BIO4A - Advanced sustainable BIOfuels for Aviation BIO4A

EUBCE
May 9th, 2022

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Project Partners

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 789562.

Call: LCE-20-2016-2017 Topic: Aviation Biofuels
Project title: Advanced sustainable BIOfuels for Aviation (BIO4A)

PROJECT CONCEPT

Accelerate the deployment of Aviation Biofuels, enabling commercial production. Supporting the accomplishment of pre-commercial plant(s) for advanced biofuels for aviation based on sustainable biomass feedstock.

PROJECT OBJECTIVES

1) To bring HEFA to full commercial scale in new plant using residual lipids (Used Cooking Oil - UCO);
2) To investigate alternative supply of sustainable feedstocks recovering EU MED marginal land for drought resistant crop production;
3) To test the entire chain and logistic at industrial scale, and assess environmental performances.
4) Positive GHG and energy balance expected

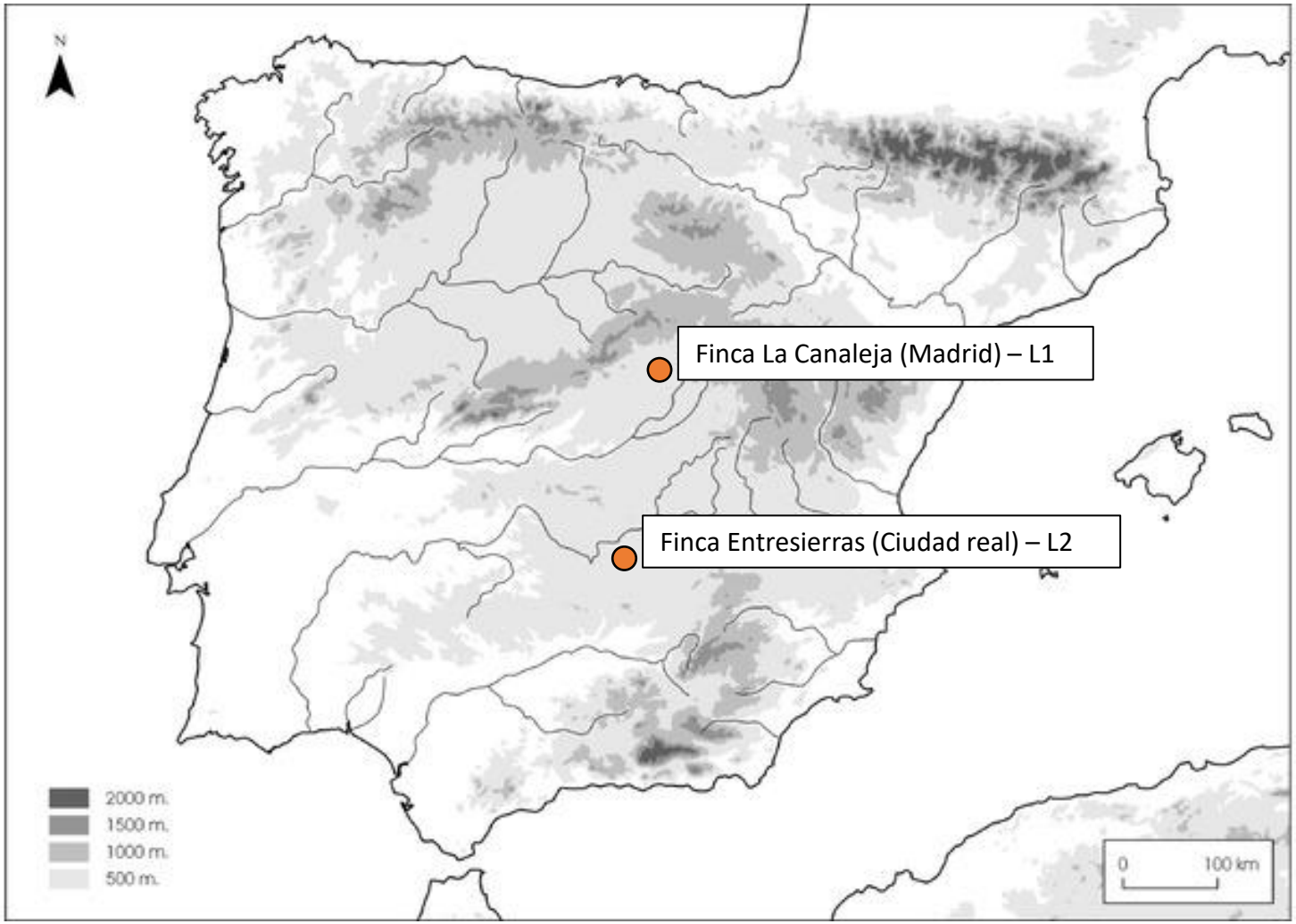
Highlights (technological/non-technological):
New Aviation Biofuel plant producing HEFA (5.000 tons)
Production and test of HEFA in commercial flights in non-segregated mode
R&D Work on marginal land in Spain and Italy recovered by biochar/compost addition producing non-food sustainable lipids
Dedicated Dissemination, Communication and Exploitation action

Industrial Activities M1 – M36

- New industrial partner (ENI, Italy) entering the Consortium from June 2021
- TRL unchanged
- AMBITION unchanged: Still largest-scale SAF production in Europe
- 14 Months Extension (end of project July 2023)

Field trials using Biochar and Combi in Spain

Locations



Biochar and Combi production (REC)

Products preparation and characterization

COMBI production in field condition		Delivery	Locations	Field trials
				
Batch 1	Summer season (Aug-Oct 2018)	CD1 CB1 CB2 CB3	L1: La Canaleja Madrid, Spain	Started in November 2018
Batch 2	Winter season (Dec-Feb 2018/19)	CD2 CB4 CB5 CB6	L2: Entresierras Ciudad Real, Spain	Started in February 2019

Feedstock and product characterization

Woodchips
Biochar
Solid fraction of digestate
COMBI products

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2. Field trials using biochar and Combi in Spain (CCE)

Biochar protocol: Trial design 2019 (Year 1)

No fertilization

Mineral fertilization

10% Biochar + Compost

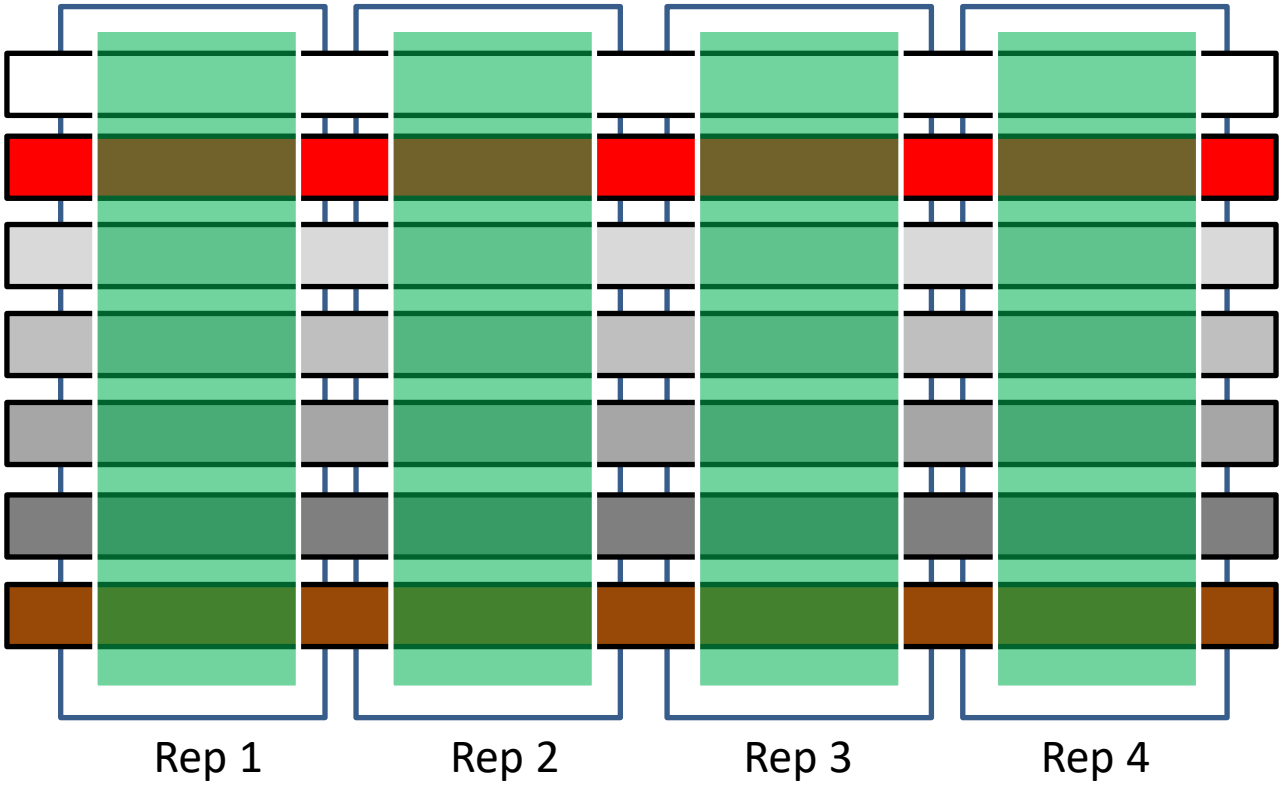
15% Biochar + Compost

20% Biochar + Compost

Biochar + mineral fert.

100% Compost

Camelina



2. Field trials using biochar and Combi in Spain (CCE)

Biochar protocol: Trial design 2020 (Year 2)

No fertilization

Mineral fertilization

10% Biochar + Compost

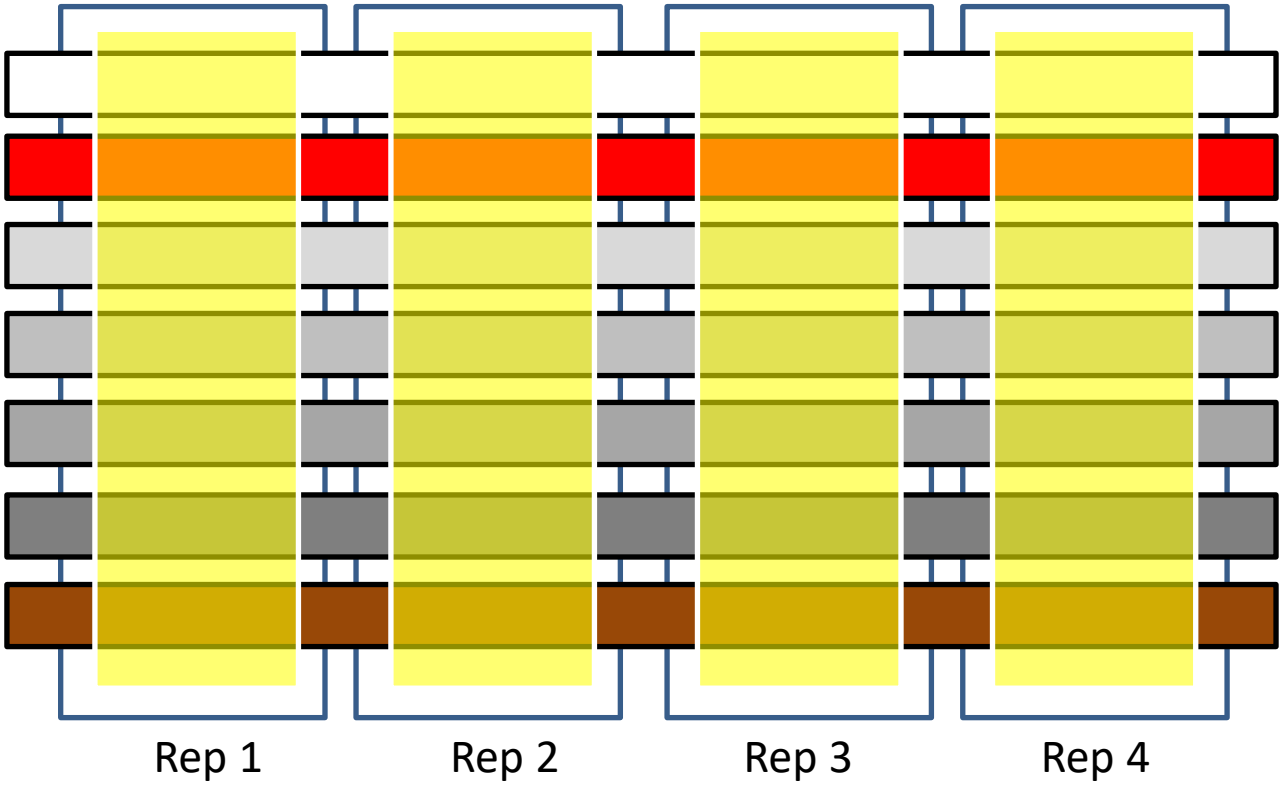
15% Biochar + Compost

20% Biochar + Compost

Biochar + mineral fert.

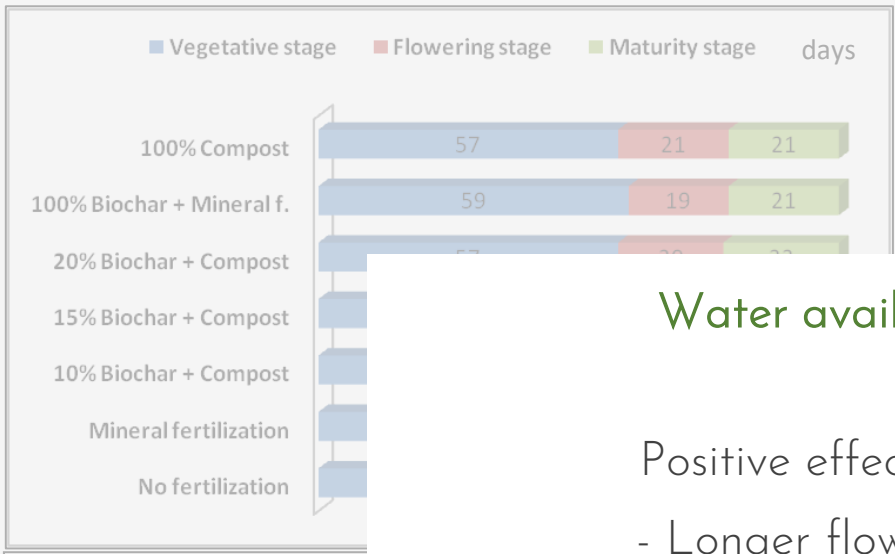
100% Compost

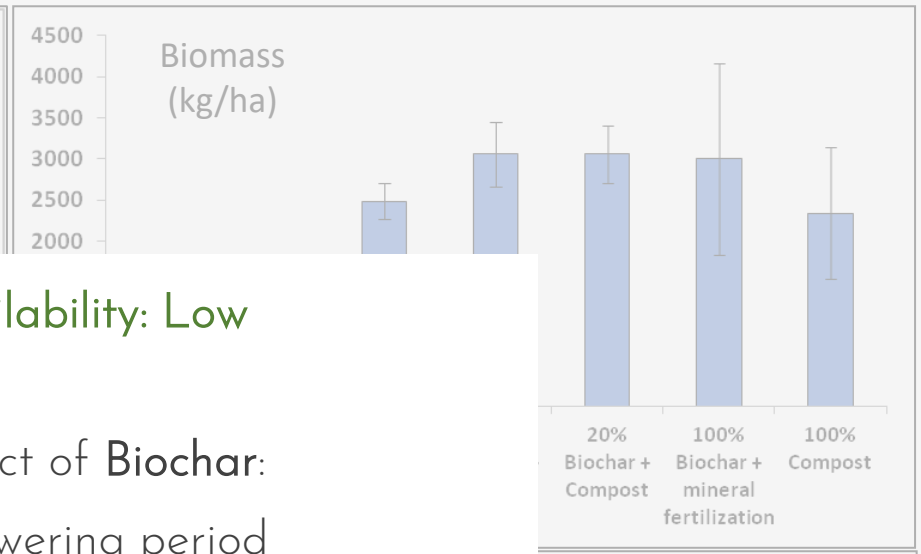
Barley



Field trials using biochar and Combi in Spain

Biochar protocol: Results in location 1



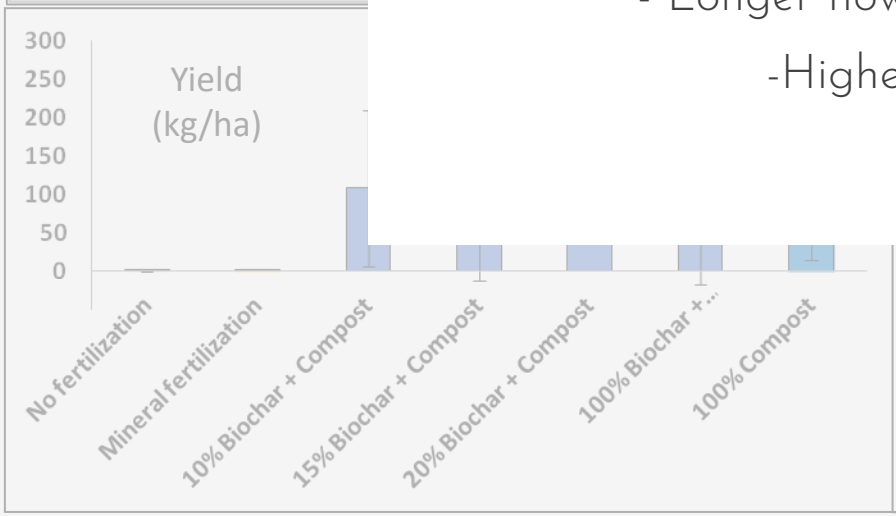


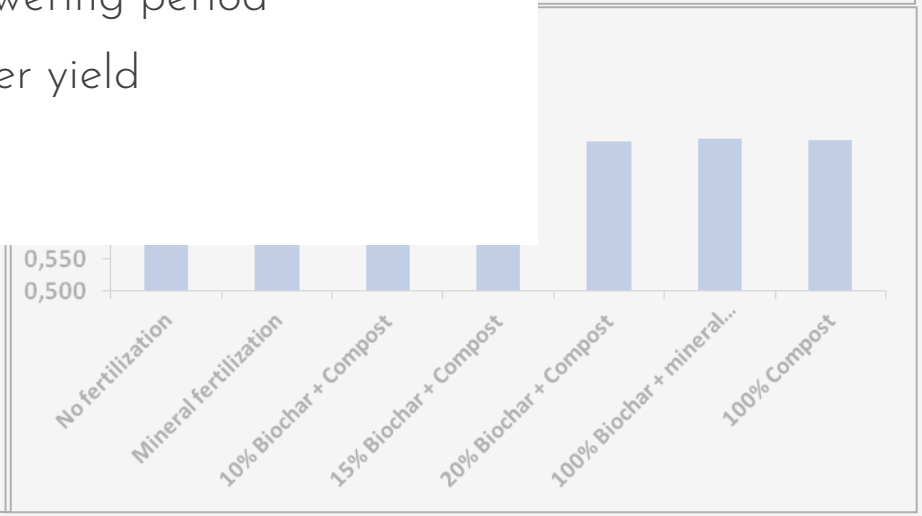
Water availability: Low

Positive effect of **Biochar**:

- Longer flowering period

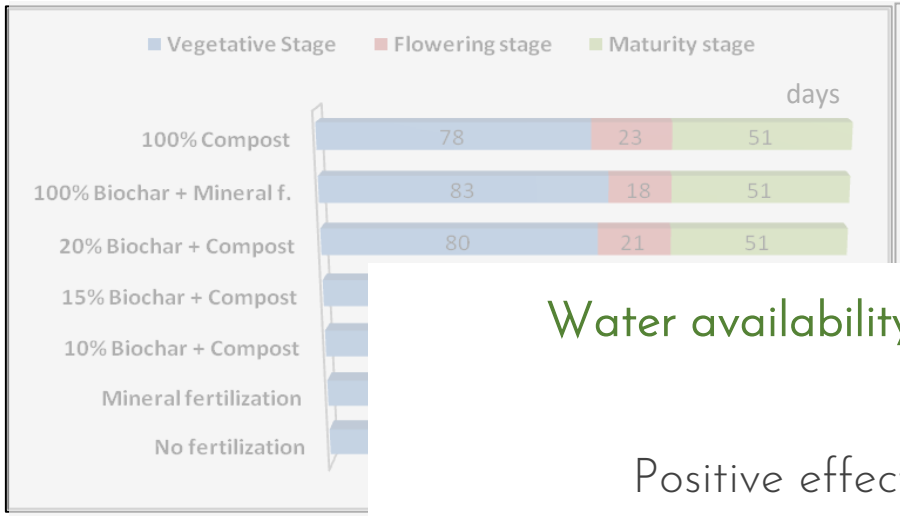
-Higher yield

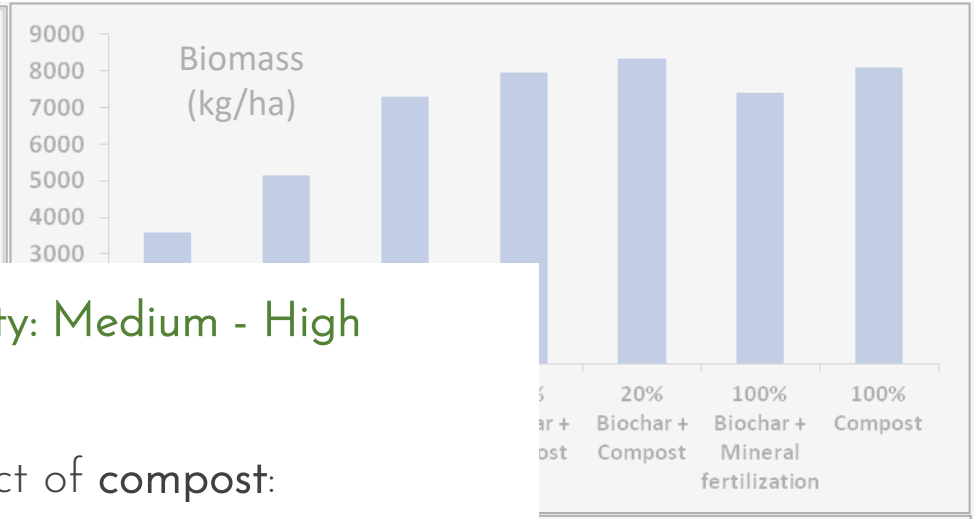




2. Field trials using biochar and Combi in Spain (CCE)

Biochar protocol: Results in location 2





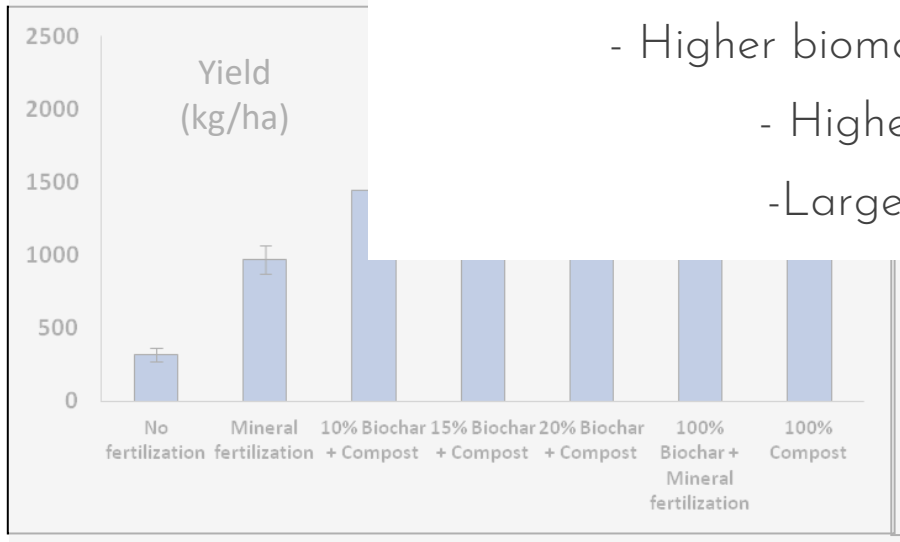
Water availability: Medium - High

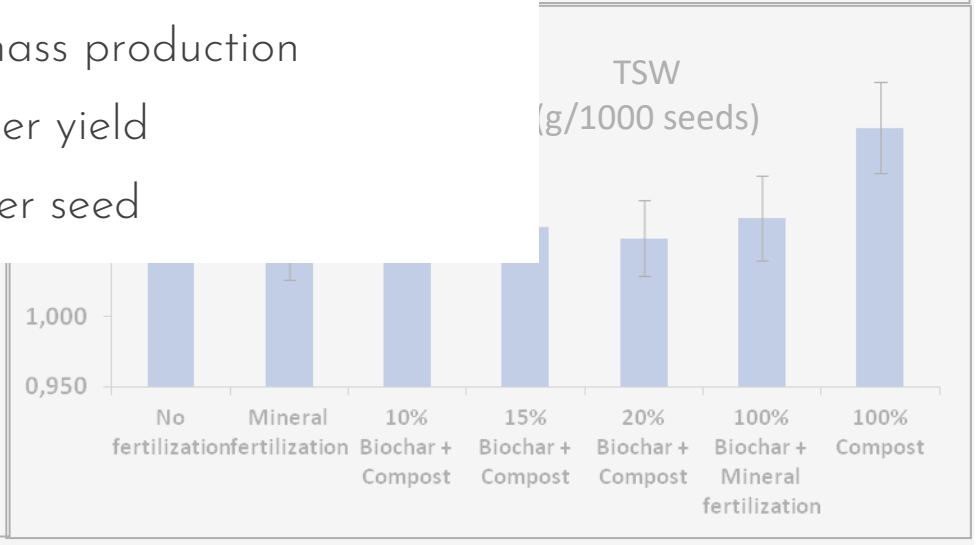
Positive effect of **compost**:

- Higher biomass production

- Higher yield

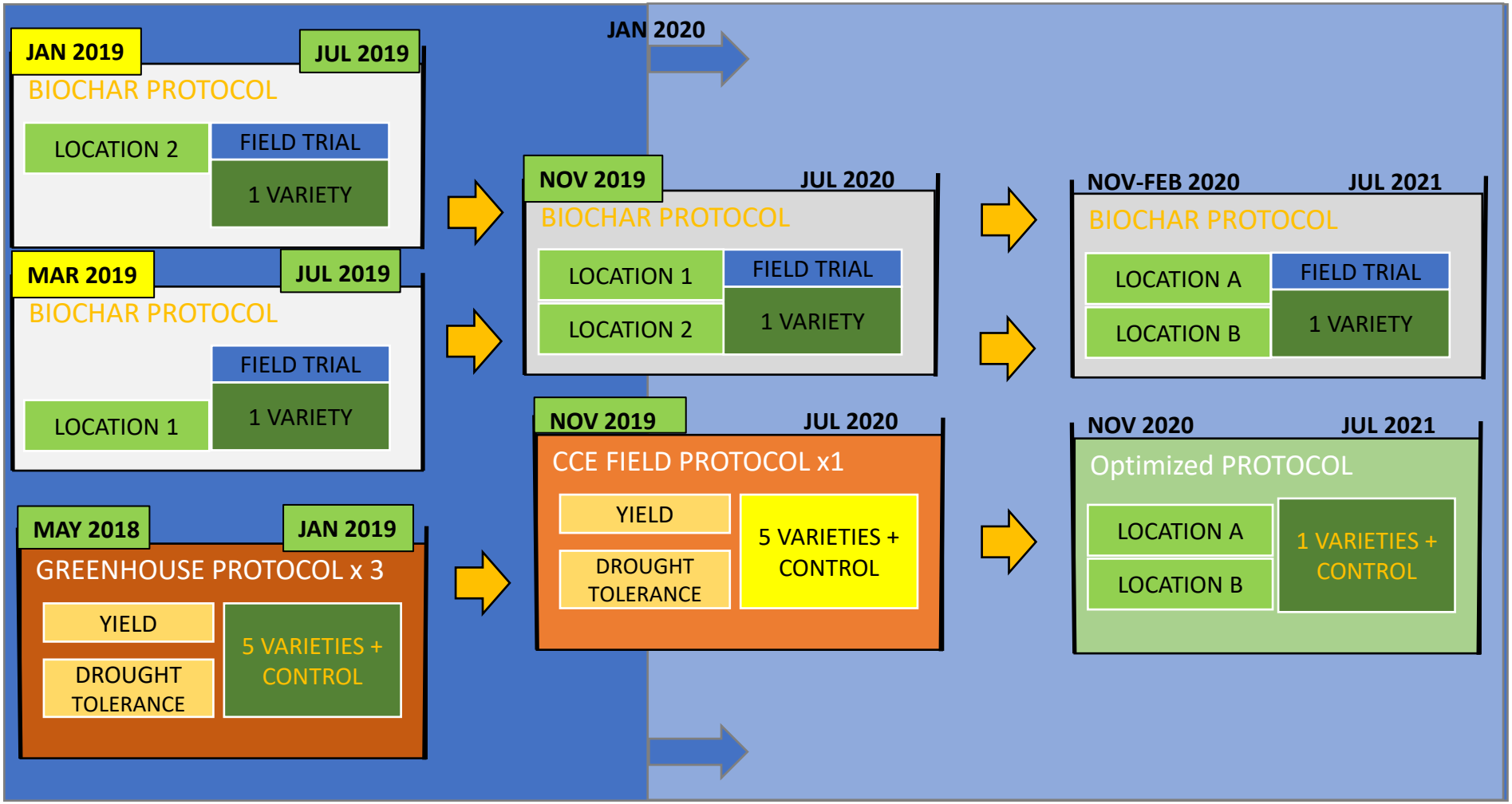
-Larger seed





Drought-resistant variety selection (CCE)

Update of the activities development situation



Lysimeters Trials in Italy

OBJECTIVES

1) Evaluate effect of biochar addition on soil humidity pattern and water holding capacity

2) Evaluate effect of biochar addition on N dynamics in soil leachate

3) Evaluate effect of biochar addition on soil GHG emissions

MATERIALS & METHODS

- Climatic chamber where field trials meteorology, soil and variety (Spain) are reproduced

- Comparation NPK vs Biochar (3 t/ha equivalent) + NPK

- 2 lysimeters for Humidity continuous monitoring

- 2 lysimeters for irrigation followed by leachate weighing (continuous) and analysis.

- Continous monitoring of ambient CO2

- Barley cultivation: variety Vinagrosa, seeding rate 250 kg/ha equivalent.

- Irrigation = Rainfall equivalent in field trial

- 3 replicates of 12 weeks experiment

Lysimeters Trials in Italy

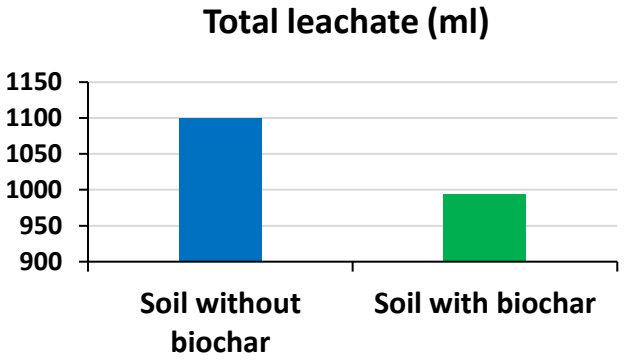
Germinated barley (1st leaf)

Lysimeters L1 and L2

Humidity Graph showing biochar effect (blue line)

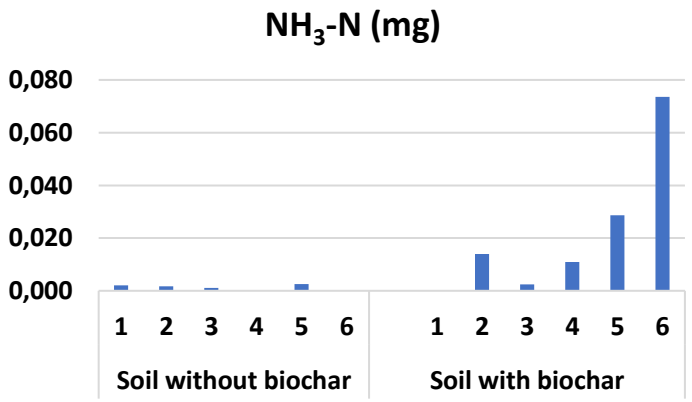
BIO4A – Lysimeter experiment: first results from Italy trial

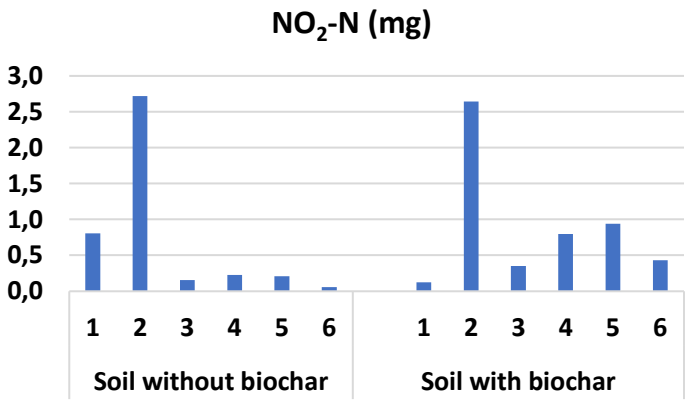
Treatments	pH	Leachate collected (ml)	Irrigation (ml)
Soil without biochar			
sample 1	7.9	59	290
sample 2	7.9	258	290
sample 3	7.9	38	90
sample 4	7.6	144	220
sample 5	7.9	190	220
sample 6	7.9	412	530
total		1100	1640
Soil with biochar			
sample 1	na	5	290
sample 2	7.8	234	290
sample 3	8.1	31	90
sample 4	7.8	123	220
sample 5	7.6	190	220
sample 6	7.7	410	530
total		*994*	*1640*

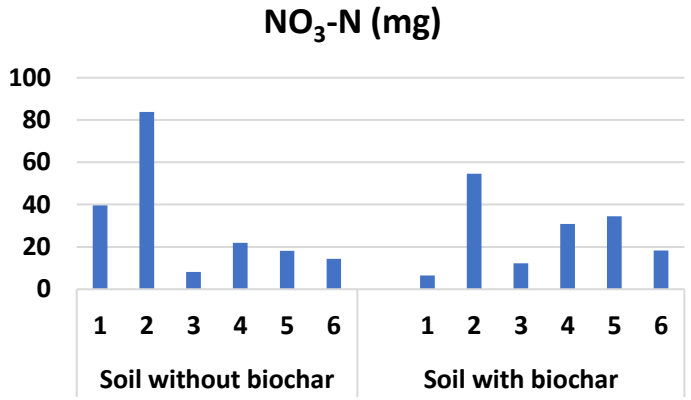


BIO4A – Total amount (mg) of N leached

	NH_3-N (mg)	NO_2-N (mg)	NO_3-N (mg)	Total N (mg)
Soil without biochar				
sample 1	0.002	0.8	39.6	40.4
sample 2	0.002	2.7	83.7	86.5
sample 3	0.001	0.2	8.1	8.3
sample 4	0.000	0.2	21.9	22.1
sample 5	0.003	0.2	18.1	18.4
sample 6	0.000	0.1	14.4	14.4
total	*0.007*	*4.2*	*185.9*	*190.1*
Soil with biochar				
sample 1	na	0.1	6.5	6.6
sample 2	0.01	2.6	54.6	57.3
sample 3	0.00	0.4	12.2	12.5
sample 4	0.01	0.8	30.8	31.6
sample 5	0.03	0.9	34.4	35.4
sample 6	0.07	0.4	18.3	18.8
total	*0.129*	*5.3*	*156.8*	*162.2*







Activities M1 – M40

- ✓ Year 3 agronomic field trials in Spain on marginal land completed, biochar protocol identified
- ✓ Year 1 agronomic field trials (larger scale) in Italy initiated (spring 2022)
- ✓ Lysimeters Experiment Experiment Completed
- ✓ Business case completed
- ✓ Report on Market Dynamics delivered
- ✓ Preliminary environmental assessment completed
- ✓ IPR Strategy identified
- Flight plan delivered

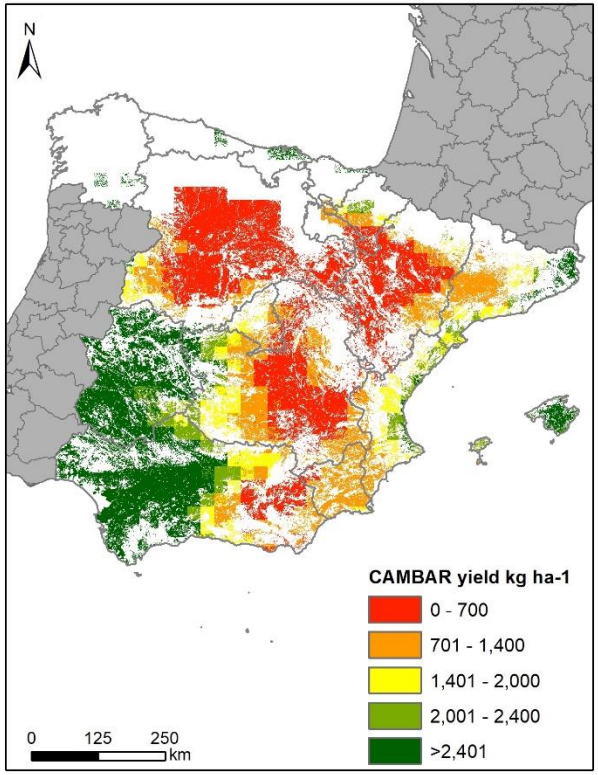
Suitability index of marginal lands for SAF production from Camelina

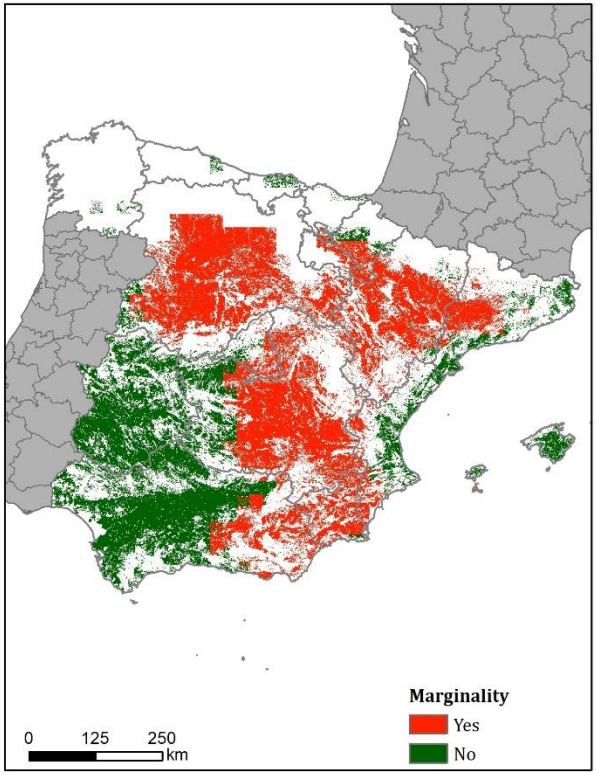
The deliverable D2.7 **Assessment of potential for drought-resistant oil crop in marginal land of Southern Europe and abroad** will build a suitability index based on the following criteria:

1) **Marginal land categories** in relation to the EU Renewable Energy Directive
2) Specific **agronomic requirements** of Camelina, including:
Camelina is a short-season crop (85–100 days), generally cultivated as a rotation crop or cover crop with cereals. When used as a cover crop, Camelina provides soil protection by reducing wind and water erosion after the main crop, when the land would normally be fallow. This characteristic supports its use during fallow periods within ongoing crop cycles.
Grows well in soils with a sandy or sandy-loam textures (even silty-loam). Can tolerate low nitrogen levels (100 kg ha^{-1}).
Climatically, it can tolerate low levels of annual precipitation (even in semi-arid conditions with annual precipitation < 250 mm), especially if cultivation is linked to winter/spring rainfall (i.e. typical of 'hot-dry summer' variant of Mediterranean climate - Köppen climate classification Csa and cold semi-arid climate - Köppen climate classification BSh)

3) Methodology for **determination of extent of production**

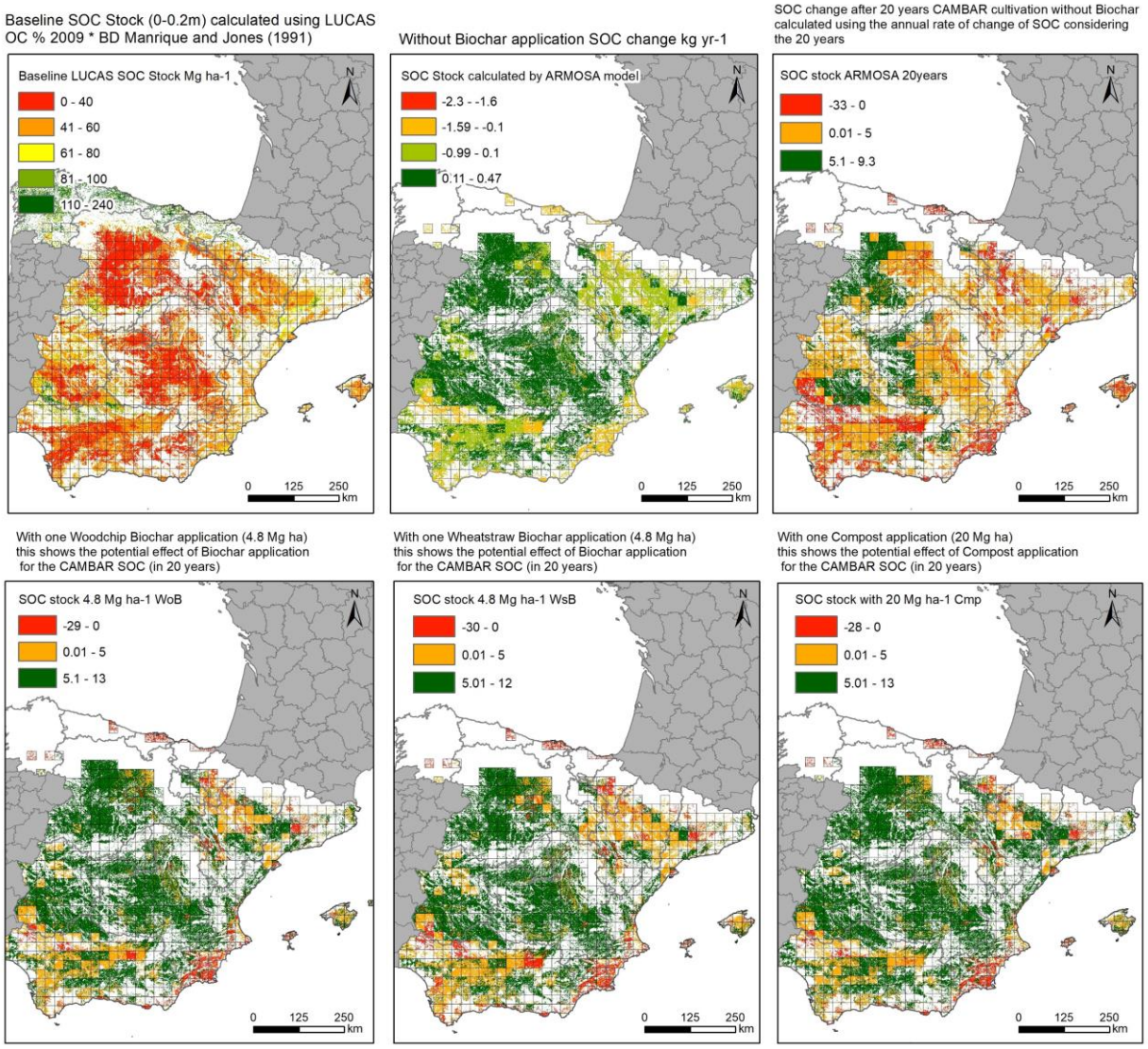
Suitability index of marginal lands for SAF production from Camelina





Model Average Change in Yield with Camelina/Barley rotation on marginal land (20 years) (Spain)

Suitability index of marginal lands for SAF production from Camelina



Model Average Soil Organic Stock (SOC) change after 20 years

(Spain)

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R&D Activities M1 – M40

R&D Activities on biochar production plant from woodchips and agroresidues

- ✓ Design and test activities on Moving bed pyrolysis reactor model adaptation and innovative concept prototype
- ✓ Mechanical works on Fixed bed carbonization unit.
- ✓ Moving bed carbonization unit installed, in operation since 2020.

R&D Activities performed on UCO pre-treatment to contribute to and enhance the long-term supply of this feedstock

✓ Hydrolysis and non-catalytic thermochemical conversion tests performed for alternative FFA production pathway

Bio4A

Advanced Sustainable Biofuels for Aviation

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Project Partners

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