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BIOCHAR FROM RESIDUAL PRESS-CAKE OF OLEAGINOUS SEEDS: PRODUCTION AND CHARACTERIZATION

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SPOKE, WP AND TASK

PNRR AGRITECH SPOKE 8 - New models of circular economy in agriculture

WP 3 - Recovery of nutrients and organic matters from waste to reduce the use of agrochemicals and close the waste cycle
TASK 8.3.2 - *Valorization and biological regeneration of waste as resources, organic fertilizers, or amendments to improve carbon storage and soil quality*

BACKGROUND AND AIM

ADVANTAGES OF BIOCHAR APPLICATION IN SOIL

Biochar is defined as the solid product of biomass thermochemical decomposition (i.e. slow pyrolysis) and is well known for its multifunctional properties. Notably, it is capable to trap within its microporous structure moisture, nutrients and contaminants.[1]

- High amount of stable carbon → Carbon stock material
- Capable to enhance soil quality → Soil amendment

AIM: BIOCHAR FOR AGRI-RESIDUES VALORIZATION

Biochar has the dual role of promoting the growth of oleaginous crops and decarbonizing the biorefining supply chain

MATERIALS AND METHODS

1. TESTED BIO-FEEDSTOCKS

As feedstock we have selected **different residual press-cakes** from mechanical extraction of various oleaginous seeds.

Cakes derived from:

- ❑ Asteracea 1 ("A1")
- ❑ Agri-supply chain residuals ("R")
- ❑ Brassicacea 1 ("B1")
- ❑ Brassicacea 2("B2")

2.SLOW PYROLYSIS RUNS FOR BIOCHAR PRODUCTION

Slow pyrolysis was chosen as reference technology because it allows to maximize the biochar production.

Operating conditions (semi-batch lab-scale plant):

- ❑ Biomass loaded = 150 g
- ❑ Temperature = 400-550-700 °C
- ❑ Oxygen-free conditions (Q_{N2}=1,5 Nl/min)
- ❑ Pressure = 1 atm

3. BIOCHAR PHYSICAL-CHEMICAL CHARTERIZATION

The biochar was characterized following a dedicated protocol.

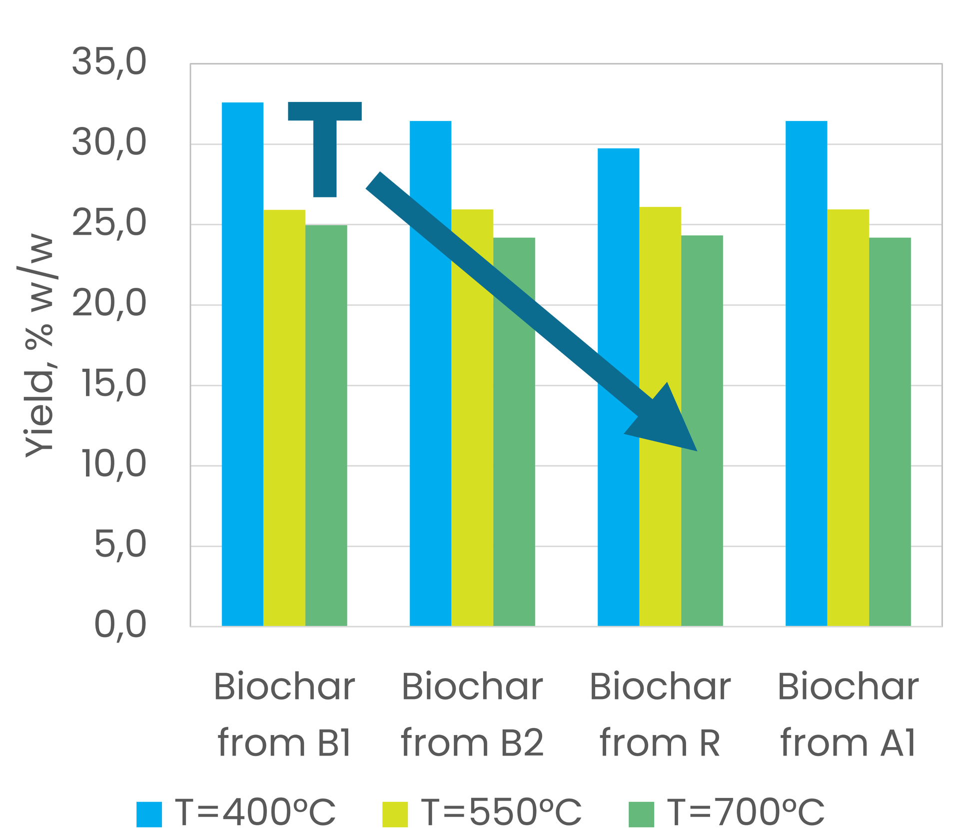
Bulk parameters: water content, ashes content, pH, conductivity.

Quantitative analysis: organic elemental analysis CHNS (H/C and C/N ratios), carbon speciation (organic and inorganic C, labile and stable carbon), organic pollutants (PAHs), inorganic macro and microelements.

Physical analysis: granulometry, bulk density, porosity.

RESULTS AND CONCLUSIONS

BIOCHAR YIELD IN SLOW PYROLYSIS RUNS



The slow pyrolysis conditions had guaranteed a good biochar yield ranging from 25-35% and favored by low temperature.

CHARACTERIZATION: CHNS, CARBON SPECIATION, ASH CONTENT, H/C AND C/N RATIOS

Tipo:	BIOCHAR from B 1			BIOCHAR from R			BIOCHAR from B 2			BIOCHAR from A 1		
T:	400°C	550°C	700°C	400°C	550°C	700°C	400°C	550°C	700°C	400°C	550°C	700°C
C tot (% d)	59,3	67,4	67,7	72,9	79,7	79,4	65,3	66,7	68,2	70,2	74,0	73,4
C org (% d)	59,3	66,2	67,6	**71,9**	**79,1**	**79,4**	58,4	64,0	67,8	**69,6**	**73,0**	**73,4**
C inorg (% d)	ND	1,2	0,1	1,1	0,7	ND	1,9	2,7	0,3	0,6	1,0	ND
H (% d)	3,2	2,1	1,1	3,5	2,2	1,1	3,6	1,9	1,0	3,6	2,2	1,1
N (% d)	**7,5**	**7,6**	**6,5**	3,3	3,1	2,7	**7,8**	**7,1**	**6,5**	5,1	4,6	4,0
S (% d)	0,9	0,4	0,6	<0,2	<0,2	<0,2	1,3	0,9	0,8	0,3	0,2	<0,2
O (% d)	14,5	6,1	6,5	6,7	7,5	2,9	11,2	17,5	5,2	11,1	11,5	8,7
Ash (% d)	14,7	16,5	17,6	**6,7**	**7,5**	**13,9**	13,7	17,6	18,3	**9,9**	11,6	12,7
H/C (-, mol/mol)	0,6	0,4	0,2	0,6	0,3	0,2	0,7	0,4	0,2	0,6	0,4	0,2
C/N (-, mol/mol)	9,3	10,4	12,2	23,9	28,2	34,2	9,1	10,2	12,2	16,2	18,8	21,3

- ❑ **The carbon is predominantly organic and is more abundant at higher temperatures.**
- ❑ **H/C ratios indicate that the organic carbon is stable and compliant with the legal limit (<0,7)[2].**
- ❑ **Biochar from R shows higher C/N ratios, thus indicating a slower release of nitrogen in soil.**
- ❑ **The ash content places the samples in Class 1 (<10%wt) and 2 (from 10 to 40%wt).**
- ❑ **The polycyclic aromatic hydrocarbons (PAHs) are below the legal limit (<6 ppm)[3].**

REFERENCES

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