PRESS RELEASE

Sustainable Iron and Phosphorus Fertilisation

After a little more than five and a half years, the Horizon 2020/CBE-JU project SUSFERT came to conclusion in December 2023. The project successfully developed novel bio-based fertilisers that aim to integrate fertiliser components and products into existing production processes and EU agricultural practices. In selected field trials over several years, SUSFERT demonstrated the effectiveness of its novel prototype components combining biodegradable coatings, probiotics and struvite as a replacement for phosphorus and iron supply, as well as lignosulfonate-based nutrigels, evaluated the economic potential and sustainability of the tested products, ensured compliance with legal regulations and finally evaluating the potential for market entry.

Considerable advancement in bio-based fertiliser and coatings alternatives was achieved making the SUSFERT fertilisers versatile and adaptable to different crop species and agricultural systems. SUSFERT fertiliser prototype products are in line with demand trends to source organic fertiliser products from local product streams. This should influence and increase their market penetration in various segments, as well as make them attractive for industry partners to pursue in a highly evolving market targeting environmentally friendly products.

Conventional agriculture relies heavily on the use of non-renewable and resource-intensive fertilisers to meet the ever-increasing demand for food and feed. In addition to nitrogen and potassium, one of the key fertiliser components for safe food production is phosphorus. Given the challenges of raw material availability, energy requirements and environmental concerns of conventional fertiliser production, more sustainable and environmentally friendly alternatives are increasingly being sought.

"The aim of SUSFERT from the very start was to demonstrate that there are sustainable and efficient solutions to iron and phosphorus fertilisation. The further the project developed more and more potential solutions were realised with the aim of incorporating a number of side streams and components into the fertilisers of the future".

Günter Brader, AIT Senior Scientist & SUSFERT Scientific Coordinator

For this purpose, also biodegradable lignin-based granular fertiliser coatings were used on SUSFERT to ensure a more controlled phosphorus release, various bacilli were used as durable micro-organisms to increase nutrient availability, and struvite was used as a renewable phosphorus source. High-quality crops should be supplied with iron using organic fertiliser as well as liquid fertiliser containing siderophores derived from yeast.

SUSFERT focused on valorising specific industrial sidestreams

The goals and impacts of SUSFERT were to reduce dependence on mined phosphate rock, strengthen the circular economy by recycling waste and by-products from wastewater treatment (struvite), bioethanol production (organic fertiliser with iron delivering properties) and pulp and paper production (controlled release of nutrients in fertilisers).

Lignin coating formulations show slow-release efficacy

This was done with the help of lignosulfonate fertiliser granule coatings as well as the novel Nutrigels developed in SUSFERT by the BOKU spin-off Agrobiogel with a high water-holding capacity for improved water supply and, as a fertiliser application of these gels, a combination with microorganisms, struvite, NPK and organic fertilisers (Figure 1) was achieved.

Figure 1: Nutrigel corn test field day / ©RTDS

The aim of SUSFERT was also to reduce soil and water pollution through the development of new types of fertilisers, to strengthen rural areas through the establishment of local value chains and raw material procurement (for example, local struvite recycling) and ultimately the market-oriented development of all ecological components and fertilisers to ensure rapid introduction into conventional farming. Crucial aspects for broader applications will be their economic feasibility and cost-effectiveness, which should be further addressed by SUSFERT's industrial partners and SMEs.

Partner collaboration between industry and research was integral to the coating results. The collaboration resulted in a unique scientific paper published in ACS Sustainable Chemistry and Engineering, titled **Physiochemical Insights into Enzymatic Polymerization of Lignosulfonates**. The paper focused on the reaction mechanisms in biotechnology and chemical reaction engineering processes where there is a current scarcity of data. The work makes a significant contribution to basic and applied research that investigates biobased reactions at industrial scale which results in major benefits to environmentally friendly production processes which are in line with European regulations. Sustainable, non-toxic processes are also a major advantage for industrial workers as they pose less health threats.

Specific field trial results as good as conventional benchmark

The fertilisers developed were tested over several years as part of SUSFERT. As an example, corn experiments were carried out to test the interaction between struvite, micro-organisms and the lignin sulphonate coatings at several German, Austrian and French locations. The tests took place in Meuselwitz (Eastern Germany) and Bowiesen (Southern Germany), in the greater Toulouse area (Southern France) and in Hagenberg, Eltendorf and Karlstein (Eastern Austria). An unfertilised control and three doses of single superphosphate (SSP) (20, 40 and 60 kg P_2O_5 kg ha-1) were used as controls for comparison with the novel struvite P fertiliser products. Struvite P fertiliser products showed performance similar to the SSP benchmark in the trials, making it possible to reduce conventional

fertiliser (Figure 2). The results further suggest that performance fluctuations can be improved by combining struvite with microorganism strains and lignosulfonate coating products.

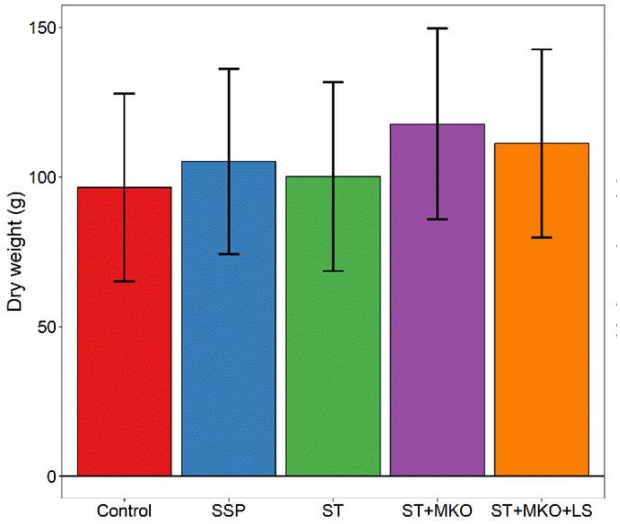

Figure 2: Dry weight (g) of corn between sites for the untreated control fertilization and single superphosphate (SSP) compared to struvite (ST), struvite and microorganisms (ST+KMO), and struvite and microorganisms and lignosulfonate coating (ST+MKO+ LS).

BioAgenasol iron delivery outperforms most conventional benchmarks

The aim of field trials with the organic fertiliser BioAgenasol on high-quality fruit crops was to show the ability of the organic fertiliser BioAgenasol to cover the iron requirements of kiwi and orange plants as well as eggplants and tomatoes. The kiwifruit trials were conducted in the same orchard with the same trees from 2018 to 2021. The orange trials were also carried out in the same orchard with the same trees, but over a longer period of 6 years. In 2022-2023, additional trials were conducted with aubergine and tomatoes outdoors and in greenhouse containers. BioAgenasol resulted in higher yield in the kiwi, orange and tomato trials compared to the market benchmark, based on a meta-analysis of all trials for each crop. BioAgenasol was only exceeded by the benchmark in the eggplant tests. In all cases, iron deficiency symptoms could be prevented through organic fertilisation.

The benefits of bio-based fertilisers, such as those developed on SUSFERT, need to be comprehensively analysed in terms of environmental sustainability, improved crop yields and quality, improved soil structure and ecological footprint. Bio-based fertilisers, such as those used in SUSFERT, are derived from organic or recycled materials, reducing reliance on synthetic chemicals. This minimises the risk of soil and water pollution and greenhouse gas emissions. By supporting natural processes in the soil, fertilisers containing lignin are said to contribute to long-term fertility. SUSFERT fertilisers are versatile and can be adapted to different crops and agricultural systems. This ability makes them suitable for a wide range of agricultural practices and crop species.

"Sustainable practices should be seen as opportunities that move the industry from niche to norm, and not as restraints or obligations that companies need to make. We need to re-set our practices and attitudes to build economies and create jobs that are in tune with nature and climate goals"
Mikael Muegge, SUSFERT Project Manager & RTDS COO & Senior Manager

Ultimately, the growth of SUSFERTs bio-based fertilisers will follow trends such as demand for organic and local products. Marketing strategies that emphasise environmental friendliness and social responsibility are becoming important factors in the mainstream adoption of bio-based fertilisers and through their use, manufacturers not only contribute to sustainable agriculture, but also position themselves for growth in a dynamic and evolving market. “Here indeed SUSFERT has made its impact to showcasing the future of biobased fertilisers” says Muegge.

To get a look behind the scenes of the SUSFERT project visit http://www.susfert.eu or watch the SUSFERT video here: https://www.youtube.com/watch?v=l5l4SExGMm4

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