



vegetal extracts for agricultural use



The green evolution

F R O M   P L A N T S   F O R   P L A N T S



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## *Natural biostimulants to meet the needs of the present building the agriculture of the future!*

**VIRIDEM®** is the result of research, innovation capacity and skills gained in the use of very advanced technologies to achieve natural products that are efficient and capable of acting on the metabolism of plants.

**VIRIDEM®** was created from the identification of bioactive substances inside various plant species, extracted with technologies which have a reduced environmental impact and made available to plants to their fullest potential.

**VIRIDEM®** is the ILSA proposal to implement conservation farming techniques that aim to preserve the functions of the soil and protect it for adapting to climate change, with solutions that enable to save water and allow to use fertilizers in an ever more efficient, sustainable and integrated way.

**VIRIDEM®: natural biostimulants** to meet the needs of the present building the agriculture of the future!





9

**BILLIONS  
WORLD  
POPULATION IN  
2050**

SOURCE: FAO



**+70%**

**GLOBAL INCREASE  
IN PRODUCTION  
FOR FOOD  
SUFFICIENCY BY  
2050**

SOURCE: FAO



**+30%**

**GLOBAL INCREASE  
IN CEREAL  
PRODUCTION TO  
BE REACHED BY  
2050**

SOURCE: FAO

## ***VIRIDEM®** for sustainable agriculture*

Improving production is a global responsibility. In fact nowadays, about 1 billion people do not have a sufficient supply of food and in 2050, the world population will exceed 9 billion inhabitants, that is 2.3 billion more than today.

To ensure "food security" for everybody, which means food in adequate quantity, of good quality and safe in terms of health, we will have to improve yields per hectare, consuming less water and less energy. All this must be obtained by adopting criteria compatible with environmental requirements.

The new challenges of agriculture are divided in two fronts: productivity and sustainability.

Our research has been moving in this direction, starting from renewable sources, using "clean"

and low energy consumption industrial technology, with the aim of developing efficient and innovative products able to support a larger number of plants per cultivated hectare, products capable of improving the production capacity of individual plants and increasing their resistance to stress, products suitable to have an effect even in the absence of water.

**VIRIDEM®** *is all this;  
observe nature, understand its  
mechanisms and extract the  
essence to help nature with its  
own tools.*



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## *Let's learn from nature*

The observation of nature teaches us that, in a balanced ecosystem, all living organisms are able to grow, reproduce and defend themselves. Plants for example, although anchored to the ground, activate particular mechanisms to grow even in difficult or adverse conditions. Adverse conditions, however, inevitably limit the activities of plants in the production of fruits, in their size and quality and make them more susceptible to attack by pathogens.

These reaction mechanisms are connected to the so-called **secondary metabolism**.

Vital activities, instead, such as photosynthesis, respiration and production of carbohydrates, are all part of its **primary metabolism**.

**Secondary metabolism** is practically responsible for all interaction activities of the plant with the surrounding environment and also for the production of compounds and substances that allow the plants to "communicate" with each other, to defend themselves from adversity, to reproduce and more generally to develop and produce in less than ideal conditions.

The mechanisms of **secondary metabolism** ensure the survival of the plant.

Optimum development is the expression of a continuous balance between primary metabolism, closely connected to the "plant life", and secondary metabolism which is responsible for "*interaction with the environment*".

ILSA, selecting and analysing many plant species, identified several substances that, when extracted in an appropriate manner, can contribute to the creation of products which have effect on the primary and/or secondary metabolism.

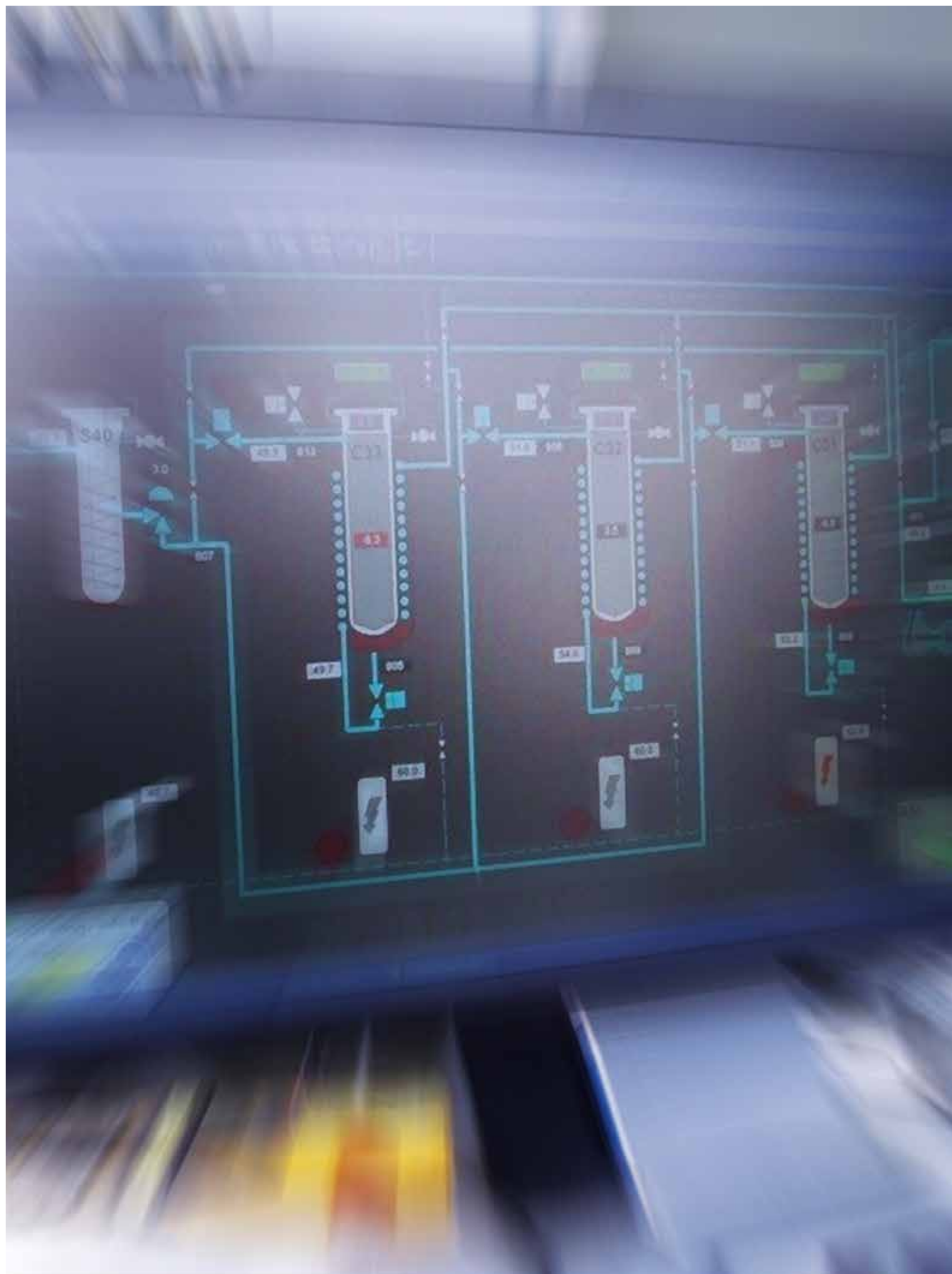
### *From plants for plants*

"From plants for plants" is the philosophy that inspires **VIRIDEM**® programme. The identification, isolation, purification and analysis of the metabolites and natural substances we were interested in required years of work and was possible thanks to the use of technologies, instrumental techniques and very specific skills.

Agronomists, biotechnologists, biochemists, chemists and engineers worked together using the latest molecular biology, microbiology, proteomics, metabolomics, physiology, chemistry and bio-processing knowledge.

This new way is open, new products are ready and many more will be available in the coming years because research by ILSA, consistent with its operating philosophy, "to strive for continuous improvement" never stops.







FULLY  
CONTROLLED  
ENZYMATIC  
HYDROLYSIS

1



SUPERCritical  
FLUID  
EXTRACTION

2

## *The technology: two unique production processes*

In addition to the plants for the production of modulated release solid organic fertilizers (a process called: FCH® - Fully Controlled Hydrolysis), ILSA is equipped with enzymatic hydrolysis plants (a process called: FCEH® Fully Controlled Enzymatic Hydrolysis), and supercritical CO<sub>2</sub> extraction system (SFE - Supercritical Fluid Extraction).

Both of these technologies are used in the food, pharmaceuticals and cosmetics fields.

By implementing and integrating the enzymatic hydrolysis and supercritical extraction processes ILSA has created a range of highly characterized and extremely effective biostimulants.

No other company in the world owns and uses these **two technologies together** to create products that enhance the performance and wellbeing of cultivated plants.







FULLY  
CONTROLLED  
ENZYMATIC  
HYDROLYSIS



1

## *Enzyme hydrolysis*

Hydrolysis consists in the cleavage of chemical bonds as a result of the addition of water and can be of the thermal type (with the aid of heat only), chemical (with the help of chemical substances at high temperatures), enzymatic (with the help of enzymes typically at temperatures below 60°C) or mixed (chemical and enzymatic). When hydrolysis is applied to a protein substance we speak of protein hydrolysis, which results in amino acids, peptides and polypeptides.

Enzymatic hydrolysis of proteins, a process carried out by ILSA, is characterised by its ability to produce amino acids in a predominantly levorotatory form, a form biologically more active and useful for plants.

The vegetable raw material is dispersed in water inside reactors of the TSR type (Top Stirred Reactor) equipped with temperature, weight and pH control. Successively, we introduced the enzyme pool composed of specific proteolytic enzymes (which cut proteins) and cellulolytic enzymes (which break down cellulose present in biomass and facilitate the rupture of the cell

wall assembly which is found in plant cells). The reaction mixture thus obtained is continuously stirred and maintained at the most suitable temperature and kept under these conditions for about 12 hours. After the enzymatic reaction, the liquid suspension is conveyed to the centrifugation and filtration stages. The liquid fraction is subjected to evaporation in a forced circulation, triple effect, vacuum concentrating plant until it reaches the desired concentration. In the latter stage, deactivation of the enzymatic pool takes place simultaneously. After further filtration, the product, stabilized, clear and free of sediment substances, is sent for final storage. All the products manufactured using this process are characterised by their tendency towards neutral pH.

This fully automated process is carried out in a sterile environment.





SUPERCritical  
FLUID  
EXTRACTION

2



GRAS APPROVED

GENERALLY  
RECOGNIZED  
AS SAFE

## *Supercritical CO<sub>2</sub> extraction*

The extraction of bioactive substances from plant matrices is conducted employing carbon dioxide (CO<sub>2</sub>) as the extraction fluid in supercritical conditions; this extraction can be highly selective by adequately modifying the pressure conditions (which can reach up to 1000 bar) and temperature (which never exceeds 80°C).

Raw plant materials, correctly dried and ground, are put into the system. Carbon dioxide (CO<sub>2</sub>), a gas that under specific environmental conditions (temperature of 31.1°C and pressure of 73.8 bar) is in the supercritical phase, is brought to the required temperature and pressure, thus starting the extraction phase.

Upon completion of the extraction, the pressure is lowered and the CO<sub>2</sub> loses its solvent strength releasing the extracted substances that are available in concentrated form.

The resulting extracts are microbiologically stable and do not require preservatives. Unlike conventional processes, the selectivity of ILSA's extraction process does not involve thermally stressing the raw materials and does not require the use of organic solvents.

Because of its very low environmental impact, the FDA (Food and Drug Administration - USA) has designated this industrial process GRAS (Generally Recognised as Safe).



# NATURAL EXTRACTED SUBSTANCES

## *Policosanols*

Are linear long chain aliphatic alcohols, or fatty alcohols, formed by a number of carbon atoms from 24 to 36 with an OH group terminal. Among the most interesting policosanols for the biological activities attributed to them are octacosanol and triacontanol, known as natural regulator of plant growth and active at very low concentrations.

## *Polyhydroxy aldehydes, polyhydroxy ketones and their derivatives*

These molecules are commonly known as carbohydrates. The main pathways of biosynthesis and carbohydrate degradation are an important component of metabolism primary, essential for all organisms.

## *Terpenoids and steroids*

Terpenoids are a large family of natural substances, structurally different between them-

selves but all composed of  $C_5$  isoprene units coupled in spin mode. The possible rearrangement reaction consists in the loss of some carbon atoms which generates steroids. Saponins belong to this **family**, so called because plants rich in these substances were used for the washing (among these the *Soapwort* and the *Quillaja saponaria*).

## *Phenylpropanoid and aromatic polyketide derivatives*

At the base of the  $C_6 C_3$  phenylpropane units we find phenylalanine and tyrosine aromatic amino acids. Among the aromatic polyketides we find flavonoids that are a huge class of metabolites. Flavonoids act as antioxidants and are widely used in the pharmaceutical industry. In plants they play an important biochemical and physiological role being necessary for the plant/environment interaction, for symbiotic interactions and to react to stressful situations both biotic and abiotic.



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### *Amino acid derivatives*

Peptides and proteins are polyamides. Many structures have additional modifications to the system with respect to a polyamide base and this gives the molecule certain biological activities. Glycine betaine (a glycine derivative) for example, is a molecule which carries out an osmoprotectant action, that is, it protects membranes and proteins from the effects of denaturants determined by high temperatures and saline stress.

These and many other substances synergistically with other amino acids, vitamins and trace elements, form and characterise **VIRIDEM®** products.

Thanks to these substances, ILSA has managed to strengthen plant growth mechanisms.

This is where our biostimulants come from and what they contain. Our biostimulants improve the physiological processes of plants, making them stronger, more productive and able to respond to situations of environmental stress.

All this was possible through the observation of the plants themselves, studying their metab-

olism and identifying the substances that they produce under certain conditions to then extract them for making our products to be applied to crops.

Innovative and very specific products capable of increasing the resistance of plants to abiotic stress, or capable of promoting their growth and the development of fruit, or suitable for improving the absorption of nutrients or, again, specific for the improvement of various quality parameters of the crop.

*This is* **VIRIDEM®**



# VIRIDEM<sup>®</sup> IN 12 STEPS

## STUDY AND ANALYSIS



1

IDENTIFICATION OF THE  
PLANT MATRIX



2

IDENTIFICATION OF THE  
COMPOUNDS  
(TARGET SUBSTANCES)



3

IDENTIFICATION OF  
THE STAGE IN THE  
PHENOLOGICAL CYCLE  
WHERE THE PLANT  
PRODUCES MOST  
COMPOUNDS  
(TARGET SUBSTANCES)

## IMPLEMENTATION AND LAUNCH



12

PACKAGING AND  
PRODUCT LAUNCH



11

LAUNCH PLAN APPROVAL  
AND INDUSTRIAL  
START-UP



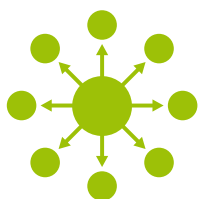
10

IDENTIFICATION OF  
EFFECTS, DOSES AND  
BENEFITS OF THE FINAL  
PRODUCT



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## DEVELOPMENT



4

CHEMICAL  
AND PHYSICAL  
CHARACTERISATION OF  
THE MATRIX AND OF  
SUBSTANCES



5

TUNING OF PARAMETERS  
AND OF THE MOST  
EFFICIENT AND  
EFFECTIVE EXTRACTION  
PROCESS IN PRESERVING  
THE INTEGRITY OF  
COMPOUNDS (TARGET  
SUBSTANCES)

## TEST AND VERIFICATIONS



6

LAB TEST AND  
PROTOTYPE  
CHARACTERISATION



7

TEST IN GROWTH  
CHAMBER



8

TEST IN CONTROLLED  
ENVIRONMENT OR IN  
GREENHOUSE



9

TEST IN OPEN FIELD

 **ILSA**  
The green evolution

# FROM VIRIDEM® THE EXCELLENCE OF PLANT DERIVED BIOSTIMULANTS



PHOTOSYNTHESIS  
AND VEGETATIVE  
DEVELOPMENT



FLOWERING  
AND FRUIT SET



SHELF-LIFE



CRACKING AND ROT



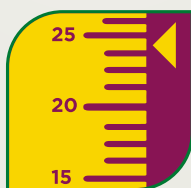
SALINITY TOLERANCE



ROOTING



SIZE



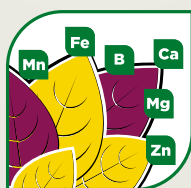
DEGREES BRIX



PLANT BIOMASS



TOLERANCE TO THERMIC  
AND WATER STRESS



NUTRITION AND NUTRIENT  
BIOAVAILABILITY



UNIFORMITY IN COLOUR  
AND RIPENING



## *ILSA innovation in the world of specifically targeted products*

The ILSA specifically targeted products can act on plant metabolism to respond to specific qualitative and quantitative needs like, for example, size increase and uniformity, stimulation of flowering, sprouting and vegetative growth, fruit set and reduction of premature fruit drop, photosynthesis and vegetative growth, plant biomass increase, rooting, internode shortening, higher Brix level, resistance to fruit cracking and rot and shelf-life increase.

They increase plant tolerance to abiotic stresses and support plants even under adverse conditions such as excessive soil salinity, temperature leaps and heat and water stresses. They reduce nitrate accumulation in leaves and support plants in stress situations caused by the application of agrochemicals. Last, they can foster plant nutrition by facilitating the assimilation of macro- and micro-elements.

### *Why are **VIRIDEM**® products unique?*

- **Because** they are the result of years of research and experimentation on specific substances extracted from plants, therefore, completely natural.
- **Because** the processes used by ILSA are exclusive and allow to extract compounds with biostimulant effects in a truly effective and sustainable way from an environmental point of view.
- **Because** for each plant matrix, each with its own peculiarities, ILSA has identified useful compounds and substances and the best method to extract them with maximum efficiency.
- **Because** thanks to in-depth scientific research and proven fieldwork, they are a **guarantee for good results.**



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