



Sustainable innovation from seed to harvest



Smart science to improve lives™

CRODA | Agriculture

SMART SCIENCE TO IMPROVE LIVES™

Better quality crops, higher yields and less waste

The world is changing quickly. The number of people in the world is growing, and with it the need for healthy food. But not at the same rate. We have looked ahead to 2030 and this is what we see. While the population will grow by 32%, the need for food will increase by up to 60%. At the same time, the area available for growing food will decrease, due to climate change and other causes. And there will be regulations that mean that the use of traditional crop protection products will be restricted increasingly. In some regions, this means a reduction of as much as 50%. We literally must do more with less. Finally, there is increasing attention on some of the negative impacts of agriculture and horticulture. Think of nitrogen, water and energy use and environmental pollution. Add all that up, and you have quite a challenge on your hands.

The world is changing

With the growing population, the increasing demand for food will require increased agricultural production. Croda Agriculture is collectively using smart science to maximise land productivity, by increasing yield and resilience, whilst protecting soil health and biodiversity.

Croda Agriculture's mission is to deliver targeted innovation to sustainably improve agricultural yields and contribute to global food security. We will accelerate our positive impact with solutions to tackle some of the biggest challenges the world is facing. We invest in innovation projects and partnerships to support crop and seed enhancement in mitigating the impact of a changing climate and land degradation.

- Growing global population
- Even greater growth in the need for food
- Less agricultural land
- Restrictions on the use of plant protection products
- Climate change
- Society's focus on negative aspects of agriculture
- Regenerative agriculture

How Croda Agriculture supports crop and seed enhancement

Spray quality control

Precision targeting, reduced product waste and off target drift

Resilience

Mitigate effects of abiotic stress

Input performance

Improved penetration and delivery of active ingredients

Nutrient uptake and mobility

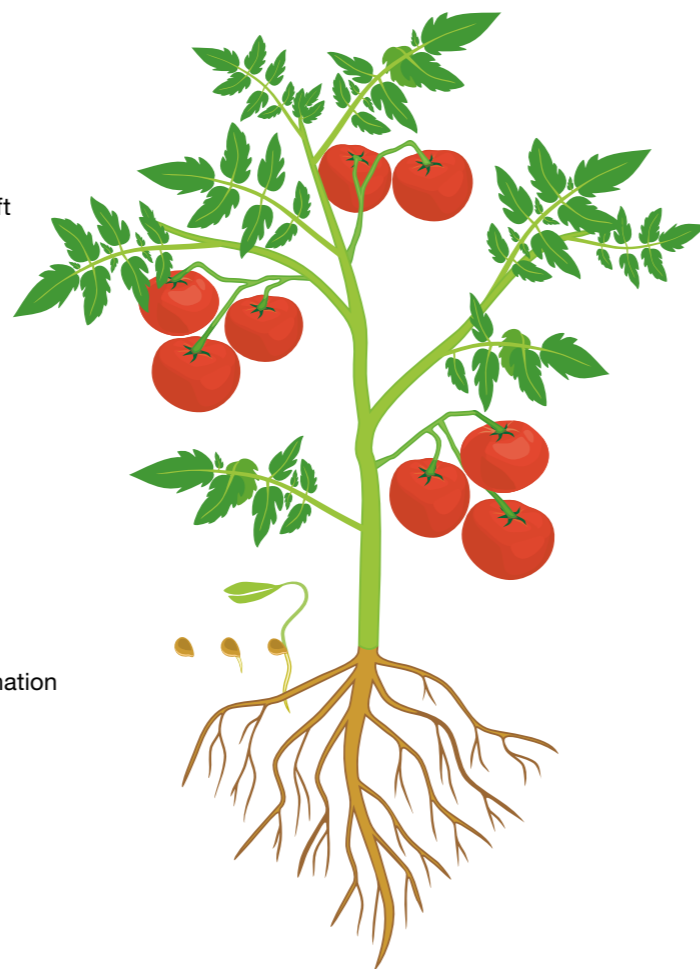
Enhanced uptake and delivery of essential nutrients

Optimise seed performance

Efficient protection of seed, quicker and more uniform germination

Soil health

Efficient penetration of water and agrochemical treatments



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It is our mission to provide innovative crop protection and seed enhancement technologies, enabling the agricultural community to improve agricultural yields and contribute to global food security.

Our biobased and low carbon delivery systems help to improve agricultural yields whilst minimising environmental impact. We help optimise land and crop input utilisation via our adjuvants, delivery systems and seed technologies and support the transition to regenerative agriculture practices through our range of sustainable, innovative solutions.

We provide sustainable delivery systems for agrochemical active ingredients both chemical and biological based.

Our high-performance formulation aids and novel range of adjuvants mean that you can accomplish even the most challenging formulations.

Incotec's solutions improve the resilience and performance of seeds and decrease the need to use plant protection products. Focusing on vegetable and field crops, our seed technologies improve germination, stimulate the healthy development of seeds and seedlings and increase crop yield.

Our novel, chemical biostimulant products improve crop quality, yield and shelf life helping growers to grow more food without using more land and reducing waste.



Smart science to improve lives™

Croda's purpose, 'Smart science to improve lives™' exemplifies our commitment to sustainability. 'Smart science' embodies our innovative philosophy and our ability to offer our customers something different and hugely valuable. 'Improving lives' describes the positive impact our products and services have in use and how, in our activities, we need to reduce the environmental impact of our actions.

By 2030, we are committed to becoming Climate, Land and People Positive and to be the most sustainable supplier of innovative ingredients. Croda Agriculture has a leading role to play in achieving our 'Land Positive' goals including our aspiration to be Net Nature Positive by 2030. We have a restorative strategy, designed to ensure that planet and society are better off because of our activities, and we are not only mitigating against negative impacts.



2030

Climate, Land & People Positive

Climate Positive

Providing sustainable delivery systems that enable our customers to lower their carbon footprint and improve lives by helping to reduce the impact of climate change.



Our 2030 climate commitment

We are reducing our emissions throughout our supply chain in line with our verified Science Based Target and are working towards our commitment to net zero by 2050. We are developing products which offer carbon benefits in use, including avoiding emissions, to support customers in reducing their carbon footprint.

People Positive

Promoting healthy lives and wellbeing through the solutions we make, the way we work and the impact we have on our local communities. We will apply our innovation to increase our positive impact on society.

With a strategy that has sustainability at the heart of what we do, Croda Agriculture is driven to work with its partners and continues to make bold progress against our outlined 2030 commitments.

We are developing solutions to improve health and wellbeing for society through our customers, promoting diversity in our business and delivering social impact in communities.



Our 2030 people commitment

We are improving the lives of millions of people worldwide through their use of our solutions across vaccines, sun protection and agricultural products. Establishing and funding a Croda Foundation helps to improve more lives within our local communities, supported by our technologies.

Land Positive

Saving more land than we use. Our Croda Agriculture business plays a crucial role in increasing agricultural land use efficiency, protecting biodiversity and ensuring food security by efficient sourcing and delivering sustainable innovation across our businesses. We are significantly contributing to our net nature positive ambitions toward a mutually beneficial relationship between Croda Agriculture and nature for a thriving planet and society.



Our 2030 land commitment

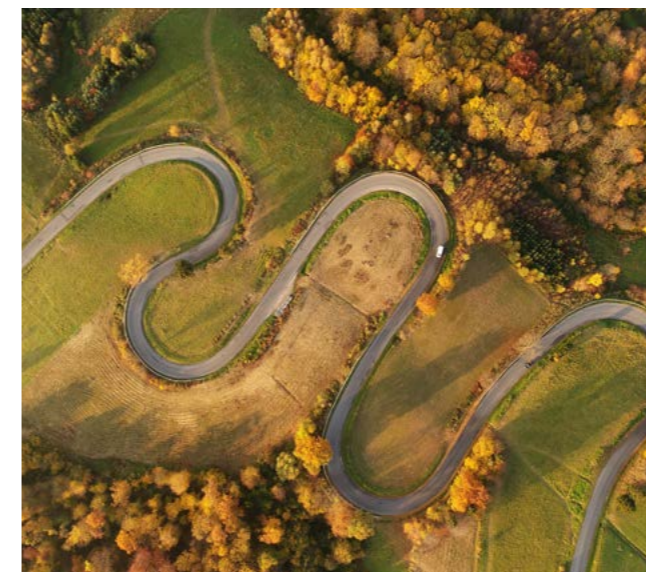
The land area saved through the improved yields and crop resilience because of the use of our crop protection ingredients and seed treatment technologies will exceed that used to grow our raw materials.

► We calculated our land use footprint for the major crops we source, and engaged with our supply chains to ensure there is no deforestation or conflict with food security. Protection of biodiversity, soil health and water consumption are key to sustainably sourcing our feedstocks.

► Our crop, seed enhancement and biostimulant technologies improve yield and quality, allowing farmers to grow more food from less land. Quantifying and

understanding these improvements will enable us to support our customers further in choosing the most sustainable solutions.

► We will invest in innovation projects and partnerships to mitigate the impact of a changing climate on land degradation. We aim to bring an average of two crop technological breakthroughs to market each year which will help our customers mitigate the impact of climate change and land degradation.



Our 2030 nature commitment

By understanding our impacts and dependencies on nature and the role that we can play to drive positive change across our supply chains we will increase focus on preserving forests and habitats, minimising our water impact, and helping to accelerate sustainable and regenerative agriculture.

Sustainable Development Goals

The United Nation Sustainable Development Goals (SDGs) have played a key part in shaping our strategy. The SDGs are a set of 17 global goals and 169 specific targets measured through 230 indicators. They are highly influential in shaping sustainable development globally.

Croda Agriculture has a major impact through enhancing efficiency and increasing yield (SDGs 2.3, 2.4, 12.2, 12.3 and 12.4), and does that in a way that shows care for the environment (SDG 14.1 and 15.5), preferably working together with partners to realise their goals (SDG 17.16).



A positive impact on increased yields and efficiency



Environmental consciousness through minimising required resources



In close collaboration with our customers and other partners across the supply/food chain





14.1:
By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

How do we get rid of microplastics?

There is growing global concern on the topic of microplastics in seed treatment, with countless publications in both the scientific community and general press. Our industry will play its part in reducing the environmental impact of microplastics.

The European Chemical Association has estimated that there will be a yearly reduction of 500 tonnes of microplastic within the European Union alone when all microplastic-containing film coats are replaced by microplastic-free seed treatment alternatives. Incotec is focusing on developing microplastic-free solutions going forward.

We are committed to helping feed a growing population in the most sustainable way and with minimal environmental impact. Our first microplastic-free coatings were launched mid-2020. By now a large part of the product portfolio is already free of microplastics. All new products that we develop are free of microplastics.

Incotec develops coatings for seed that have all the benefits of traditional seed coating, but do not contain any microplastics.

> 500
tonnes/yr
microplastic reduction



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production [...]

Mitigating abiotic stress in young plants

Changing climates mean that higher temperatures, periods of severe drought and higher salinity are becoming an increasing problem for farmers. Our seed enhancement business, Incotec, is developing new seed treatment solutions to mitigate the impact of these abiotic stresses on certain crops.

First trials demonstrated improved germination under stress conditions, and up to 10% increase in crop yield has been realized, as shared by a customer in their field trials in Mexico. Incotec is committed to further develop the product for various crops and to understand in which conditions the beneficial effect is most prominently seen and where the benefits for the farmer are greatest.

Higher temperatures, severe drought and higher salinity are an increasing problem for farmers. We work on seed treatment solutions to mitigate the impact of these abiotic stresses.

up to
10%
increase
of yield



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17.16: Enhance the Global partnership for Sustainable Development, complemented by multi stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources to support the development of the SDGs [...]



15.5: Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

Speeding up reforestation

The 'Speed Up Reforestation' project is a collaboration between Incotec and tech-driven reforestation company Land Life and focuses on the global problem of deforestation and the threats facing forests. Globally, ambitious targets have been set for forest restoration and protection, and Incotec is uniquely contributing to this mission by focusing on accelerating reforestation.

Together Incotec and Land Life pioneer in projects integrating smart coating technologies on tree seeds. The projects will scale up reforestation practices as they enable Land Life to seed large areas of land. To achieve this Incotec applies its technology to enhance seeds, including improving and controlling the germination of seeds by using special treatments and coatings. Coated seeds are already widespread practice in agriculture, but hardly in forestry. The first coated seeds have already been introduced on various sites in Colorado, USA, Victoria, Australia, and Northern Spain.

The cooperation was rewarded with the Plantum Sustainability Award 2023. The independent jury praised 'Speed Up Reforestation' as a concrete initiative that plays a crucial role in addressing a global issue. The application of technology and knowledge from the seed sector in the forestry sector is an excellent example of the contribution the seed sector can make to sustainability.

Seed enhancement can help to ramp up reforestation.

3
countries

5
native species
of trees



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production [...]

Promote crop growth and yields

To help respond to the pressure for food in the context of a growing global population, aligned with our purpose 'Smart science to improve lives™', we launched a new biostimulant, Symiro™, a seed applied technology in development for more than five years. Initially designed for use on soybean seed, Symiro has been shown to promote crop growth and yields.

As a vital source of food, protein, and oils, improving the yield of soybean in the Latin America region eases pressure on food production and provides economic benefit to farming communities. InSync™ Plus, our Symiro containing formulation has been proven to increase soybean yields in Brazil by on average 5.6%.

Symiro has been shown to promote crop growth and yields.

5
years of
research

5.6%
yield
increase



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production [...]



17.16:
Enhance the Global partnership for Sustainable Development, complemented by multi stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources to support the development of the SDGs [...]

Improving yield in Brazil

Tween™ 24, a novel adjuvant, has shown to enhance the bioavailability of the active ingredient in a fungicide formulation, improving yield and reducing land and water used and associated CO₂ emissions. In partnership with a customer, Land Use and Crop Science Innovation field trial studies were carried out in Brazil. Conducted over three growing seasons, the study showed how incorporating Tween™ 24 into a fungicide formulation against soybean rust can significantly improve yield and reduce land use, as well as identify associated water and carbon savings.

As a result of the yield improvement, a greater mass of crop can be produced per hectare, lowering the land area required to grow one tonne of soybeans; this can be expressed as a land saving. This land would typically require energy inputs, all of which will have associated carbon emissions; in reducing the land required to grow the crop, significant carbon and water savings can be achieved, these have been externally validated by Avieco.

By enhancing the bioavailability of the active ingredient, yield is increased while less land and water are needed.

3
growing seasons

3.47kg
CO₂ potential emissions saved per kg Tween 24



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2.3: By 2030, double the agricultural productivity and incomes of small-scale food producers

Making a difference to African farmers

Cocoa is a delicate and sensitive cash crop which is important to West Africa, Latin America and Southeast Asia. In West Africa cocoa is predominantly grown by smallholders. African farmers are facing significant challenges including low productivity, limited availability to market, pests and diseases, environmental concerns, poor access to grower education and falling numbers of young people willing to take on these farms.

Our biostimulant foliar spray for cocoa, distributed by a partner in West Africa, actively promotes the production and retention of cocoa pods which increases yield potential by up to 40% as well as improving the quality of the crop. This has been proven to make a significant difference to African farmers in terms of the amount of cocoa produced and therefore the amount of income they can generate for themselves and their families.

The technology is now being seen by several major cocoa processors and chocolate manufacturers as a key part of their well-publicised commitments to create 100% sustainably produced cocoa.

Our biostimulant for cocoa can result in better quality and a higher yield.

Up to **3** years of robust studies

Up to **134** field trials

up to **40%** increase of yield on average



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production [...]

No space wasted

The most efficient way to grow a crop is to have seeds planted evenly in the field, whereby no space is wasted; every seed should be planted at the ideal distance from another seed in order for plants not to compete for nutrition, water, or sunlight. This goal can be reached with mechanical planting equipment. Some seeds are small or unevenly shaped, which make mechanical planting difficult.

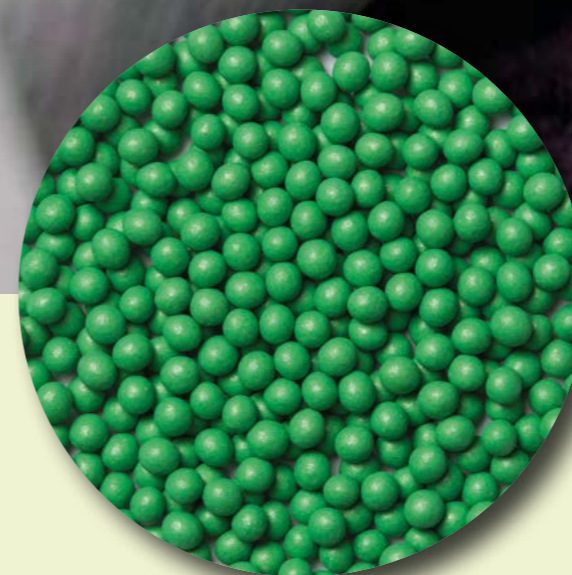
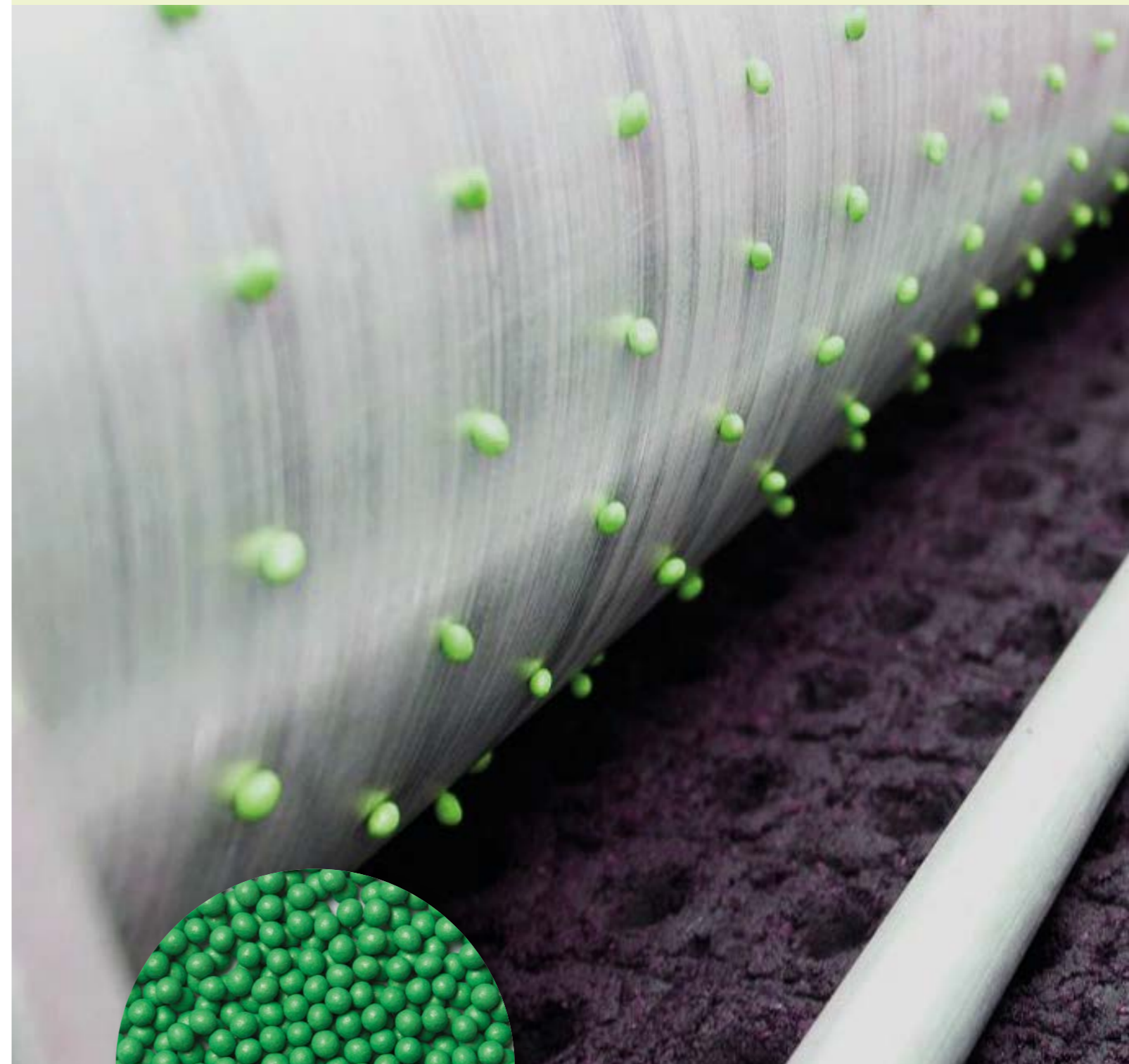
Open field planted crops like onion, carrot, parsnip, sugarbeet and brachiaria are well-known examples of seeds that are difficult to plant mechanically. Additionally crops which are sown in nurseries, like lettuce or tomato, can be small or uneven leading to planting difficulties. To overcome this, seeds can be made larger and rounder via technologies such as encrustment and pelleting, which allows for faster and easier mechanical planting, supporting the farmer and plant raiser in optimising their land use. Nowadays almost all lettuce seeds are pelleted meaning misses or double seeds are hardly ever seen anymore after planting. This will increase the income potential for growers.

Encrustment and pelleting technologies facilitate easier and more efficient mechanical planting. This increases efficient land use and optimises yield potential.

Sowing speed increased up to two-fold while skips and doubles are halved.

100%
lettuce seeds
are pelleted

<1%
seed misses
or doubles



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that [...] strengthen capacity for adaptation to climate change [...]

It all starts with the seed

Most agricultural production starts with seeds that need to germinate well to produce a crop. Some crops germinate either very slowly or irregularly, or very poorly under certain circumstances. Priming of seeds can be a way to speed up the germination process and to allow the seed to germinate in suboptimal conditions, such as warmer temperatures. Lettuce seed will hardly germinate at higher temperatures. After the seed is primed however, the temperature range at which germination takes place can be up to 10°C higher. This allows cultivation of lettuce over a much longer period of the year, from early spring to hot summer conditions, including places which previously were not considered fit for certain crops.

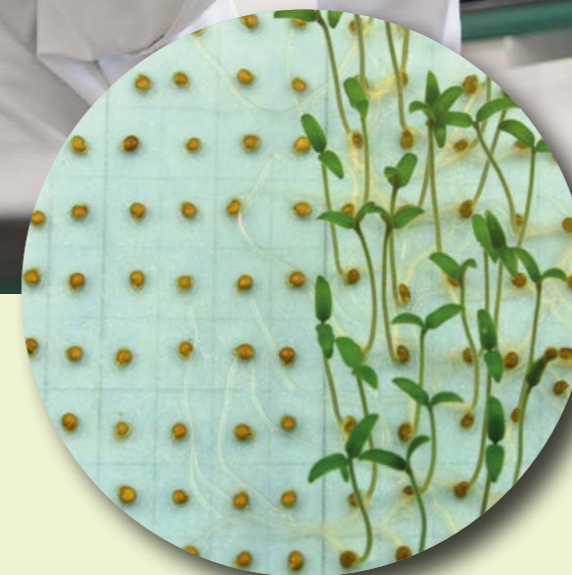
With changing climate conditions, priming of seeds will allow the seed to be more tolerant of warmer conditions. An example is growing lettuce in the Yuma desert in southern California where primed seed can be planted from early September onwards. If unprimed seed were to be used in this area, one would be more likely to wait well into October before planting to minimise the risk of losing the crop. In nurseries, where conditions are generally hotter, primed seed will germinate more easily and quicker, increasing efficiencies.

A similar argument is valid for crops which require warmer conditions to germinate; through priming it will be possible to start these crops earlier in the season, also improving efficient cultivation of crops.

Priming helps seeds to germinate under various climate conditions, improving cultivation efficiency.

+/- 10°C
broader temperature range

>20%
increase in yield potential



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2.4:
By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production [...]

Making soybean stronger

Soybeans are one of the world's most important agricultural crops, providing a valuable source of vegetable protein for livestock feed and human consumption. Globally, around 330 million tonnes of soybeans are produced every year. The United States, Brazil and Argentina are the three largest soybean producers, together accounting for over 80% of global output. The demand for soybeans has risen substantially in recent years, driving substantial changes in land use in several South American countries.

Veritas™, has been demonstrated to stimulate nutrient uptake in soybean plants. This leads to increased crop resilience and more robust plant growth, resulting in a greater number of soybean pods and grains per plant.

In Brazil, over 2000 separate field trials using Veritas carried out between 2012 and 2018 have shown an average yield increase of 188kg / hectare, representing a yield uplift of 5.2% over untreated controls. Comparable results have been found in trials carried out in Paraguay and Bolivia. This represents a significant improvement in yield and land use over conventional techniques.

Veritas biostimulant gives a substantial benefit in soybean production, resulting in higher yields and efficient land use.

5.2%
yield uplift
(188kg/ha)



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12.2:
By 2030, achieve the sustainable management and efficient use of natural resources

12.4:
By 2030, achieve the environmentally sound management of chemicals and all wastes [...] and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

Reduced fossil use identical performance.

Croda Agriculture's ECO range offers 100% bio-based non-ionic surfactants for crop protection formulations. 100% renewable and produced using renewable energy, the ECO surfactants have identical performance to petrochemical-based alternatives.

Ethylene oxide is a key raw material of Croda Agriculture's surfactant range. The traditional feedstock process for petrochemical production of ethylene oxide relies on naphtha/natural gas. Croda Agriculture has developed an alternative bio-based production process that uses corn-based feedstocks replacing the need for traditional fossil fuel-based ingredients. This directly contributes to Croda's commitment that by 2030, 75% of our organic raw materials by weight will be bio-based, absorbing carbon from the atmosphere as they grow.

Reducing our reliance on petrochemical feedstocks, using an increased level of renewable energy and eliminating rail transportation of ethylene oxide are all part of our continued assessment of the total life cycle impact of our products. We are committed to reducing our emissions in line with limiting the global temperature rise to 1.5°C.

Croda Agriculture's ECO range delivers high performance fully renewable ethoxylated products reducing our reliance on fossil fuels.

100%
renewable

100%
bio-based



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12.4:
By 2030, achieve the environmentally sound management of chemicals and all wastes [...] and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment

Happy seeds, happy farmer

Seeds need protection and nourishment. For this, various plant protection products are available and must be applied effectively. Film coating is an effective way of doing this. By applying plant protection products directly onto the seed, the amount of chemicals can be reduced by up to 90% compared to in-furrow or foliar applications.

The same holds true for applying certain microbials or fertilisers; by placing them directly onto the seed, the products are being used more effectively as well as more safely. Using film coats which keep the plant protection products on the seeds reduces the risk of environmental damage, as well as improving farmers' and factory workers' safety. Our film coats have excellent adhesion properties and keep plant protection products, biologicals and stimulants all within the thin film coat layer.

We have many different film coat formulations, each one tailored to meet the unique and specific needs of the crop it is designed for.

Film coating makes actives and additives on the seed more effective and is safer for the farmer and the environment.

up to
90%
reduction of
chemicals





15.5:
Take urgent and significant action to reduce the degradation of natural habitats, halt the loss of biodiversity and, by 2020, protect and prevent the extinction of threatened species

Let's be clear about this

Using plant protection products is an efficient way to protect the seed from fungi and insects. Yet, if seed were not treated properly, there would be a risk that the plant protection products would be released to the environment around the farming area during planting of the seed, due to the friction the seed undergoes when it is loaded into the seed hopper as well as during the planting itself. This would mean that the plant protection products would be working against non-target organisms and have unintended negative effects on microbial life or insects outside the target area. With optimal seed treatment the release of dust is minimised to an enormous extent.

Currently there are specific dust norms set by the European authorities. With the currently available film coats the official dust-norms can always be met, and use of an optimal film coat will typically reduce the amount of dust by 50-80% when compared to seed treated with only plant protection products. The reduction in dust release is measured by use of the Heubach protocol.

Significantly less dust will be released to the environment when using a good quality seed coating.

50-80%

decrease of dust when using an optimal film coat



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15.1:
By 2030, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems [...]



17.16:
Enhance the Global partnership for Sustainable Development, complemented by multi stakeholder partnerships that mobilize and share knowledge, expertise, technology, and financial resources to support the development of the SDGs [...]

On target

Whilst agricultural spraying is widespread practice amongst the farming community, it can result in off-target drift. Often, the plant protection product does not always land on the target it is intended for but instead it drifts causing environmental damage to surroundings including hedgerows, water, and wildlife.

To enhance the performance of any pesticide formulation that is sprayed, it must be delivered efficiently and effectively to the target site. By controlling the droplet size of the agricultural spray, we can improve the spray delivery to the target therefore reducing both drift and run-off providing environmental and economic benefits.

Croda Agriculture has a range of drift reduction products that help to control the droplet size of agricultural spray and ensure that more of the spray is delivered to the intended target crop. Croda Agriculture developed a low-speed wind tunnel in collaboration with academic and industry partners around the world including, agricultural, mechanical, and aerodynamic engineers. This helps to conduct in-depth research on spray droplet size control and drift reduction mechanisms.

The measurement and high-speed imaging capabilities in our bespoke wind tunnel enable us to assess how our products can help to improve spray delivery and develop new formulations that better meet customer, market, and environmental needs.

Croda Agriculture's drift reduction products help targeted spraying, meaning less waste and less impact on animals, plants, water and land.

50%
reduction in driftable
fine particles



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incotec

the seed enhancement company

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