Advancing Circular Economy in Agriculture

22/10/2024 BRUSSELS (BELGIUM)

Improved Soil Biodegradability of Chicken Feather via Steam Explosion for Sustainable use in Agricultural Bioplastics

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This project has received funding from the Bio-based Industries Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement Nº 101023306

UNLOCK

END PRODUCTS

Mulch film

Hydroponic foams

Seed Trays

Mulch film

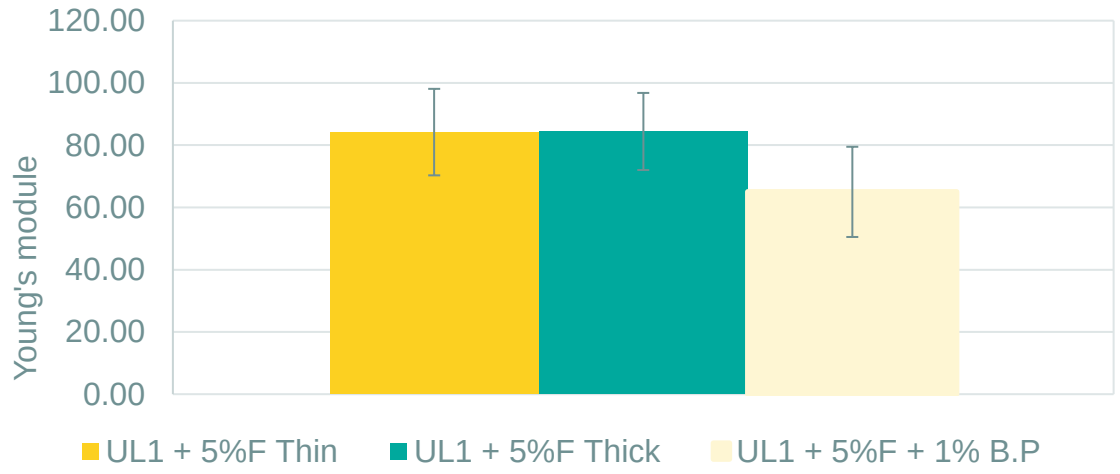
UL1 matrix from **BIOMI** was selected for the final mulch film formulation:

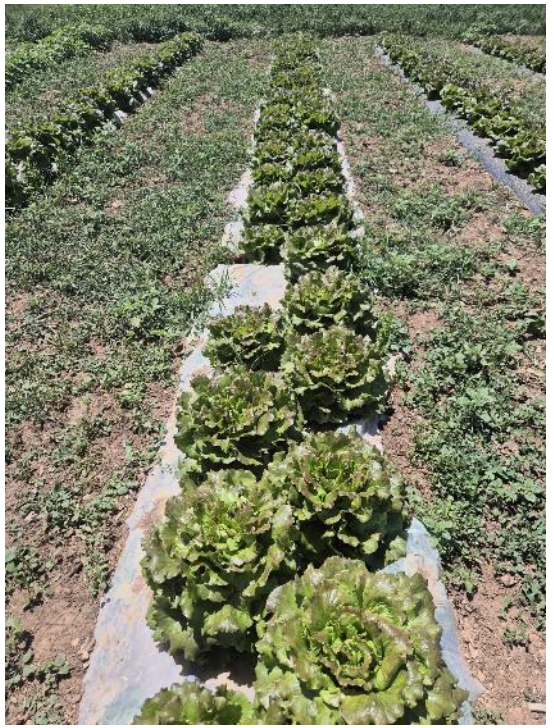
Formulation
UL1 + 5%SE

Blown extrusion requires to melt the material and fed into a heated barrel with a single screw until it enters in a vertical die and gets extruded to form a thin-walled tube. Air is injected into the tube, expanding the melting blend. It gets pulled upwards to cool down and the bubble is flattened until collapse into film layers. Finally, it gets rolled.

Mulch film characterization

Name	YOUNG'S MODULE (MPa)	MAXIMUM FORCE (Mpa)	MAXIMUM ELONGATION (%)
UL1 + 5%F Thin	84 ± 14	4,6 ± 1	209,34 ± 57,96
UL1 + 5%F Thick	84 ± 12	4,1 ± 0,6	311,66 ± 31,34
UL1 + 5%F + 1% B.P	65 ± 14	3,7 ± 0,5	230,7 ± 36,81





Lettuce crops

Until now, it has been seen that due to its speed of degradation, this type of mulch is more suitable for short crops such as lettuce and broccoli.

Currently, a study is being carried out on its biodegradability on soil.

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Hydroponic foams - Context

Hydroponics

Horticulture technique which involves growing plants ***without soil*** in an artificial environment.

Inorganic substrate (perlite)

Polyurethane substrate

Substrates are generally porous media that retain moisture, oxygen and nutrients, providing physical support for plant roots in hydroponic systems.

Hydroponic foams have been developed in the **UNLOCK Project** as a novel substrate media which:

- Aims to provide an **alternative substrate**, based on **biopolymers**, with **reduced environmental impact** and generating **zero waste** compared to other substrates, such as PU foams.

- Uses **keratin fibers** as part of their formulation, enhancing **biodegradability** at its end of life and **providing nutrients** to the soil.

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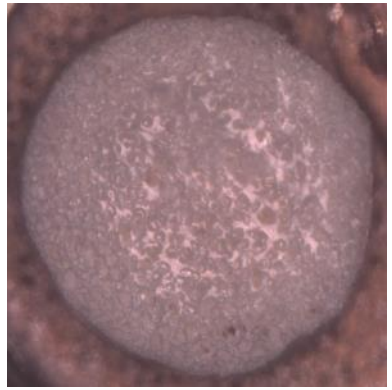
Hydroponic foams

UL1 matrix from **BIOMI** was selected for the final foam formulation:

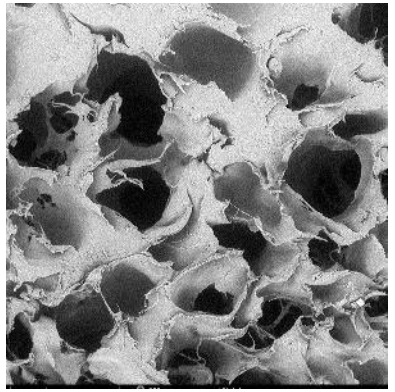
Formulation
UL1 + 1%SE-190ºC-4min + 5% ATBC

Physical foaming by extrusion involves injecting gas as a blowing agent in the process while the polymer is molten. As the material exits the die, the gas expands creating a foamed structure:

Foams obtained



1 cm



1 mm

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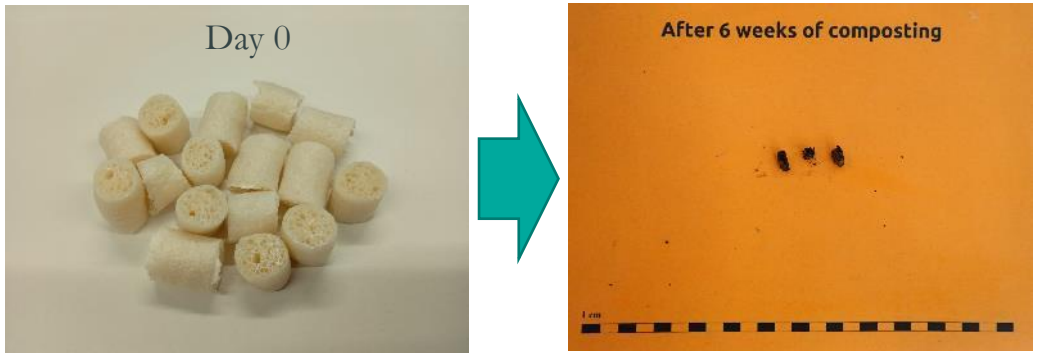
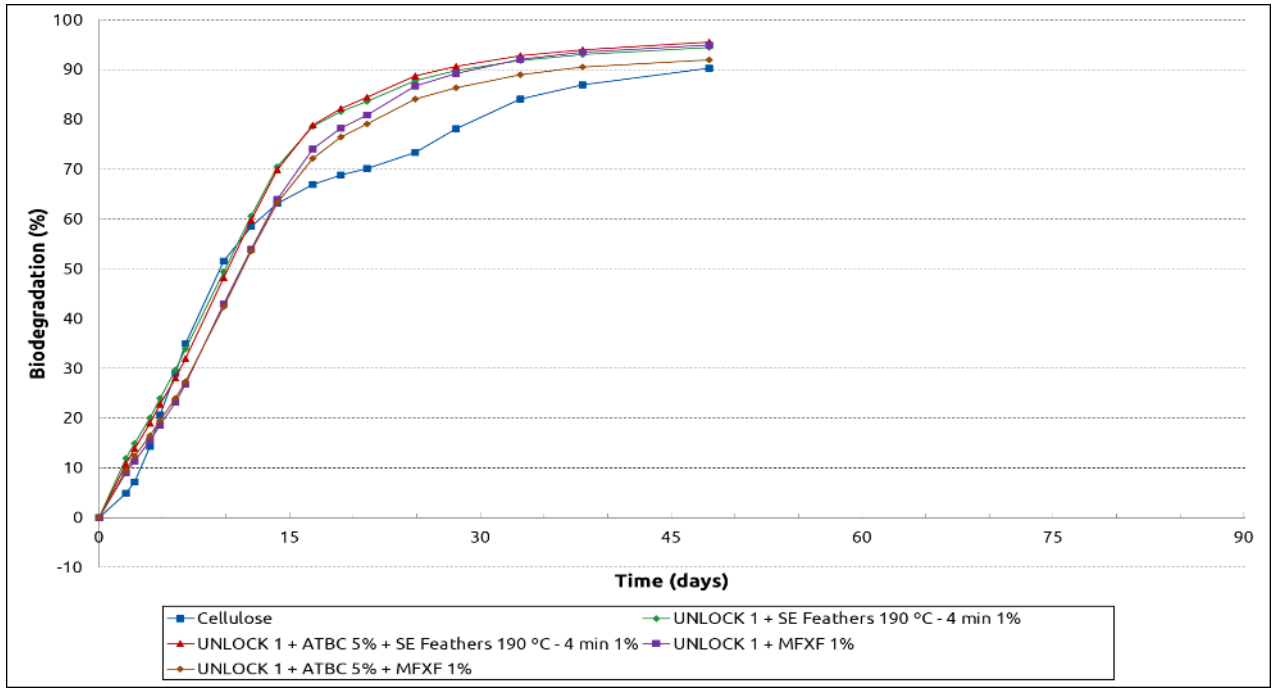
Hydroponic foams characterization

Property	Value
Density (g/cm^3)	0,19 – 0,21
Diameter (mm)	85 - 90
Cell size (microns)	150 - 300
pH	Neutral (6,5 – 7,5)



Disintegration tests



Biodegradation under industrial composting conditions

UNLOCK foams show enhanced **biodegradability (**composting conditions) due to the presence of **feather keratin**.

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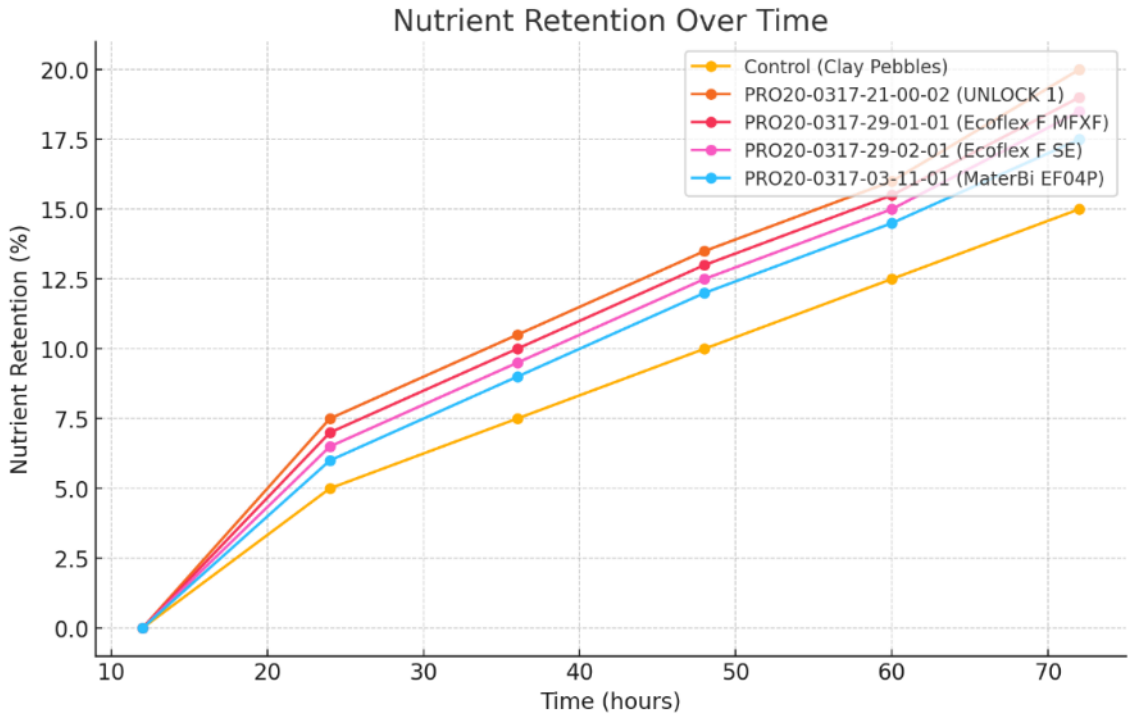
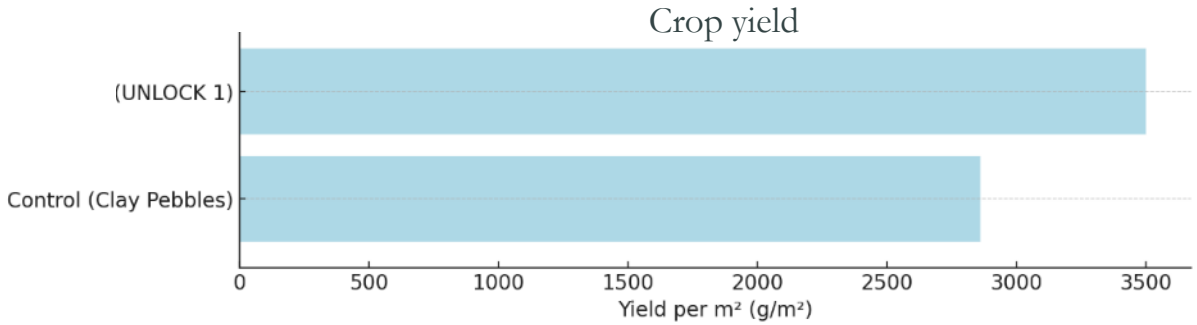
T.A. Terra Aquatica

Hydroponic foams – Product validation

Validation tests involve comparing **UNLOCK foams** with a **conventional substrate** (clay pebbles):





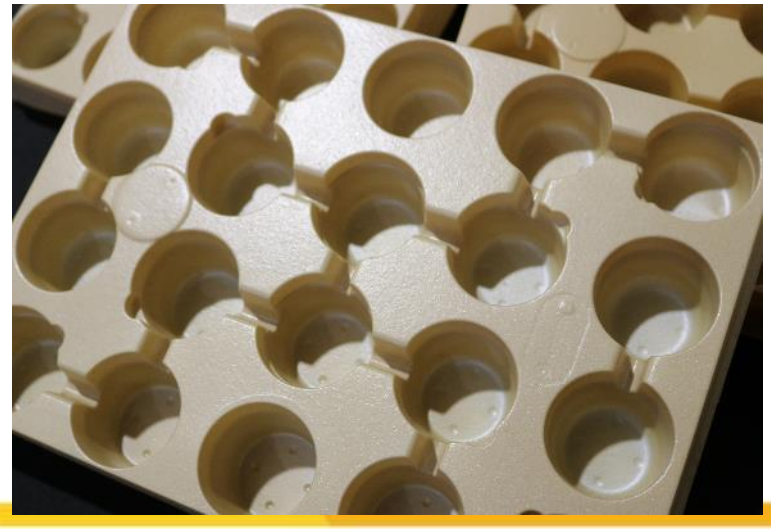
- **UNLOCK foams** exhibit great yields, **outperforming** the conventional substrate clay pebbles **by 20%.**
- Higher **nutrient retention rates** from UNLOCK foams is a key factor contributing to crop yield.
- Other factors such as **water absorption**, or its **organic structure** due to the **keratin fibers** also positively affect the UNLOCK foam's performance.

Seed Trays

UL6 rigid matrix from **BIOMI** was selected for the final seed trays formulation:

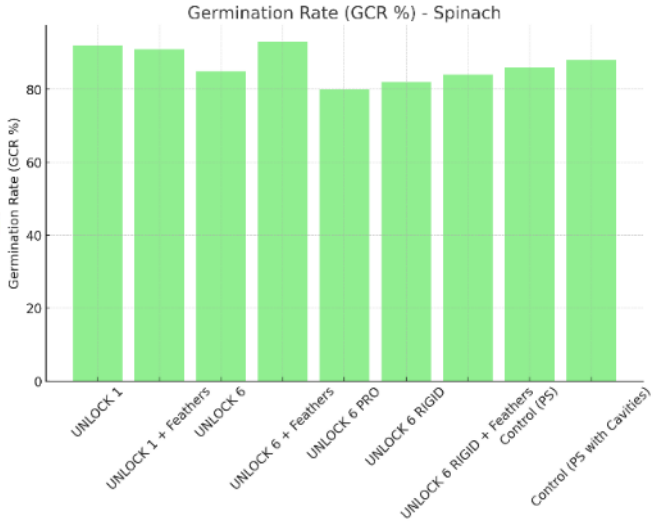
Formulation
UL6 rigid + 10%SE F

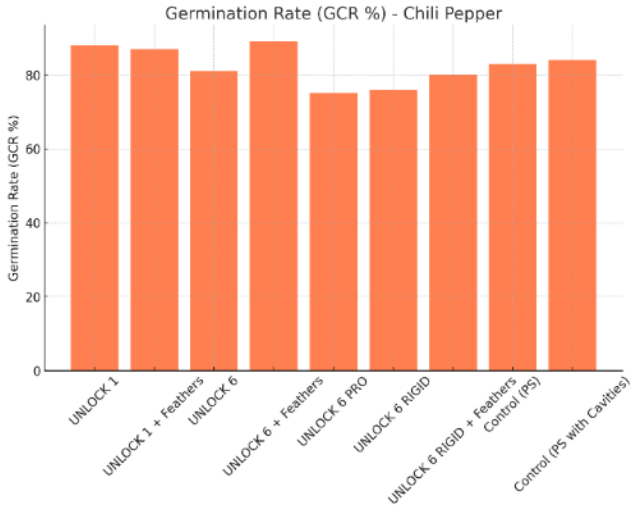
Thermoforming process consists of heating the sheet until it becomes soft, after which the mold is applied on it so that it acquires the shape of the mold. A vacuum is applied to eliminate air between the sheet and the mold and then the sheet is separated from the material.



- Made from non-fossil materials
- Biodegradable in compostable conditions
- Enhances circularity by turning waste feathers into valuable agricultural products

Seed Trays





UNLOCK materials performed the best, with germination rates of arounf 90%.

Seed trays allow for precise control over moisture, temperature, and light, creating optimal conditions for germination.

The production and end-of-life phases of UNLOCK trays contribute to a reduction in overall CO2 emissions.

Thanks for your attention !

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Thank you!

Questions??

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