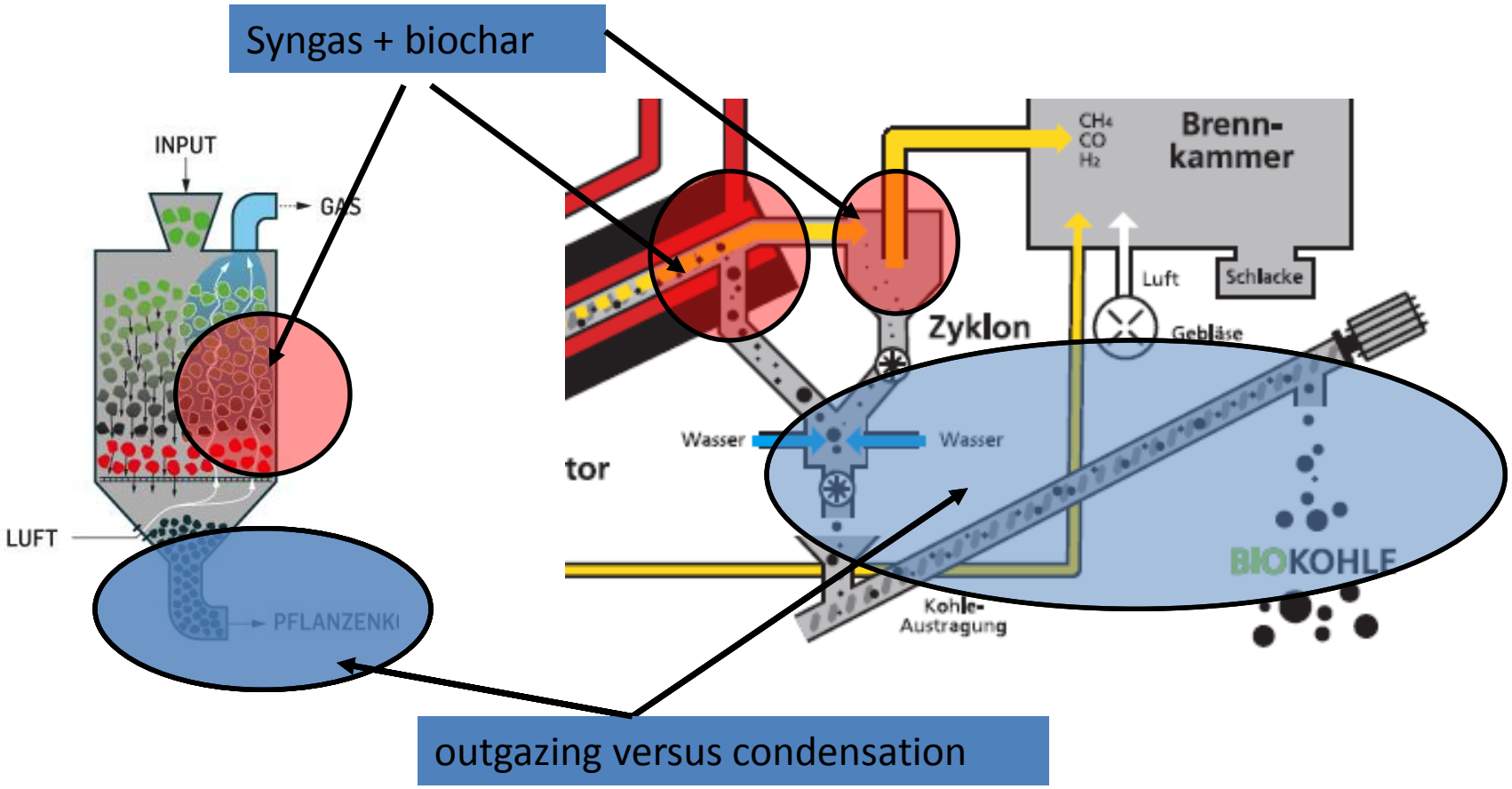
Volatile Organic Carbon at 900°C

	Proximate analysis*			
Sample	Fixed C%	Volatile Matter%	Ash%	Total%
Pine 350-5	47.8	50.8	1.4	100
Pine 450-5	62.2	34.9	2.9	100
Pine 550-5	73.9	22.0	4.2	100.1
Pine 650-5	78.9	15.2	5.9	100
Pine 350-100	58.0	38.7	3.4	100.1
Pine 450-100	63.6	33.0	3.4	100
Pine 550-100	77.7	21.6	0.7	100
Pine 650-100	81.6	13.4	5.0	100
RH 350-5	32.4	30.3	37.3	100
RH 450-5	36.4	19.1	44.5	100
RH 550-5	38.5	14.6	46.9	100
RH 650-5	40.5	9.3	50.3	100.1
RH 350-100	39.3	20.7	40.1	100.1
RH 450-100	35.0	19.4	45.6	100
RH 550-100	37.0	11.3	51.7	100
RH 650-100	38.6	11.3	50.0	99.9
WS 350-5	49.5	39.6	10.9	100
WS 450-5	59.2	23.2	17.6	100
WS 550-5	62.8	17.2	20.0	100
WS 650-5	64.4	14.2	21.3	99.9

Table 2 Proximate analysis data for biochar samples produced from selected feedstock at four temperatures (350, 450, 550 and 650°C) and two heating rates (5 and 100°C min^{-1})

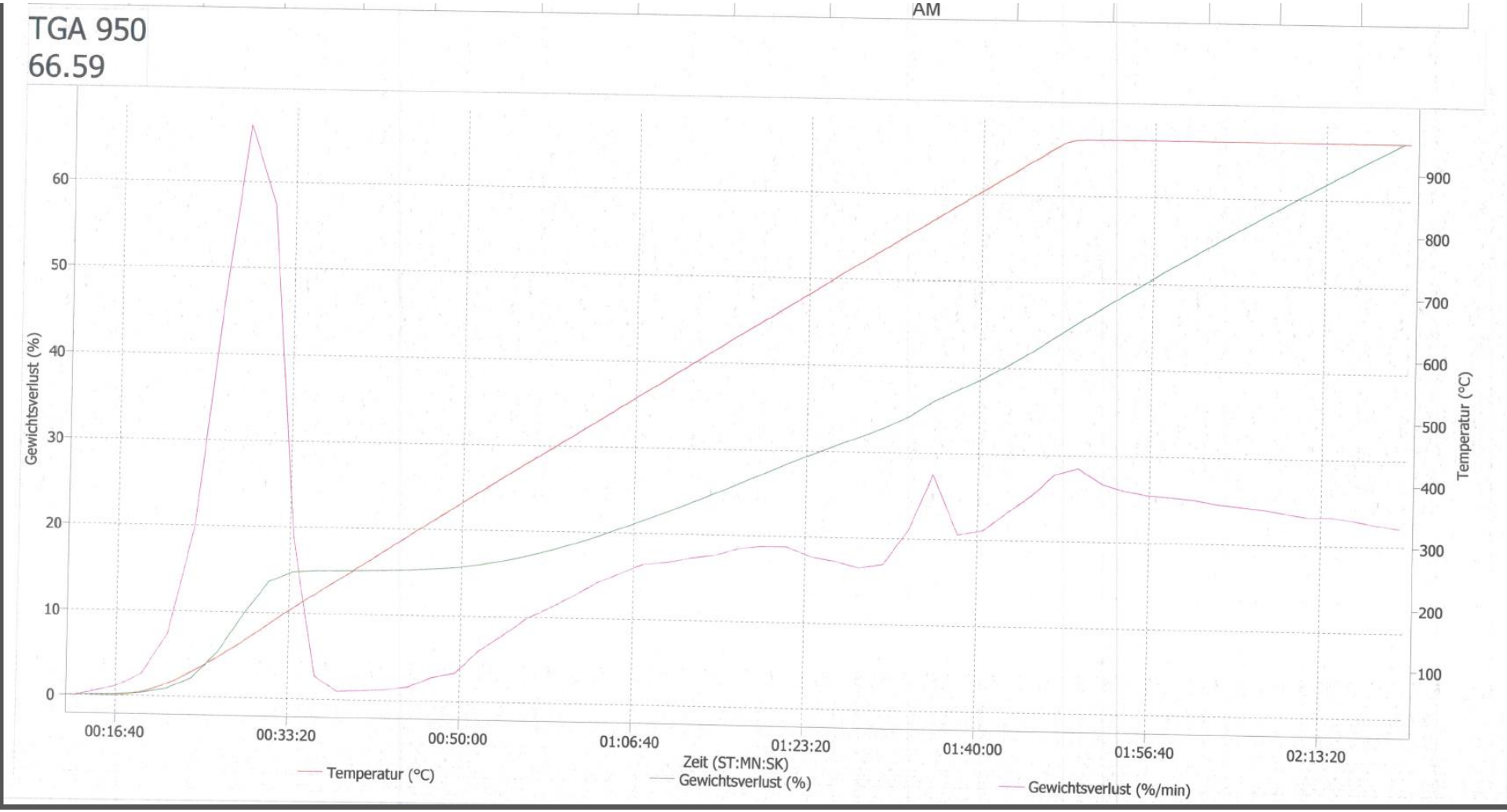
Crombie et al. 2013

Syngas – Biochar - Condensates

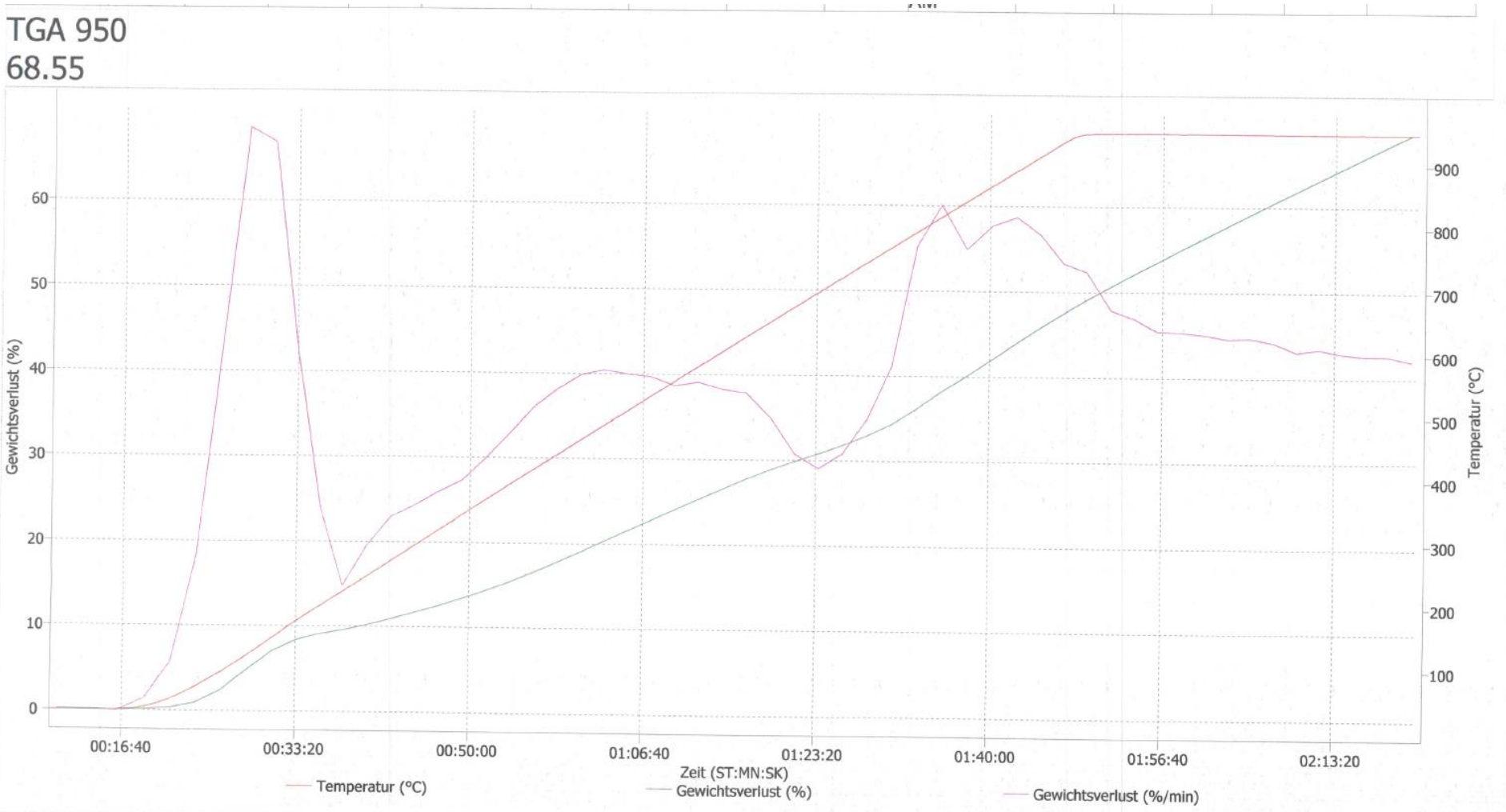


equal & continuous syngas flow
for whole batch

thermographique analysis (woodchar)



TGA olive pomeces



VOCs & DOCs

- **Chemical classes**
- Alcohols
- Acides
- Amines
- Aldehydes
- Ketones
- Ph
- Li
- Di
- Su
- N-
- Ca
- Aliphatics
- Fatty acids
- Furans
- PCB
- PAH
- …..

Some known mo toxic molecules

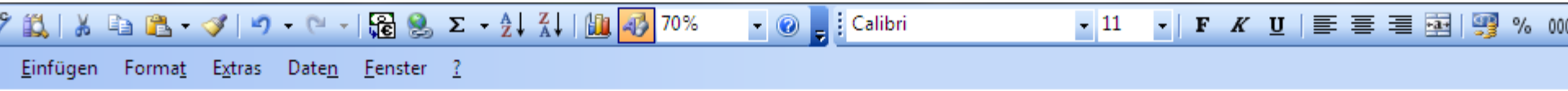
Glycol
Hydoxy-propionic
Butryric acids

Benzene
Trichlorethene
Toluene…..

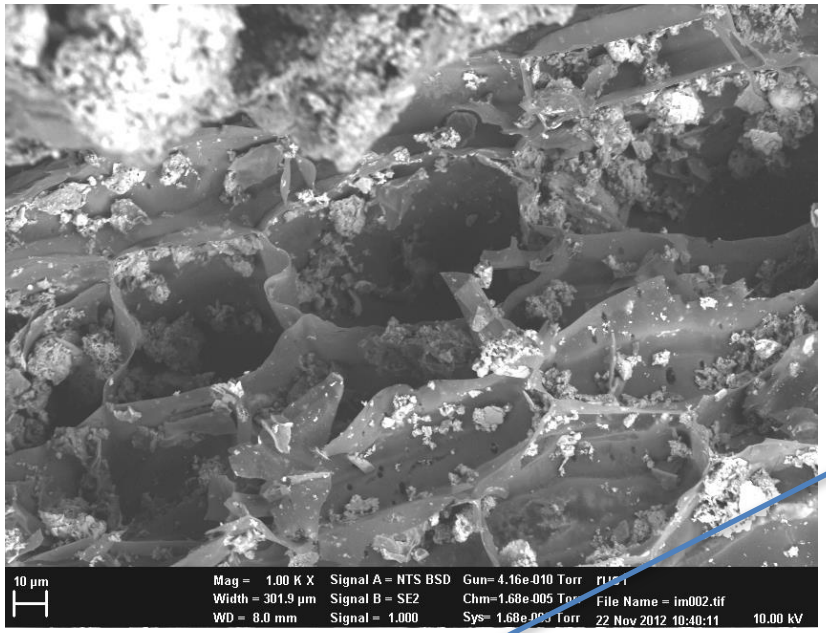
More than 1500 carbonaceous molecules

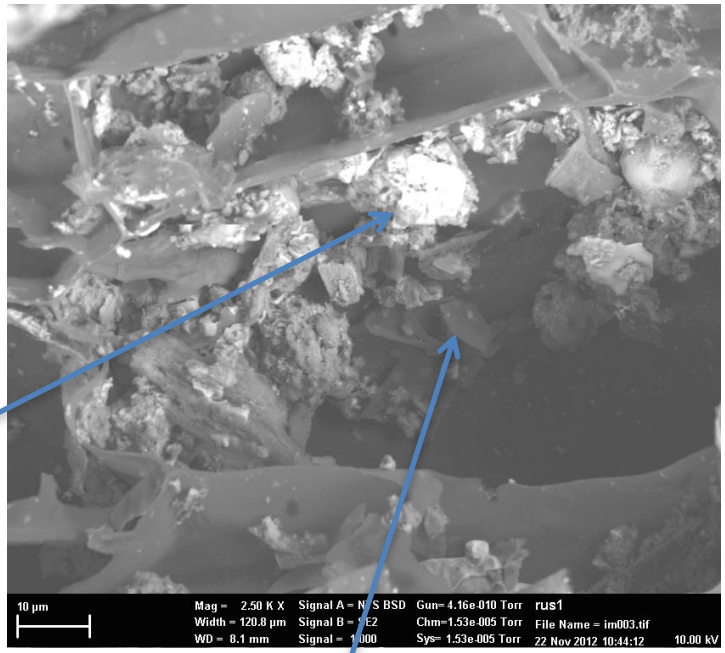
Graber & Elad 2013

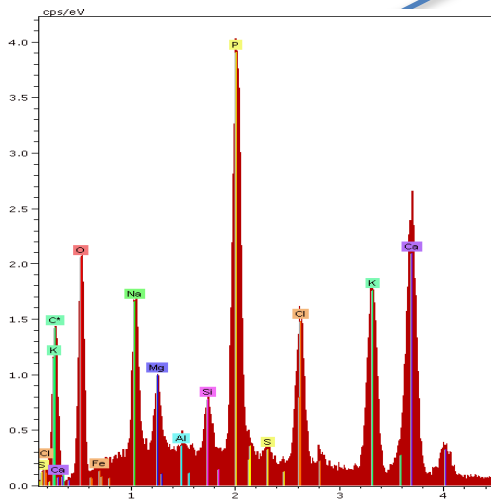
47 trace elements analysed in all biochar samples



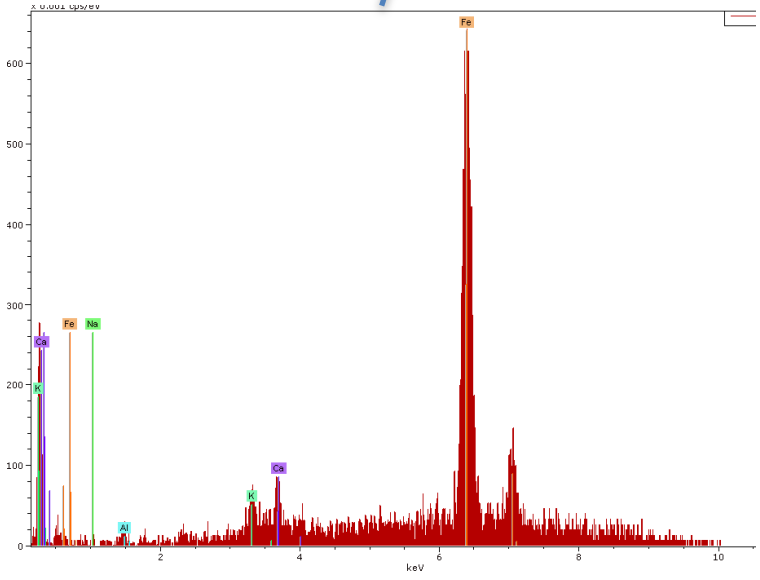
B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
detection limit	Al	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Dy	Er	Eu	Fe	Gd
Biochar (ppm)	5	0.2	0.0005	0.0007	12	0.0002	0.006	0.005	0.13	0.009	0.203	0.0004	0.0002	0.0001	3	0.0005
plant (ppm)	3	0.2	0.0003	0.0005	9	0.0001	0.005	0.004	0.09	0.006	0.145	0.0003	0.0002	0.0001	2	0.0004
soil (ppm)	45	2.1	0.0048	0.0069	120	0.0015	0.064	0.05	1.28	0.088	2.028	0.0045	0.0025	0.0014	26	0.0050
number																
1	62259	56	1.333	4.7390	20484	1.511	17.66	5.01	31.91	1.591	128.33	0.750	0.454	0.229	27349	1.094
2	26680	315	1.288	0.1692	24849	0.491	26.70	6.80	50.73	3.553	30.57	1.788	1.029	0.480	15561	2.094
3	6684	278	0.215	0.0637	13568	0.377	8.70	1.53	9.46	0.583	15.76	0.453	0.261	0.084	12261	0.597
4	15103	311	0.792	0.1154	14676	0.635	18.21	2.99	12.29	1.470	22.27	1.173	0.712	0.299	11560	1.421
5	5228	434	0.117	0.0110	21557	0.243	4.52	1.84	11.11	0.417	11.97	0.268	0.152	0.038	8351	0.370
6	3980	146	0.121	0.0067	19094	0.033	5.57	5.20	12.96	0.484	12.17	0.291	0.166	0.069	2663	0.417
7	4104	39	0.047	0.0176	2781	0.060	1.52	0.25	5.69	0.037	2.24	0.097	0.059	0.024	1460	0.115
8	6121	216	0.181	0.0608	15430	0.498	4.92	1.85	10.28	0.362	9.68	0.362	0.210	0.073	7927	0.434
9	35251	184	1.143	0.1487	66342	0.248	35.04	7.77	16.16	3.300	26.69	2.143	1.239	0.568	19504	2.746
10	473	27	0.020	0.0076	4131	0.102	0.37	0.33	2.61	0.119	31.65	0.021	0.011	0.008	1037	0.028
11	83	12	0.007	0.0022	1179	0.188	0.13	0.11	0.24	0.016	1.49	0.008	0.005	0.002	244	0.009
12	202	39	0.011	0.0019	5817	0.047	0.35	0.32	0.66	0.039	7.16	0.019	0.010	0.005	262	0.027
13	87	16	0.004	0.0024	4017	0.080	0.10	0.07	0.06	0.012	1.63	0.008	0.005	0.002	78	0.009
14	4590	126	0.129	0.0082	58274	0.060	4.78	1.55	20.39	0.495	16.37	0.315	0.172	0.073	2802	0.412
15	1567	35	0.039	0.0280	18514	0.098	1.78	0.46	1.47	0.176	18.76	0.125	0.073	0.030	1035	0.144
17	7370	119	0.224	0.0187	69324	0.017	9.19	1.88	44.83	0.792	68.63	0.564	0.314	0.146	5413	0.753
16	33350	247	1.083	0.2367	41412	0.422	34.33	6.60	16.77	3.334	34.89	2.528	1.457	0.623	18455	2.747





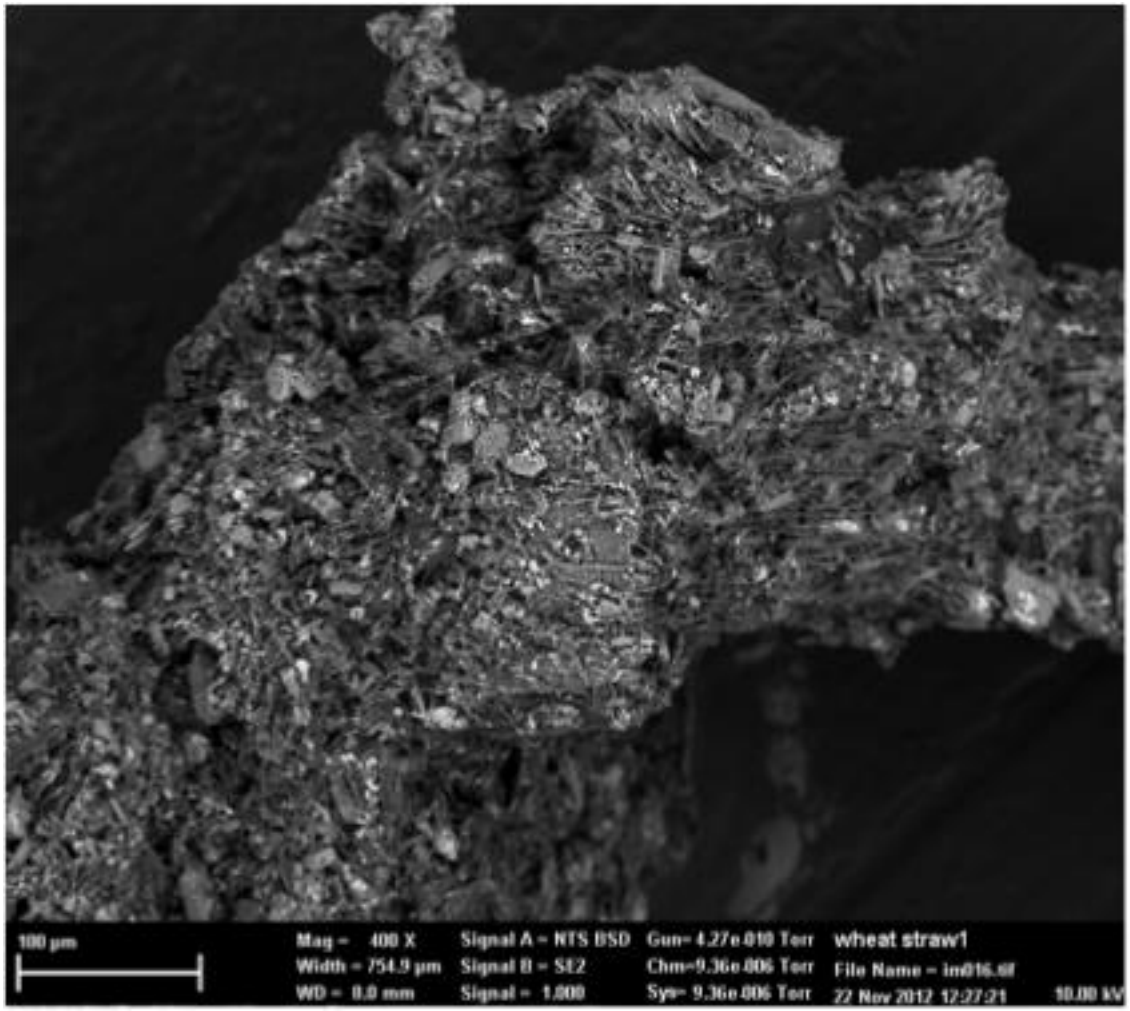


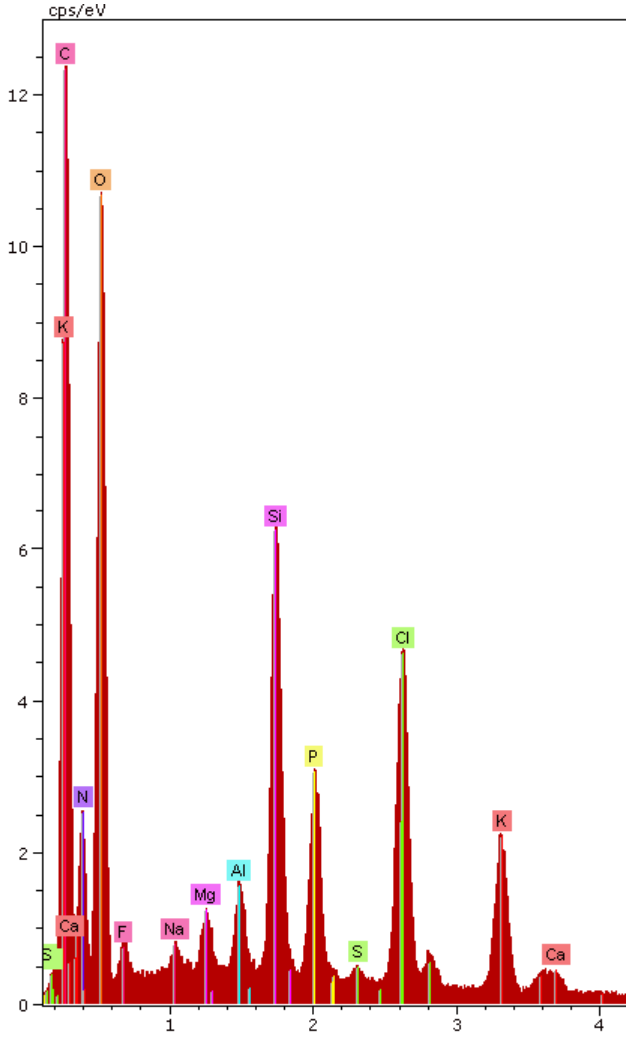
Micron Size Ca P phase



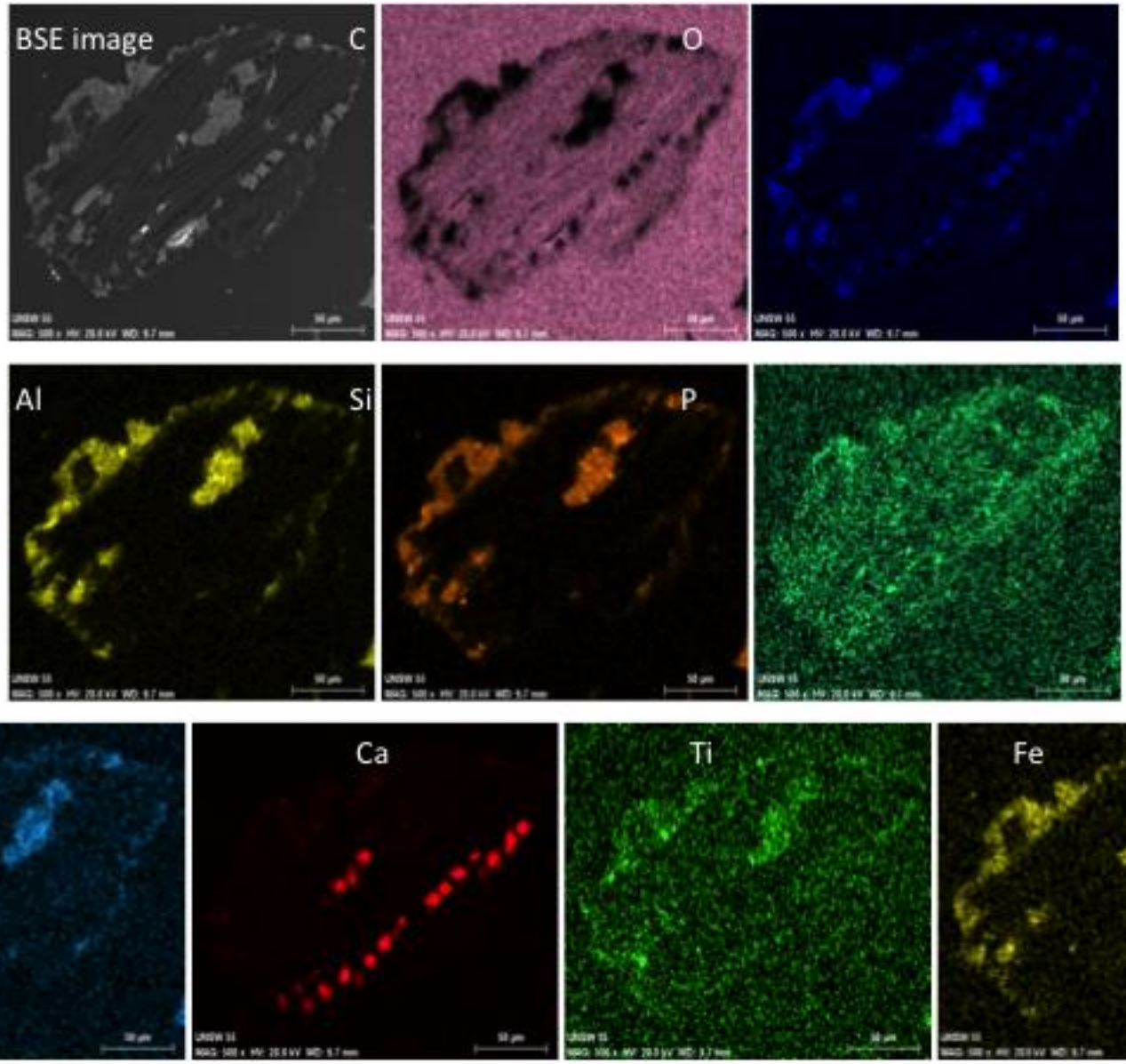
High Fe content in the p

wheat-straw-char with NPK-minerals



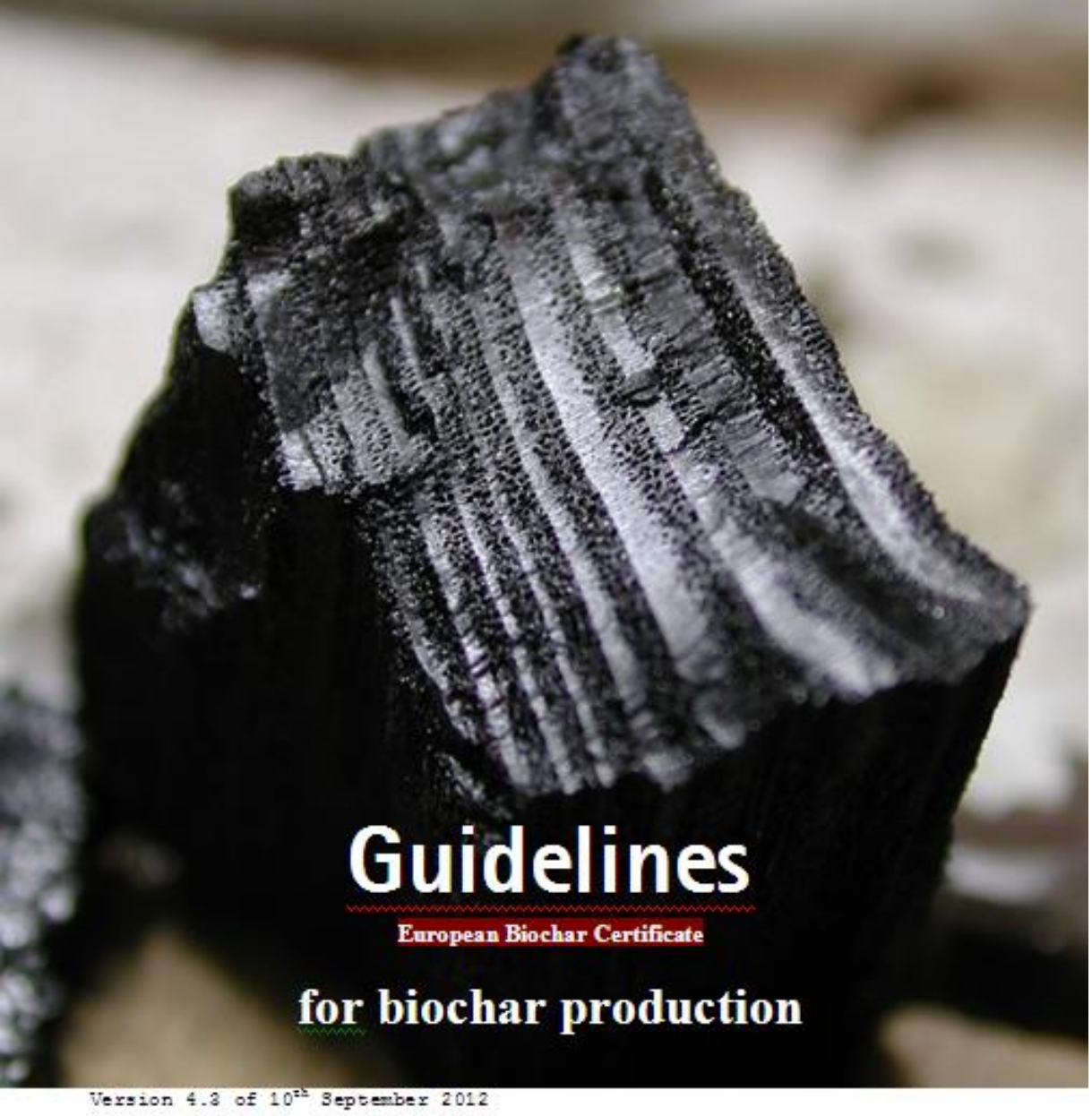


Biochar Mineral Complex



Technical Definition of Biochar

	EBC	IBI
C-content	> 50 %	> 60% / > 40 / > 10
H/Corg	< 0.7	< 0.7
Contaminents (HM)	Pb, Ni, Cr, Hg, Zn, Cu, Cd	Pb, Ni, Cr, Hg, Zn, Cu, Cd
Org. Contaminents	PAH, PCB, Dioxines, Furanes	PAH, PCB, Dioxines, Furanes
nutrients	declaration	declaration
BC, VOC, pH, BET, WHC	declaration	declaration
feedstock	positive liste	any
production	positive energy balance	any



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Schmidt HP,(Delinat Institute), Abiven S (University Zurich), Kammann C (University Giessen), Glaser B (University Halle), Bucheli T (ART Reckenholz), Haren Rv (Kiemkracht), Starmann I (InKnowCom), Leifeld J (ART Reckenholz)

Pillars of the EBC-Certificate

www.european-biochar.org

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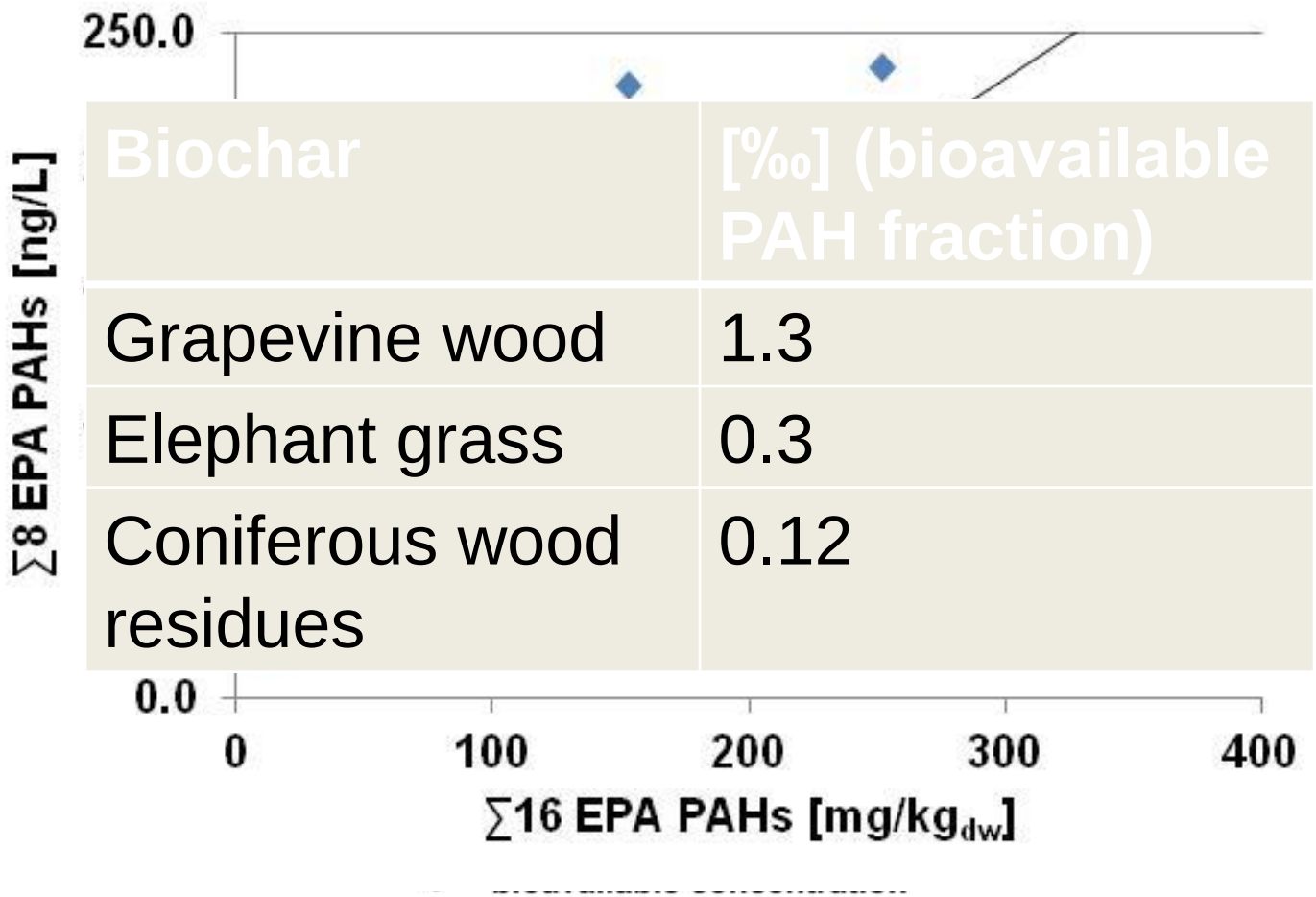
1. Sustainable provision and production of biomass **feedstock – (positive list)**
2. Energy efficient, low emission **pyrolysis** technique
3. **Biochar characterization** – key parameters
4. **Biochar quality** – low contaminant level
5. Low hazard **use and application** of biochar

ID	Measure	Analysis value	basic	premium	Annexe *	Method	Remarks, thresholds
Biomass used							
301	Only biomasses listed in the positive list were used?		☐				
302	All non-organic waste was removed		☐				
303	The biomasses were not contaminated by paint, solvents or other synthetic materials.		☐				
304	When using primary agricultural products, it is guaranteed that these were grown in a sustainable manner.			☐			
305	No forestry products were used from forests not managed in a sustainable manner		☐				
306	Biomasses used were not transported to the pyrolysis plant over distances greater than 80 km			☐			exemption
Biochar properties - test results per batch							
501	Biochar carbon content in %	_____	☐		x	☐	Threshold: 50%
502	Black carbon content in % of the overall carbon content	_____					Guideline: 10 - 40% (not mandatory)
503	H/Corg ratio of the biochar	_____	☐			☐	Threshold: 0.7
504	O/Corg ratio of the biochar	_____					Guideline: 0.4
505	An analysis of the nutrients contained in the biochar is available and attached to the delivery documents?		☐		*		
506.01	Lead concentration in g/t	_____	☐	☐		☐	basic: 150 g/ t_____ premium: 120 g/t
506.02	Cadmium concentration in g/t	_____	☐	☐		☐	basic: 1.5 g/t _____ premium: 1 g/t
506.03	Copper concentration in g/t	_____	☐			☐	Threshold: 100 g/t
506.04	Nickel concentration in g/t	_____	☐	☐		☐	basic: 50 g/t _____ premium: 30 g/t (exemption)
506.05	Mercury concentration in g/t	_____	☐			☐	Threshold: 1 g/t
506.06	Zinc concentration in g/t	_____	☐	☐		☐	basic: 400 g/t _____ premium: 300 g/t
506.07	Chromium concentration in g/t	_____	☐	☐		☐	basic: 90 g/t _____ premium: 80 g/t
507,01	pH value	_____	☐				

Just an example: PAH threshold

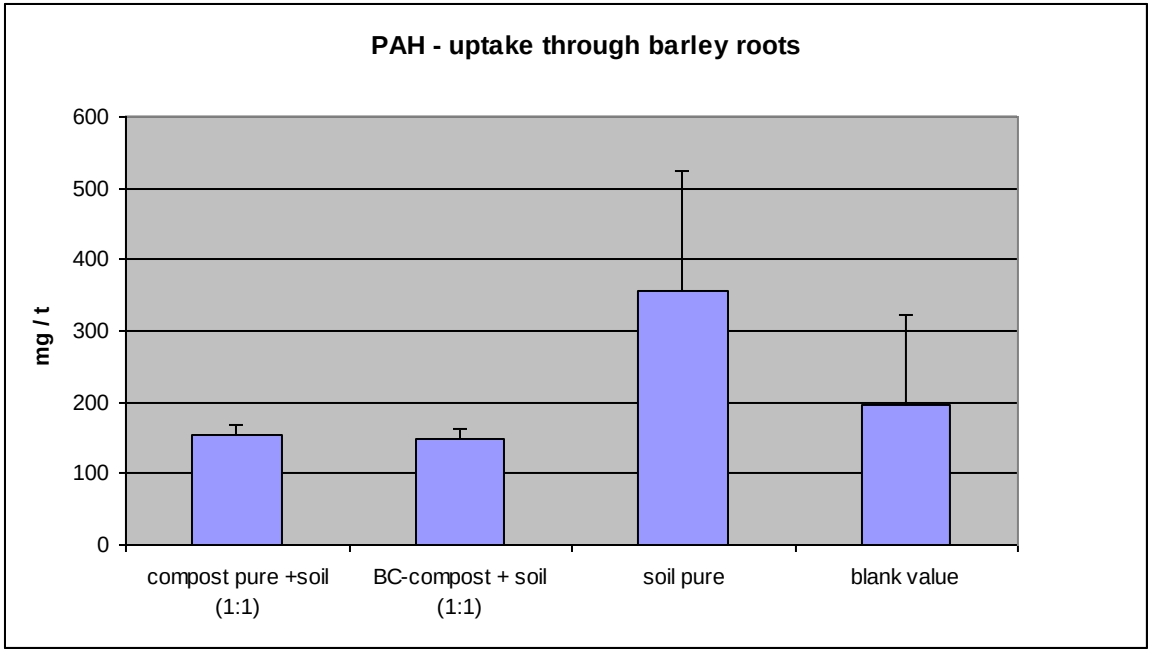
5.8 The biochar's PAH content (sum of the EPA's 16 priority pollutants) must be under 12 mg/kg DM for *basic* grade and under 4 mg/kg DM for *premium* grade biochar.

Total and bioavailable PAHs



Biochar	[‰] (bioavailable PAH fraction)
Grapevine wood	1.3
Elephant grass	0.3
Coniferous wood residues	0.12

PAH uptake by plant roots

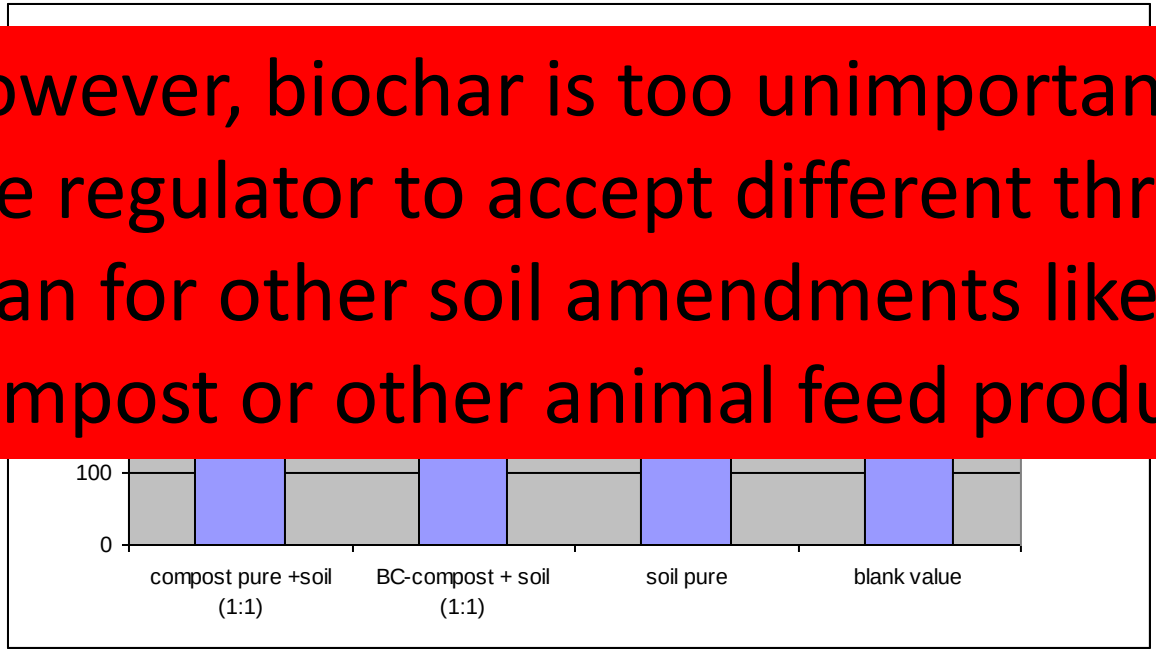


30% biochar in compost

equivalent to 900 t biochar / ha

PAH in biochar 9100 mg / t

PAH uptake by plant roots



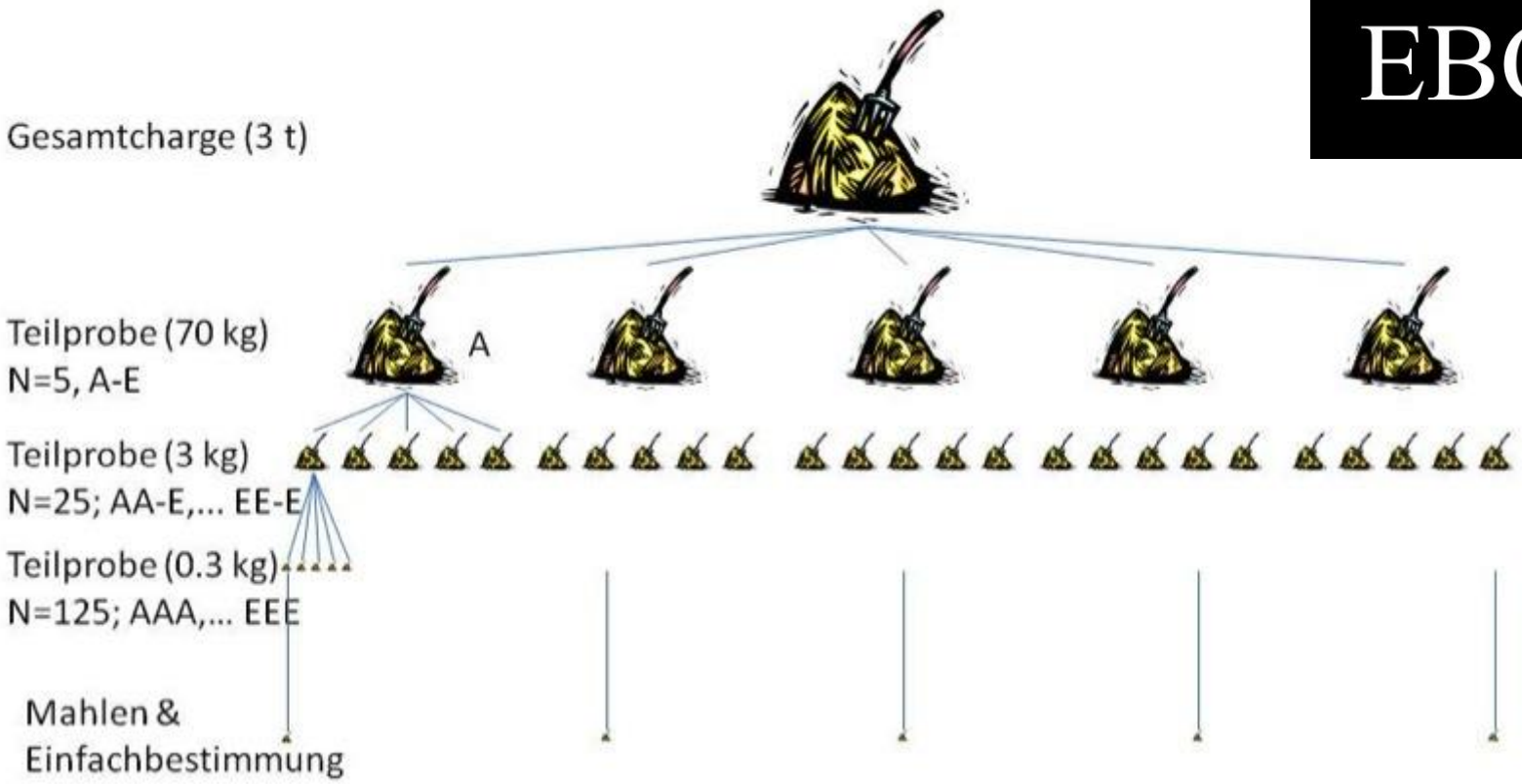
However, biochar is too unimportant for the regulator to accept different thresholds than for other soil amendments like compost or other animal feed products.

30% biochar in compost

equivalent to 900 t biochar / ha

PAH in biochar 9100 mg / t

How to take samples ?



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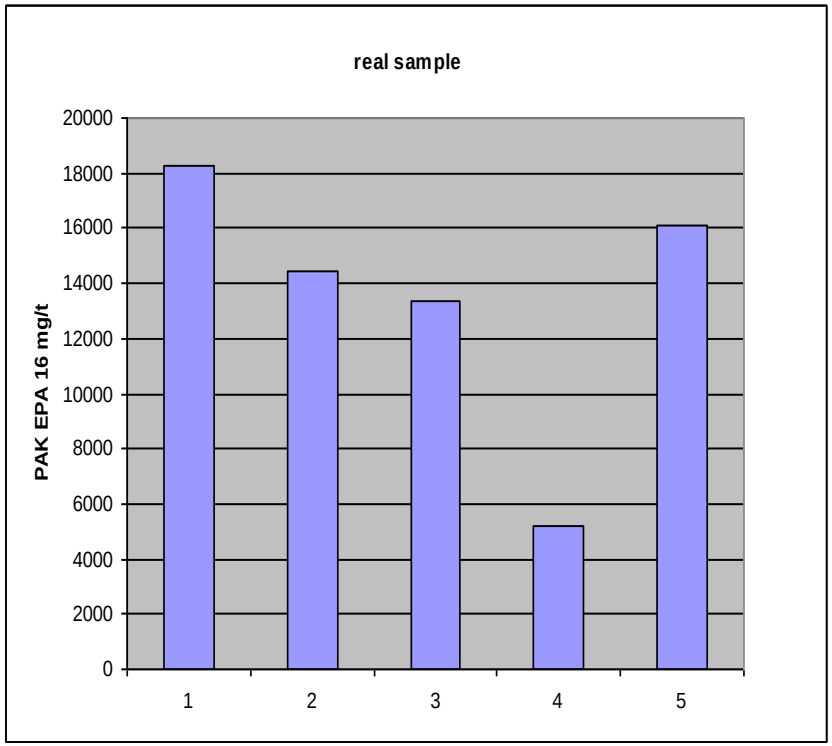
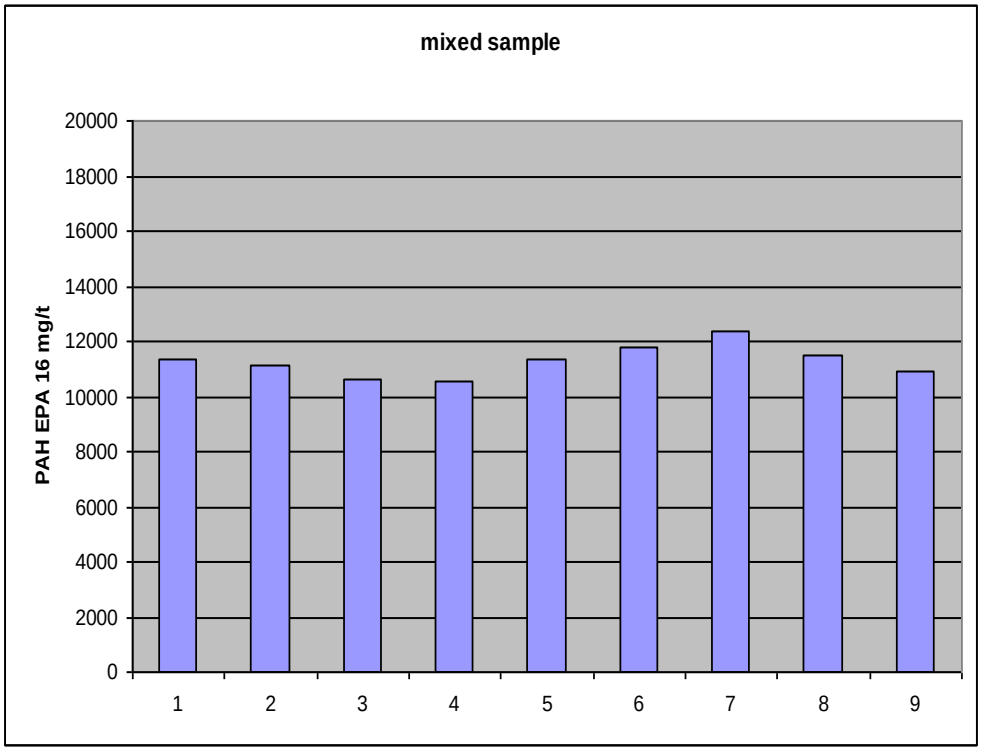
PAH values in real and mixed samples

Random sampling 120 g



Mixed sampling AAA - 3kg



Sample precision: 0.041

Pillars of the EBC-Certificate

- Independent on-site control (governmental accredited: q.inspecta)
- Independent sampling
- Unified analytical methods (accredited labs)

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EUROFINS Umwelt Ost GmbH
Ndl. Freiberg

Prüfverfahren: Bestimmung:	
der Schüttdichte	DIN 51705
Probenvorbereitung - Probenteilung fester Brennstoffe	DIN 51701-3
des Wassergehaltes und der Analysenfeuchtigkeit (thermisches Verfahren)	DIN 51718; TGA 701 D4C
des Aschegehaltes	analog DIN 51719; TGA 701 D4C
des Brennwertes und Berechnung des Heizwertes Verfahren mit adiabatischem Mantel	DIN 51900, Teil 1 und Teil 3; Kalorimetersystem C 4000 A/ C 5000 DUO
des Gesamtgehaltes an Kohlenstoff, Wasserstoff und Stickstoff instrumentelle Methoden	DIN 51732; Analysenautomat Leco TRU SPEC CHN
des Schwefelgehaltes (Gesamtschwefel) instrumentelle Methoden	DIN 51724 Teil 3; Analysenautomat SC-144 DR
der Elementarzusammensetzung und Berechnung des Sauerstoffgehaltes	DIN 51733
des Gehaltes an Carbonat-Kohlenstoffdioxid	DIN 51726
der polyzyklischen aromatischen Kohlenwasserstoffe (PAK) mittels GC/MS	DIN EN 15527
von Polychlorierten Dibenzodioxinen (PCDD) und Dibenzofuranen (PCDF) und von polychlorierten Biphenylen (PCB) (FF)	AIR DF 100, HRMS
des pH-Wertes	analog DIN ISO 10390
der spezifischen elektrischen Leitfähigkeit	DIN ISO 11265
Salzgehalt - Leitfähigkeit des wässrigen Auszugs (N)	nach VDLUFA-Methodenbuch Bd. I, A 10.1.1
Probenahme und Probenvorbereitung an festen Brennstoffen zur Bestimmung der Gehalte an Spurenelementen	DIN 22022-1
von 62 Elementen durch Anwendung induktiv gekoppelter Plasma-Massenspektrometrie (ICP-MS)	DIN EN ISO 17294-2 (E 29)
von Quecksilber (Hg)	DIN EN 1483 (E 12)
der chemischen Zusammensetzung von Brennstoffaschen [und Schlacken]	DIN 51729, Teil 1, Teil 11 (Aufschluss, Messung: ICP)
von Ag, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Si, Sn, Sr, Ti, W, Zn, Zr	DIN EN ISO 11885 (E 22)

Methodes

ring trials

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Pillars of the EBC-Certificate

- Independent on-site control (governmental approved: q.inspecta)
- Independent sampling
- Unified analytical methods (authorized labs)
- Regular revision of standard by the scientific board of the EBC
- Legally backed-up
- Economical viable
- Close to practice, understandable
- Voluntary industrial standard

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Safeguarding Biochar quality

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- Conferences & News
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- Ithaka Journal

The European Biochar Foundation

The European biochar foundation has the objective to promote sustainable biochar production and sustainable biochar application for environmental, agricultural and industrial use in Europe and the rest of the world.

The European biochar foundation achieves its objective by

1. Supporting and stimulating Biochar applied research and development in the domains of environment, agriculture, industrial applications, biochar production technologies and biochar feedstocks.
2. Promoting sustainable production and application of biochar by biochar knowledge dissemination by organising conferences, courses, masterclasses, summer schools workshops, and by the use of media (print and digital media) and any other means
3. Advising authorities, enterprises, non-governmental organizations, educational institutes and biochar feedstock producers, biochar producers and biochar end-users
4. Developing and implementing biochar certification schemes for sustainable biochar production and biochar application
5. Developing best practice advices and directives for the use of biochar in agriculture, for climate mitigation and optimising nutrient cycles
6. Controlling biochar certification schemes by auditing and certification and by authorizing organizations to certify biochar feedstock, biochar production and biochar application.
7. Participating in (inter)national cooperations, enterprises, foundations and other organizations
8. Taking and protecting Intellectual Property
9. And any other legal means

The European Biochar Foundation will be founded on 29th of August 2012.

EBC foundation | certificate

European Biochar Foundation

non for profit foundation

Supported by

- **EU-INTERREG IVb NSR Biochar and**
- **EU COST ACTION TD 1107**

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The Foundation has as its object:

Promoting sustainable biochar production and sustainable biochar applications for environmental, agricultural and industrial use in Europe and the rest of the world;

End of Waste (EoW)

- charcoal made from untreated forest wood can be used in agriculture
- charcoal made from grape pomaces, green clippings, straw is considered as waste and can‘t be used in agriculture
- It has to be defined which biomass and when it is charcoal / biochar

EXAMPLE 2 – A BUSINESS TOOK CONTAMINATED BIOMASS AND MADE CHARCOAL. THEY THEN BLENDED THE CHARCOAL WITH SAWDUST AND MADE BRIQUETTE'S. EOW WAS GRANTED AS THIS MATERIAL WAS SOLD AS AN ORGANIC COAL LIKE SUBSTITUTE, USED IN THE SAME WAY AND WITH NO FURTHER ADVERSE EFFECTS TO THE ENVIRONMENT. HTTP://A0768B4A8A31E106D8B0-50DC802554EB38A24458B98FF72D550B.R19.CF3.RACKCDN.COM/LIT_6700_ED6A43.PDF

R.E.A.C.H.

EXEMPTIONS CONSUMPTION.

- Tittle 1, Chapter 2, article 2. Section 5.
- The provisions of Titles II, V, VI and VII shall not apply to the extent that a substance is used:
- (b) in food or feeding stuffs in accordance with Regulation (EC) No 178/2002 including use:
- (i) as a food additive in foodstuffs within the scope of Council Directive 89/107/EEC of 21 December 1988 on the approximation of the laws of the Member States concerning food additives authorised for use in foodstuffs intended for human consumption;
- (iii) as an additive in feeding stuffs within the scope of Regulation (EC) No 1831/2003 of the European Parliament and of the Council of 22 September 2003 on additives for use in animal nutrition;
- (iv) in animal nutrition within the scope of Council Directive 82/471/EEC of 30 June 1982 concerning certain products used in animal nutrition.

R.E.A.C.H.

EXEMPTIONS
WASTE.

- Tittle 1, Chapter 2, article 2.
  Section 7.
- The following shall be exempted from Titles II, V and VI:
- (d) substances, on their own, in preparations or in articles, which have been registered in accordance with Title II and which are recovered in the Community if:
- (i) the substance that results from the recovery process is the same as the substance that has been registered in accordance with Title II; and
  the information required by Articles 31 or 32 relating to the substance that has been registered in accordance with Title II is available to the establishment undertaking the recovery.

REACH

Annex V
EXEMTIONS FROM THE OBLIGATION TO REGISTER IN ACCORDANCE WITH ARTICLE 2

SUBSTANCES WHICH OCCUR IN NATURE: MEANS A NATURALLY OCCURRING SUBSTANCE AS SUCH, UN GRAVITATIONAL MEANS, BY DISSOLUTION IN WATER, BY FLOTATION, BY EXTRACTION WITH WATER, BY STEA EXTRACTED FROM AIR BY ANY MEANS;
NOT CHEMICALLY MODIFIED SUBSTANCE: MEANS A SUBSTANCE WHOSE CHEMICAL STRUCTURE REMAI TREATMENT, OR A PHYSICAL MINERALOGICAL TRANSFORMATION, FOR INSTANCE TO REMOVE IMPURITIES;

www.european-biochar.org

www.ithaka-journal.net

Biochar use, market and legislation in Europe

Hans-Peter Schmidt,
ithaka institute for organic carbon cycling, Switzerland

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