"Nutrient efficiency technologies can directly reduce agriculture's environmental footprint"

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In an exclusive interaction with AgroSpectrum, **Sondre Lomeland, Product Manager, Plant Nutrition at Borregaard**, discusses the launch of **Activance NUE**, a next-generation biostimulant ingredient designed to improve nitrogen and phosphorus use efficiency while helping growers maximise returns from fertilizer investments. He explains how the CE-marked technology combines multiple modes of action to enhance nutrient uptake, reduce leaching losses, and deliver measurable gains in root development, crop performance, and environmental sustainability.

Lomeland also highlights the growing role of proven, fertilizer-compatible biostimulants in helping agriculture transition from input-intensive practices to efficiency-driven crop nutrition strategies. Looking ahead, he shares Borregaardâ??s broader vision for sustainable agriculture and previews future innovations that could further redefine nutrient management and organic farming systems.

Activance NUE enters the market at a time when nutrient-use efficiency is becoming a central focus for agriculture. What specific industry challenges were you aiming to address through the development of this biostimulant ingredient?

First, being certified under the EU Fertilising Products Regulations, customers can confidently buy a product that is safe to use and supported by documented agronomic efficiency. Historically, it has been difficult for farmers and fertilizer manufacturers to distinguish between biostimulants that consistently deliver measurable field performance and those that rely primarily on marketing claims. The biostimulant sector has expanded rapidly, but the lack of harmonized standards and independent validation has often created uncertainty around product efficacy. By obtaining certification under the EU regulatory framework, Activance NUE provides assurance that its nutrient-use efficiency benefits have been demonstrated through rigorous testing and verified according to recognized standards. This gives growers greater confidence that the product will perform under real-life field conditions and helps manufacturers bring a proven solution to market without undertaking extensive validation work themselves.

Second, Activance NUE was developed with a strong focus on compatibility with common fertilizers and existing application systems. Many biostimulants face challenges when mixed with fertilizers, often causing tank sedimentation, precipitation, filter blockages, or nozzle clogging. These issues can create operational inefficiencies and discourage adoption, particularly in large-scale farming systems where ease of application is critical. Activance NUE has been formulated to work seamlessly with widely used fertilizer products, enabling growers to integrate nutrient-use efficiency benefits directly into their current crop nutrition programs. This compatibility allows farmers to apply fertilizers and biostimulants together without disrupting existing practices, making adoption simpler and more practical.

Ultimately, the goal was to develop a solution that combines proven agronomic performance, regulatory credibility, and operational simplicity, addressing some of the key barriers that have limited wider adoption of biostimulant technologies in agriculture.

The product is certified under the EU Fertilising Products Regulation as a PFC 6(B) non-microbial plant biostimulant. How significant is this CE-marking from a commercial and regulatory perspective for fertilizer manufacturers operating in Europe?

Europe is a heavily regulated market for biostimulants. In order to receive the CE-marking, we have conducted a lot of field trials and got verified nutrient use efficiency from an external party. Now we can sell Activance NUE as a B2B product to manufacturers of specialty fertilizers, and they can include the nutrient use efficiency on their label, without needing to conduct time-consuming and expensive field trials on their own.

Activance NUE claims to improve both nitrogen and phosphorus use efficiency. Can you explain how its three modes of action work together to enhance nutrient uptake while reducing nutrient losses?

Activance NUE has been shown to improve nutrient-use efficiency through three complementary modes of action that work together at both the plant and soil level.

The first mode of action is the stimulation of plasma membrane H+-ATPase activity. This enzyme plays a central role in plant physiology and is often referred to as the engine that drives nutrient uptake. Increased H+-ATPase activity promotes stronger root growth and development, improving the plant's ability to explore a larger volume of soil and access available nutrients. It also enhances the transport of mineral nutrients across root cell membranes and supports the plant's ability to adapt to abiotic stresses such as drought, temperature fluctuations, and nutrient limitations. By strengthening these fundamental physiological processes, the plant becomes more efficient at acquiring nutrients from its environment.

The second mode of action involves improving the plant's ability to absorb and utilize nitrogen. In corn trials with Activance NUE, we observed stimulation of both nitrate reductase activity and nitrate transporters. Nitrate transporters facilitate the movement of nitrate from the soil into the plant, while nitrate reductase is a key enzyme involved in converting absorbed nitrate into forms that can be used for growth and development. By supporting both uptake and assimilation pathways, Activance NUE helps plants make better use of available nitrogen, increasing nutrient efficiency rather than simply increasing nutrient supply. This is particularly important as nitrogen is often one of the most expensive and environmentally sensitive inputs in modern agriculture.

The third mode of action occurs in the soil, where Activance NUE improves the availability and retention of phosphorus and nitrogen through its complexing capacity with phosphates and nitrates. In many soils, phosphorus can become fixed and unavailable to plants, while nitrogen is susceptible to leaching beyond the root zone. Activance NUE helps reduce these losses by keeping nutrients in more plant-available forms for longer periods. This not only improves nutrient accessibility for crops but also contributes to reducing nutrient losses to the surrounding environment.

Together, these three mechanisms create a synergistic effect. The plant develops a stronger root system capable of accessing more nutrients, its internal processes become more efficient at absorbing and utilizing those nutrients, and the nutrients themselves remain more available in the soil. The result is improved nitrogen and phosphorus use efficiency, enabling plants to make more effective use of applied fertilizers while supporting both productivity and sustainability objectives.

Field trials showed improvements in root growth, nitrate uptake, and crop yields across multiple crop categories. Which results surprised you the most during the development and validation process?

One of the most surprising results came from a broccoli field trial that was originally designed to measure nitrogen-use efficiency rather than environmental outcomes. During the trial, irrigation and fertilizer injection events created conditions where nitrates could be washed away from the topsoil and move beyond the root zone. Since the contract research organization (CRO) was already monitoring nitrate concentrations in the leachate as part of the study, we had a valuable opportunity to directly observe how the product influenced nutrient losses under real field conditions.

What stood out was that the plots treated with Activance NUE consistently showed lower nitrate leaching compared to the untreated control plots. While we expected to see improvements in nutrient uptake and crop performance based on the product's mode of action, the magnitude and consistency of the reduction in nitrate losses were particularly encouraging. It provided direct evidence that the product was not only helping plants utilize nutrients more effectively but was also keeping more nitrogen available within the root zone where it could be used by the crop.

This finding is significant because nitrate leaching represents both an economic and environmental challenge. From a grower's perspective, nutrients lost through leaching are nutrients that have been paid for but never utilized by the crop. From an environmental perspective, nitrate movement into groundwater and surrounding ecosystems is an increasing concern for regulators and the agricultural industry alike. Seeing a measurable reduction in leaching reinforced our understanding that improving nutrient-use efficiency is not only about increasing yields but also about reducing nutrient losses.

Beyond the broccoli trial, we were pleased to see consistent improvements in root growth, nutrient uptake, and yield performance across multiple crop categories. However, the nitrate-leaching results were particularly memorable because they highlighted an additional sustainability benefit that complemented the agronomic gains. It demonstrated that technologies designed to improve nutrient efficiency can deliver value on multiple levelsâ??supporting crop productivity, improving fertilizer return on investment, and reducing the environmental footprint of agricultural production.

With fertilizer prices remaining volatile and growers under increasing pressure to maximise input efficiency, how do you see nutrient-use efficiency technologies reshaping fertilizer strategies over the next decade?

I believe volatile prices and uncertain supply of fertilizers are changing the fertilizer programs across the world. Instead of adding fertilizers to reach a maximum yield, the dosage is targeted for the maximum return of investment. Biostimulants are key ingredients in this strategy, where they can maintain high crop yields while reducing the amount of fertilizer applied to the fields.

Many fertilizer manufacturers are now looking beyond traditional nutrient formulations toward biological and biostimulant-enhanced products. How do you see the role of ingredients like Activance NUE evolving within the broader crop nutrition market?

Activance NUE is specifically designed as a B2B ingredient for fertilizer manufacturers, and we see its role becoming increasingly important as the crop nutrition market continues to evolve toward higher-value, performance-driven solutions. Fertilizer manufacturers are investing more heavily in specialty fertilizers and biostimulant-enhanced products as growers demand solutions that deliver measurable agronomic benefits, improve nutrient-use efficiency, and help address sustainability goals.

A key trend we are observing is that manufacturers are becoming more selective about the technologies they incorporate into their products. They are looking for ingredients that not only offer proven agronomic performance but are also supported by robust scientific validation and regulatory compliance. Activance NUE addresses this need by providing documented nutrient-use efficiency benefits and certification under the EU Fertilising Products Regulation, giving manufacturers greater confidence when bringing new products to market.

Another important factor is formulation compatibility. Many biostimulants show promising results in trials but can be difficult to incorporate into commercial fertilizer formulations because they are incompatible with high-salt environments, low pH formulations, or commonly used fertilizer ingredients. This often creates challenges related to product stability, storage, handling, and application. Activance NUE was specifically developed to overcome these barriers. Its compatibility with a wide range of fertilizer systems allows manufacturers to integrate the technology into existing product portfolios without extensive reformulation work.

From a commercial perspective, this compatibility significantly shortens time-to-market. Fertilizer companies can incorporate Activance NUE into liquid fertilizers, water-soluble fertilizers, fertigation products, and other specialty nutrition solutions more efficiently, reducing development timelines and accelerating product launches. This is particularly valuable in a market where innovation cycles are becoming shorter and customer expectations are increasing.

Looking ahead, I believe ingredients like Activance NUE will play an increasingly strategic role within the broader crop nutrition industry. Rather than being viewed as optional additives, biostimulant ingredients with proven efficacy will become core components of next-generation fertilizer products designed to maximize nutrient efficiency, improve crop performance, and reduce environmental impact. As the industry shifts toward more sustainable and resource-efficient agriculture, manufacturers will increasingly seek technologies that combine scientific credibility, regulatory acceptance, formulation flexibility, and measurable field performanceâ??and that is precisely the role Activance NUE is designed to fulfill.

The product has been developed for compatibility across liquid NPKs, fertigation systems, hydroponics, and water-soluble fertilizers. How important was formulation flexibility in the design process, and what feedback have you received from potential industry partners?

The formulation flexibility is one of the key advantages of Activance NUE in the biostimulant market. The feedback from industry partners has been very positive. In broadacre systems, growers value that it can be mixed directly into liquid starter fertilizers such as 10-34-0 and applied in standard field operations. In horticulture, it is appreciated that it can be used in fertigation systems, for example together with WSF, without causing clogging issues. The compatibility makes it easier for formulators and growers to adopt the technology in current practices.

Agriculture is increasingly expected to balance productivity with environmental stewardship. To what extent can improved nutrient-use efficiency contribute to reducing nutrient runoff, greenhouse gas emissions, and overall environmental impact?

Fertilizer use is a significant contributor to global greenhouse gas emissions, both through the energy-intensive manufacturing process and through emissions generated after fertilizers are applied in the field. Today, less than half of the nitrogen fertilizer applied to agricultural land is actually utilized by the crop. The remainder is often lost through leaching, runoff, volatilization, or conversion into nitrous oxideâ??a greenhouse gas that has a substantially higher global warming potential than carbon dioxide.

Technologies that improve nutrient-use efficiency directly address this challenge by helping plants utilize a greater proportion of the nutrients that are applied. When crops can absorb and use nitrogen and phosphorus more effectively, growers can maintain productivity while reducing fertilizer application rates. This not only lowers input costs but also reduces the environmental footprint associated with fertilizer production, transportation, and field application.

Improved nutrient-use efficiency can also play an important role in reducing nutrient runoff and leaching into surrounding ecosystems. Excess nitrogen and phosphorus can contribute to water quality issues, including eutrophication of rivers, lakes, and coastal waters. By increasing nutrient availability to the plant and minimizing nutrient losses from the soil, efficiency-enhancing technologies help keep more nutrients within the crop production system and out of the environment.

Beyond nutrient losses, there is also a broader sustainability benefit. Agriculture is under increasing pressure to produce more food from limited resources while meeting climate and environmental targets. Nutrient-use efficiency technologies provide a practical pathway to achieve both objectives simultaneouslyâ??supporting high yields and crop quality while lowering resource consumption and environmental impact.

As regulatory frameworks become more focused on sustainability and as food value chains place greater emphasis on climate-smart production, technologies that improve nutrient-use efficiency will become increasingly important. In that context, solutions that enable growers to achieve more output from every unit of fertilizer applied can make a meaningful contribution to reducing greenhouse gas emissions, improving water quality, and enhancing the overall sustainability of modern agriculture.

Looking ahead, what is Borregaardâ??s broader vision for biostimulants and sustainable crop nutrition? Are there additional innovations in the pipeline that could further transform how nutrients are managed in modern agriculture?

Borregaardâ??s vision is to contribute to a shift from input-driven to efficiency-driven agriculture. We already support this through a broad portfolio of crop nutrition solutions, including complexing agents, organomineral fertilizers, and soil conditioners. In the innovation pipeline we do have a new biostimulant that could change the way organic farming is managed. The product launch will likely happen towards the start of 2027.

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