

BIAM : Seven platforms or mutualized technological resources

PHYTOTEC

Environmental stress

Isotopic labelling

Measures and culture under controlled conditions

Experimentation under modified atmosphere

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SALTO

Microbiology and plant lab for the use of radioisotope tracers or radionucleides

ZOOM



ACCES REGLEMENTE

Pool of microscopes (optic, spinning disk confocal, raman)

PROTEINTEC

recombinant proteins

Medium-throughput expression of

From purification to structural analysis

IONOTEC

Measure of ion concentration

- ICP-OES
- ICP-MS





HELIOBIOTEC

Culture in controled photobioreactors Metabolomic analysis of lipidic compounds Gas exchange measurement



CBiB Bio-Informatics and bio-statistics









HOW IT WORKS



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- Platforms at the service of the BIAM staff but functions also in the form of collaboration or service with external partners
- Some are associated with a team, others have a team rank (Phytotec)
- Access by contact with the platform manager
- Steering committee (local)
- Existence of a charter since 2019
- Operating account and fee schedule





PHYTOTEC PLATFORM

A multidisciplinary team with dedicated staff (5 FTE)

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EQUIPMENTS





> 8 GROWTH CHAMBERS for specific cultures conditions and control of the gazeous atmosphere



Janvier 2024

Journées LSCE/BIAM

- > 1 CHAMBER IMAPLANT for growth and phenotyping of plants in response to dynamic climate
- Mechanical and electronic WORKSHOPS for technical innovation





Aix+Marseille



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PHYTOTRONS

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- The platform includes 11 phytotrons and two *in vitro* phytotrons built in 2020
- ~ 100 m² of cultivable surface (adapted to GMO)
- Latest generation LED lighting (up to 1250 μ mol photons/m²/s)
- Variable temperature, humidity and lighting
- More plants of agronomic interest; wheat, corn, potatoes, peas...
- NEW: Use of topsoil in place of potting soil will be allowed







VEGELED SUNLIKE







GROWTH CHAMBERS

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- The 8 chambers allow the cultivation of a wide range of plants under controlle conditions: humidity, temperature, gas atmosphere, watering and lighting
 - Allow to generate and control extreme environmental conditions
 - Monitoring of gas exchanges: photosynthesis, respiration, transpiration
 - Tightness allowing the labelling of plants with stable isotopes : ¹³C and ¹⁵N enrichment > 95%
 - Unique in France
 - increase of ¹³CO₂ price x 4 in 18 months
 - Monitoring of gases present at very low concentration













IMAPLANT

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- Innovative and unique device issued from R&D BIAM
- > Enables the study of phenotypic responses of *A. thaliana* plants
- Simulation of rapid climatic changes thanks to the very fine control of environmental conditions
- Monitoring of the physiological state of the plants (81 pots) thanks to 3 types of embedded cameras: visible, IR and fluorescence
- IMADATA data analysis software allowing a real time and remote monitoring of measurements









Technological innovation workshop

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Ensures the maintenance of the installation and the development of innovation experimental devices

Rapid response to technical problems for all BIAM teams



CITÉ

v cea

DES ÉNERGIES

Electronics and electromechanics workshops



Imaging robots for petri dishes





IMAPLANT chamber





LEDs ceiling light





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HELIOBIOTEC





PLATFORM « HelioBiotec »

Equipe « Environment Bioenergies Microalgues Plantes »

Head: Yonghua Li-Beisson

Scientific advisers:

Fred Beisson (DR2, CNRS) Gilles Peltier (DR, CEA)

Technical experts:

Bertrand Légeret (IE, CNRS) Stéphan Cuiné (IE CEA) Marie Bertrand (AI, CNRS)

A steering committee meets bi-annually to oversee its management Composition: F. Beisson, G. Gras, Y. Li-Beisson, G. Peltier, C. Santaella; D. Pignol



CITÉ DES ÉNERGIES **CEA** has a long tradition of studying algal fuels......



byCea

Pierre Guérin de Montgareuil created in 1978-1980 « Association for Research in Solar Bioenergy » CEA, CNRS, ORSTOM, TOTAL, ELF Aquitaine, Rhône-Poulenc

(Funding 40% ADEME)

Héliosynthèse

« Inauguration 2010 »

HelioBiotec





Gilles Peltier 2009







Botryococcus braunii



Haematococcus pluvialis



Chlamydomonas reinhardtii







Objectives

Objective: to explore the potential of **microalgae** for the production of **biofuels**.

A timeline:

- Initial funds: a state-region (CPER) contract.
- Created in 2009 by G. Peltier
- Labelled by the European platform network IBISBA (2017-).
- Directed by Y. Li-Beisson since 2018 (as part of the EBMP team).







« Noël 2021 »



Savoir-faire and instrumentation

Algal cultivation:

- Controlled cultivation chambers; cryo-tank for strain conservation
- Flow cytometer
- Robotized high density strain management (96/384)

Physiology, genetics and strain characterizations:

- Instrumented photobioreactors
- On-line gas analysis Membrane Inlet Mass Spectrometry
- Photosynthesis measurement PAM, JTS
- Genetic manipulaiton and genome editing (Crispr-cas9)
- MoClo toolkit for Chlamydomonas

Lipidomics:

- For small volatil hydrocarbon analysis: GC thermo desorber
- For fatty acid composition analysis: GC-MS, GC-FID/MS
- For lipid classes analyses: HP-TLC
- For lipidomics: UPLC-QTOF-MS/MS ; UPLC Orbitrap MS/MS





Highlight 1: from algal cultivation, genetic manipulation to biophysics











Vacuum pump



Spéctromètre de masse Prima ôB. Crédit: E. Billon/CEA

New purchases:

Membrane Inlet Mass Spectrometry (MIMS) Funding: 50% EBMP + 50% Region







Highlight 2: A complete range of lipidomics tools

From lipid extraction, lipid classes and fatty acid analysis to lipid molecule species



Type of apparatus:

Flow cytometer HPTLC 2 GC-MS GC-FID/MS thermo-desorber GC-MS and LC-MS/MS (Q-tof; Orbi-trap)

New purchase : Capillary electrophoresis-mass spectrometry (CE-MS) Funding: 50% EBMP + 50% Region

ntensity





Major results and collaborations

Major results (past 5 years):

- **75 projects** (37 with funding; ANR, industriel, Europe...)......
- 76 papers in peer-reviewed journals: (2 Science, 1 Nature, 1 Nature Comm., 3 PNAS, 2 Plant Cell...)



Local, national to international



CITÉ DES ÉNERGIES Budget, teaching and access

Budget:

- The initial funding was obtained from the CPER project..
- Running cost: internal EBM grants, IBISBA, Collaborative ANR, Inter-Institute CNRS......

Teaching and formation:

- Teaching of M1, and M2 classes on lipids and bioenergy.
- Internships (BTS, fin de etude, M1, M2...); and other exchange students (IRAMUS etc)
- Training on lipidomics (Plinius PhD program at the IM2B institute-AMU).

Access to the platform:

- The platform operates in a collaborative mode.
- It is open to all academic and industrial partnerships where a common goal could be established.
- A « operating chart » is in place since 2016.















Equipements

✓ Inductively Coupled Plasma Atomic Emission Spectrometer (ICP-OES)

> measuring the wavelengths emitted by the ions

Agilent 5100 dual view with SPS 4 autosampler





240 samples

Determination of over 70 elements Detection limit: 0,1- 1 ppm (mg/L) Wide spectral range from 160 to 800 nm Automatic sample changer



Equipements

✓ Inductively Coupled Plasma Mass Spectrometer (ICP-MS)

> for the analysis of elements according to their mass to charge



Perkin Elmer NexIon350X with autosampler

Determination of over 70 elements

Detection limit: 0,1-1 ppb (µg/L)

Ability to measure elemental isotope ratios

Automatic sample changer