fertilizers europe

Fertilizer basics

INFINITE FERTILIZERS

Continuing to feed the world

- Why we need fertilizers
- Where fertilizers come from
- How fertilizers work
- How fertilizers are used

Why we need fertilizers

FOOD PRODUCTION MUST INCREASE SIGNIFICANTLY BY 2050 TO ENSURE GLOBAL FOOD SECURITY.

The United Nations' Food and Agriculture Organization (FAO) predicts that the world's population will reach 9.1 billion people by 2050 and that global food production will have to increase by some 60% above 2005/2007 levels to keep pace with demand.

This increase could be achieved by devoting more land to agriculture. However, this land is not readiliy available and the negative impact on the environment and bio-diversity of further converting the planet's natural forests and wild areas is well documented. Today, changes in land use account for some 12% of the greenhouse gas emissions that lead to global warming.

The more sustainable option is to make better use of land currently used for agriculture. This faces challenges of its own, however, in the form of increasing urbanisation, soil erosion and nutrient exhaustion, as well as increasing water scarcity. Since the "green revolution" of the 1960s and 1970s, growth in agricultural productivity has started to slow down in many regions and recent climate change studies predict that this slowdown will continue.

Global food security rests on reversing this trend through better agricultural efficiency, including more effective crop nutrition.

Food security in Europe

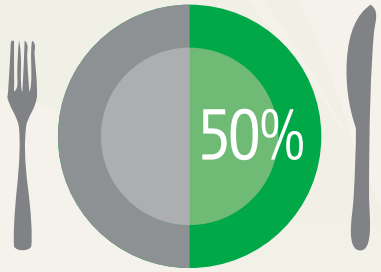
Europe is fortunate in that it has both the climate and enough farmland to be potentially self-sufficient in food production.

Food imports, however, have increased by some 40% over the past 10 years and agricultural land outside the EU the size of Germany is now devoted to producing these. Given the increasing global food demand, this land could be more effectively used to support local food needs.

European agricultural policy has a decisive role to play in ensuring that Europe maintains a strong and diverse agricultural sector. It must encourage European farmers to optimize their production at the same time as reducing their environmental impact.

This "sustainable intensification" of European agriculture requires more widespread adoption of the best agricultural practice and soil management and cultivation techniques.

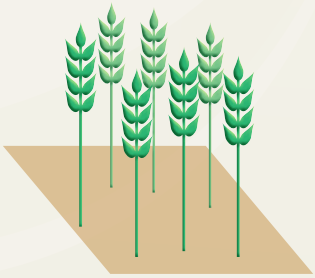
European agriculture must also be economically viable so that Europe's farmers can invest in their operations. Mineral fertilizers have helped European agricultural productivity to become the highest in the world. Every euro invested in a fertilizer in Europe provides, on average, a five-fold return for the farmer, ensuring increased food production and his or her financial security.

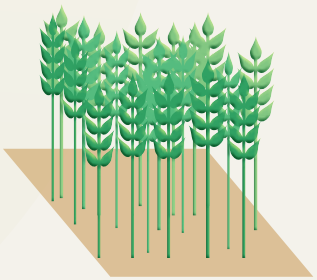


Today, fertilizers* account for **50%** of global food production

in 1960
2 people
were fed from
1 hectare
of land

in 2025
5 people
will need to be fed
from 1 hectare
of land





*mineral-based fertilizers

Where fertilizers come from

FERTILIZER PRODUCTION TRANSFORMS NATURALLY OCCURRING RAW MATERIALS INTO PRACTICAL PRODUCTS THAT SUPPORT PLANT GROWTH.

Each year, the European fertilizer industry transforms millions of tonnes of naturally occurring raw materials such as air, natural gas and mined ores into products primarily based on the three essential nutrients nitrogen, phosphorus and potassium, which plants need to grow to their full potential.

For nitrogen-based fertilizers, the largest product group, the process starts by mixing nitrogen from the air with natural gas at high temperature and pressure to create ammonia. Approximately 65% of the natural gas is used as the raw material for sourcing hydrogen, with the remainder employed to power the production process.

The ammonia is then used to make nitric acid, with which it is subsequently mixed to produce nitrate-based fertilizers such as ammonium nitrate. Ammonia may also be mixed with carbon dioxide to create urea fertilizers. Both these fertilizers can also be further mixed with water to form UAN (urea-ammonium nitrate) solution.

Phosphorus and potassium-based fertilizers are both produced from mined ores. Crushed phosphate rock is primarily converted into phosphoric acid, which is then either concentrated or mixed with ammonia to make a range of products. By-products of phosphoric acid production include the fertilizers calcium sulphate or calcium nitrate.

Muriate of potash (potassium chloride) is separated out of crushed potash ore. This potassium fertilizer may then be further treated with nitric or sulphuric acid to produce potassium nitrate or sulphate of potash.

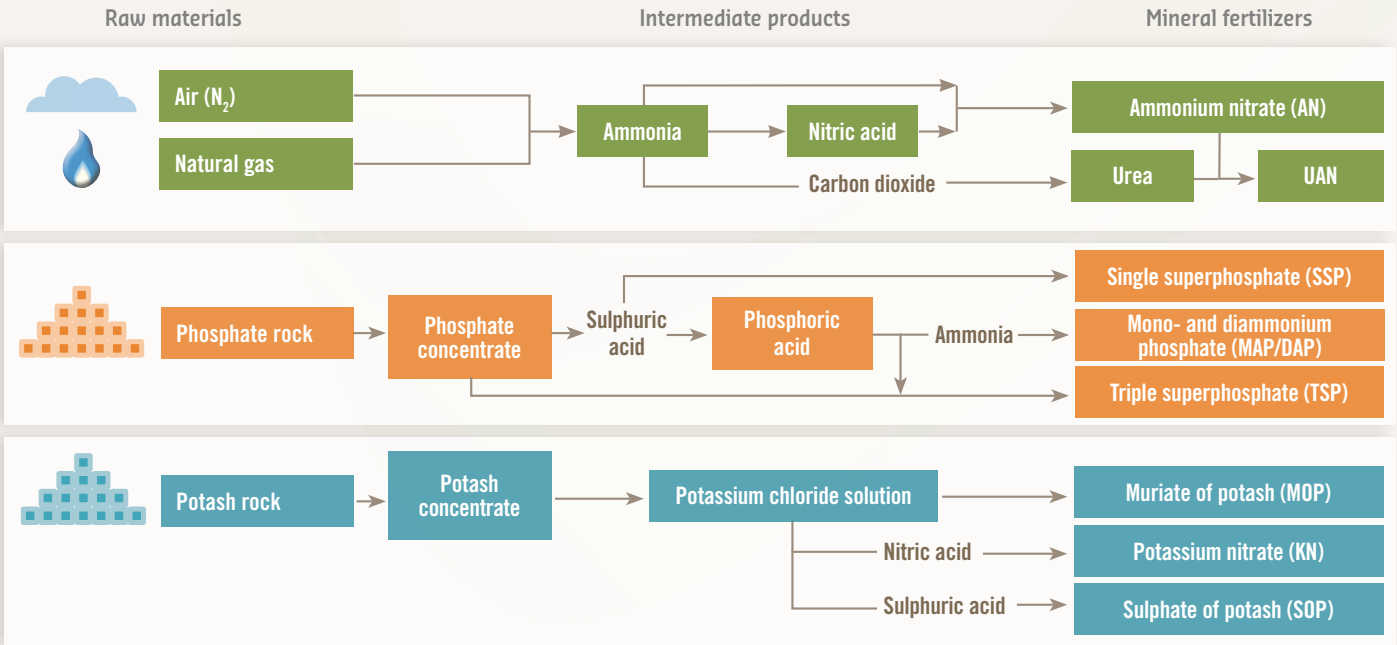
Environmental efficiency

While the basic ammonia synthesis process (Haber-Bosch) has remained unchanged since its invention 100 years ago, process efficiency, control systems and skills have changed dramatically.

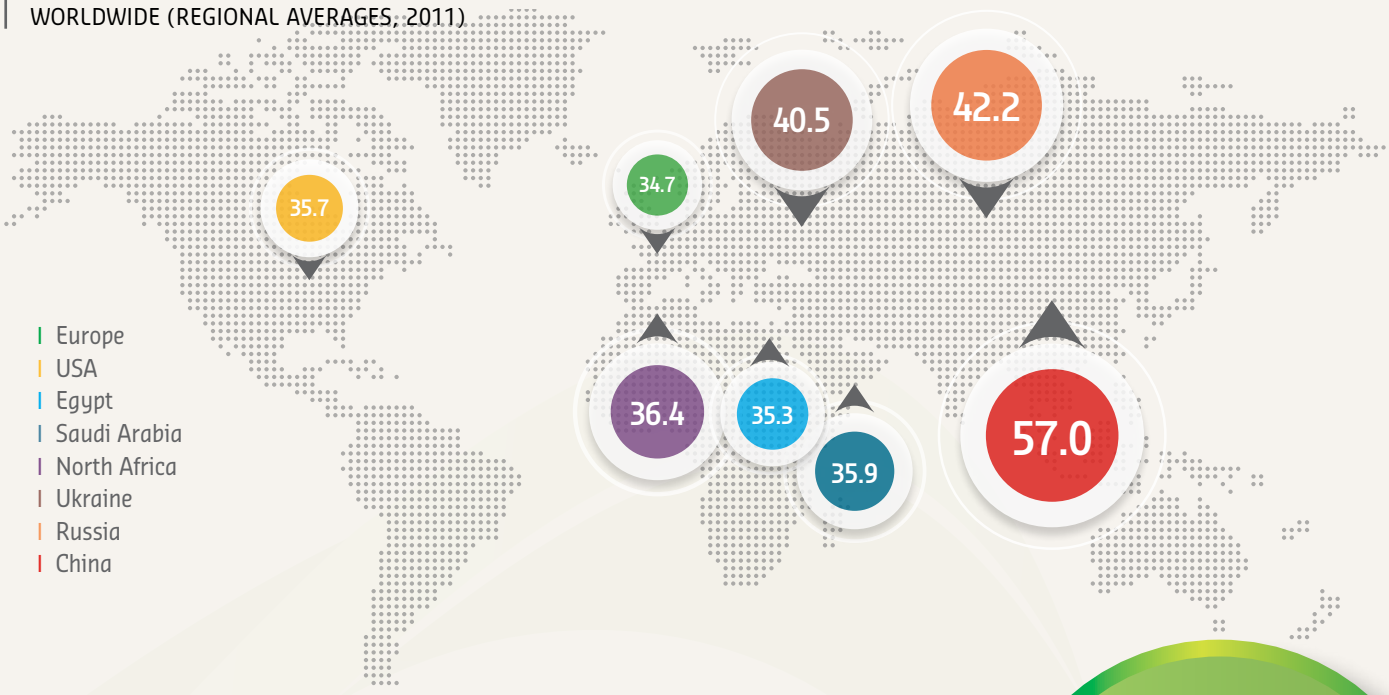
Due to innovative advancements in technology, the European fertilizer industry's ammonia plants are among the most energy efficient worldwide, with the lowest greenhouse gas (GHG) emissions. Its nitric acid plants are also equipped with advanced greenhouse gas emissions reduction technology.

Europe's strict environmental legislation has meant that over the past few years the European industry has invested steadily to increase its efficiency and reduce GHG emissions.

PRODUCTION OF MAIN FERTILIZER PRODUCTS



ENERGY CONSUMPTION (GJ PER TONNE OF PRODUCT) IN AMMONIA PLANTS WORLDWIDE (REGIONAL AVERAGES, 2011)



Industry competitiveness

While deposits of natural gas, phosphate and potash rock are all relatively abundant globally, they can only be found to a limited extent within Europe. The European fertilizer industry is therefore highly dependent on the quality and availability of imported raw materials.

This challenges the industry to be highly efficient in its raw materials use but also makes it vulnerable to the supply and pricing policies of countries outside Europe.

In particular, the high price of gas in Europe makes it very difficult for the industry to remain cost-competitive in a global market. Europe's energy cost-competitiveness is a priority for fertilizer industry profitability, as well as for safeguarding jobs.

Competitive energy costs are essential for a vibrant fertilizer industry in Europe.

Product stewardship

The fertilizer industry's aspirations for efficient, safe and environmentally-friendly fertilizer production has led Fertilizers Europe to develop an industry-wide management system to ensure its advanced production controls are consolidated and maintained.

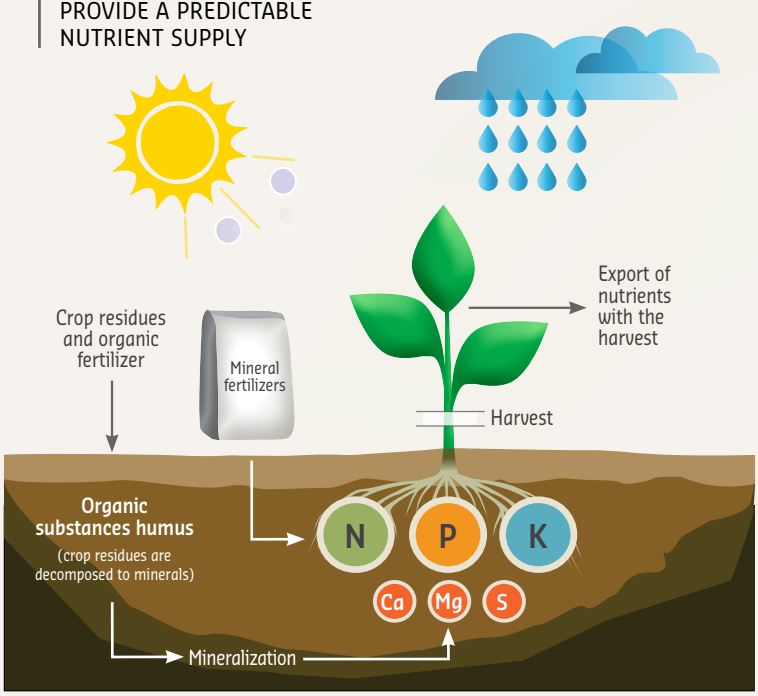
The Fertilizers Europe Product Stewardship program is compulsory for all members of the association and sets the highest global standards for programmes of this type.

The program (www.productstewardship.eu) also ensures that the industry oversees the transport, distribution and storage of its products, working closely with the supply chain to ensure the secure handling of fertilizers on their way to Europe's farmers.

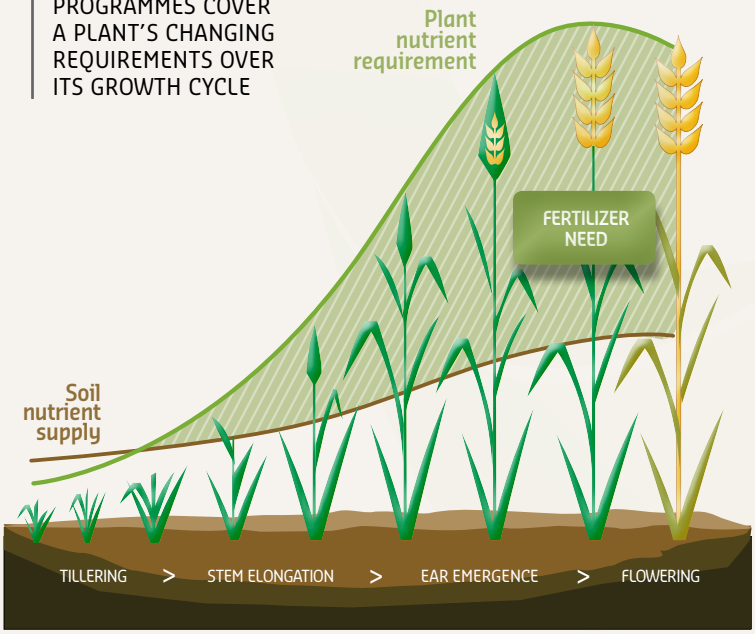
How fertilizers work

EFFECTIVE CROP NUTRITION IS THE KEY TO INCREASING CROP YIELDS AND OPTIMIZING PRODUCTION.

MINERAL FERTILIZERS PROVIDE A PREDICTABLE NUTRIENT SUPPLY



EFFICIENT FERTILIZATION PROGRAMMES COVER A PLANT'S CHANGING REQUIREMENTS OVER ITS GROWTH CYCLE



Crop growth requires sunlight, carbon dioxide (CO_2), water and a balanced supply of the primary nutrients nitrogen, phosphorus and potassium, as well as secondary and micronutrients. These nutrients support a plant's essential metabolic functions.

The water and nutrients are primarily absorbed from the soil via the plant's root system to allow it to develop to its full potential and provide maximum nutritional value. When the plant is harvested, the nutrients it has absorbed are therefore lost from the soil.

Unless the nutrients are replenished, the soil's productive capacity declines with every harvest. Natural processes that break down crop residues and organic material in the soil replace, on average, about half of the required nutrients. The remainder needs to be provided by mineral fertilizers and other organic sources such as manure.

Predictable nutrient supply

The main mineral fertilizers are based on one or more of the essential nutrients, which are delivered in a form that can be readily taken up by the plant.

They enable farmers to offer a specific crop a predictable, balanced supply of the primary nutrients, as well as important secondary elements such as calcium, magnesium and sulphur, and other micro-nutrients. The nutrient content of manures and other organic sources are far less predictable.

Effective fertilization programmes aim to closely balance the composition and availability of the nutrients in the soil with a plant's changing requirements over its growth cycle.

Mineral fertilizers close the gap between the nutrient supply from the soil and organic sources and the the plant's nutrient requirement for optimum development. Targeted application maximizes plant nutrient uptake and ensures healthy and productive growth. It also minimizes nutrient losses from the soil, either to the atmosphere or waterways.

Main fertilizer types

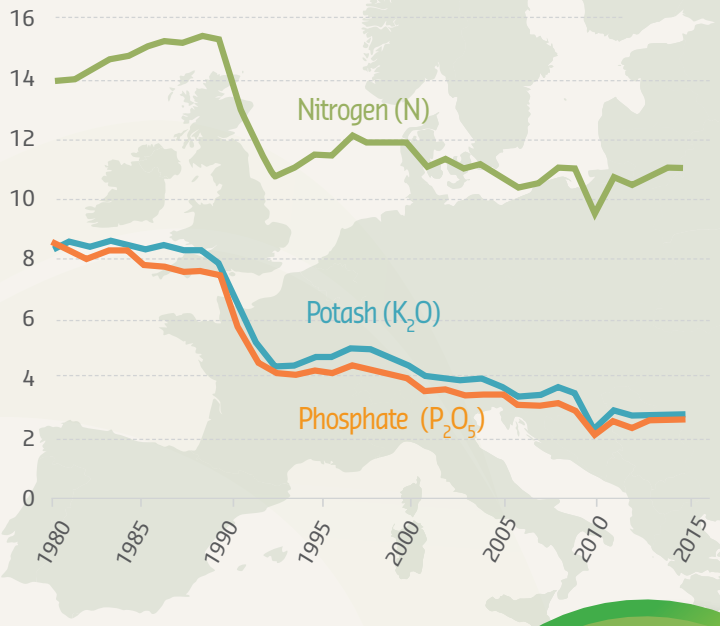
Nitrogen-based fertilizers account for the vast majority of fertilizer use (67% of total consumption in Europe). Phosphate and potash fertilizers account for some 16% and 17% of European fertilizer consumption respectively and can be applied in combination with nitrogen fertilizers.

Most European farmers consider ammonium nitrate (AN) and calcium ammonium nitrate (CAN) to be the most effective sources of crop nitrogen with European climatic conditions. By combining ammonium and nitrate, the two forms of reactive nitrogen that are directly absorbed by the plant roots, they offer the highest nitrogen-use efficiency.

Other nitrogen fertilizers, such as urea and urea-ammonium nitrate solution (UAN), are also available in Europe and are widely used in other parts of the world.

However, unless preventative measures are taken, nitrogen losses to the atmosphere can occur when these latter products are progressively transformed into the nitrate form in the soil. This increases emissions from the field and also reduces their nitrogen-use efficiency.

ANNUAL FERTILIZER USE IN EUROPE (MILLION TONNES)



Source: Fertilizers Europe

Ammonium nitrate and calcium ammonium nitrate are the preferred choice of European farmers.

How fertilizers are used

THE CORRECT USE AND APPLICATION OF FERTILIZERS ARE KEY TO SUSTAINABLE AGRICULTURE AND EUROPE'S FOOD SECURITY.

Sustainable agriculture relies on providing the necessary growing conditions for optimal crop production over the long term. It requires Europe's farmers to adopt the best agricultural practice to optimize crop yields and reduce the environmental impact of agriculture. Fertilizer selection and use are an integral part of this process.

Agricultural experts, legislators and providers of agricultural inputs all have a role to play in ensuring the availability of suitable fertilizers and in promoting good agricultural practice. The European fertilizer industry plays an active role in explaining the specific attributes of its products and in the development of advanced farm management strategies.

Techniques such as crop rotation, minimum tillage and cover crops can help maintain the structure and fertility of the soil, while the basic rule for the correct selection and application of fertilizers is provided by the four principles - the right product, at the right rate, at the right time, at the right place.

Best practice

Modern fertilizer products and application technology are increasingly tailor-made to meet specific crop requirements and cater for different locations and soil types, as well as for the different weather conditions encountered in Europe. Best practice in fertilizer application takes advantage of these characteristics to optimize nutrient-use efficiency.

Modern application machinery is often equipped with new technology such as GPS soil and biomass mapping, which can define nutrient demand down to within a few metres on a particular field. Smart sensors enable highly targeted application patterns, with small coefficients of variation, improving crop productivity and reducing nutrient losses.

While investment in the very latest farm equipment takes time before it becomes mainstream, the fertilizer industry continues to focus on developing practical tools, including GSM-based mobile applications, for improving on-farm nutrient management. Over the years, it has also built up a comprehensive range of information for farmers that addresses the issues of productivity, energy efficiency and the management of emissions.

Reducing environmental emissions

Climate change predictions and the continued focus on the environment mean that reducing atmospheric and water-borne emissions from agriculture remain a priority.

Best practice in fertilizer application takes advantage of product characteristics to optimize nutrient-use efficiency.

Atmospheric emissions include ammonia and greenhouse gases (GHGs) such as methane, nitrous oxide and carbon dioxide. They primarily result from livestock production, organic sources of nitrogen and the application of certain types of fertilizer.

Ammonia emissions can directly affect human health, as well as cause soil acidification and the eutrophication of waterways. Mitigation measures include a variety of techniques such as low-nitrogen feeds, low-emission housing for livestock, covered slurry storage, and more targeted application of manures and slurries.

Techniques for the reduction of atmospheric emissions resulting from mineral fertilizer use include application measures and the use of inhibitor technology, as well as recommendations for fertilizers outlined in the UN's Gothenburg Protocol and EU Air Quality legislation. With the availability of new fertilizers that limit emissions, the main focus of current GHG mitigation efforts is on the promotion of nitrogen-use efficiency. This has increased by 45% in Europe since 1985, but there is still further scope for improvement.

Fertilizer leaching

Leaching of excess nitrate or run-off of phosphate from the soil can also lead to the eutrophication of waterways and excessive algae growth.This normally occurs when the soil is saturated with water and nitrate is washed beyond the plant root zone or phosphate moves with run-off and soil erosion.

As most losses occur outside the cropping period, good agricultural practice aims to minimize excess nutrient concentrations in the soil after crops have been harvested.

For winter cereals, application of nitrogen fertilizer at the economic optimum rate has been shown to not only maximize nutrient-use efficiency and crop productivity but also to significantly decrease excess nitrate concentrations in the soil after the harvest.

Other agricultural practices to limit soil erosion and nutrient run-off include maintaining a porous soil structure, using cover crops to catch residual nitrogen and protect the soil against erosion, and the better synchronization of nutrient availability with crop demand through split fertilizer applications or by using nitrification inhibitors. More appropriate application methods for spreading manure and slurry, such as soil injection, can also have a significant impact.

CARBON FOOTPRINT OF FERTILIZERS

CFT
COOL FARM TOOL

Caculation of the environmental impact of fertilizer application used to be a complicated process. Increasingly, however, European farmers now use electronic applications like the 'Cool Farm Tool' carbon footprint calculator to check the overall environmental impact of their operations. More on this tool can be found later in this publication.

Nutrient use and recycling

Recent attention has focused on “closing the fertilizer loop” through the more effective use of on-farm waste and nutrient recycling. Techniques primarily involve recycling crop waste through composting, anaerobic digestion of manure for energy or fuel generation, and the more efficient use of manure within the overall fertilization strategy.

On an industrial scale, incineration of meat and bone waste and sewage sludge, with the resulting ash being recycled as a raw material for fertilizers, has been successful in several regions. Research continues into other viable nutrient recycling schemes. These contribute to better nutrient-use efficiency, leading to major improvements in resource use.

Product innovation

European fertilizer producers continuously improve their products and processes based on feedback from farmers and explore any possibilities that open up within the food and energy production chain. The focus is on new fertilizer compositions and structures, as well as application technology, to enable more efficient crop nutrition.

Specific fertilizers and application technologies such as fertigation and foliar spraying are increasingly targeted at individual crops to make the most productive use of both nutrients and water.

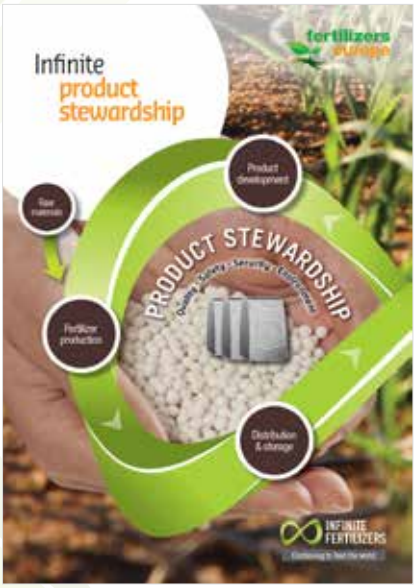
Infinite Fertilizers

In line with its vision of Infinite Fertilizers, Fertilizers Europe cooperates closely with farmers organizations and other stakeholders within the food chain to develop a coherent approach to Europe’s agricultural, environmental and economic challenges and to advancing best agricultural practice within its farming community.

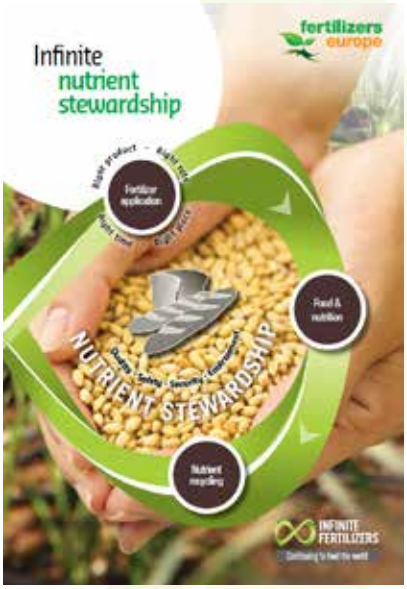
New fertilizers are increasingly being targeted at specific crops and offer a variety of release profiles.

For more information on the European fertilizer industry's vision of Infinite Fertilizers, please request a copy of our Product & Nutrient stewardship books at main@fertilizerseurope.com

Product Stewardship



Nutrient Stewardship



INFINITE FERTILIZERS

Continuing to feed the world

Infinite fertilizers guides the European fertilizer industry's initiatives to ensure that Europe's farmers have access to a variety of safe, high quality, locally produced products, as well as information on their use, environmental impact and nutrient recycling opportunities.

fertilizers europe

Fertilizers Europe represents the majority of fertilizer producers in Europe and is recognized as the dedicated industry source of information on mineral fertilizers. The association communicates with a wide variety of institutions, legislators, stakeholders and members of the public who seek information on fertilizer technology and topics relating to today's agricultural, environmental and economic challenges. The Fertilizers Europe website provides information on subjects of relevance to all those interested in fertilizers contribution to global food security.

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