

## Laboratory for sustainability, quality and safety of Agrifood productions

Its main research activities are focused on:

Development of efficient production processes with low waste production, precision and resilient agriculture for sustainability and phytosanitary measures for crop protection with the aim of fostering the food system towards Climate Smart Agriculture-based models in order to improve the adaptation to climate change and to promote reduction of inputs and greenhouse gas emissions.

Use of renewable sources and improvement of the eco-efficiency of food systems throughout a cascade-type approach for biomass exploitation and agrifood waste valorization and for reducing food losses.

Validation and application of diagnostic methods for food safety, qualification of the production, analysis and assessment of chemical and microbiological transformations in the production qualification processes, processing, preservation and packaging, identification and quantification of components and quality markers to demonstrate authenticity and origin of foods and to ensure traceability.



## Diagnostics for Food Quality and Safety

Development and application of analytical methods for:

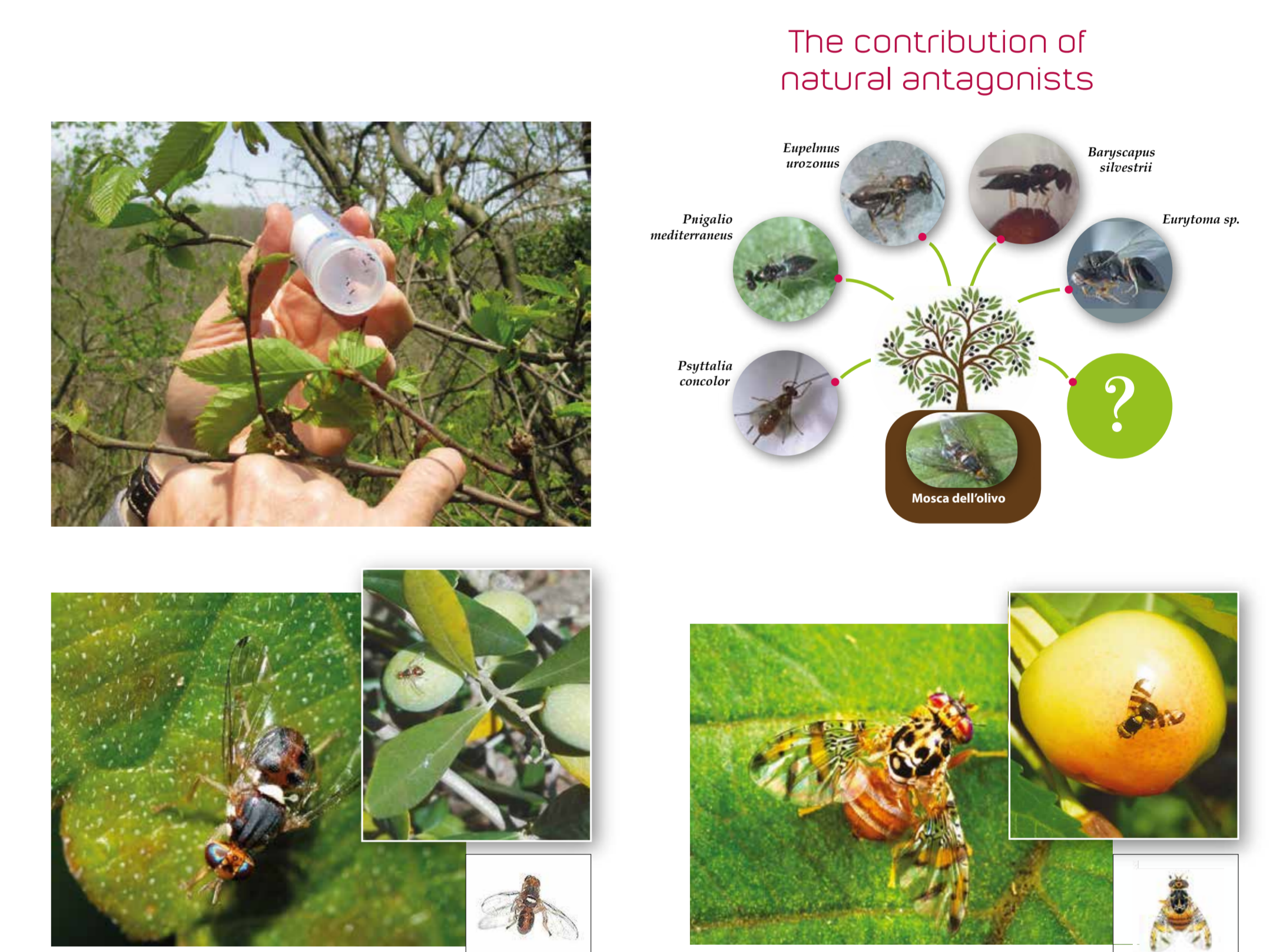
- characterisation, qualification and valorisation of agro-ecosystems;
- identification and quantification of biological contaminants, in particular toxigenic fungi and toxins in raw materials and final products of the agro-industrial sector;
- individuation of "quality" markers for healthy food production and extraction of high-value molecules;
- characterization of plant species and microorganisms as a source of bioactive compounds;
- identification/quantification/definition of markers and patterns for food authenticity and origin demonstration, to ensure a complete traceability all along the supply chain.
- assessment and improvement of chemical and microbiological transformations in food processing, preservation and packaging.



## Integrated management of insect pests and vectors

To enhance resilience of agro-ecosystems and to reduce agrochemicals impact:

- Study of insect pests to develop sustainable methods for suppression at field level
- Enhancement resilience of agro-systems and forests resilience
- Biotechnological control of invasive insect species
- Development of mechanistic process-based models (PBMs)



## Environmental Microbiology and Biotechnology

Main research areas:

- Microbial ecology and genetic /functional diversity of environmental and soil bacterial populations
- Investigating the role of natural habitats as reservoirs of opportunistic Pathogens;
- Fermentative conversion of biomass into biofuels/chemicals and microbial dynamics in anaerobic reactors.



## Partnership with Companies



Ecoinnovazione srl spin-off ENEA offers customized solutions for sustainability based on the most advanced scientific analytical methods and in line with policies trends at EU and national level. Our goal is making sustainability a key strategic driver for value creation in organisations.

**Thanks to the cooperation with ENEA**

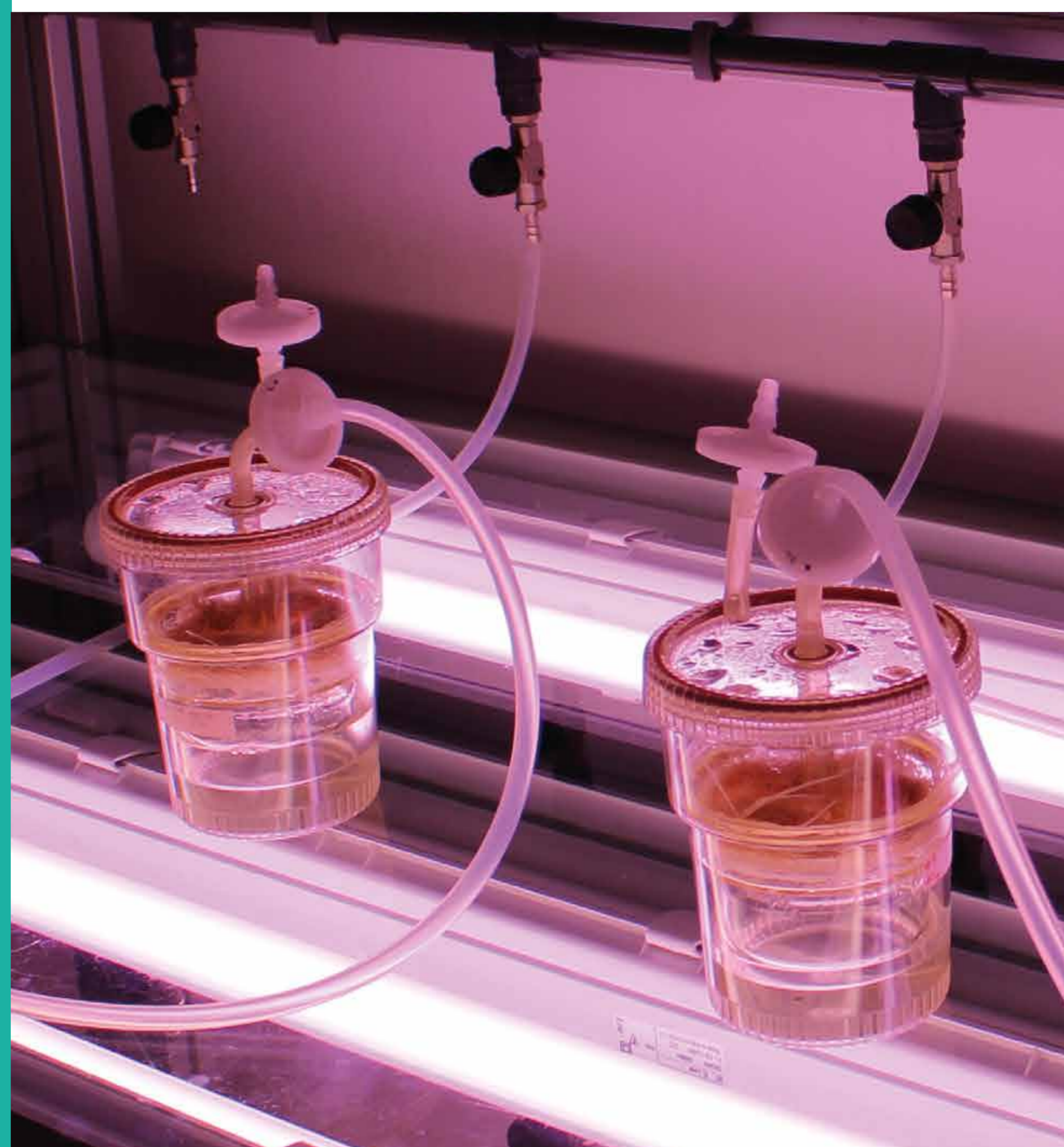
the results of research and innovation activities are tailored to and brought into the market, supporting the value-creation.

## The Biotechnology Laboratory

pursues projects that combine research and development goals in the field of advanced biotechnology, mainly oriented to the enhancement, sustainability and competitiveness of agricultural food (green biotech) and pharmaceutical (red biotech) production, exploring the potential of nanotechnology (nano biotech).

Taking advantage of the pervasive power of these technologies towards the objectives of the Bioeconomy, the Laboratory is focused on the development of high-added value and highly technological products. In fact, in a ten-year horizon, biotechnology is due to have a significant impact in the production of pharmaceutical (80%), agricultural (50%), chemical and industrial (35%) products, for an estimated direct value of 2.7% of the global gross domestic product (GDP).

The activities are accomplished through specialized expertise and advanced technology platforms of Genetics, Molecular and Cellular Biology, "Omics" Sciences, projected especially to the construction of novel plant "ideotypes".



## Indoor Smart Agriculture

Advances in agronomy allow soilless cultivation of plant species in unconventional environments, even in extreme conditions such as those found in the orbiting space stations. This technology makes use of advanced systems, tailored for specific needs, based on modular "hydroponic" plant farming resulting in significant reductions of energy consumption and water resources as well as in the removal of harmful substances (i.e. pesticides, heavy metals).

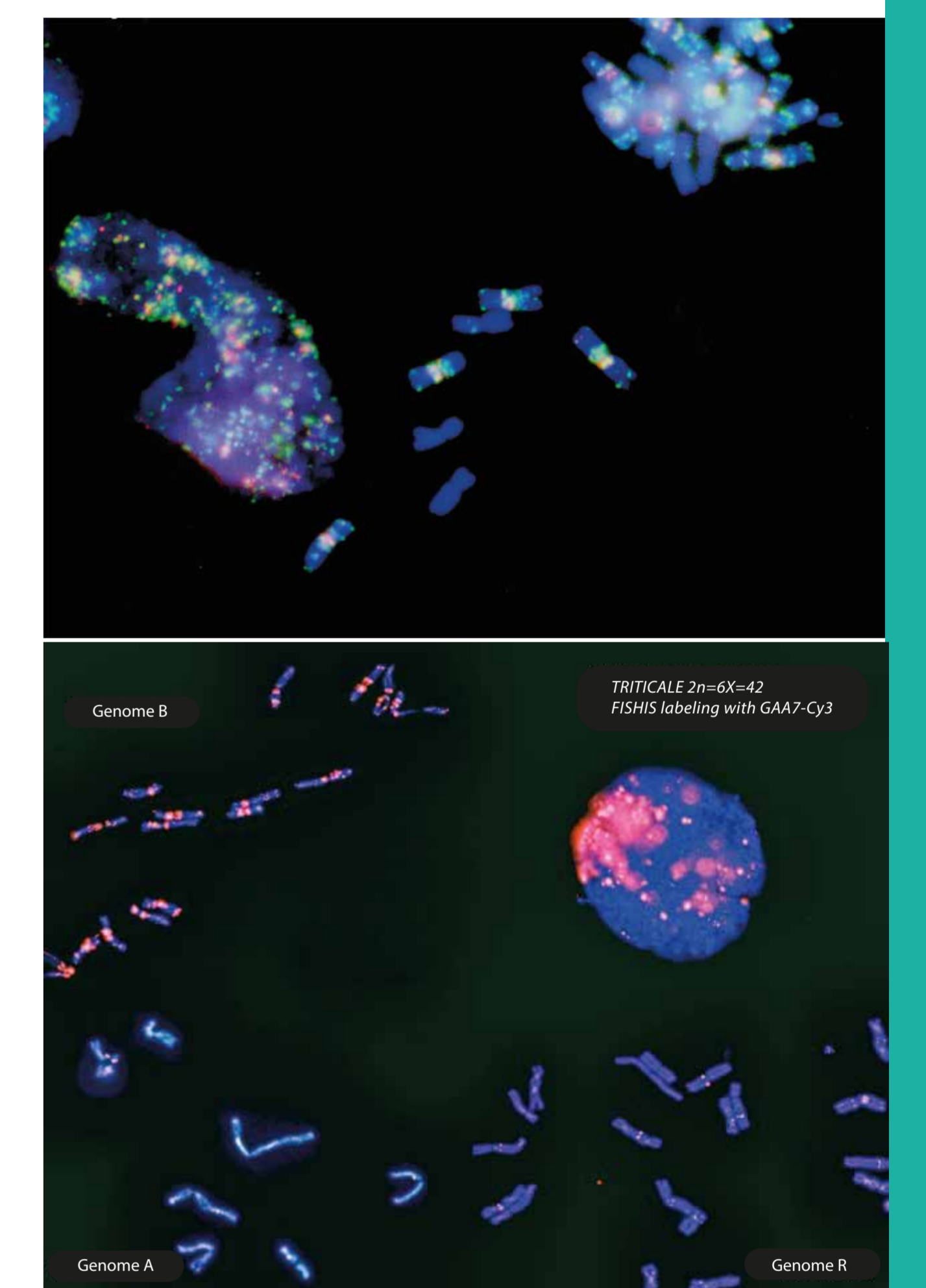


## "Omics" Sciences

From the greek suffix "-OMA" indicating all, "omics" sciences applied to biology indicate the study of complete gene pools (Gen-omics), protein arrangements (Prote-omics), metabolite sets (Metabol-omics), representing a real technological revolution of this century.

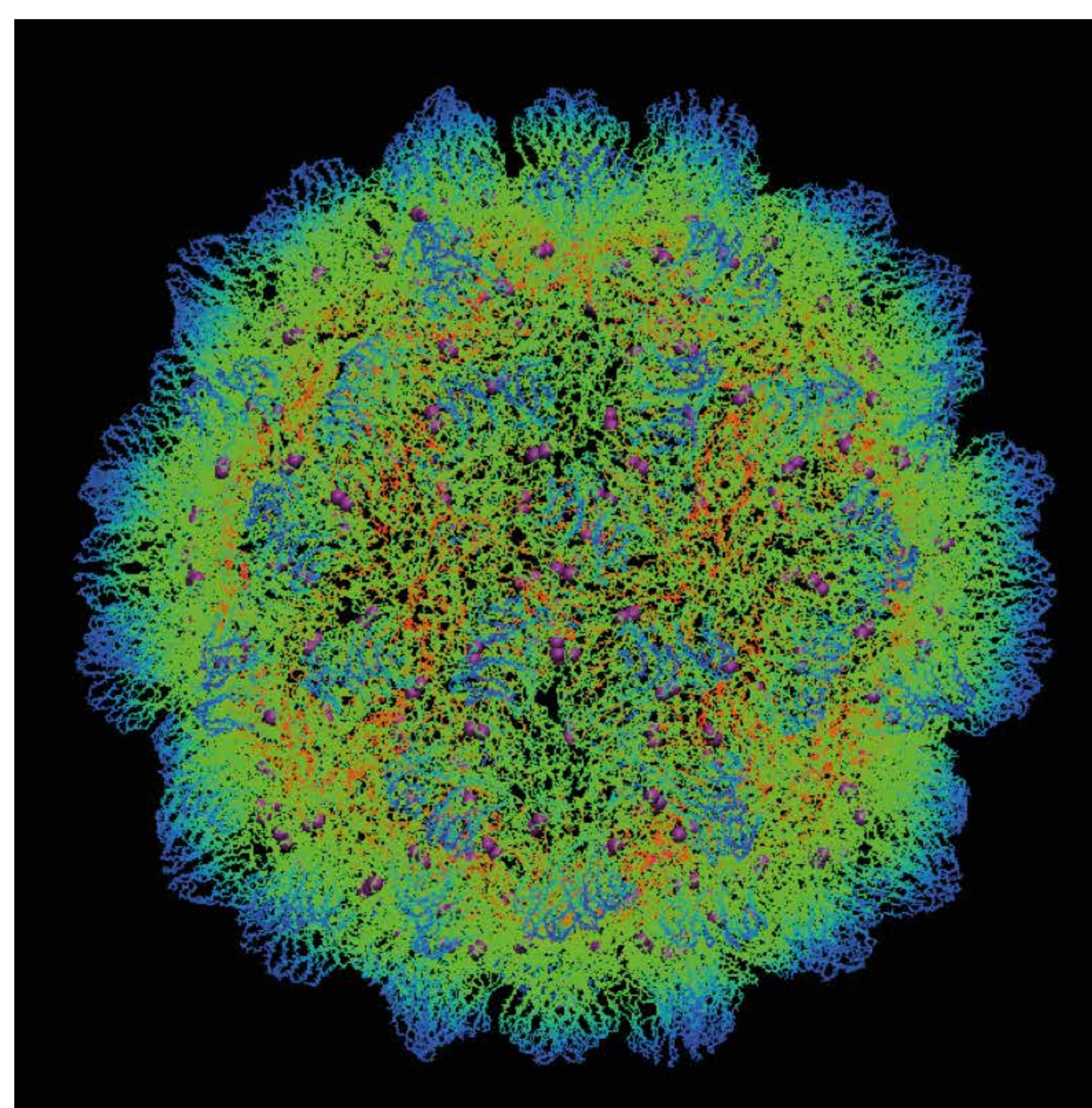
Deciphering the genome of agricultural plants as well as pathogenic or beneficial microorganisms, is becoming less complicated thanks to the evolution of technologies related to the sequencing of nucleic acids.

Simultaneously, Mass Spectrometry is opening new horizons for the detection of proteins and metabolites related to physiological or pathological stages of a particular cell line, tissue, organ, allowing to identify biosynthetic pathways of natural molecules useful for the pharmaceutical, nutraceutical, cosmeceutical industry.



## Biopharmaceuticals and bioactive molecules

Biopharmaceuticals represent the last frontier of medicinal products for the treatment of numerous diseases. The term "biologic" refers to the fact that these molecules are synthesized only by cells and not through chemical synthesis. One of the innovative systems to produce biopharmaceuticals is through plants that can function as a true and proper "biofactories" for the synthesis of macromolecules such as antibodies, vaccines, enzymes and protein complex scaffolds. Furthermore, it should be underlined that plants with the secondary metabolism products, are an endless source of bioactive molecules such as antioxidants, vitamins, antimicrobials and immunostimulants.



## Partnership with Companies



Plants can be used as biofactories for the production of biomolecules for several different applications

### ENEA and DIAMANTE

have developed a highly innovative, sustainable technology that uses plant viruses as nanomaterials for the development of an accurate, rapid tool for a novel non-invasive diagnosis of autoimmune diseases



Celiac disease (CD) is an immune-mediated chronic disorder affecting approximately 1% European population

### ENEA and ATP R&D

are collaborating to improve quality of life of people affected by this disease and to find innovative solutions contributing to the development of the European Bioindustry

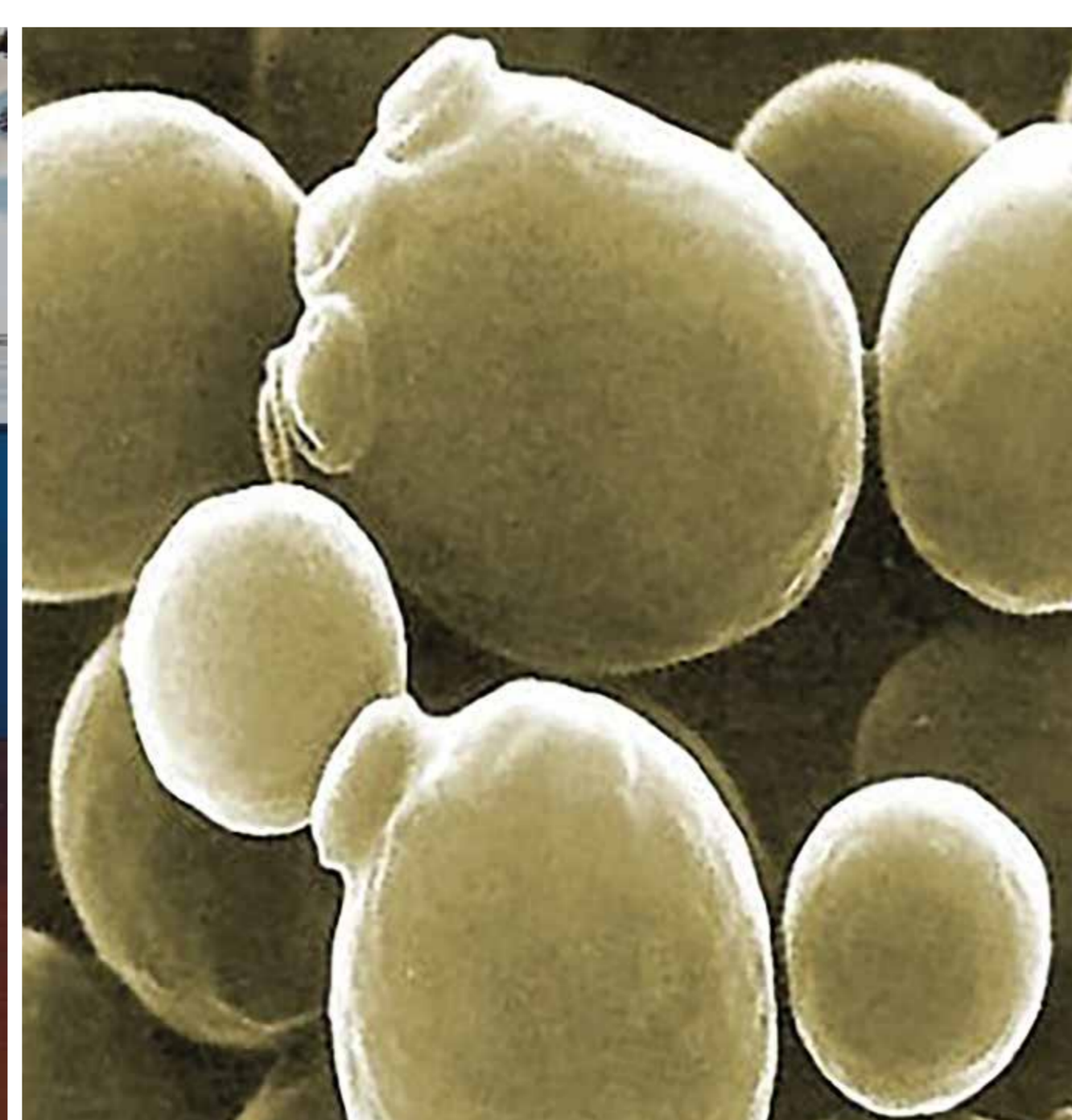
## The Bioproducts and Bioprocesses Laboratory

RD&T activities are focused on the topics of sustainable development aimed at developing sustainable and competitive production systems of the areas food and non-food, exploiting biological resources, food and industrial crops, microbial by-products and wastes. The approach of the laboratory is centered on setting-up and coupling best available technologies (Key Enabling Technologies – KETs) in order to recovery and to extract all valuable substances contained in bioresources (crops, vegetables, microorganisms, fungi, bacteria, algae) by-products and wastes from agri-food industry as declined by Bioeconomy concepts. Beyond a simple approach of smart disposal and depuration, we developed processes by use of Mild Technologies and advanced solutions in order to turn a bioresource or a waste or an effluent in a new real resource valorizing its biochemical composition towards the obtaining of new products and the individuation of novel market opportunities (nutraceutical, novel foods, feed, pharmaceutical, cosmetic). The activities are accomplished through specialized expertise and advanced multifunctional biotechnological and chemical plants platforms (Technological Hall) from lab scale to pilot scale.



## Industrial Biotechnologies

Particular attention is devoted to the development of applications of Industrial Biotechnologies (White Biotechnologies) and Process Technologies in the productive field of agribusiness and bio-industry. The Laboratory main activities are performed by making use of innovative infrastructures, equipment, technologies and service platforms, pilot facilities for the development of processes (fermentation in bioreactors from lab-scale to pilot scale) to obtain new products or metabolites from metabolism of microorganisms (bacteria, fungi, micro-algae) for use in nutraceutical, cosmetic or in feed sector. The processes are completed by using freeze-drying, dehydration or concentration, evaporation, membrane separation, supercritical extraction technologies, facilities for characterizing biometric chemistry (NMR).



## Downstream Processing

Membrane technologies are downstream physical process techniques (the others are freeze-drying, dehydration, concentration, evaporation) capable to separate solutes in aqueous solutions without the use of heat, but using only pressure as driving force.

These techniques (Mild Technologies) are characterized by a highly selective separating power, in terms of molecular structure, they are able to separate solutes between them, according to molecular weight or structural conformation of the molecules considered. Membrane technologies can be applied to recover water from agro-industrial processes or for “dismountle” a heterogenic liquid matrix as, milk, whey, plant extracts in its fundamental constituents to obtain fractions, bioactive compounds and metabolites (i.e. sugar, salts, proteins, flavonoids, polyphenols).

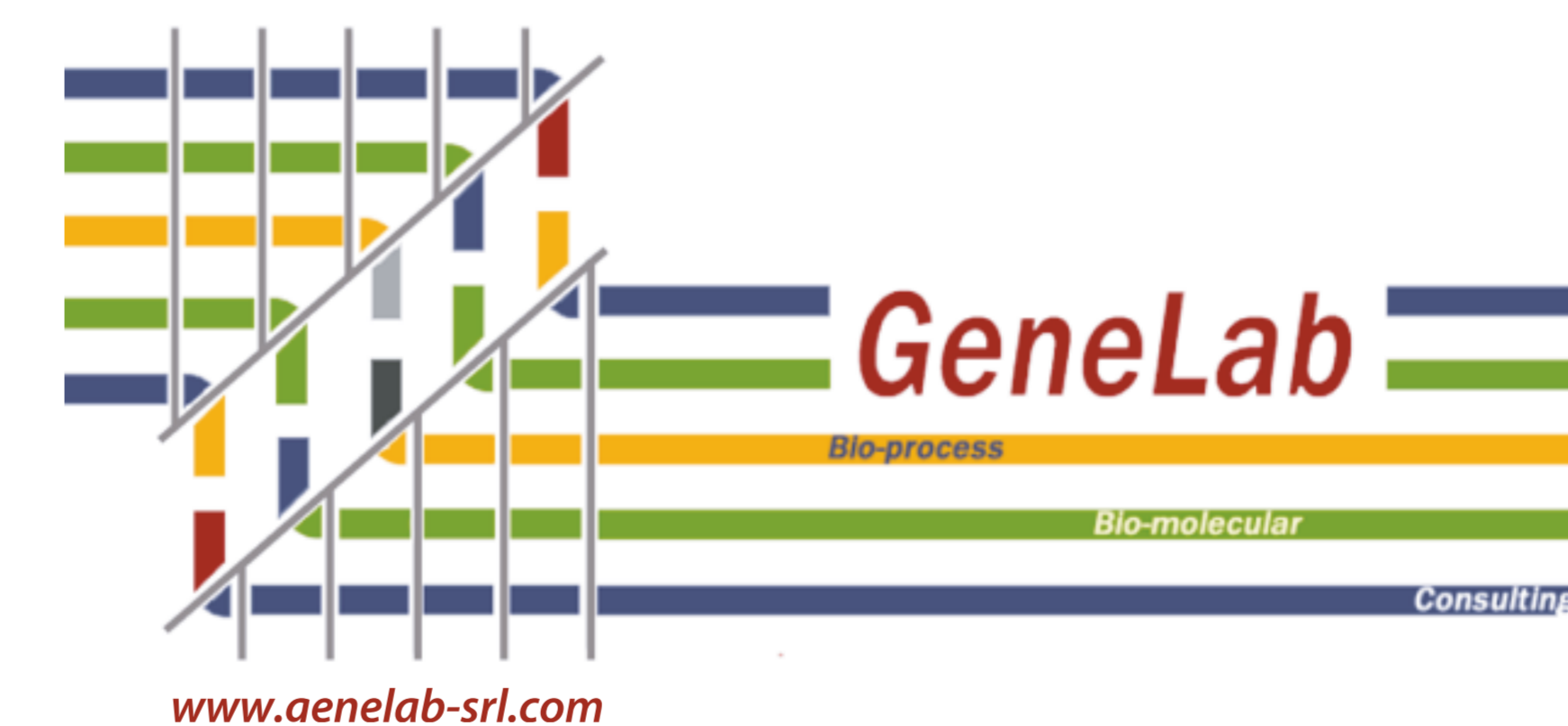


## Valorisation of biological resources

With the aim to increase a sustainable development the European Commission road map to 2020, gives a priority to bio-economy promoting the use of 'bio-based products and processes to green industries'. The aim is to integrate traditional approaches to innovation by developing new sustainable systems for a wider use of biological resources in food e no-food sectors. So we can extract high level of phytonutrient and antioxidant by Hazelnut to obtain beneficial effects on human health, or produce novel foods with Buckwheat flours with high level of antioxidant, or bioactive and phytoterapic compounds, oil or ingredients for feed from Artichoke and Cardoon. Opuntia is a example of multifunctional crop: this crop is a source of bioactive compound for food, cosmetic, therapeutic, furnishing, glues, building, natural color and biogas.



## Partnership with Companies



GeneLab s.r.l. was born from the fellowship of young researchers (biologists, engineers, economists) skilled in the field of plant molecular biology and in downstream technologies applied to industry. The scientific and technical background of Genelab staff was maturated in ENEA. The company's core business is centered in development and design of innovative processes based on membrane and CO<sub>2</sub>-SFE technologies, for food and nutraceutical specialty production.

**Genelab has been partner, with ENEA, of Granarolo (major dairy italian company) for a research program for innovative Lactose free milk formulas**

**Genelab is developing with ENEA new plant formulation (from artichoke) for nutraceuticals production**