



Biologicals Solutions and Regenerative Agriculture

YieldON™

Innovation
powered by nature

syngenta
Biologicals

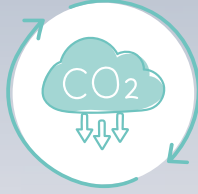


Biologicals' four benefits to Regenerative Agriculture



Healthier soils

Biologicals can help improve the biochemical activity of the soil, contributing to its capacity to function as a vital living ecosystem that sustains the life of plants, animals, and humans.



Reduced greenhouse gas emissions

The integration of biological inputs in crop management can help contain emissions through a more efficient use of resources and an increase in productivity.



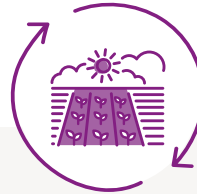
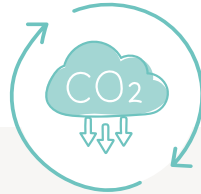
Better water management

Biologicals for water use efficiency help farmers optimize the use of agricultural water, making the most of this precious resource.



Increased farm productivity and profitability

Biologicals can help crops be more productive and face the abiotic and biotic stresses that jeopardize their yield and quality, therefore protecting farmers' incomes and limiting the expansion of agricultural land.



Biologicals Solutions for Regenerative Agriculture: YIELDON™

Summary

1. Rethinking Agriculture	7
<i>What is Regenerative Agriculture?</i>	<i>8</i>
<i>The role of Biologicals in Regenerative Agriculture .</i>	<i>9</i>
2. YIELDON™ for Regenerative Agriculture	11
<i>The productivity challenge: more food,</i>	
<i>less impact</i>	<i>12</i>
<i>YIELDON™: highest crop productivity, highest</i>	
<i>return for farmers</i>	<i>13</i>
<i>On the Field</i>	<i>15</i>
3. Bibliography	15



Rethinking Agriculture

The availability of food for the whole world depends, directly or indirectly, on agricultural production.

The increase in crop productivity achieved over the last century has alleviated poverty and malnutrition around the world, and, at the same time, has made it possible to limit the conversion of habitable land for agricultural purposes to feed a growing population.

However, this success was only temporary. The combined effects of global warming, scarcity of resources and population

growth, which reached 8 billion in 2022, now make it necessary to **rethink the way we produce food.**

Guaranteeing enough healthy food for the entire world population, and, at the same time, limiting the consumption of resources and safeguarding the health of plants, soil and ecosystems: this is the challenge that modern agriculture is facing, a challenge that requires a rigorous approach and globally coordinated measures.

To drive change, the United Nations



has dedicated a goal of the Sustainable Development Goals (UN-SDGs) to food production, number 2, which aims to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture".

However, as a confirmation of the central role that agriculture occupies in our society, and its transversal impacts, the goals connected to the production of food among the UN-SDGs are the majority,

and are distributed among objectives of an environmental, social and economic nature.

In this complex and interconnected panorama, **all the players in the food chain will have to find effective and innovative solutions to face the challenge that awaits us.**

Solutions leveraging both on the imperative of ecosystems conservation and on the answers provided by scientific innovation.

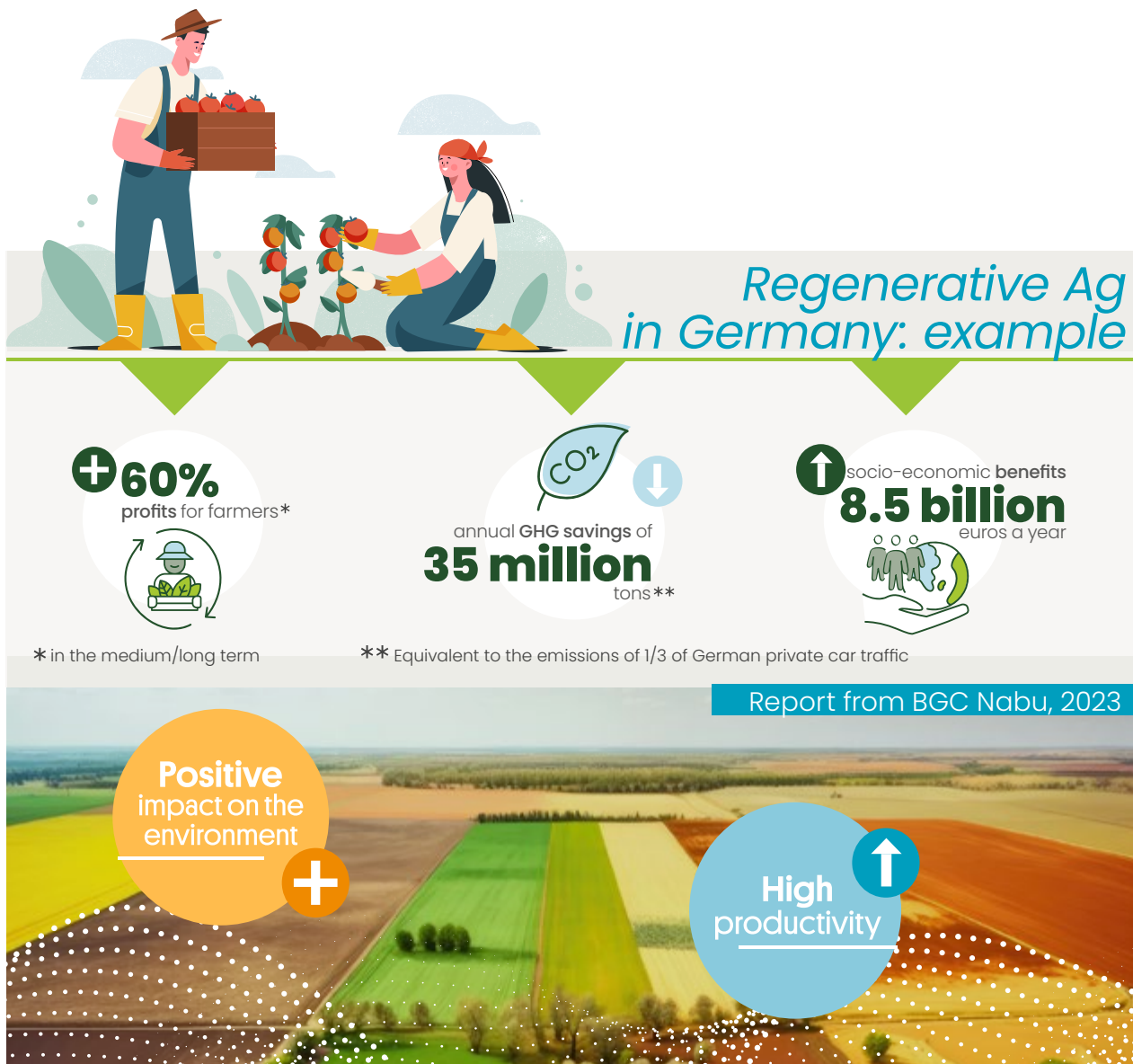
What is Regenerative Agriculture?

We define regenerative agriculture as an **outcome-based** approach, that is to say, oriented towards obtaining specific agronomic and ecological results. Some of these objectives are:



At the same time, we identify **principles and practices** that are functional to achieving these goals. According to the principles of regenerative agriculture, **traditional practices** such as minimal or no-tillage, the use of cover crops, or crop rotation meet with **innovative solutions and technologies** in accordance with the specific needs of crops and land, to tailor an approach that is simultaneously beneficial to humans, the environment and the entire value chain.

This strategy supports the UN-SDG Objective n.2 in its promotion of a "sustainable agriculture", with the idea that **only by safeguarding the well-being of the environment and of the crops themselves it is possible to obtain results that are sustainable in the long term from an economic, social and environmental point of view.**



Regenerative agriculture requires rethinking not only the way of cultivating the land, but also the systemic agronomic strategy and the use of external inputs for crop nutrition and protection. The latter are still considered, but managed in the principle of **precision application**: administered in a targeted way, minimizing waste, and leveraging on the most innovative technologies to optimize treatments on the basis of the single crop or area.

In this context, an important help is provided by **Biologicals**, innovative products that **valorize the action of molecules and organisms present in nature** with the aim of improving crop performance and soil quality. These solutions are designed on the basis of a **deep knowledge of the chemical and biological mechanisms underlying the physiology of plants** and their interactions with the environment, to ensure their **health and productivity** while respecting ecosystems.

Biologicals are made up of three main categories: **biostimulants, biocontrol, and nutrient use efficiency**

The role of Biologicals in Regenerative Agriculture

products. Biostimulants improve the natural physiological processes of crops to increase their **quality, resilience to climatic stress and efficiency in the use of resources**, also benefiting the **microbial activity of the soil**. Biocontrol help plants to face and overcome the pitfalls posed by **weeds or parasites**. **Nutrient use efficiency products** – considered biostimulants or biofertilizers in some markets – improve macro- and micronutrient availability and uptake to promote growth, increase resilience or enhance yield.

Biologicals are not born as alternative solutions to traditional inputs, but to be used in synergy with them and to optimize their use. In particular, Biostimulants improve the health and nutrition status of plants; by doing so, they allow crops to better react to adverse climatic events, or, depending on the type of product, to make the best use of the available resources, minimizing the waste of nutrients.

Products in the Biocontrol category, on the other hand, exploit molecules and substances present in nature to implement highly targeted, specific and low-impact crop defense strategies. An example is the use of pheromones, chemical substances used by parasites for signals between individuals, used to alter reproductive behavior in areas of agricultural interest without harm to the surrounding environment. Lastly, nutrient use efficiency products can effectively support fertilization, by helping plants optimize the nutrients at their disposal and prevent yield reductions that may be caused by nutrient loss.



Biostimulants

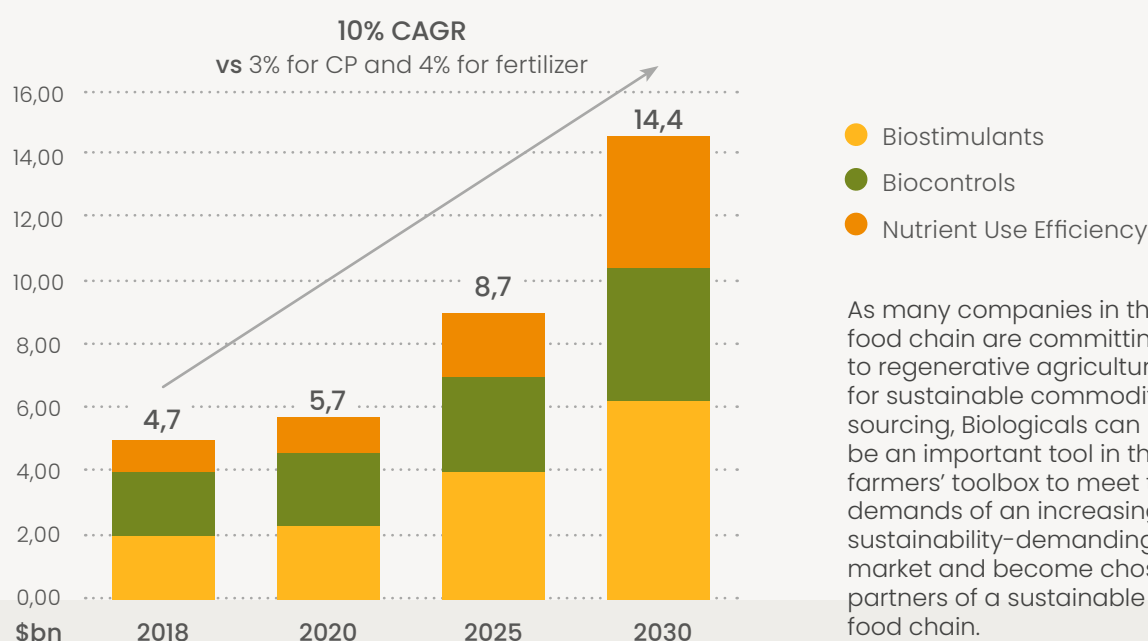


Biocontrol



Nutrient Use Efficiency

Market perspectives reflect farmers' increasing interest in Biologicals.





**YieldON™ for
Regenerative
Agriculture**

YieldON™ is a biostimulant able to increase row crops productivity by modulating the efficiency of the plant's physiological

processes, guaranteeing a more efficient use of the agricultural land and an optimal return on investment to the farmer.



The productivity challenge: more food, less impact

In order to meet the demands of a growing population, two options are available: either to expand agricultural land, or to increase productivity of existing agricultural lands. Since an approach based on the former would have unbearable consequences in terms of sustainability, farmers now need the most diverse tools in their toolbox to improve the productivity of their farmlands with a lesser impact on the environment.

According to the UN FAO, approximately 38% of the global land surface is used for agricultural purposes, a percentage that becomes close to 50% if we consider the global habitable land. Croplands – defined as arable areas and permanent crops – occupy one third of this area.

Land is a limited resource, and the greater demand for food, linked to the growth of the global population, has caused increasing pressure on it. In order to meet the global food demand in the next decades, agricultural land is expected to expand – with massive consequences in terms of biodiversity loss, ecosystems disruption and increasing GHG emissions. As an example, even considering the continuation of the baseline yield gains that have been achieved in the last

50 years thanks to better technologies and improved crop breeding, the World Resources Institute projects that, by 2050, agricultural land will expand by 593 million hectares to meet expected food demand. Furthermore, many consider that achieving a yield increase comparable with the one usually assumed as a baseline will be challenging itself. In fact, many major technologies that have been responsible for the yield increase in agriculture over the past decades – like fertilizers, or irrigation – have been already progressively adopted in most parts of the world, leaving limited space for improvement. Last, but not least, such scenario does not consider one of the most urgent aspects to tackle: the need to limit the use of resources and inputs for sustainability reasons.

This issue becomes particularly relevant when considering row crops, as this sector comprises the most important crops in terms of global cultivated area. Soybean, corn, wheat, rice, rapeseed, sunflower and cotton are generally cultivated through intensive farming systems used to obtain high yields by employing elevated quantities of organic and mineral fertilizers. Considering the impact of such inputs, as

well as the need to limit the increase in area of arable land, it becomes evident that the world needs to make efforts greater than before to boost productivity and provide food for everyone in a sustainable way. This is also one of the core objectives of Regenerative Agriculture, that aims at increasing productivity in existing farmlands, therefore limiting the need for further land conversion to agricultural use, and, consequently, making agriculture more profitable for farmers. While yield increase can be also an indirect consequence of other RA practices (as an example, increasing soil health through the building of soil organic matter can improve yields), an important and shorter-term beneficial role is played by the administration of solutions that sustainably enhance crops performance and yield under a system of precision farming.

Thanks to the integration of the most advanced technologies such as Genomics, Phenomics and Next Generation Sequencing, YieldON™ is born - the biostimulant able to increase productivity of row crops in a way that is sustainable and in full respect of the plant's natural physiology. The result is an increased profitability for farmers and a limited impact on the environment.

YieldON™ contains a selection of extracts from three families of plants and seaweeds, enriched with trace elements manganese, zinc and molybdenum. This successful formula is able to boost some key physiological processes of the plant that are linked to an increase in yield:

Uptake improve. YieldON™ improves the uptake of nitrate ion and zinc and iron microelements, while also increasing phosphate use efficiency. An optimal level of such nutrients enhances crop productivity and grain quality.

Phloem loading. Phloem is the vascular tissue in plants that transports from the leaves to the rest of the plant the organic nutrients (sugars) built during photosynthesis. YieldON™ increases phloem loading and thus improves sugar transport.

Cell division promotion. The active molecules in YieldON™ coordinate specific hormonal process in the plant, that lead to optimal cell division and expansion. This leads to optimal plant embryo formation and seed development.

Fatty acids biosynthesis and transport (observed in Soybean). Fatty acids are fundamental and valuable compounds both in food and in industrial use of crops. YieldON™ has been observed to increase the content of fatty acids and improve their transport in soybean crops.

YieldON™:
highest crop
productivity,
highest return
for farmers





Thanks to these effects, investigated by means of the most innovative technologies (Briglia et al., 2019), YieldON™ can be a precious tool in support of traditional nutrition inputs to increase yield in row crops, responding to the needs of an agricultural production that is both sufficiently large and sustainable. At the same time, it makes row crops farming more profitable for the farmer.

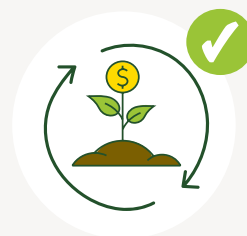
As such, this solution can give a significant support to the Regenerative Agriculture outcomes, especially to the ones related to agricultural impact, productivity and profitability:



Reduction of the environmental impact of agricultural activities
as YieldON™ can help contain emissions through an increase in productivity.



Increase in the productivity of existing farmlands
as they contribute to a sustainable yield increase and limit agricultural land use expansion.



Protection of farmers' profit margins
as it allows an optimal return on investment for farmers, increasing their income and profitability.

On the field



Key crops performances

Total average yield increase on all crops refers to all trials done with YieldON™.

Crops	Average Yield Increase (%)
Bean	12
Cotton	11
Sunflower	10
Rice	9
Soft Wheat	6
Corn	5
Soybean	5
Oilseed Rape	4
Barley	2

Wheat
+0,30 t/ha
ROI* 3:1

Rice
+0,66 t/ha
ROI* 14:1

Soybean
+0,27 t/ha
ROI* 9:1

Corn
+0,64 t/ha
ROI* 7:1

*Return on investment (ROI) is calculated by dividing the profit by the related investment, based on an average value in the European market.

Cultivating Sustainability

Sustainable practices and use of products such as biologicals are good enablers of regenerative agriculture, but this is still not enough! First and foremost, a culture of sustainability must be cultivated along the whole supply chain, leading to a deeper awareness of the issues that we are facing, their repercussions on a global scale, and what tools can be used to address them. In addition, biologicals such as YieldON™, although actually simple to use, require training and technical assistance for an optimal result configured on the precise needs of the customer.

For this reason, we devote ourselves to providing farmers frequent technical trainings on the use of biologicals solutions in the framework of Regenerative Agriculture. From region to

region, a special focus is put on the management of the local key crops and the main pain points for farmers, in order to close the knowledge gap that often hinders the adoption of new sustainable practices and products.

In addition, **we guarantee a system of continuous, widely distributed on-field support**, with a technical support team composed of experienced specialists in the field of Biologicals, competent in the agronomic field

and, at the same time, **trusted advisors for customers from plantation to harvest.** These figures, combining excellent technical, commercial and human skills, have a strategic role in creating a link between the technology and its use, contributing to the goal of spreading Regenerative Agriculture practices, in order to create strategies that combine environmental and economic sustainability while respecting margins.

Bibliography

<https://sdgs.un.org/goals/goal2>

The Case for Regenerative Agriculture in Germany—and Beyond, January 2023

Zheng et al., Sci Rep. 2018, 8(1), 14762.

<https://www.fao.org/sustainability/news/detail/en/c/1274219/>

Course 2: Increase Food Production without Expanding Agricultural Land, World Resources Institute

Briglia et al., Agronomy 2019, 9(11), 761.

YieldON™ trials book, Valagro



syngenta
Biologicals

Biologicals Solutions and Regenerative Agriculture