Potential of Biochar in Growing Media

Dr Munoo Prasad

Consultant

Irish Nursery Stock Conference October 24th 2018

BORD NA MÓNA

Naturally Driven

New Research in Additives

Biochar - climate saving growing media

Potential of Biochar in Growing Media

- Biochar Production
- Biochar Properties

Biochar Applications

Growing Trials – In House

– External

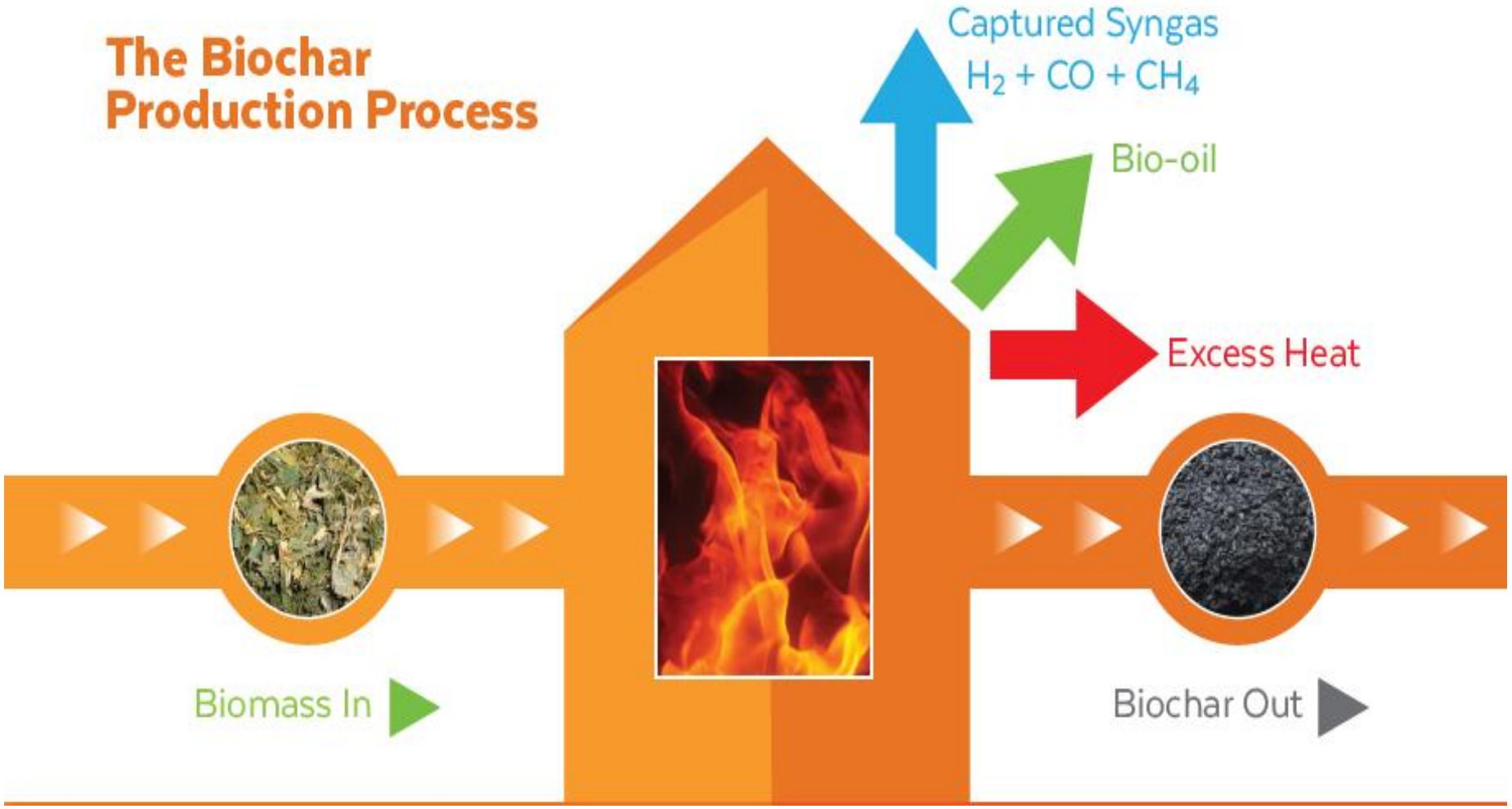
- Seedling Production
- Herbs/Tomatoes
- Nursery stock
- Green roof
- Disease Suppression

Environmental Benefits

- Greenhouse Gases

Conclusion

The Biochar Production Process



- **Biochar; a carbonaceous solid product of pyrolysis**
- **Few material that actively removes carbon from the atmosphere**
- **Suitable for a range of agricultural use e.g. animal feed, environmental e.g. filter and horticultural e.g. growing media**

- **Biochar Effect on plants can be Positive, Neutral and Detrimental**

- **Biochar production process can be tailored to form "Designer Compost" that has specific chemical and physical characteristics**

- **At this stage we do not know all the characteristics that is most suitable for use as a growing media**

Improves nutrient availability by increasing cation exchange capacity, captures nitrate

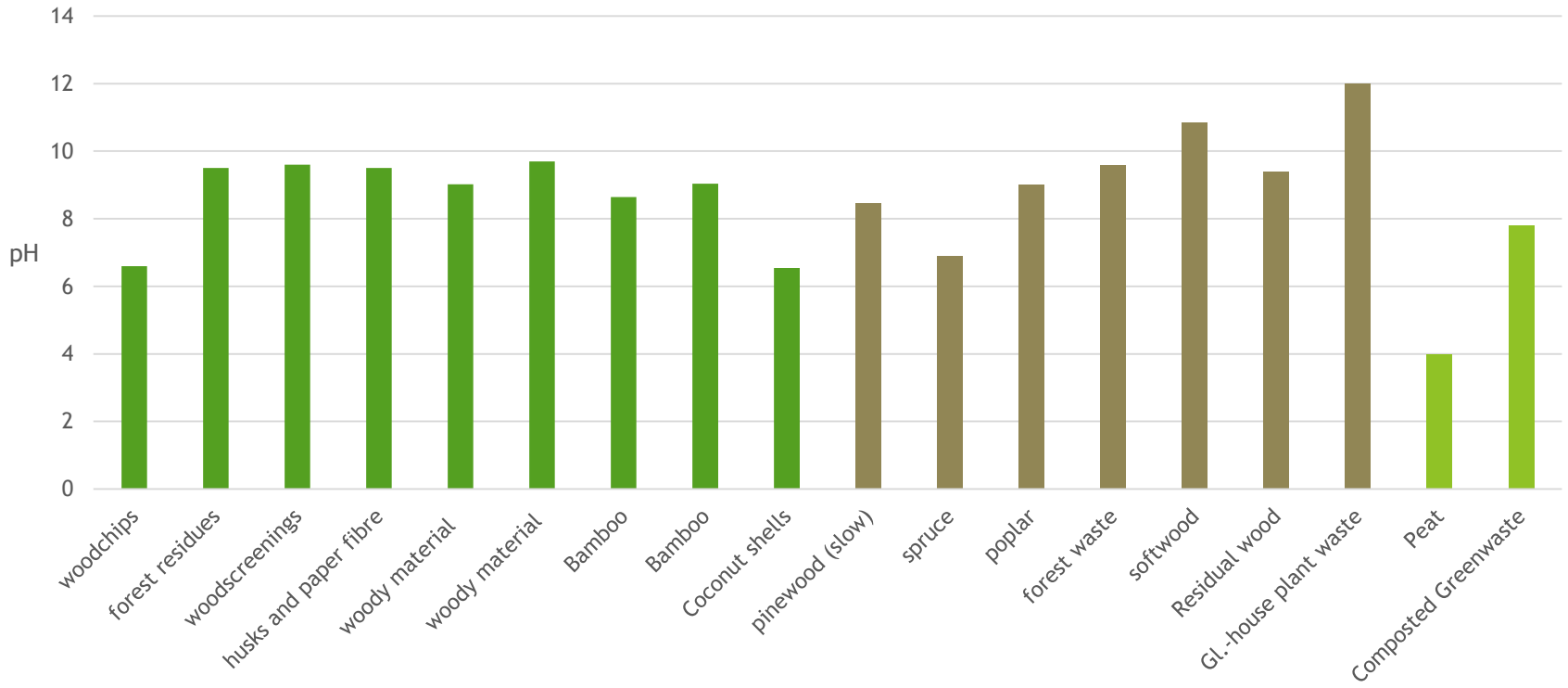
Physical properties/water retention, saturated hydraulic conductivity and aeration depending on particle size.

Increases pH

Increases physical and chemical stability

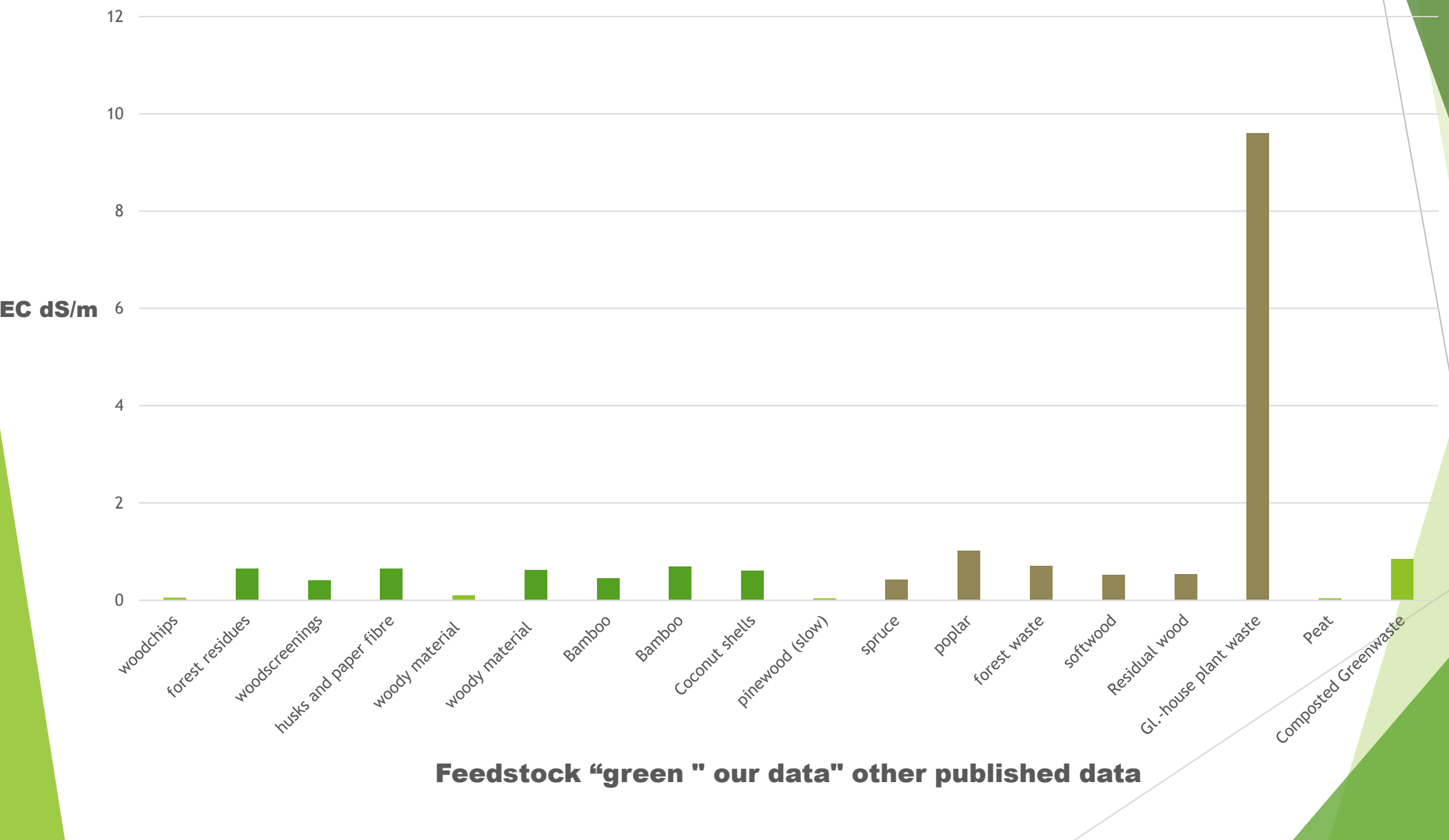
Fine dust- must be moistened before use

pH of various biochars destined for use as a component of growing media

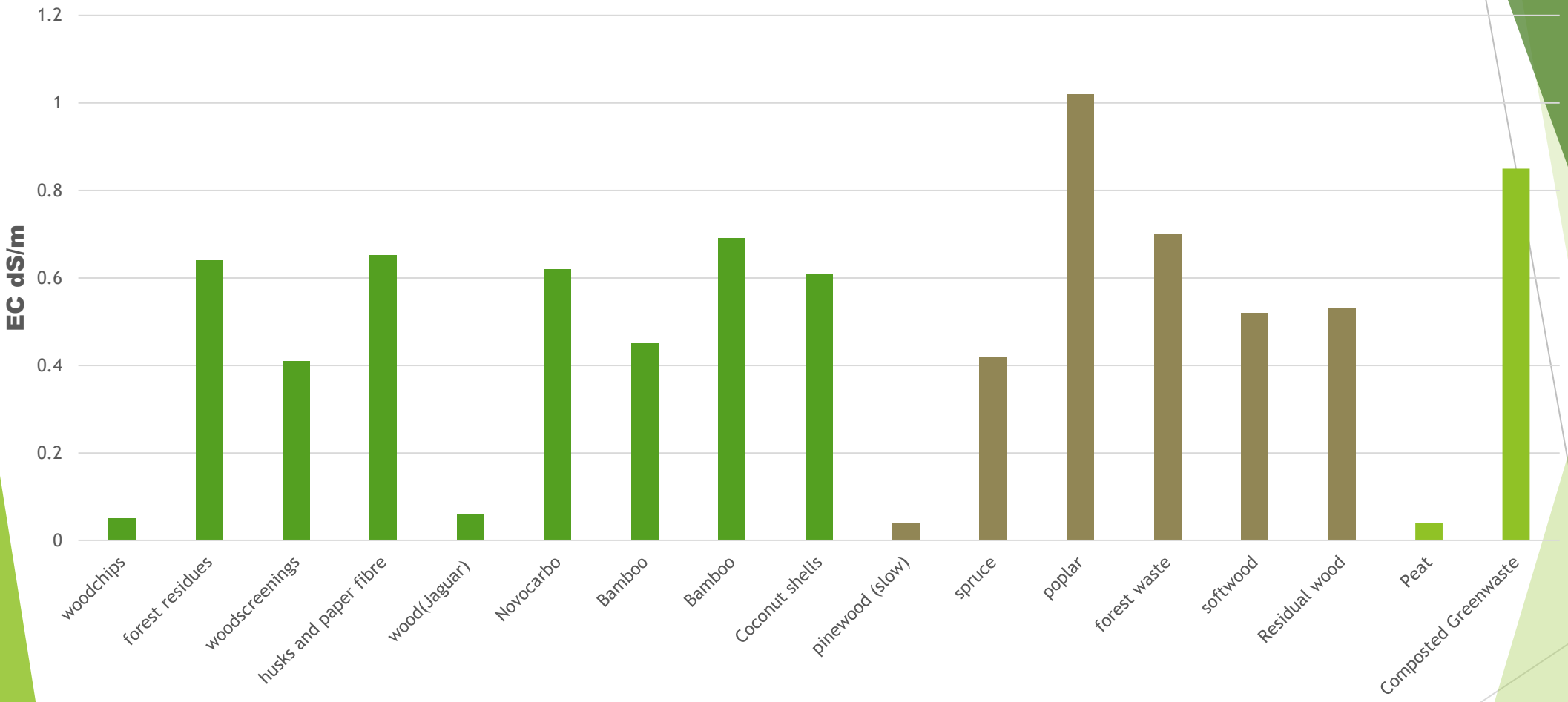


Feedstock, “green" our data, other published data

EC of various biochars destined for use as component of growing media

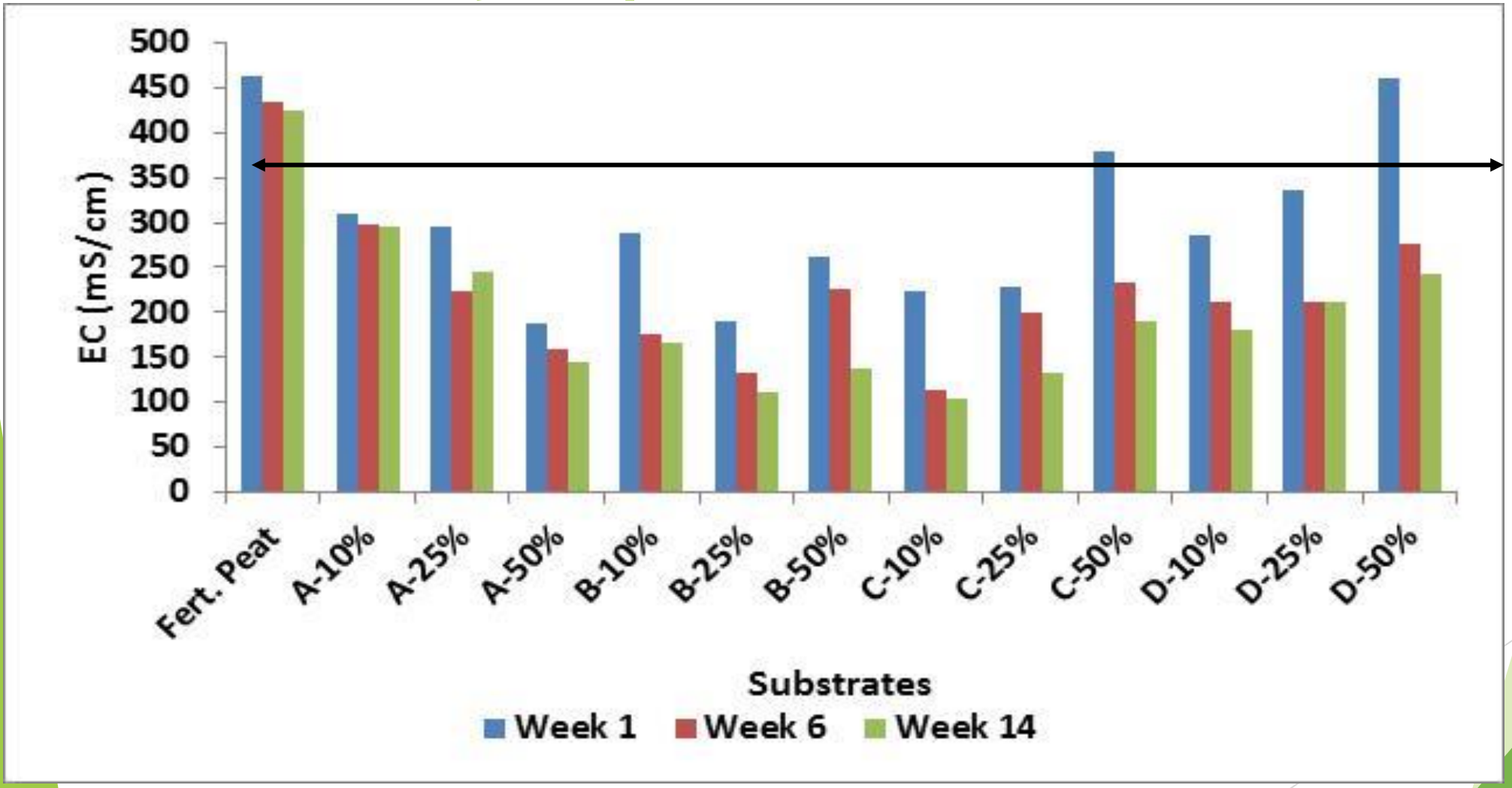


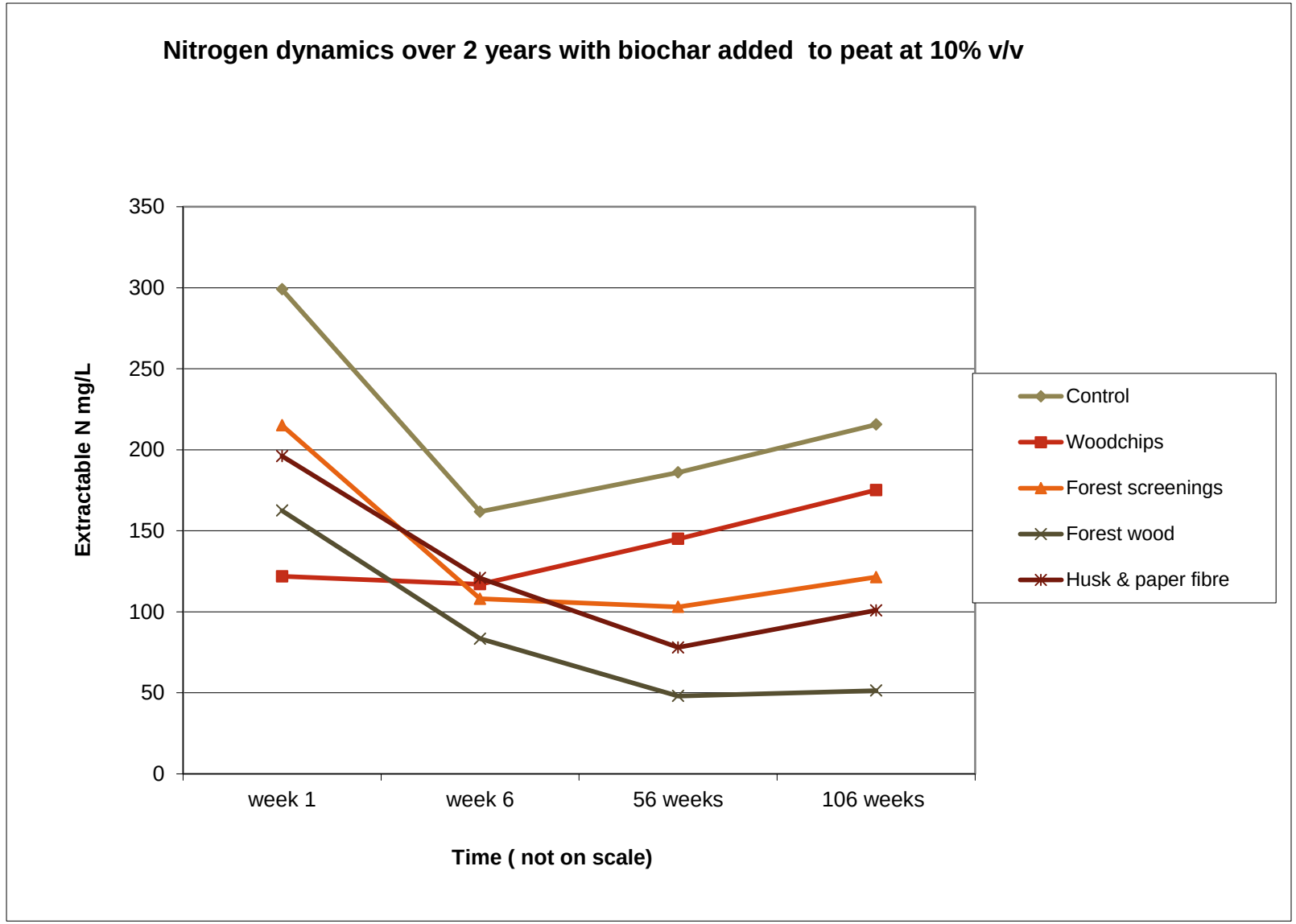
EC of various biochars destined for use as a component of a growing media

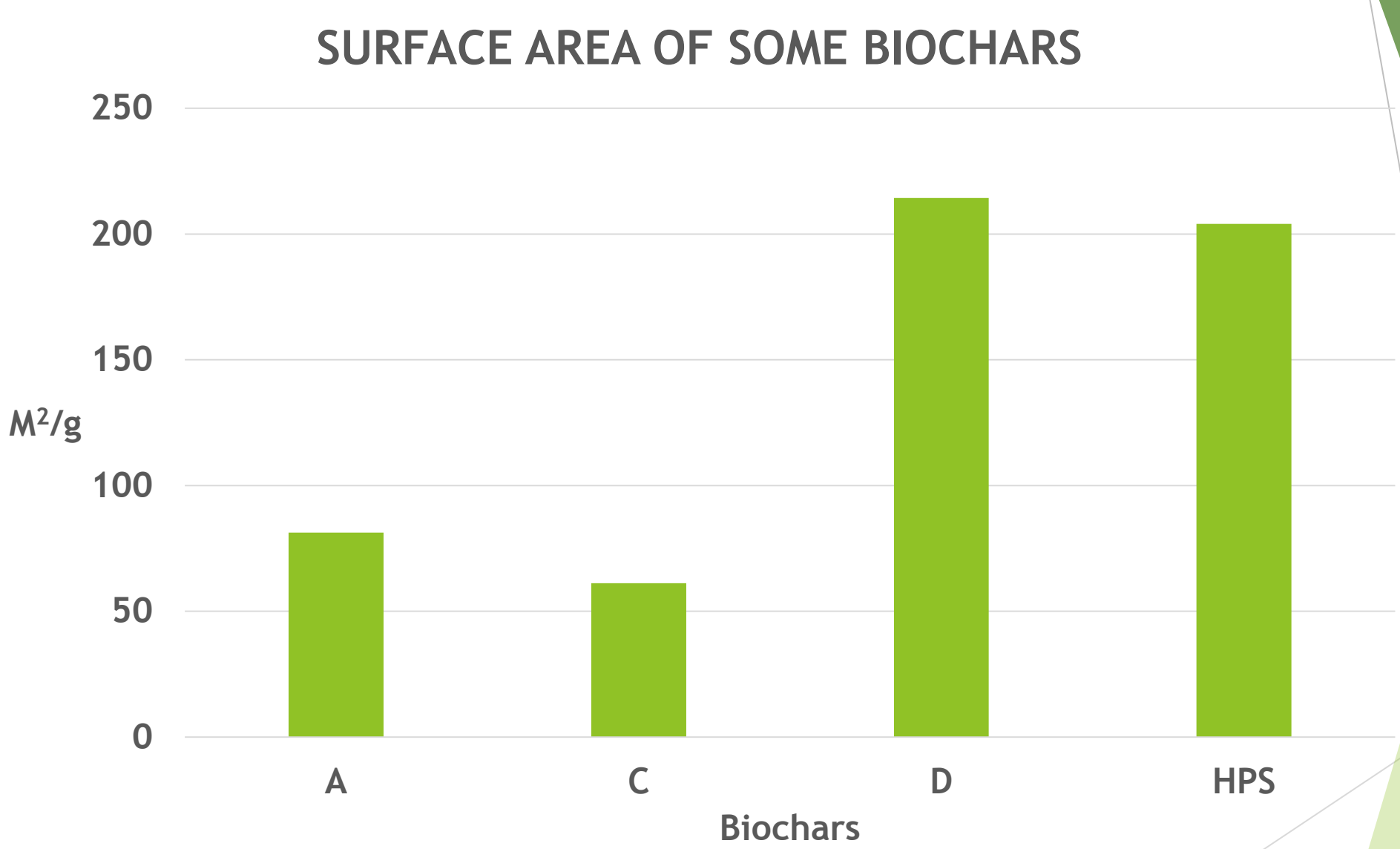


Feedstock“green" our data other publishrd data.
Note one very high figure omitted

Effect of biochar addition on electrical conductivity of peat-biochar mixtures

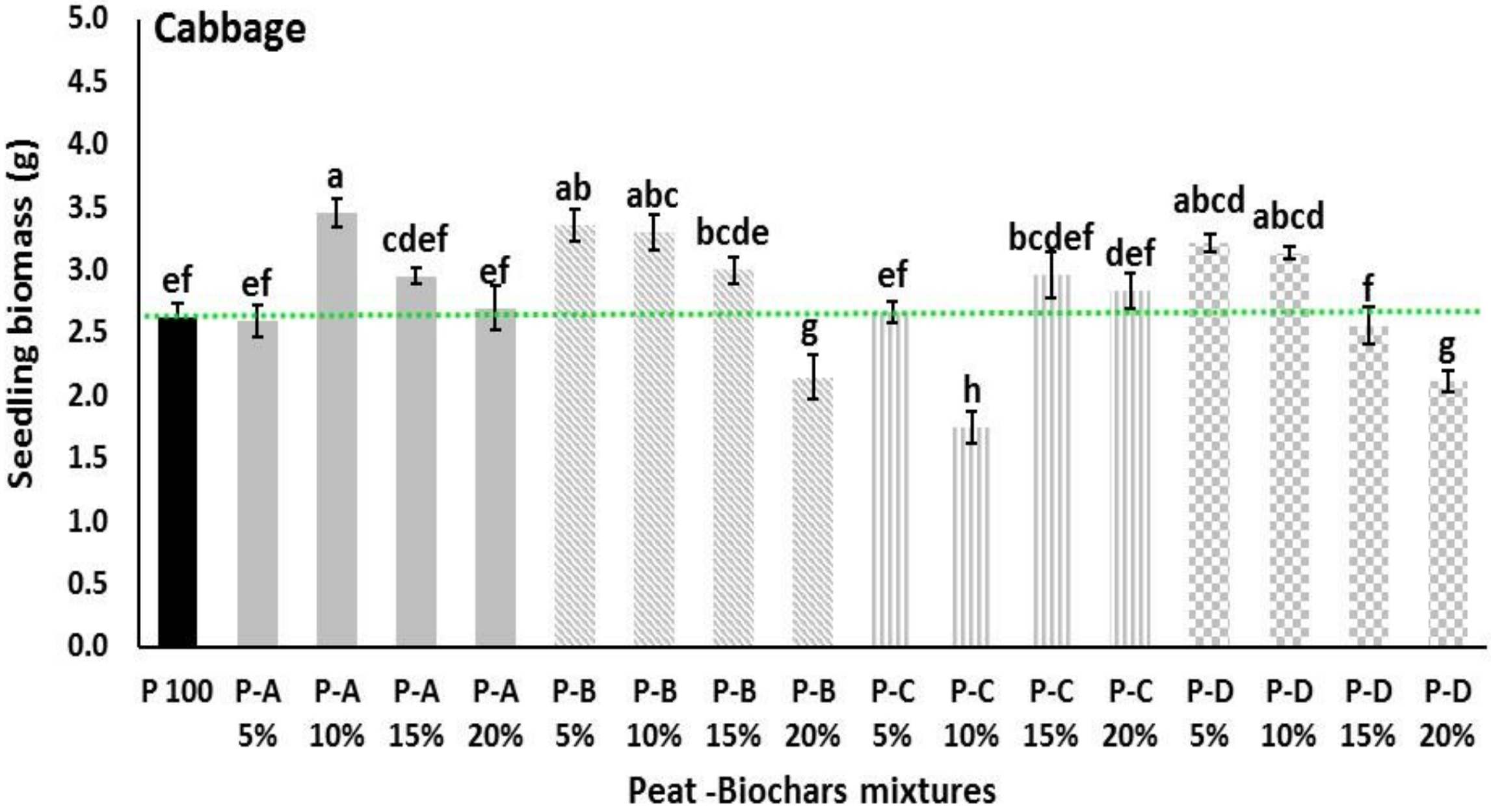


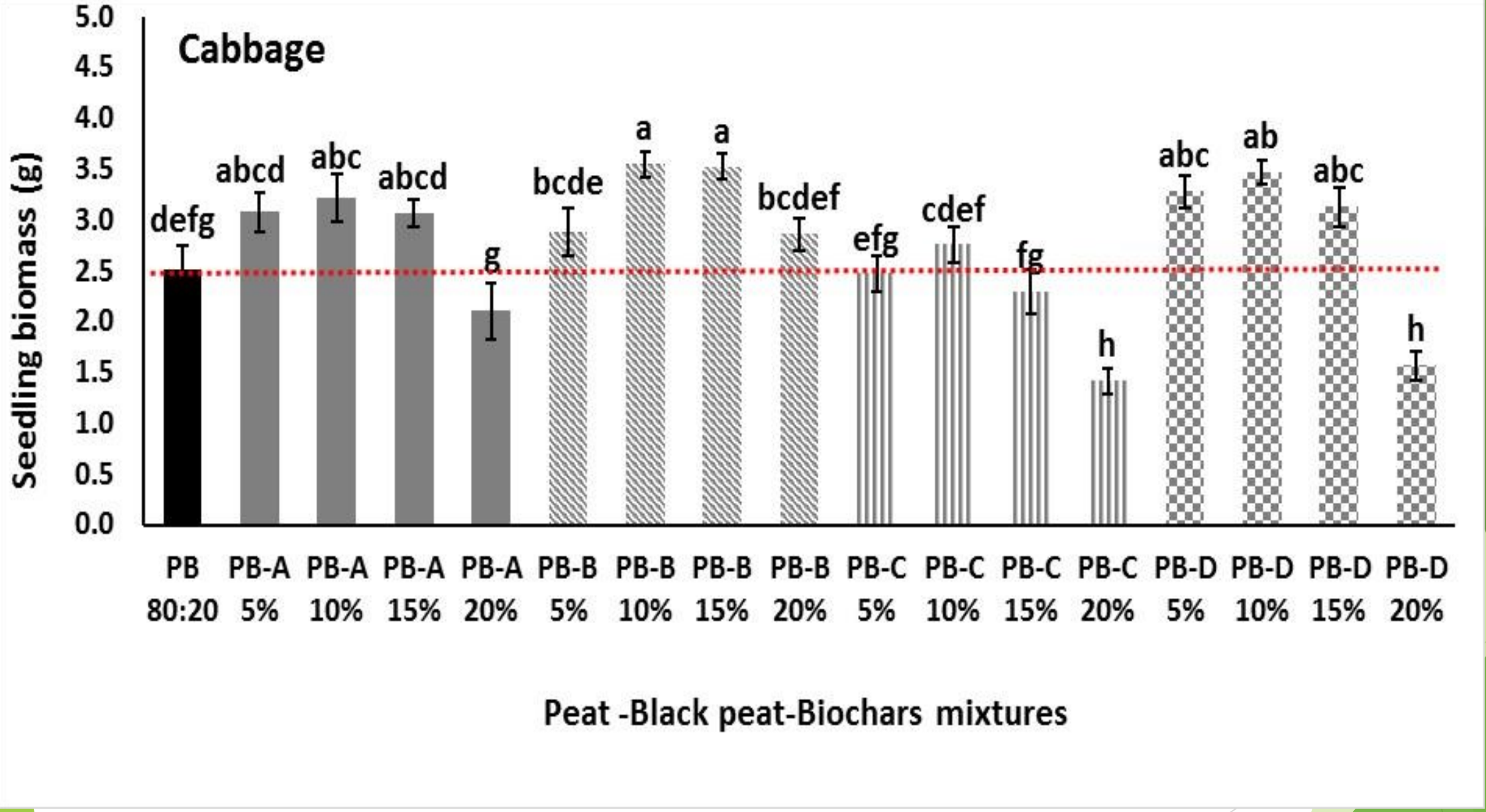

Nitrogen dynamics over 2 years with biochar added to peat at 10% v/v
Extractable N mg/L
350
300
250
200
150
100
50
0
week 1
week 6
56 weeks
106 weeks
Time (not on scale)
Control
Woodchips
Forest screenings
Forest wood
Husk & paper fibre

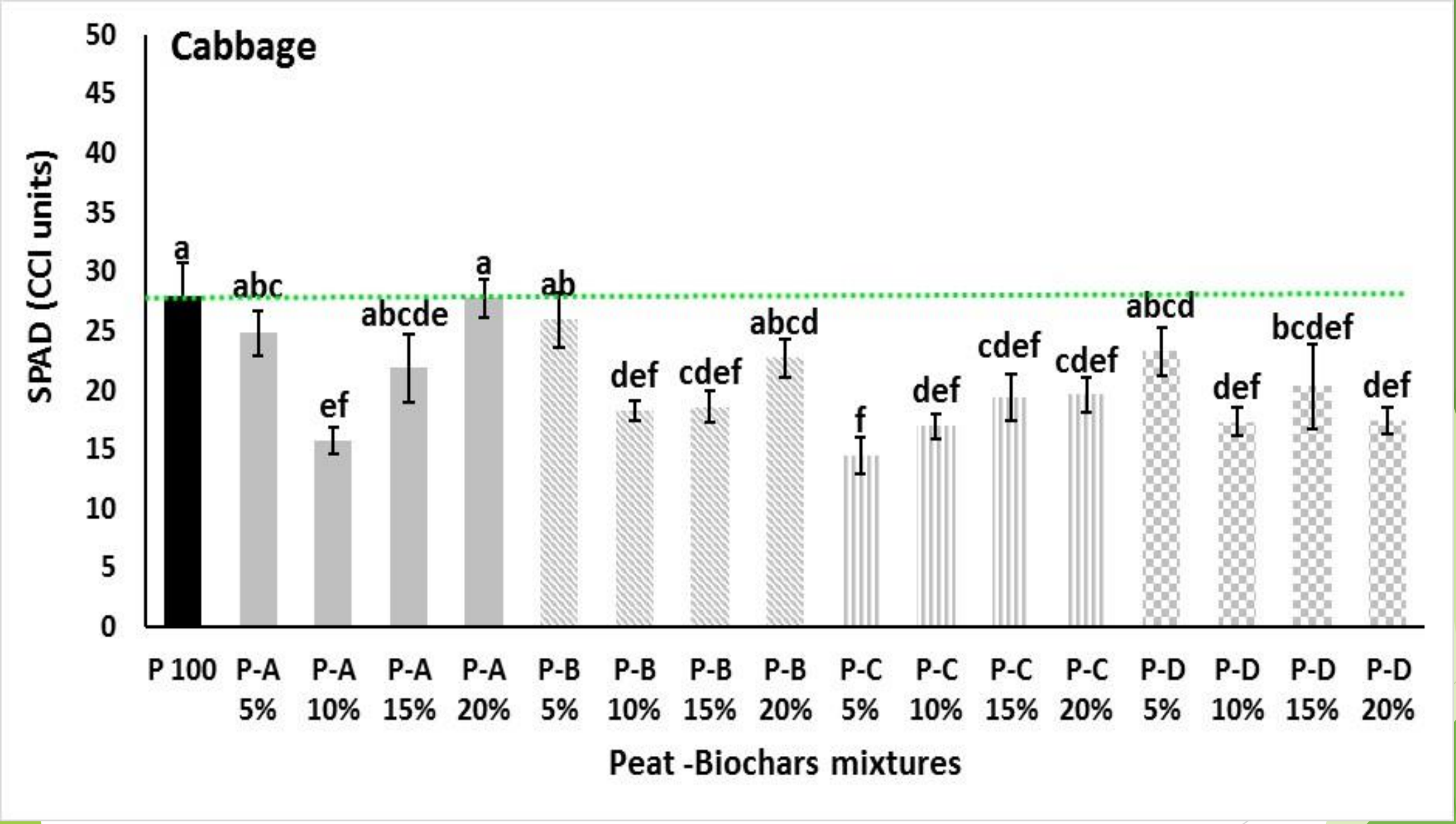

SURFACE AREA OF SOME BIOCHARS
250
200
150
100
50
0
M2/g
A
C
D
HPS
Biochars

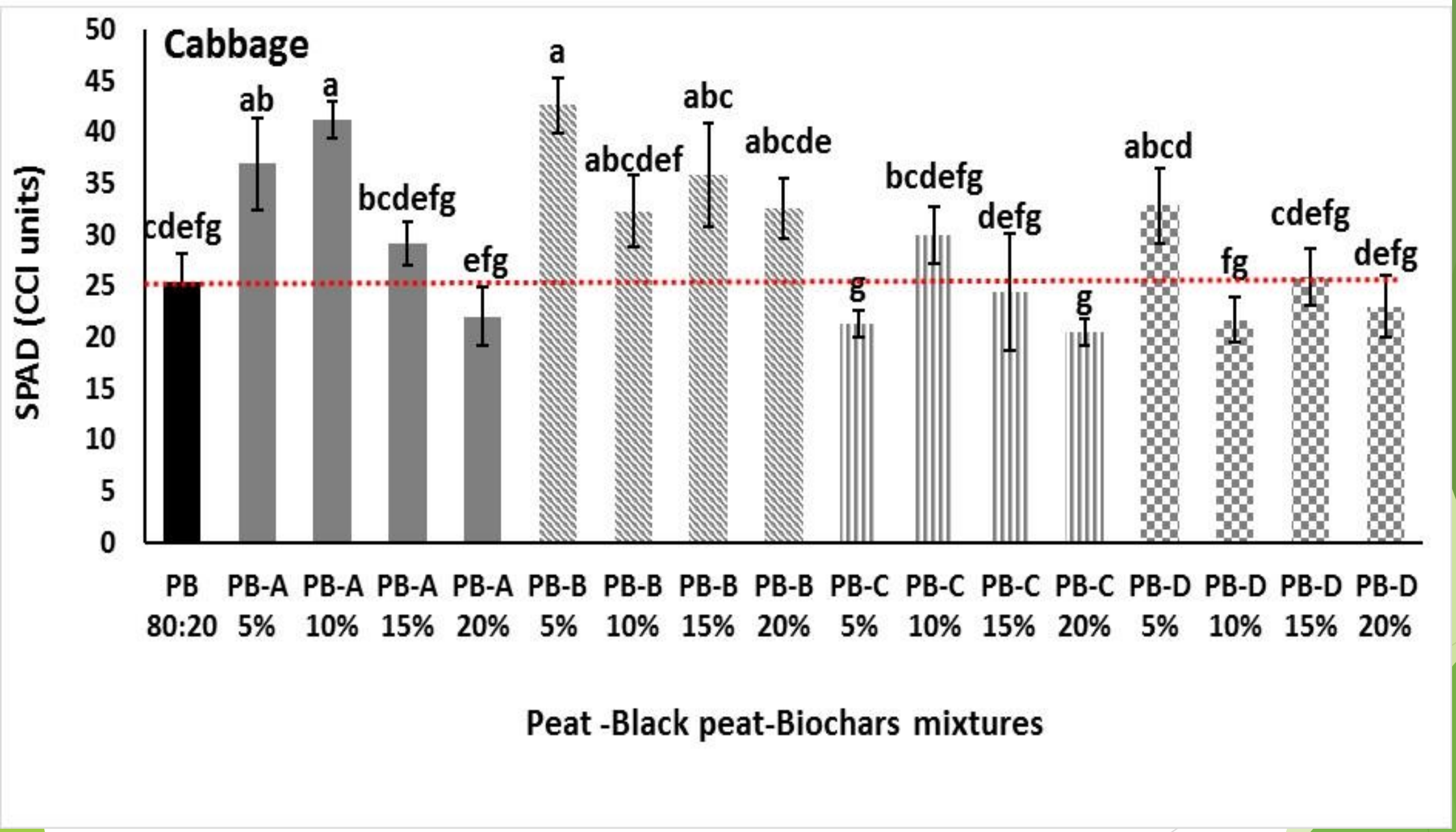
P 100 P:Carbon Terra 5% P:Carbon Terra 10% P:Carbon Terra 15% P:Carbon Terra 20%

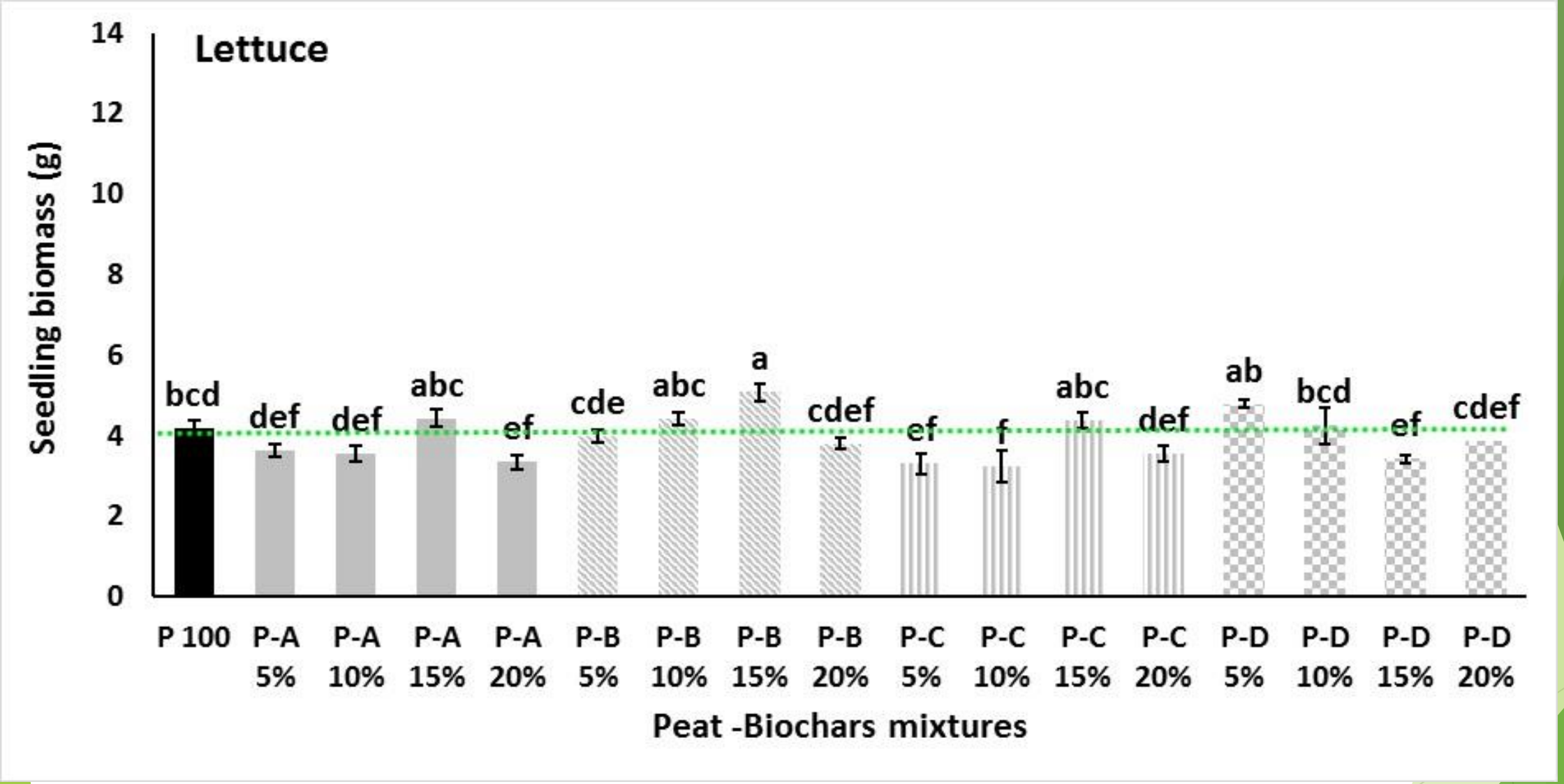
P 100 P:Schmidt 5% P:Schimidt 10% P:Schmidt 15% P:Schmidt 20%

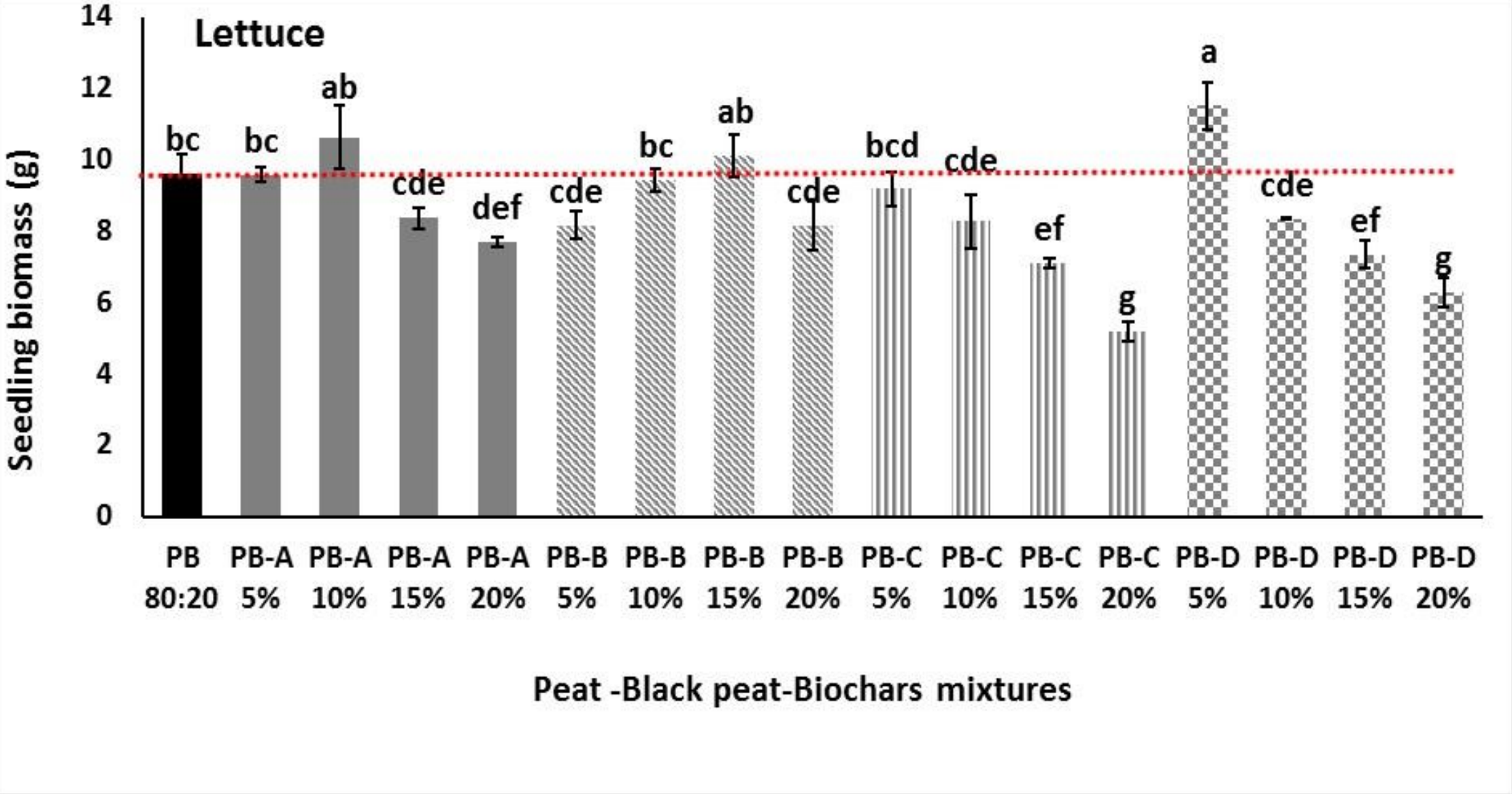

Cabbage
Seedling biomass (g)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ef
ef
a
cdef
ef
ab
abc
bcde
g
ef
h
bcdef
def
abcd
abcd
f
g
P 100
P-A 5%
P-A 10%
P-A 15%
P-A 20%
P-B 5%
P-B 10%
P-B 15%
P-B 20%
P-C 5%
P-C 10%
P-C 15%
P-C 20%
P-D 5%
P-D 10%
P-D 15%
P-D 20%
Peat -Biochars mixtures

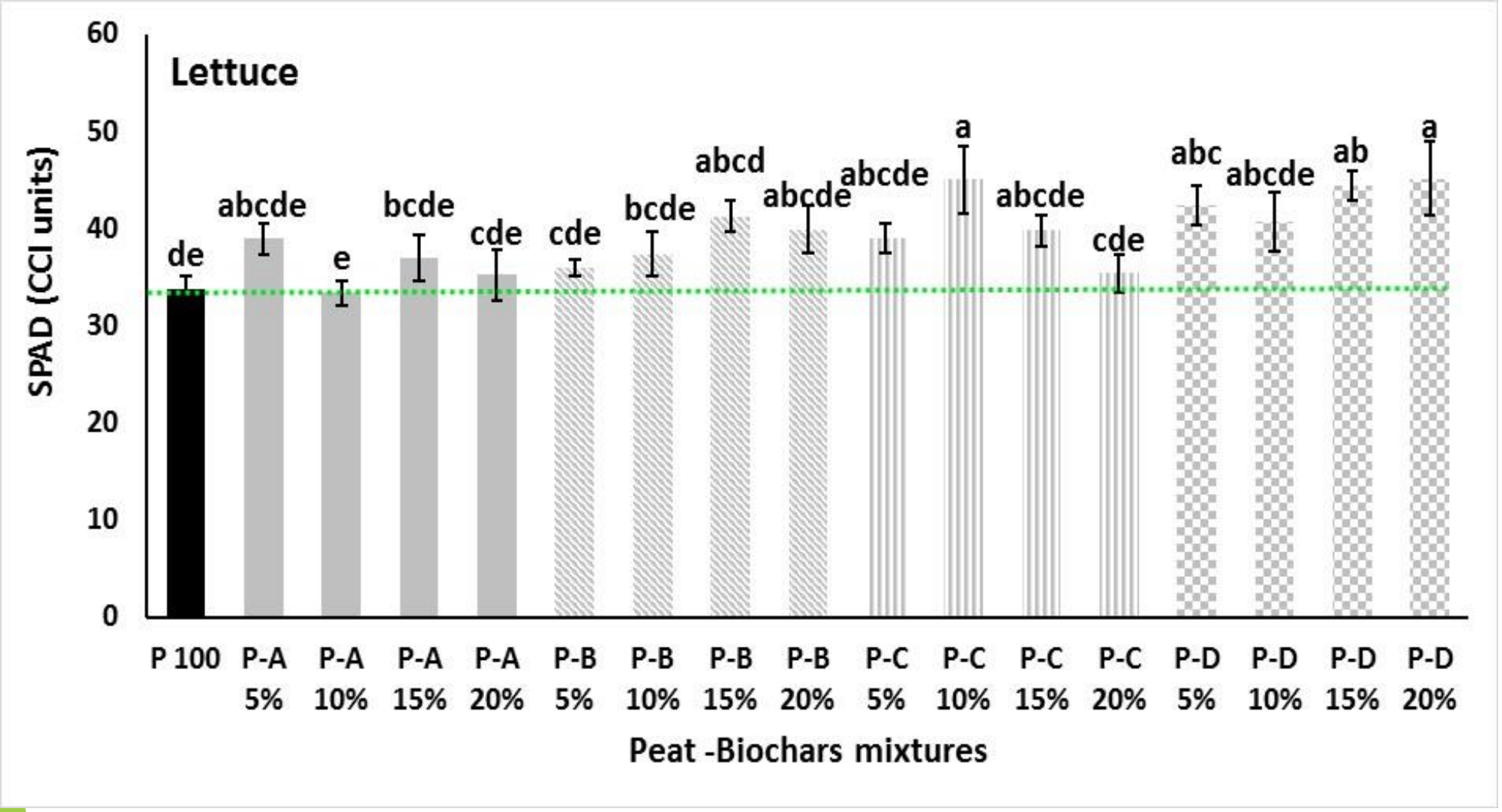

Cabbage
Seedling biomass (g)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
defg
abcd
abc
abcd
g
bcde
a
a
bcdef
efg
cdef
fg
h
abc
ab
abc
h
PB 80:20
PB-A 5%
PB-A 10%
PB-A 15%
PB-A 20%
PB-B 5%
PB-B 10%
PB-B 15%
PB-B 20%
PB-C 5%
PB-C 10%
PB-C 15%
PB-C 20%
PB-D 5%
PB-D 10%
PB-D 15%
PB-D 20%
Peat -Black peat-Biochars mixtures

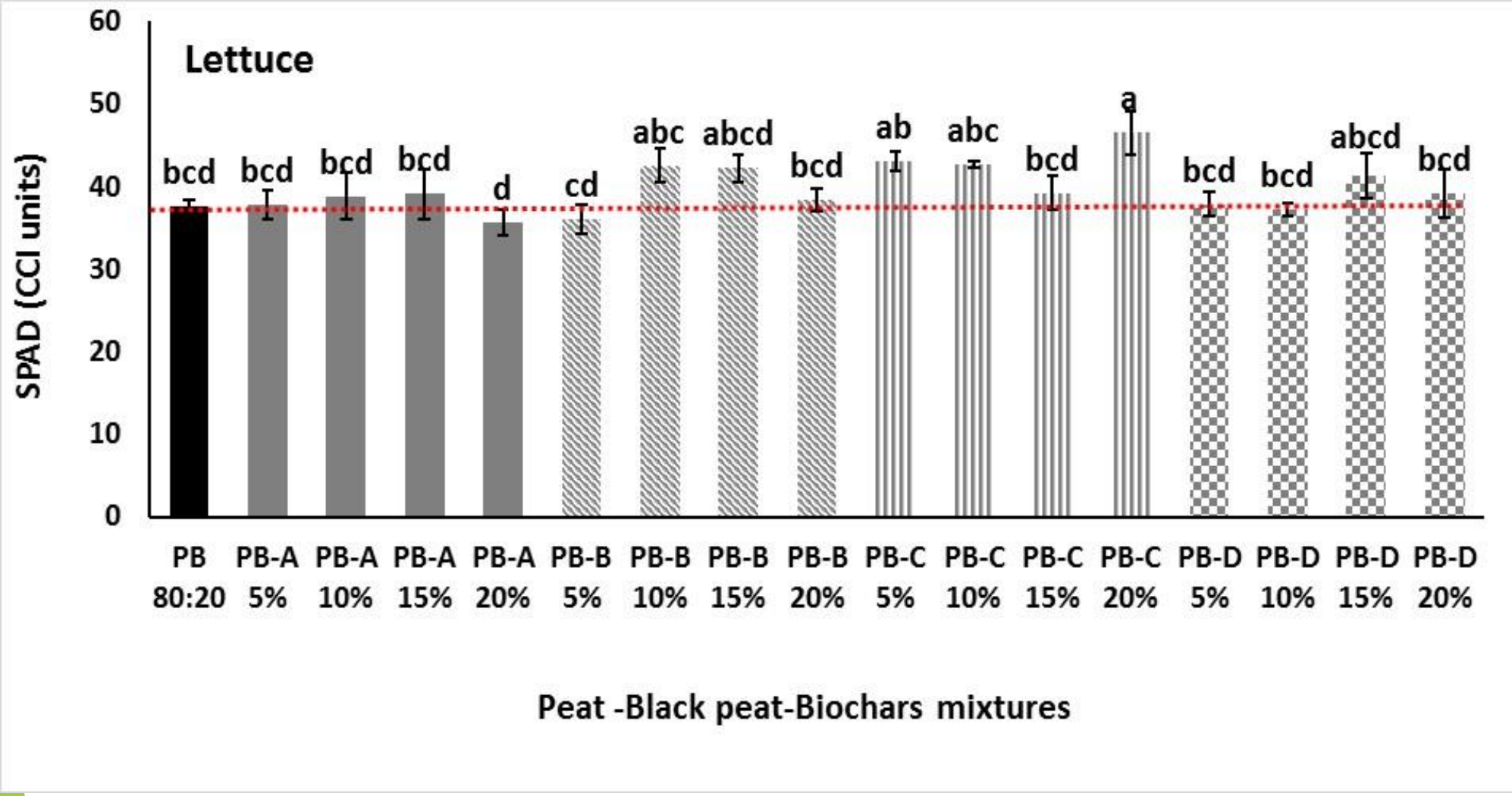

Cabbage
SPAD (CCI units)
50
45
40
35
30
25
20
15
10
5
0
a
abc
ef
abcde
a
ab
def
cdef
abcd
f
def
cdef
cdef
abcd
def
bcdef
def
P 100
P-A 5%
P-A 10%
P-A 15%
P-A 20%
P-B 5%
P-B 10%
P-B 15%
P-B 20%
P-C 5%
P-C 10%
P-C 15%
P-C 20%
P-D 5%
P-D 10%
P-D 15%
P-D 20%
Peat -Biochars mixtures


Cabbage
SPAD (CCI units)
50
45
40
35
30
25
20
15
10
5
0
cdefg
ab
a
bcdefg
efg
a
abcdef
abc
abcde
g
bcdefg
defg
g
abcd
fg
cdefg
defg
PB 80:20
PB-A 5%
PB-A 10%
PB-A 15%
PB-A 20%
PB-B 5%
PB-B 10%
PB-B 15%
PB-B 20%
PB-C 5%
PB-C 10%
PB-C 15%
PB-C 20%
PB-D 5%
PB-D 10%
PB-D 15%
PB-D 20%
Peat -Black peat-Biochars mixtures

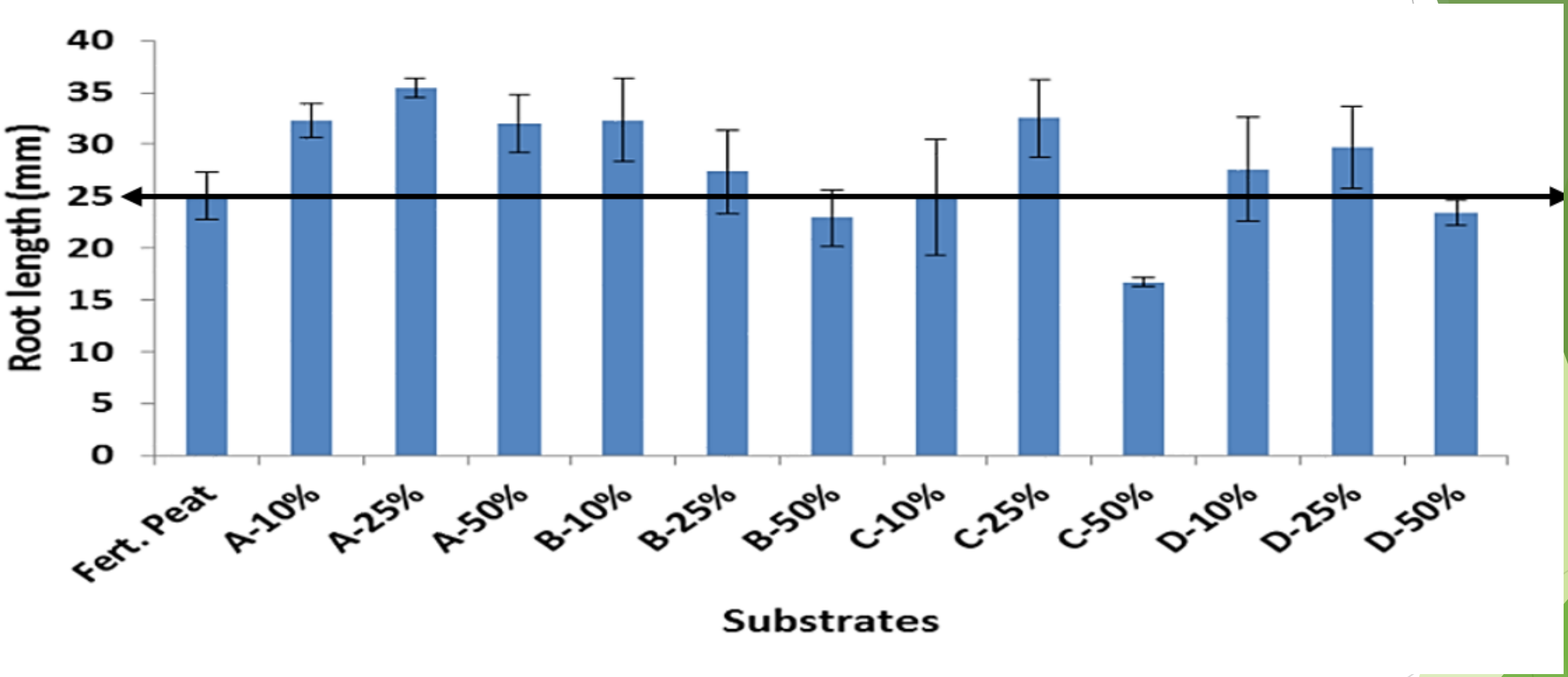

Lettuce
Seedling biomass (g)
14
12
10
8
6
4
2
0
bcd
def
def
abc
ef
cde
abc
a
cdef
ef
f
abc
def
ab
bcd
ef
cdef
P 100
P-A 5%
P-A 10%
P-A 15%
P-A 20%
P-B 5%
P-B 10%
P-B 15%
P-B 20%
P-C 5%
P-C 10%
P-C 15%
P-C 20%
P-D 5%
P-D 10%
P-D 15%
P-D 20%
Peat -Biochars mixtures


Lettuce
Seedling biomass (g)
14
12
10
8
6
4
2
0
bc
bc
ab
cde
def
cde
bc
ab
cde
bcd
cde
ef
g
a
cde
ef
g
PB 80:20
PB-A 5%
PB-A 10%
PB-A 15%
PB-A 20%
PB-B 5%
PB-B 10%
PB-B 15%
PB-B 20%
PB-C 5%
PB-C 10%
PB-C 15%
PB-C 20%
PB-D 5%
PB-D 10%
PB-D 15%
PB-D 20%
Peat -Black peat-Biochars mixtures


Lettuce
SPAD (CCI units)
60
50
40
30
20
10
0
de
abcde
e
bcde
cde
cde
bcde
abcd
abcde
abcde
a
abcde
cde
abc
abcde
ab
a
P 100
P-A 5%
P-A 10%
P-A 15%
P-A 20%
P-B 5%
P-B 10%
P-B 15%
P-B 20%
P-C 5%
P-C 10%
P-C 15%
P-C 20%
P-D 5%
P-D 10%
P-D 15%
P-D 20%
Peat -Biochars mixtures


Lettuce
SPAD (CCI units)
60
50
40
30
20
10
0
bcd
bcd
bcd
bcd
d
cd
abc
abcd
bcd
ab
abc
bcd
a
bcd
bcd
abcd
bcd
PB 80:20
PB-A 5%
PB-A 10%
PB-A 15%
PB-A 20%
PB-B 5%
PB-B 10%
PB-B 15%
PB-B 20%
PB-C 5%
PB-C 10%
PB-C 15%
PB-C 20%
PB-D 5%
PB-D 10%
PB-D 15%
PB-D 20%
Peat -Black peat-Biochars mixtures

Effect of root length in peat-biochar mixtures in comparison to peat



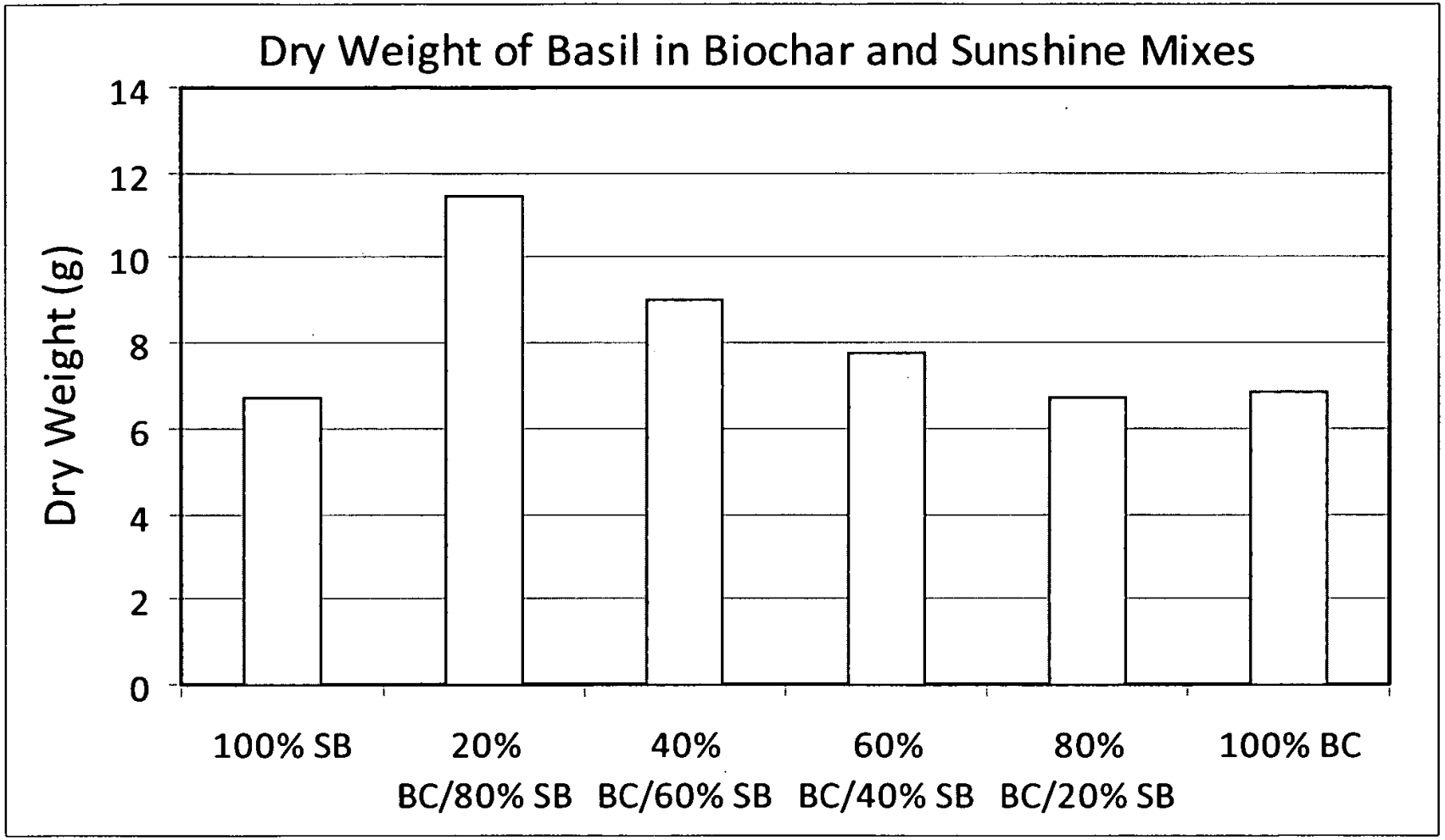
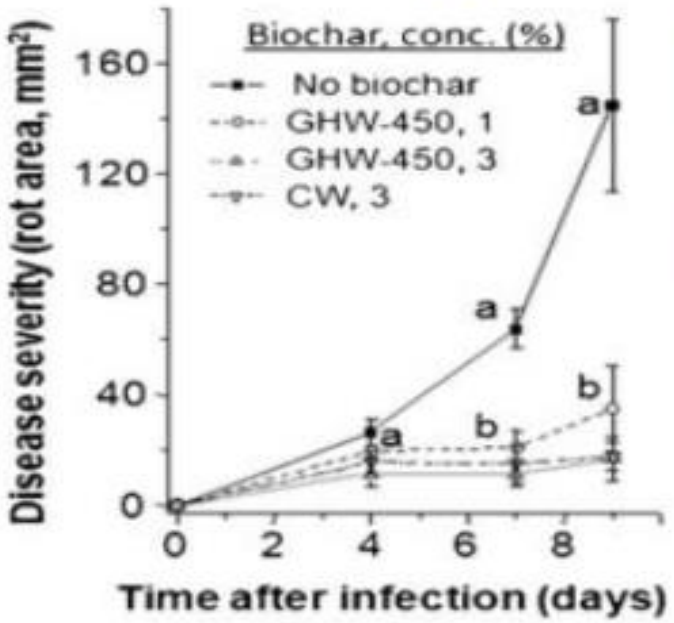

Dry Weight of Basil in Biochar and Sunshine Mixes
Dry Weight (g)
14
12
10
8
6
4
2
0
100% SB
20% BC/80% SB
40% BC/60% SB
60% BC/40% SB
80% BC/20% SB
100% BC

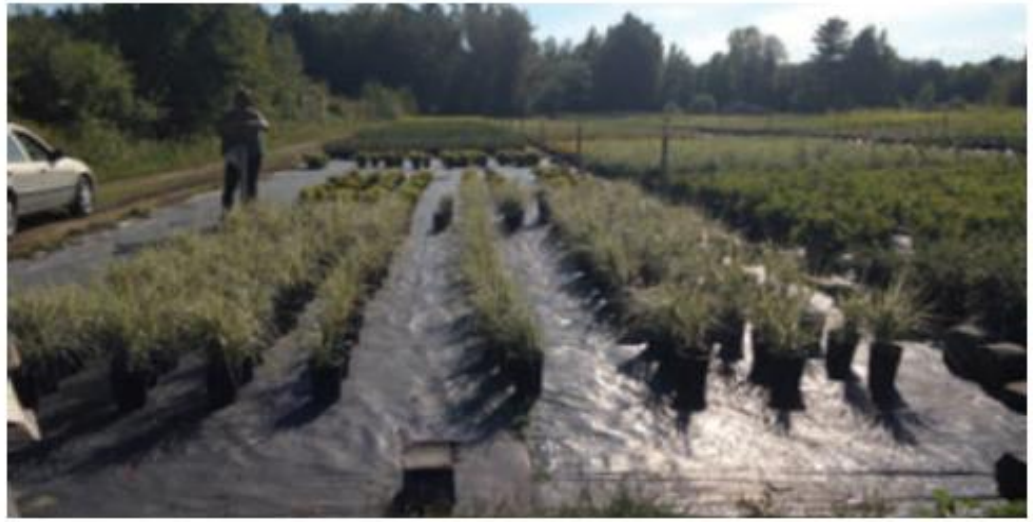
Figure 26

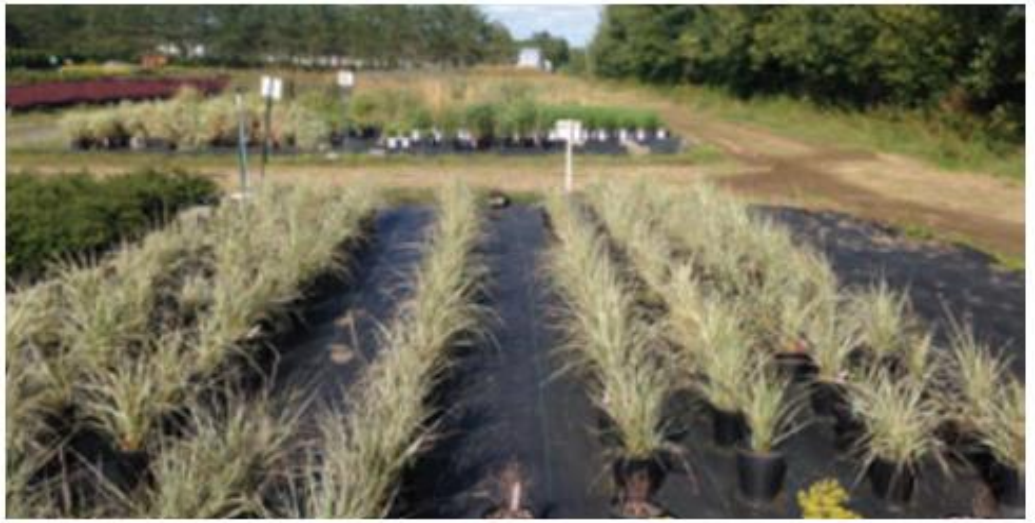
Biochar in Horticulture & Substrates

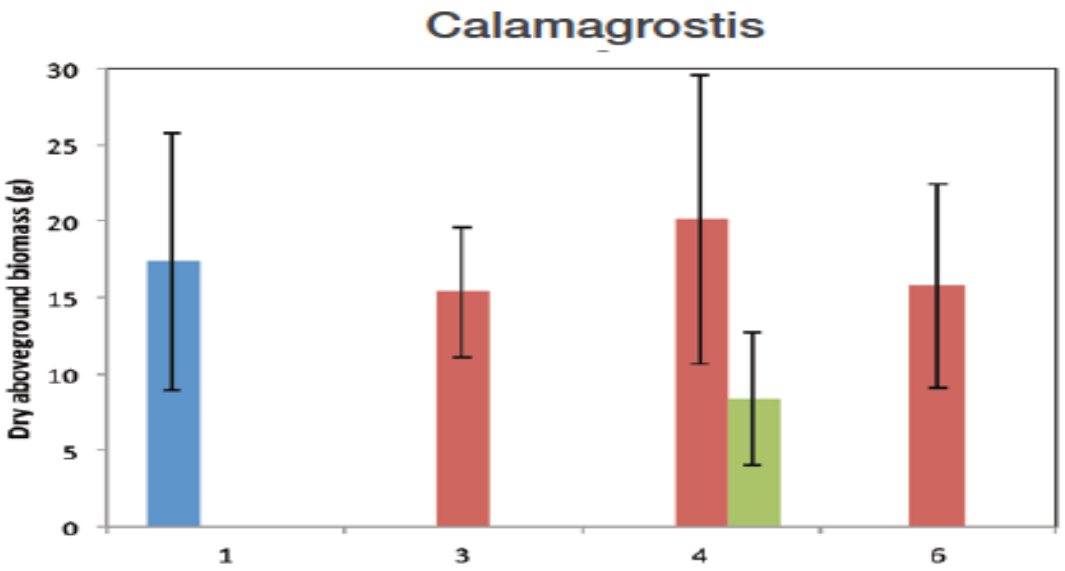
Fig. 1 Effect of biochar amendment on development of gray mold on attached strawberry leaves. Plants were grown in coconut:peat potting medium amended with either greenhouse waste (GHW-450) or citrus wood (CW) biochar for 25 days. *Botrytis cinerea* infection is presented as rot area through nine days. Bars represent the standard error of the mean of six replicates. Data points labeled by a common letter are not significantly different according to Fisher's protected LSD test. Pictures (bottom) represent gray mold on strawberry leaves 9 days after *B. cinerea* infection from treatments of no biochar (left), 1% GHW-450 (middle), and 3% GHW-450 (right)

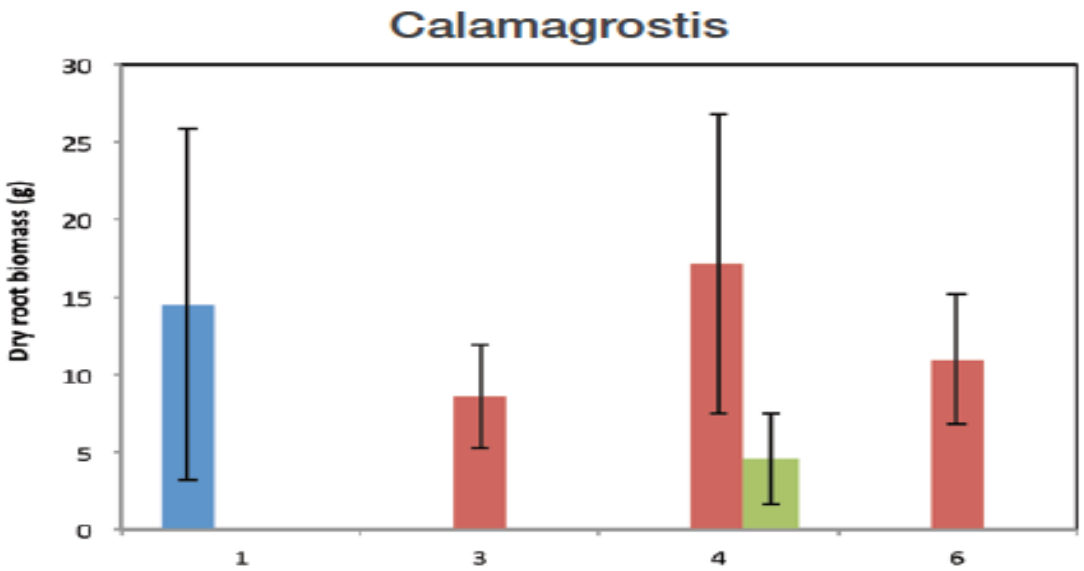


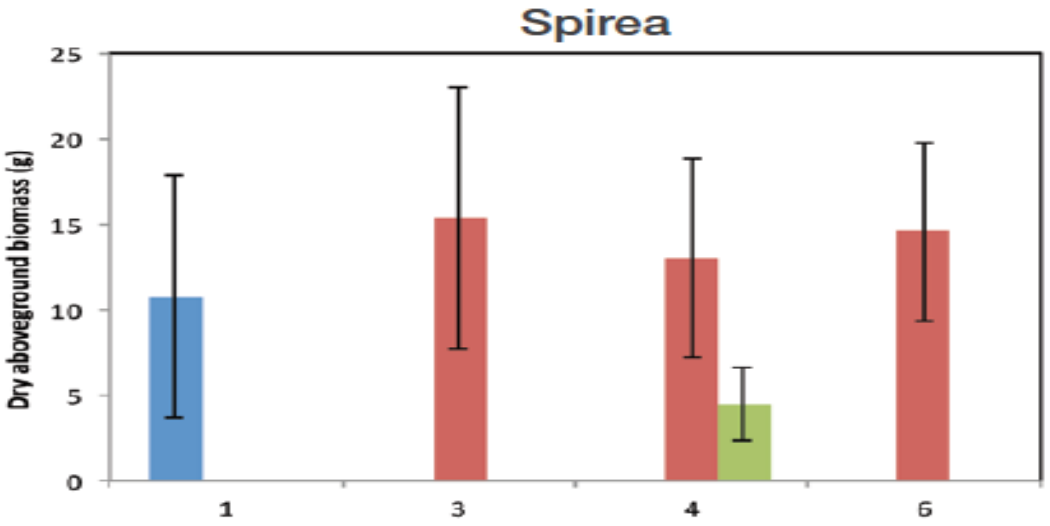
Meller-Harel et al. 2012
Jaiswal et al. 2014
etc. (→ E. Graber)

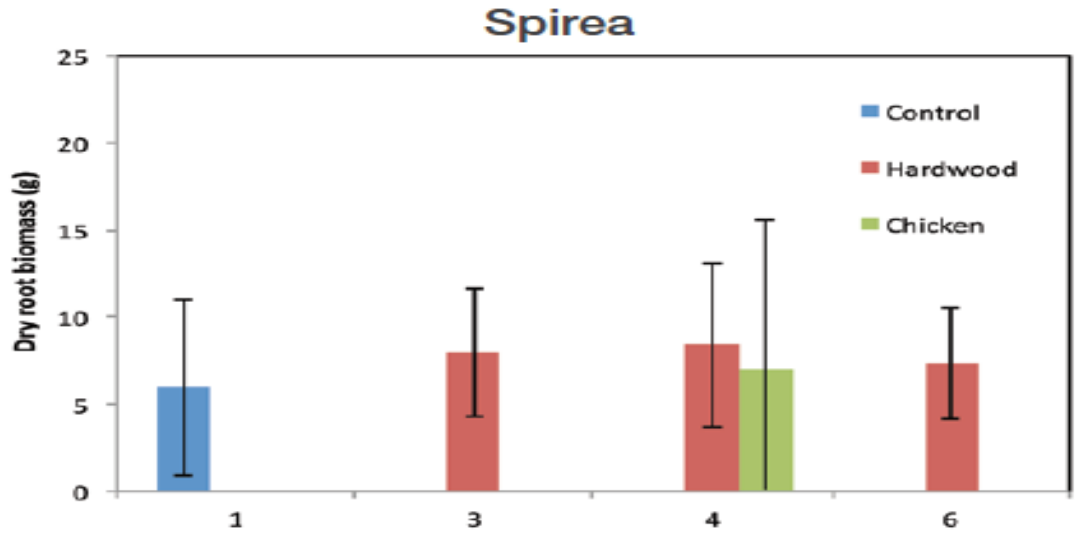










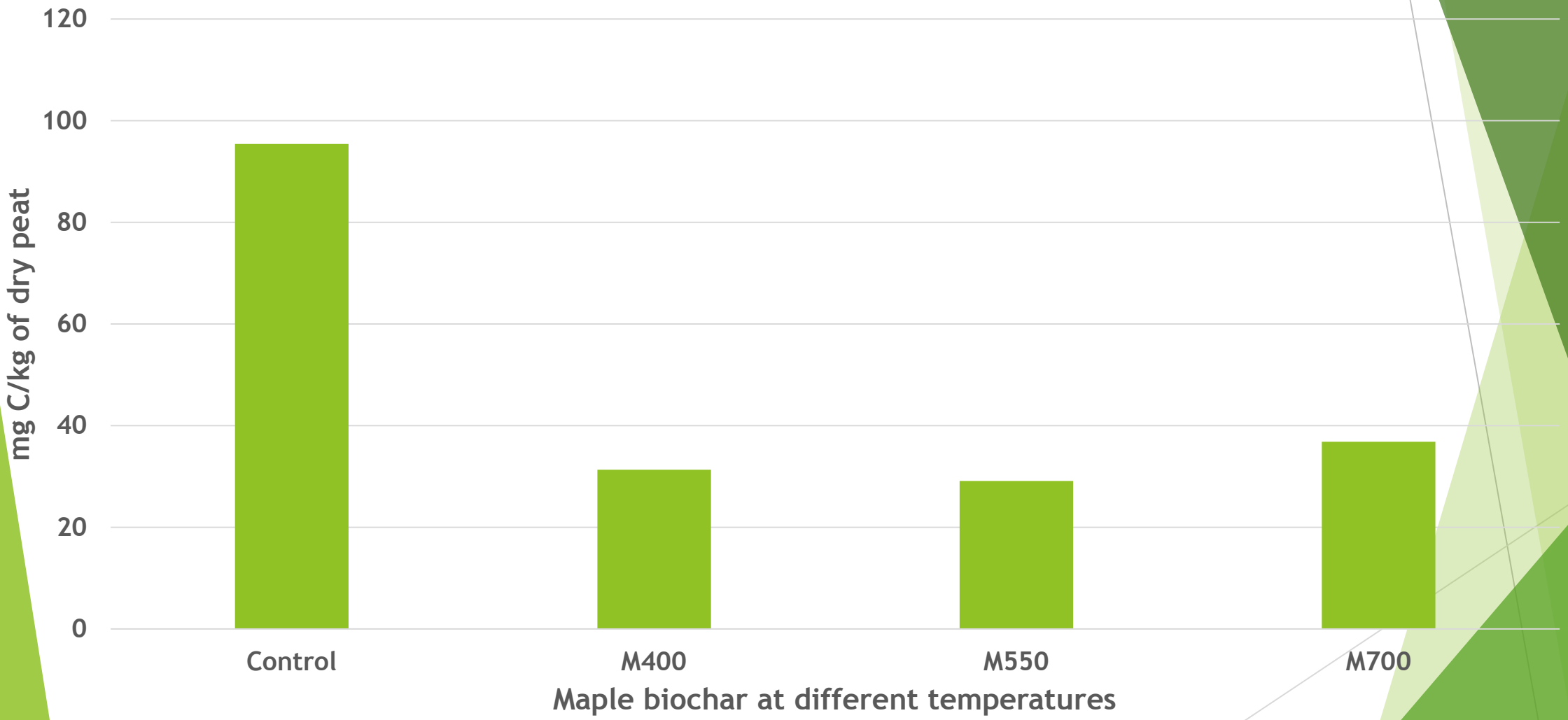


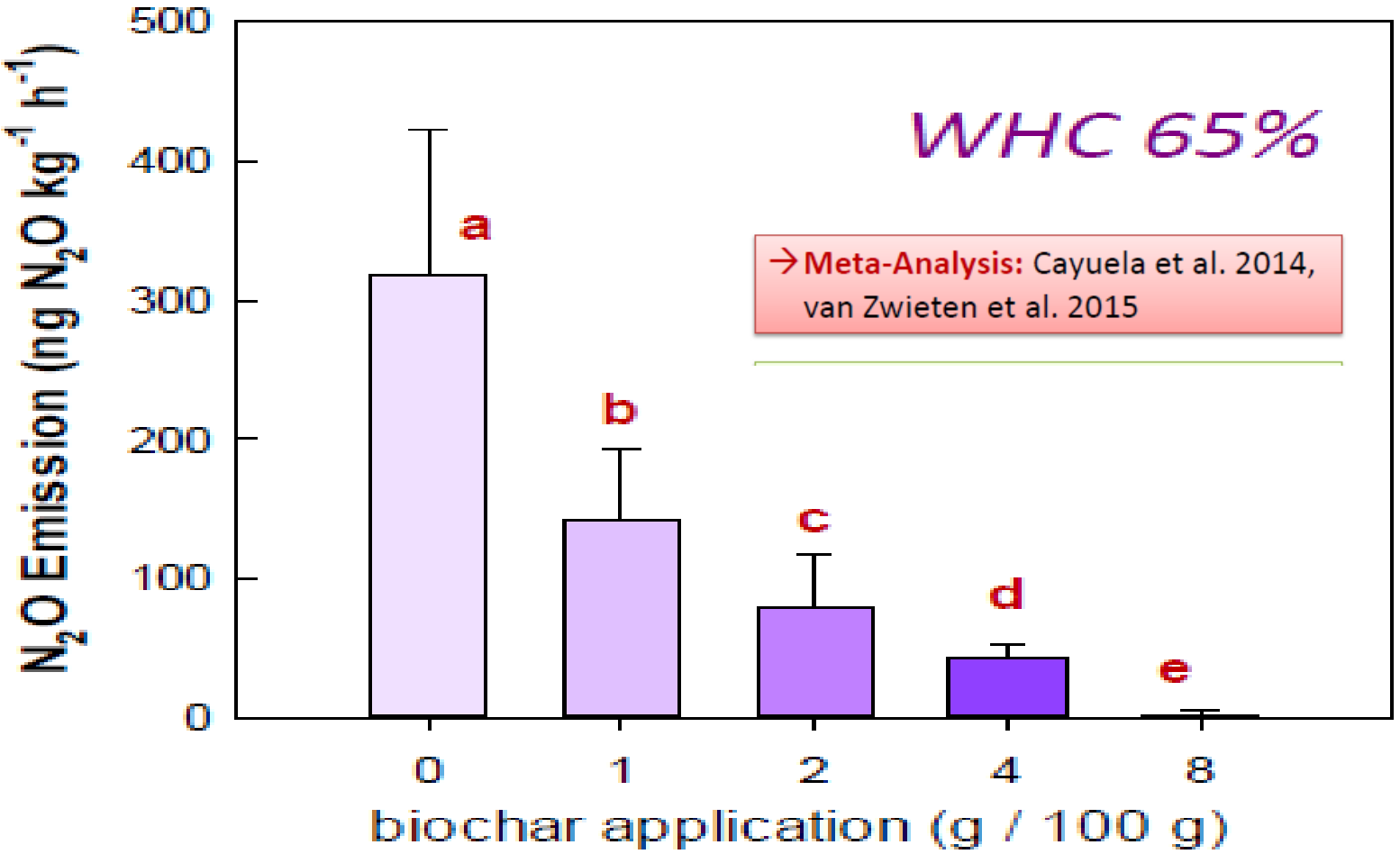
1=Peat Control, 3=Peat +14% Biochar 4= Peat+ 28% Biochar 6= 25%Biochar+25% Perlite

Use of Biochar in Green Roof

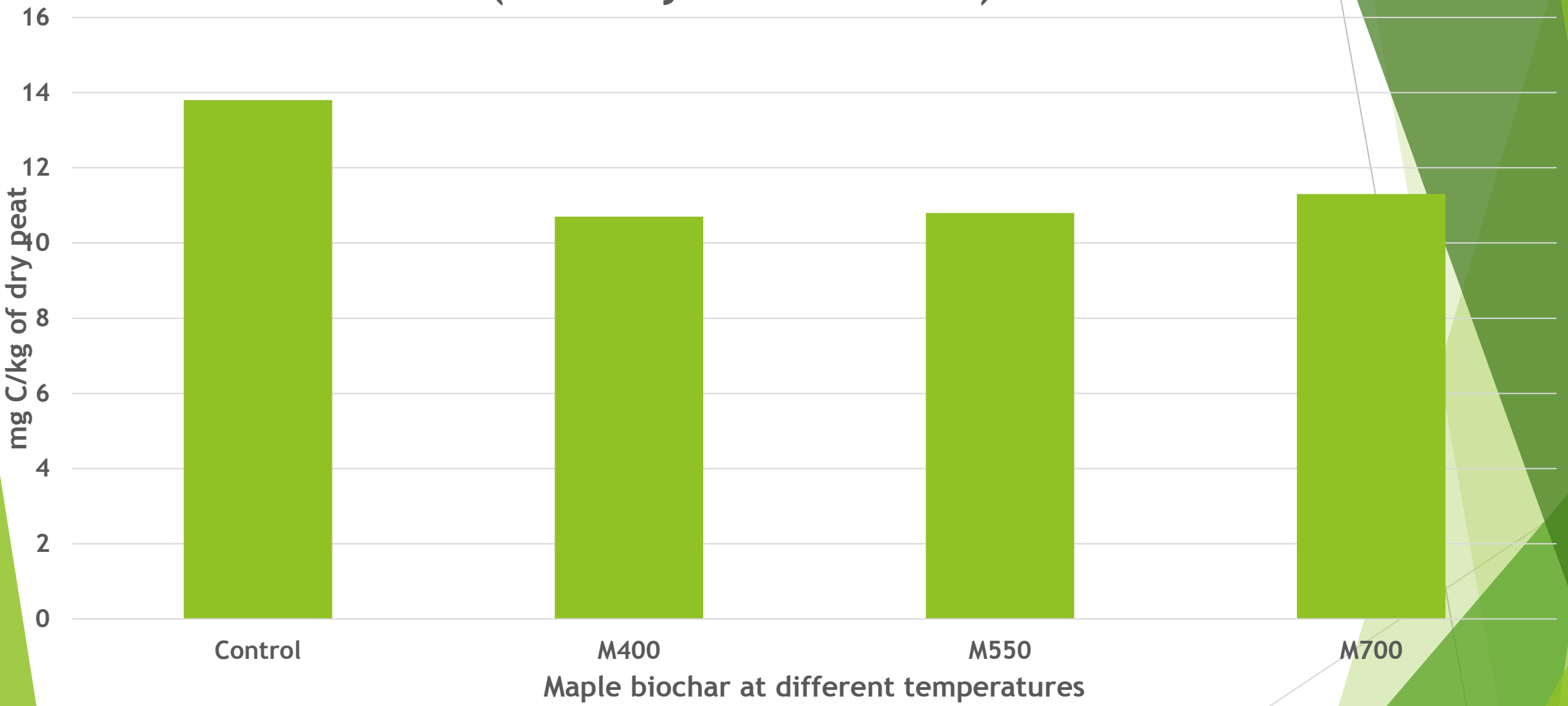
- Reduced the quantity of run-off
- Improved the quality of run-off
- Need to take into account variable properties of biochar
- Improved the water retention
- Decrease in total N in run-off
- Decrease in total Phosphate in run-off
- Decrease in total NO3 in run-off

The effect of addition of maple biochars to peat at 15% on Nitrous Oxide emission(Potency 300 to 400 times Carbon dioxide)

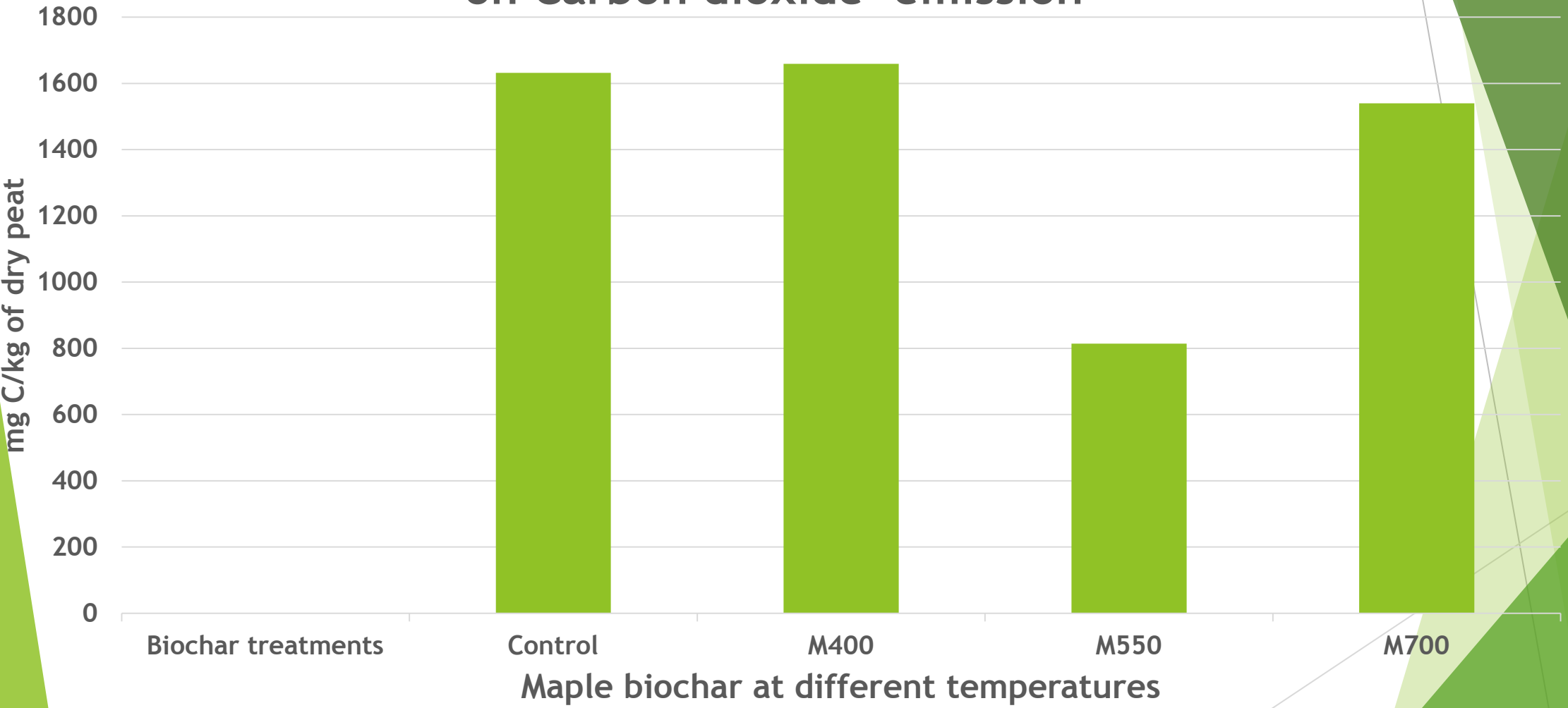



WHC 65%
→Meta-Analysis: Cayuela et al. 2014, van Zwieten et al. 2015
N2O Emission (ng N2O kg-1 h-1)
500
400
300
200
100
0
a
b
c
d
e
0
1
2
4
8
biochar application (g / 100 g)

The effect of addition of maple biochars to peat on Methane emission(Potency 20 times CO2)



The effect of addition of maple biochars to peat at 15% on Carbon dioxide emission



Conclusion

- Change to biochar at Nursery level will not occur unless there is financial incentive from government (Carbon Credits) or market incentive.
- Financial incentives may include the proximity of Biochar, therefore reduction in transport costs
- Financial returns for carbon sequestration if nurserymen or pyrolyser group together

NOT ALL BIOCHARS ARE MADE EQUAL !!

POTENTIAL TO PRODUCE PLANTS WITH LOWER CARBON FOOTPRINT

“CLIMATE SAVING” GROWING MEDIA

THANK YOU FOR YOUR ATTENTION!