Layman's report

The first plant-based biostimulant from cultivated crops



Plants for Plants® Life Project This project is co-funded by the European Union's LIFE Programme under Grant Agreement LIFE18 ENV/ NL/000043.











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Introduction

Dlants are smart little fellows. During millions of Onventional agriculture provides for 95% of the World's food production but is very resource years they have overcome numerous diseases dependent. The sector is overall reluctant to shift and adapted to changing circumstances. towards more resource-efficient practices due to With **Plants for Plants**[®] we are able to blend the limited existing solution. Moreover, productivity evolutionary achievements of plants into the growth is stagnating and in many areas declining, everyday practice of agriculture. affected by pollution, declining soil quality and biodiversity loss.

Recent policymaking has increased the pressure on farmers to look for alternatives, often strengthened by public opinion.

odays agro-systems face multiple challenges: to be more productive to cope with rising food demand; to be more efficient to counter resource scarcity and climate change; and to deliver ecosystem services to preserve soils, water, air and human health.







First we figure out what the crop lacks, then we look for other species that already have acquired the properties needed.

By applying organic extracts of these plants, we trigger specific reactions in the crop. This improves water and nutrient use efficiency and strengthens the plant by increasing crop fortification.

Plants for plants is a truly revolutionary approach. It can be used for organic and conventional agriculture.

Plants talk, we listen.





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CURRENT MARKET OF BIOSTIMULANTS

Existing Biostimulants...



Market situation and future growth

The traditional biostimulants are today representing almost 90 % of the market.

New biostimulants such as microbial are representing 11%. Plant extracts derived from cultivated crops will also become part of this family of New Biostimulants in the near future.

Market Share by Revenue (%), Active Ingredients, Global, 2019



Projected growth rate of revenue 2020 - 2025

Active Ingredients	CAGR%2020
Traditional Biostimulants	12%
New generation Biostimulants	14%
Total	13%

Source: Mordor Intelligence Analysis

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Humic Acid

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Fulvic Acid

Amino Acids

Protein Hydrolysates

Seaweed Extracts

New generation **Biostimulants**









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WHY DID WE CARRY OUT THIS PROJECT?

ENVIRONMENTAL ASPECTS

Biostimulants are defined as substances and/or micro-organisms whose function, when applied to plants or the rhizosphere, is to stimulate natural processes that promote/improve the absorption or use of nutrients, tolerance to abiotic stresses, the quality or yield of the crop, independently of the presence of nutrients.

A biostimulant product is defined by its mode of action more than by the nature of its constituents, which can be of various natures and used alone or in combination.

Nutrient and Phosphorus

Plants need Phosphorus (P) for their root formation and growth and all energetic processes like bud development and flowering. Although needed in smaller quantities in comparison to N and K, P plays a major role in achieving good yields.

Phosphorus: application of P fertilizer to crops is inefficient, as fresh applied P is easily fixed to the soil particles and therewith becomes less available for the plants. Due to the problem of soil fixation of P application of P fertilizers to crops is less efficient and accumulates in the soil.

The accumulation of nutrients in effluents and soils often leads to soil contamination, eutrophication of surface waters and pollution of underground aquifers.

Possible solution: Improving plants' P Use Efficiency could lead to a reduced Phosphorus supply and at the same time reduce accumulation of nutrients in effluents and soils.

The supply side is even more critical: P is extracted from phosphate rock which is a finite resource. The explosive growth expected in worldwide demand within 2050, increasing environmental concerns, cost of energy, geopolitical crises, etc. may accelerate the onset of a potential shortage to significantly less than 100 years. Currently the efficiency on the mine-to-fork pathway is calculated to be at around merely 20%, leaving much room for improvement.



Water

The challenges in regard to water are related to quality as well as availability.

Water demand is expected to face a 30% growth by 2030.

Industrial agriculture is responsible for more than 2/3 of world's water withdrawal.

Abiotic stresses (extreme temperatures, drought, soil salinization, etc.) are responsible for a an average yield loss of over 50% for most of major crops.

Possible solution: improving plants water use efficiency could be a big support to climate change adaptation, impacting on preservation of agricultural productivity, soil quality, water and energy consumption.

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Soil

Due to increased use of mineral fertilizers, intensive agriculture has lead to soil degradation specifically affecting soil microbial life.

Microflora is essential for healthy soil regeneration as well as maintaining soil fertility.

Possible solution: To be able to feed the world, production should become more sustainable maintaning high yields. This requires an increased care of the microflora and reduced usage of mineral fertilizers.



OBJECTIVES OF THE PROJECT

he LIFE Plants for Plants (P4P) Project was designed to introduce new organic plant-derived biostimulants (PBS) in conventional agriculture as well as organic farming. The precisely defined and reliable performance of our P4P Products can be considered their Unique selling proposition (USP). This new generation of plant-derived biostimulants, called Standardized Metabolites Phytocomplex (SMP) is able to enhance crops resource efficiency, improving their resilience to climate change and diseases while at the same time maintaining or increasing yield resulting in a more profitable crop for the farmer.

• Following intensive development and trial activities, in spring 2022 three plant-derived biostimulants are introduced on the market, focusing on improving Nutrient Use Efficiency (NUE), more specifically Phosphate Use Efficiency (PUE) and Water Use Efficiency (WUE), under the commercial names: "4-Good", "4-Vita" and "4-Terra".









NEW APPROACH IN FURTHER DEVELOPMENT OF BIOSTIMULANTS

Most growers are reluctant to be the early 2. Following these scientific trials, we scaled adopter, when it comes to innovative products. them up into broad demonstrations (B5). The fear to loose the yield of long months of These allowed growers and their distributors work is too big and so is the pressure to cope to make first hand experiences with the P4P with external climate pressures. Therefore we solutions. decided to design a trial phase in our project, Reversing the approach, which responds to growers' fears.

For this purpose we set up trial campaigns during 4 years, fulfilling distinct purposes:

Our approach towards convincing farmers to innovate: The P4P trial campaigns

1. Our B4 trials - conducted from 2019 until 2021 - were carried out under intensive monitoring, of the most relevant parameters on plants' nutrient uptake, water uptake, growth and health. The protocol conforms to EPPO-guidelines (European and Mediterranean Plant Protection Organization).

These trials were functional to identify the right dosage and crop stage for nutrient application. We also carried out analyses of soil microbioma in this context in 2020 and 2021.

starting from the challenge



Product development and production



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The Plants for Plants[®] range

The first products from the new generation of Plant-based Biostimulants





SMP : Standardized Metabolites Phytocomplex

Solution	The main SMP (metabolites)	Application	Target
4-Vita – 4-Good	Flavonoids + Organic Acids	Foliar	WUE-NUE
4-Terra	Heterosides + Organic Acids	Fertigation	NUE

Clear positioning and targeted claims

Dosage Ha/season	5
Packing size	10 litres
Target crops	All crops with focus on wine grapes
Application time	Before periods of strong growth and heat – Fruit setting
Application	Ś
Mode of action	Reduction of oxidative stress : • Decreased ROS (Reactive Oxygen Species) production • Decreased need of antioxidative system activity and antioxidants production • Less energy needed for ROS detoxification, more energy to grow Maintain efficient photosynthetic activity modulating the chloroplastic membrane
Effect	Yield Quality Stress protection
Claim	ŴŬĔ
Product name	Plants for Plants® 4-Vita

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1 61		
10 litres	20 litres	
All crops with focus on potato	Fertigated crop, vegetables, fruit trees, vineyard and soft fruits	
Early stage, vegetative stage	Early stage and vegetative stage	
1		
Reduction of oxidative stress : Decreased ROS (Reactive Oxygen Species) production To cercased need of antioxidative system activity and antioxidants production The senergy needed for ROS detoxification, more energy to grow Improved Phosphate assimilation improved Phosphate assimilation chloroglastic orthophosphate PHT2.1 gene activation, a phosphate transporter	 Improved Phosphate mobility and assimilation due to chloroplastic orthophosphate PH12;1 gene activation, a phosphate transporter Increased microbial activity in the soil as well as nutrient availability 	
Yield Quality Stress protection Yield Quality Plant and soil		
NUE	NUE	
Plants for Plants [®] 4-Good	Plants for Plants [®] 4-Terra	

LET'S MAKE THE GREEN SWITCH

WHAT MAKES PLANTS FOR PLANTS[®] UNIQUE?

THE FIRST PLANT-BASED BIOSTIMULANT FROM CULTIVATED CROPS

What does it mean?

We grow the crops containing the active ingredients and extract them. This extraction is than formulated to a product suitable for application.

It's a fully controlled and patented process:

- 1. We grow the crops/cultivars that we have selected
- We check the active ingredients concentration at harvest 2.
- We extract those active ingredients 3.
- And finally, we formulate the end-product 4.



Sustainable and Safe

What does it mean?

in



- Environmental friendly : no exhaustion of natural resources
- · Natural plant extracts processed in a food grade factory : safe for users, consumers and the environment
- Suitable for Organic and Conventional Agriculture

Study of the Mode-of-Action

- Gene expression analysis were conducted to determine how the product facilitate the nutrient uptake
- Metabolomics was used to identify which compounds are being synthesized during the interaction of the product with the crop
- Biochemistry helped to determine how the product protects the plant against oxidative stress (ROS-degrading enzymes)

Cristina Sudiro is the Scientific Director and Area Manager of Plant Biostimulation, and this is the laboratory where she tests plant extracts. Vicenza, Italy







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WHAT DID WE ACHIEVE?

ENVIRONMENTAL FOOTPRINT ASSESSMENT:

Life Cycle Assessment (LCA) has been conducted and conceived in 3 parts, according to the requirements of NEN-EN ISO 14040 [1] and NEN-EN ISO 14044 and in line with the standardised methodology for developing Environmental Product Declarations (EPDs).

 Life cycle assessment of the Plants for Plants 4-Good biostimulant: Contribution analyses: highest impact from cultivation, 2nd transport, 3th storage

• Life cycle assessment of the Plants for Plants 4-Terra biostimulant: Contribution analyses: highest impact from cultivation, 2nd transport, 3th storage

Environmental benefits of applying the Plants for Plants biostimulants.

Environmental footprint of 4-Good production and application:

• In trials with reduced P-fertiliser application, results show yield increase, CO2-eq reduction and reduced eutrophication especially on freshwater eutrophication.

• The impact of prevention of the production of Phosphate is included, not the impact on possible reduced leaching. In fact total impact could therewith be expected to be bigger, especially eutrophication freshwater

· An alternative crop had to be chosen as a proxy for the vegetal raw material used for the production of 4-Vita and 4-Good, due to a data gap in the Ecoinvent database. It is fair to assume that the environmental footprint of production would improve if this gap is filled with data on the actually used crop, especially if this data furthermore accounts for organic cultivation.

Group	P2O5 reduction	CO2-eq reduction(%)	Eutrophication, freshwater (kg Peq) reduction (%)
Western Europe (n=3)	-25%	-15%	-17%
Mediterranean (n=2)	-30%	-13%	-28%
Scandinavia(n=2)	-30%	-19%	-24%
Central Europe (n=1)	-50%	-31%	-39%
Average of trials - P reduced	-31%	-18%	-24%

Environmental footprint of 4-Terra production and application:

• In trials with reduced P-fertiliser application, results show yield increase, CO2-eq reduction and reduced eutrophication

• The impact of prevention of the production of Phosphate is included, not the impact on possible reduced leaching. In fact total impact could therewith be expected to be bigger, especially eutrophication freshwater

• Also in this case a proxy had to be used due to a data gap, which might influence data accuracy. It is to be expected that in case the right crop was used, impact would be more positive than it already is, especially when grown organic.

Group	P2O5 reduction	CO2-eq reduction(%)	Eutrophication, freshwater (kg Peq) reduction (%)
Mediterranean (n=7	-30%	-28%	-30%
SW Europe (n=2)	-30%	-18%	-23%
Western Europe (n=2)	-30%	-14%	-24%
Average of trials - P reduced	30%	-23%	-27%

Lessons learned

· Continuation to improve amount of active ingredients harvested per ha will have an additional positive impact on the environment

Similar counts for optimization of the production process

• VII will keep on working on these aspects although we already see a positive impact of the application of 4-Good, 4-Vita and 4-Terra in order to support global agriculture to increase sustainability.

 Specific LCA's on cultivation of product source materials are needed to avoid bias, as they provide for major environmental impacts

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BROAD-SCALE DEMONSTRATION TRIALS RESULTS (B5)

On a total of 414 ha, good results have been achieved in more than 60% of the trials. For 56% of trials, results were clearly positive, while only in 4% of trials no effect or lower produce have been observed.

Year 2020

29 trials - 8 countries - 16 crops (data available from 24 trials)

	()	(:)	
16 x LL002	2 trials	3 trials	11 trials
(WUE + PUE)	(12.5%)	(18.75%)	(68.75%)
8 x LL004	-	1 trial	7 trials
(PUE)		(12.5%)	(87.5%)
Total	2 trials	4 trials	18 trials
	(8.3%)	(16.7%)	(75%)

Year 2021

95 trials - 17 countries - 30 crops - 500 Ha - 17 countries

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4-Vita / 4-Good (WUE + NUE)	5%	32%	64%
4-Terra (NUE)	7%	27%	67%
Total %	5%	31%	64%

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More than 120 trials • 50 crops 6 climate zones 24 countries 25% 69%

RESULTS CONCLUSIONS

Almost 70% of the trials showed positive results meaning better quality and yield.

25% of the trials have shown neutral results meaning that the yield was similar to the control but with less input of water or nutrient.

Finally 7% of the trials have shown no positive impacts after application of the products.



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ECONOMICAL IMPACT AT GROWER LEVEL

Plants for Plants[®] 4-Terra Fertigation - Apricot Trial in Rivesaltes, France – Pyrénées Orientales,











Plants for Plants[®] 4-Vita: Foliar - Winegrapes Trial in Bages, France – Pyrénées Orientales – Jonquières D'Oriola Vineyard





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4-Vita Winegrapes in France

Plants for Plants® 4-Good: Foliar - Potato



Plants for Plants® 4-Terra: Fertigation - Florina Pepper Trial in Avlonas, Greece - Athens Province







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LET'S MAKE THE GREEN SWITCH

SOCIO-ECONOMIC IMPACT ANALYSIS

Evaluation of satisfaction level for P4P products after completed trial experience

2020: 11 questionnaires have been received - 13 trials on 9 crops.

2021: 29 guestionnaires received - 47 trials on 19 crops.

Satisfaction level per trial	n°	%
1 - not a all satisfied	0	0%
2- not so satisfied	0	0%
3 - slightly satisfied but expected more	25	42%
4 - satisfied	30	50%
5- verv satisfied	5	8%

Willingness to buy P4P products per trial experience

2020: 11 questionnaires have been received - 13 trials on 9 crops.

2021: 29 questionnaires received - 47 trials on 19 crops.

Willingness to buy	n°	%
1 - No	0	0%
2- Probably not	0	0%
3 - Maybe	20	33%
4 - Probably I will	23	38%
5- Yes, I will	17	28%

Farmers' goals for the use of P4P products

2020: 11 guestionnaires have been received - 13 trials on g crops.

2021: 29 questionnaires received - 47 trials on 19 crops.

Main farmers' aim	n°	% of trials
To increase yield	28	47
To improve crop quality	14	23
To reduce irrigation (irrigated crops)	14	23
To reduce the quantity of Phosphorus fertilizer use	13	22

Conclusions

Growers satisfaction from P4P experience was high. 66% are willing to buy the product and 33% is considering. This lead to our go-to-market decision.

Main reasons for the farmer to use the P4P products are increase of yield, improved crop quality and reduction of water and fertilizers.

IMPACT ON THE SOIL

These biostimulants proved to be soil-friendly

The analyses on the soils hosting the crops of the P4P project demonstrated a positive effect on qualities linked to their equilibrium and fertility. As an example, in the eggplant cropping trials, when the phosphorus supplementation was reduced by 30 %, the content of healthy soluble organic compounds in the soil showed a reduction as well. But if the soil with low P addition was supplemented by either **4-Vita**, **4-Terra**, **4-Good** or both, the amount of soil soluble organics was restored.



In terms of microbial biodiversity, meaning the number of different species and types of bacteria and fungi that constitute the soil community and guarantee the variety and functionality of its ecosystem services, it was not affected by the treatments with the biostimulants and in some cases both species' richness and community evenness values were higher in treated samples.

The biostimulants therefore passed the fundamental ecology tests, having shown to confer only positive impacts on the soil ecosystem and on its overall biodiversity.



LET'S MAKE THE GREEN SWITCH



PRODUCT REGISTRATION

 Registration in Europe via the mutual recognition track has been started, with first products having been registered successfully.

 Moreover, P4P Products have recently passed the audit for registration as biostimulants under the new EU law.

 As of July 2022 'Mutual recognition is not needed anymore, as P4P products will be registered EU wide as PBS, being one of the first products in Europe.

Registration in other countries outside Europe are also started.



Label example of the product Plants for Plants[®] 4-Vita

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NETWORKING

Platform meeting: Crop Efficiency Enhancement Webinar

• In April 2022 we organized a meeting in the form of a webinar. We have managed to gather different target groups during this meeting: distributors from and outside the EU, agro-advisors, growers, complementary companies (technology providers, seed producers, agro-waste producers, competitors) and eventual B2B-candidates worldwide: sector representatives, regulatory/certification bodies, retailers, policy makers, scientists.

• The main goal of this webinar was to discuss newly innovative biostimulants and in particular, plant extracts and microbial with a focus on Crop Efficiency Enhancement and Nutrient Use Efficiency. The host of the webinar was Luke Hutson, Chief Editor at New Ag International magazine.





NETWORKING

LIFE Plants for Plants[®] Project – Final Conference

The Final conference of the LIFE Plants for Plants® Project is organised in May 2022. The invited guests are the P4P club members. The Conference is also open to the public through a live stream viewable from the Van Iperen International. During the 2 days program our team together with the partners will share the results of the last demonstration trials of 2021. The agronomy team will give an update on the scientific knowledge of the products, especially the mode-of-action. Finally, the marketing and the sales strategy will be sharedalong with the Business sucess story of Greece (thanks to the presence of our Greek partner).



To view the program, please visit : www.vaniperen.com/ wp-content/uploads/dlm_uploads/2022/05/Green-Switch-Journey-Program-18-and-19-May-2022.pdf



DISSEMINATION PRINT

Examples of technical and marketing documents

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P4P Product Range brochure



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DISSEMINATION PARTNERS

In order to create interaction and group spirit between the partners - distributors, we have created a P4P club. During the 2 years of the LIFE program, the Club was animated through a Whatsapp group and all members met during the kick-off meeting in February 2020. A P4P club webinar was organised in December 2020 to disseminate the trial results of the year 2020.



P4P club meeting - Kick Off February 2020



DISSEMINATION ONLINE (examples)

Word of mouth marketing - growers sharing their experience with P4P products, articles and advertisements in the digital magazines, P4P animation and social media campaigns.





Examples of a social media communication during P4P campaign globally and in Greece *All videos were broadcasted on SM, website, official VII YT channel and during P4P presentations

Example of Whatsapp messages in the P4P club group

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DISSEMINATION CONFERENCES AND FAIRS





Biostimulation Congress – Miami, (December 2021)



16th Congress of Fruit and Grapevine Producers - Serbia (March 2022)

















Total budget: 2.94 MEUR EU contribution awarded: 1.58 MEUR Duration: 35 months Contact details: Marc van Oers marc@Iperen.com Project webpage: <u>www.plantsforplants.com</u>



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Plants for Plants® Life Project

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Thank you for reading. In case you are willing to share your feedback, please send it at <u>marketing@iperen.com</u> We are looking forward to receiving your impressions.