Corso di Dottorato di Ricerca in Scienze della Vita e dell'Ambiente - Ciclo XXXVII

Development of algae-based biostimulants according to the principles of the circular economy

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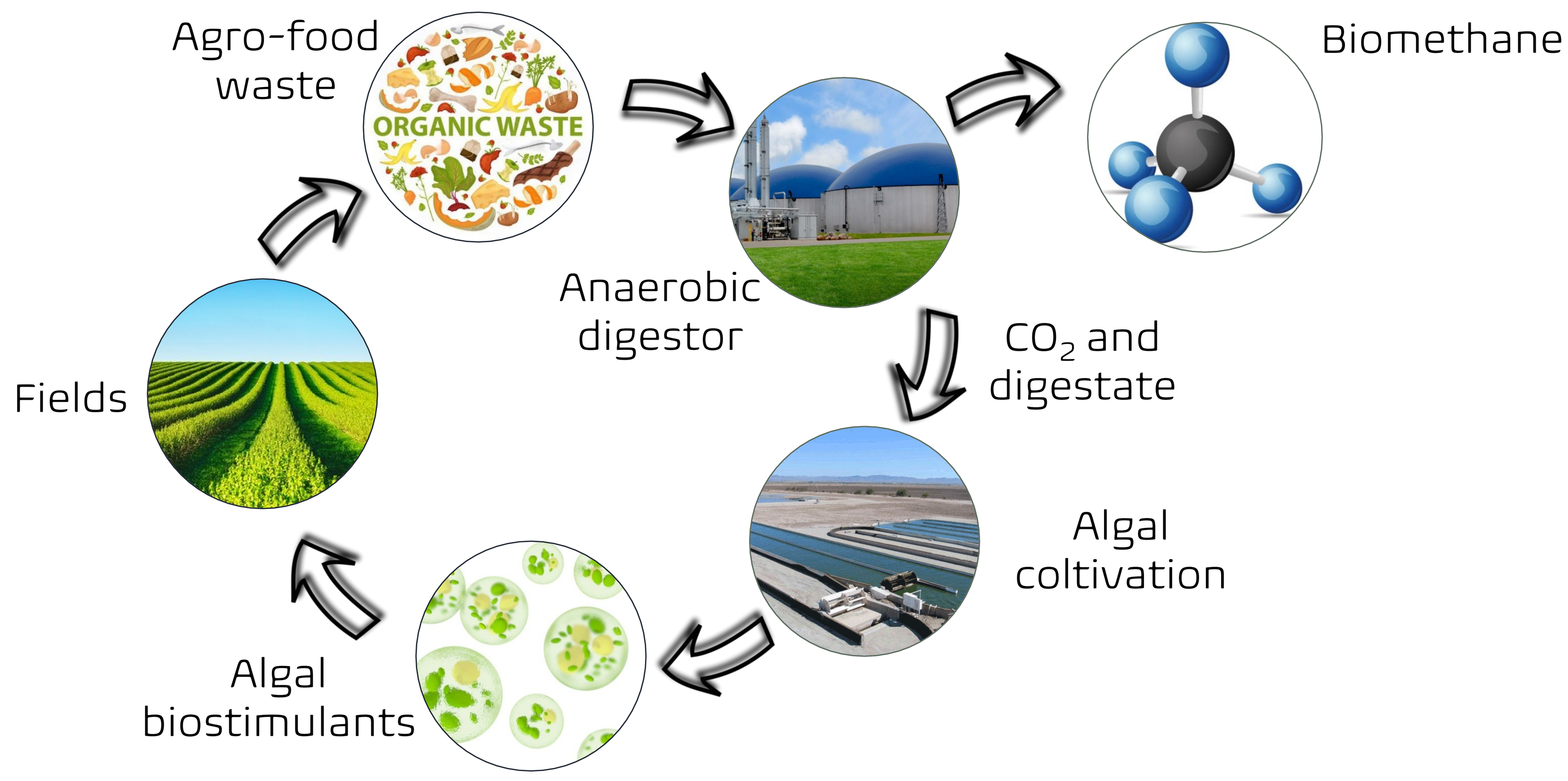
INTRODUCTION



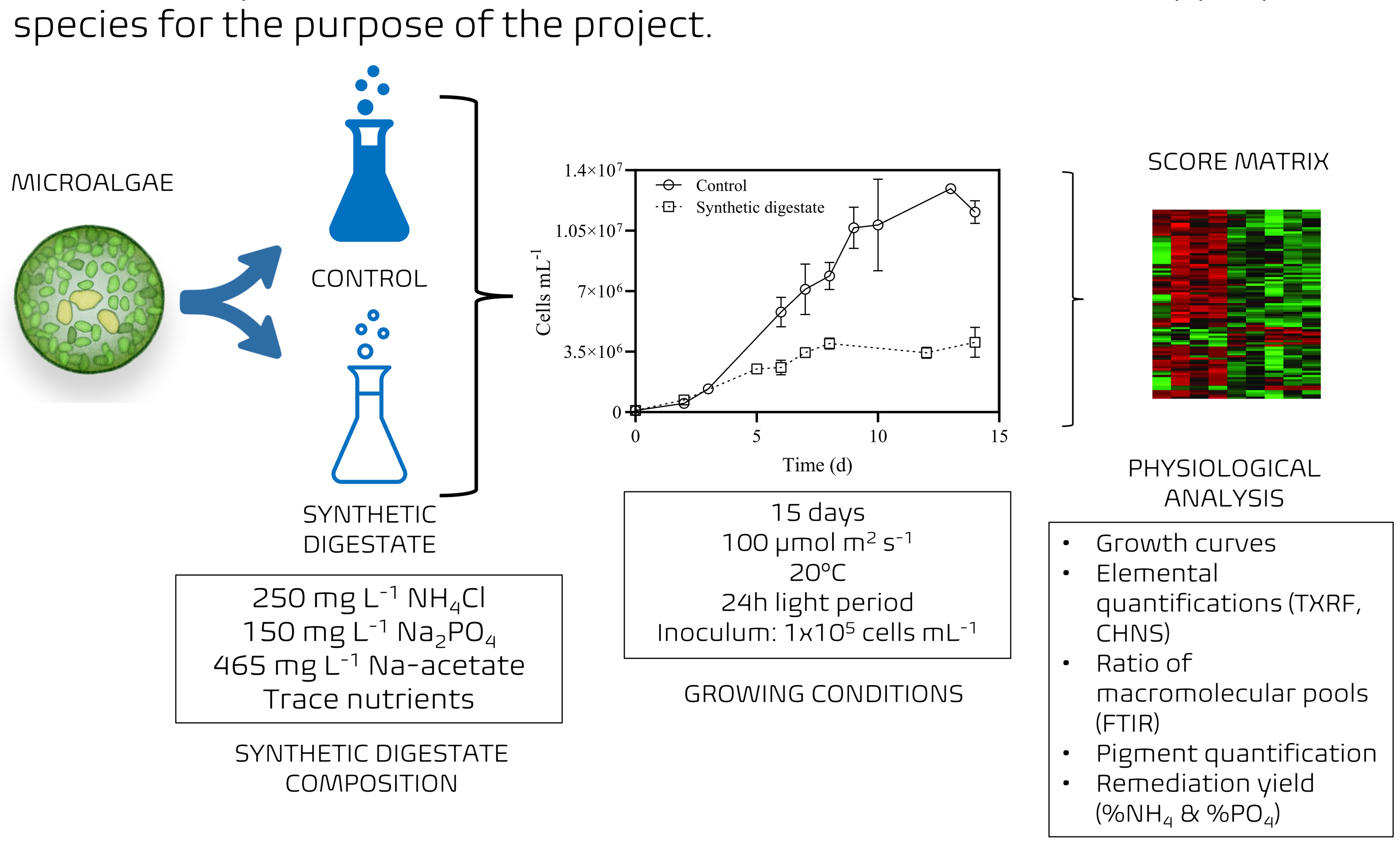
The main goal of the PhD project is to realise a «field-to-field» circular process where microalgae are used to remediate wastewaters (digestate) and CO2 coming from the anarobic digestion of organic waste and the upgrading of biogas to biomethane. The algal biomass produced during the remediation will be used to biostimulate crops grown on the same fields the waste came from.

Digestate is rich in ammonia, phosphate and organic carbon, thus representing an alternative nutrient source to microalgae. The high concentration of ammonia and an unbalanced nutrient stoichiometry require the selection of the appropriate algal species in order to guarantee the sustainability of the process.

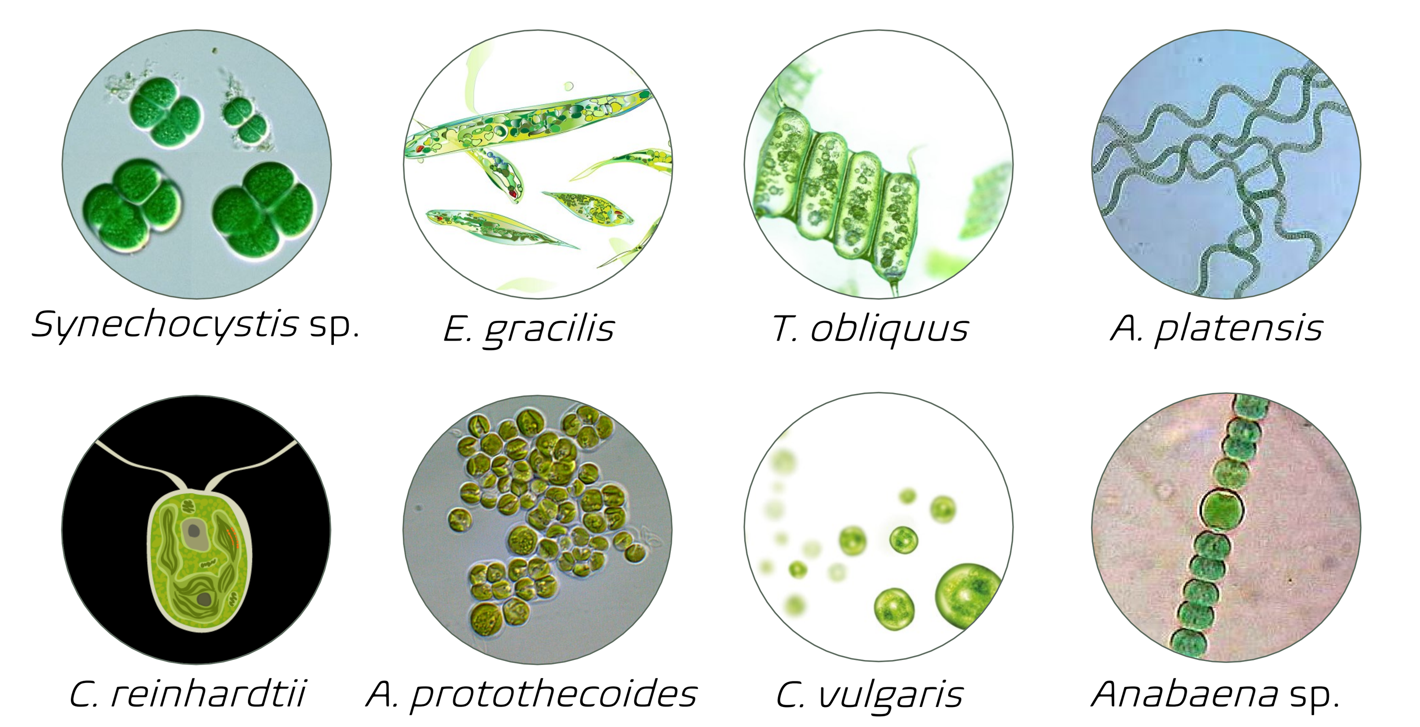
1st YEAR

EXPERIMENTAL DESIGN

Microalgae are grown in synthetic digestate where the nutrient concentrations are about 1/5 of the corresponding concentrations in a real digestate. Growth is then compared to the one in control conditions and several parameters are taken into account to select the appropriate species for the purpose of the project.



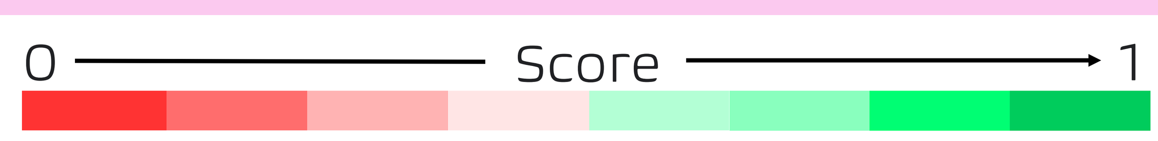
SELECTION OF THE MICROALGAE



According to a bibliographic search the species with suitable features for growth in synthetic digestate are listed above.

Algal requirements:
- Freshwater species
- Ability to remediatiate wastewaters
- Ability to thrive at high CO_2 concentrations
- Known biostimulant activity.

RESULTS AND FUTURE PERSPECTIVES



	Growth rates [d^{-1}]	Biomass at stationary phase [mg mL^{-1}]	Productivity [mg mL^{-1} d^{-1}]	Biomass per day [mg d^{-1} mL^{-1}]	Nitrogen removal [%]	Phosporous removal [%]	Score
C.reinhardtii	0,46 ± 0,02	1,72 ± 0,03	0,88 ± 0,02	0,18 ± 0,01	81% ± 0%	30% ± 3%	0,57
A.protothecoides	0,53 ± 0,03	1,38 ± 0,23	0,73 ± 0,09	0,27 ± 0,05	76% ± 1%	57% ± 3%	0,73
T.obliquus	0,63 ± 0,01	2,12 ± 0,20	1,33 ± 0,15	0,26 ± 0,02	94% ± 0%	42% ± 13%	0,90
E.gracilis	0,24 ± 0,01	0,65 ± 0,15	0,16 ± 0,04	0,12 ± 0,01	91% ± 0%	61% ± 1%	0,46
Anabaena sp.	/	/	/	/	/	/	0
A.Platensis	/	/	/	/	/	/	0
Synechocystis	0,08 ± 0,03	0,42 ± 0,05	0,03 ± 0,00	0,01 ± 0,01	71% ± 1%	32% ± 4%	0,02
C.vulgaris	0,55 ± 0,02	0,35 ± 0,05	0,19 ± 0,03	0,20 ± 0,02	92% ± 0%	36% ± 10%	0,47

Three algal species are selected based on 6 different parameters. Four of them regard growth performance and two are about the remediation yield. *T. obliquus* is the species obtaining the best score, followed by *A. protothecoides* and *C. reinhardtii*.

These three species will be used in monospecific cultures and in algal consortia for the remediation of a pre-treated digestate. Eventually, a probiotic bacteria like *Azospirillum brasilense* will be added to the consortia to enhance algal growth and remediation yield.