We create chemistry that makes performers love plastics.

Plastic additives for agricultural plastics

BASF
We create chemistry

Pushing back the boundaries of plastics

Success in plastics depends not least on having the right plastic additives. That is why it's important to choose a partner who not only has all the products you need, but can work with you to develop innovative new solutions.

BASF lets you create entirely new additives applications. We are a partner you can rely on to work with you, far into the future. We pioneered the plastics industry in its earliest days and are dedicated to helping our customers achieve sustainable worldwide success in the future. Creating better products. Pioneering new possibilities. And with the vision to shape the future of plastics.

BASF supplies the global plastics industry with an extensive range of additives. Our long experience in stabilization and protection, comprehensive technical support and innovation empower plastics producers to come up with the right solutions throughout the value chain.

We create chemistry that makes enablers love plastics.

Smart solutions to the challenges of the future
However the plastic processing industry develops in the coming years, you can rely on BASF to deliver the plastic additive solutions you need. Working with our customers to enable new plastics applications and support innovative solutions has been part of our DNA for many decades. No one is better positioned to enable you to successfully achieve your goals.

We create chemistry that makes pioneers love plastics.

Innovating the future together
Our pioneering spirit combined with your need for ever-more innovative solutions will drive the development of next-generation plastic additives for tomorrow's world. Together we can explore new possibilities and seek out more sustainable, high-performance solutions for the future.

We create chemistry that makes originals love plastics.

All the knowledge you need for your future success
Since the birth of the modern plastics industry back in the 1950s, BASF has been leading the way in plastic additives. Many of our innovations have gone on to become industry standards and benchmarks. Today, our long experience, expertise and unceasing passion for discovery mean you can rely on us to deliver the solutions you will need tomorrow.

We create chemistry that makes global challenges love plastics.

Your partner, across the globe
As globalization increases, new opportunities are certain to follow. But wherever your plastics business takes you and whatever additive solutions you need, you'll find BASF is already there. Waiting to support you with local knowledge and solutions customized to meet the needs of your new market.

We create chemistry that makes builders love plastics.

The power of curiosity, ambition and expertise
Tomorrow's plastics processing industry will need people with all of these qualities, builders who can deliver the cutting edge solutions that the future demands. With our global reach, innovation leadership, wide product portfolio and uncompromising commitment to product quality, BASF can help you make it happen.

We create chemistry that makes partners love plastics.

Together, we can achieve tomorrow's solutions
We in the Plastic Additives business have been working in close partnership with our customers for many decades: developing new ideas, responding to changing needs, and creating new solutions. So you can rest assured that we will be here to support your business by delivering the sustainable, innovative solutions you need to grow in the future.

We create chemistry that makes visionaries love plastics.

Working together to maximize sustainability
The future of plastics will rely on our shared vision to make the industry truly sustainable with plastic additives. Together, we can shape a bright future for plastics by continuously anticipating new market trends in the emerging economies and achieving best-in-class standards in resource conservation, production efficiency and environmental responsibility.

A growing market for agricultural plastics

According to United Nations estimates, the world's population will exceed 9 billion people by 2050. The amount of arable land needed to feed them, however, will not expand at the same rate – indeed, it could even decrease.

The use of plastics in agriculture, often referred to as "plasticulture", is one way of alleviating this situation. With the aid of agricultural plastics, growers can **secure and significantly increase produced output** per hectare while enhancing crop quality. At the same time, protected cultivation reduces significantly the consumption of water and other resources.

The wide range of plasticulture applications includes greenhouse covers, tunnel and low tunnel films, mulch films, disinfection films, silage films (stretch, bag, sheet), irrigation pipes, nettings (bale wrap, ventilation, shading), nonwovens, twines and substrate/ hydroponic bags.

Continued growth in food production has also created increased demand for effective additives for plastics in agricultural applications. Agricultural plastic converters require products that enhance the durability of plastics and improve crop productivity and quality, while meeting increasingly stringent requirements with regard to the environmental impact of agriculture, water consumption and cost of materials.

Currently, about 3,500,000 metric tons of film is produced every year for the plasticulture market.

The plasticulture market enjoys an average annual growth rate of about 5 % depending on application and region.

The main applications, greenhouse and mulch film, account for almost

75%

of the total market, with more than one million tons being produced for each.

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The seeds of change: challenges for agriculture and plasticulture

The plasticulture market needs to continuously adapt to the rapidly changing agricultural scenario. This is because practices can have an important effect on the choice of films and their stabilization.

Plasticulture is strongly influenced by three main trends that are shaping the market and driving innovation.

- Improving production efficiency
- Increasing yield with fewer resources
- Adopting responsible agricultural practices

Improving production efficiency

The rising price of energy and growing scarcity of raw materials, including seeds and fertilizers, are making it necessary for growers to adapt agricultural practices to make them more efficient. Agricultural plastics with extended durability contribute to improving efficiency.

Increasing yield with fewer resources

The growing world population and continuous depletion of raw materials require more productivity with fewer resources available such as water and arable land due to climate change. Agricultural plastics play an important role in helping to enhance crop productivity and quality in such a difficult environment.

Adopting responsible agricultural practices

Increasingly stringent regulations require the adoption of more responsible agricultural practices. New approaches, such as biological or integrated pest management (IPM), result in different uses of agro-chemicals treatments, making it necessary to stabilize and protect agricultural plastics with light stabilizers which are resistant against these agro-chemicals. The same films must also be resistant to new greenhouse soil disinfection practices which involve higher levels of chlorine.

Creating Value by Excellent Performance

As a leading supplier of plastic additives, BASF provides a full range of solutions for the agriculture industry.

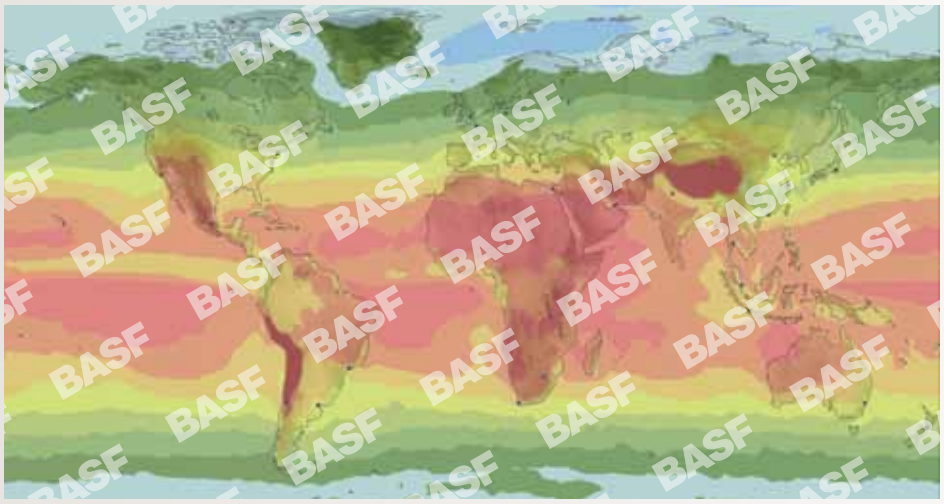
Light stability is one of the key requirements for plastics in agricultural applications. Agricultural plastics are mostly made of polyethylene or ethylene copolymers. These materials are susceptible to photo and thermal oxidation, resulting in rapid and dramatic loss of physical, mechanical and optical properties. Energy-rich solar radiation causes plastics to become brittle. BASF offers a wide range of light stabilizers that help to protect agricultural plastics during their service life.

Durability in the presence of agro-chemicals is a further important requirement. Sulfur and other agro-chemicals are widely used to protect crops against the occurrence and spread of disease and pest infestations. These agro-chemicals can contain sulfur or active halogens, such as chlorine or bromide, which promote polymer degradation and interact with light stabilizers.

BASF products for agricultural plastics
The degree of stabilization required depends on the prevailing environmental conditions and the agro-chemicals used. BASF offers a wide variety of light stabilizers that meet different requirements. Backed by many years of experience in the field, BASF experts can provide help in making the right choice.

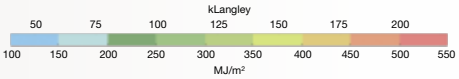
> **Tinuvin® NOR® 371 and Tinuvin® XT 200 can protect agricultural plastics even in presence of very high amounts of agro-chemicals and elemental sulfur (burnt, wettable or powder).**

Global UV Radiation Mapping Enabling Improved Life Time Prediction for Plastic Applications



The map shows the dose of UV radiation reaching earth surface in one year.

In agricultural film applications, multi-years, multi-seasons films have to be designed and protected in relation to the exposure to cumulative UV radiation and other external and environmental factors affecting the film integrity during its entire service life.



Map generated and licensed by German Aerospace Center DLR in cooperation with BASF

Greenhouse and tunnel film

Greenhouses, as well as small and large tunnels, provide an ideal environment for plants. They protect vegetables from the effects of frost, wind and rain; ensure uniformly high quality; help fruit, vegetables and flowers ripen faster, allowing several crops to be harvested in one year. Moreover, modern plastic film can be tailored specifically to the unique light and temperature requirements of many field-grown fruits and vegetables. At the same time, plastic films help reduce water consumption by reducing evaporation.

Durability and crop quality

Whenever converters produce a greenhouse film, they have to allow for solar irradiance, expected film durability, type of cultivation as well as type and frequency of agro-chemicals used. Chimassorb®, Tinuvin®, Tinuvin® XT and Tinuvin® NOR® light stabilizers allow converters
to match any combination of these conditions.

In addition, the manifestation and spread of pests inside greenhouses can be influenced by the use of UV absorbers such as Chimassorb® 81 and Tinuvin® 326. Their accurate loading will also allow the use of natural pollinators inside the same greenhouse.

Combinations of our HALS and UV absorbers have proved to have synergistic effects to enhance the performance and features of agricultural films.

Recommended BASF additives for agricultural films:

HALS

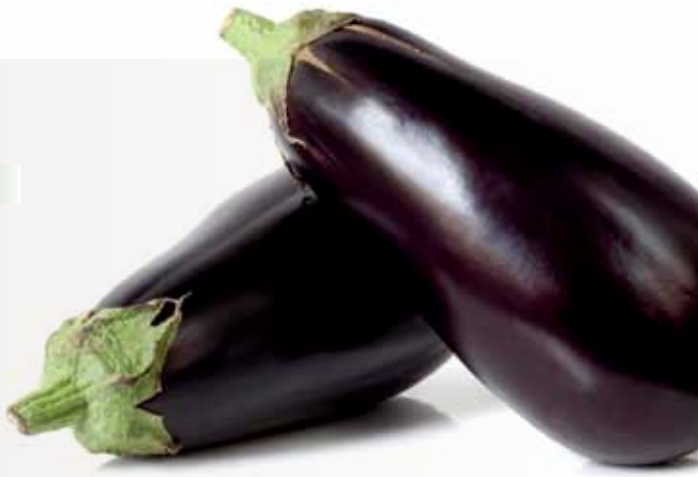
Agrochemical resistance (High → Low)

- Tinuvin® NOR® 371
- Tinuvin® XT 200
- Tinuvin® 494
- Tinuvin® 111
- Chimassorb® 2020
- Chimassorb® 944
- Tinuvin® 783

HALS may be used in combination with UV absorbers to enhance the performance and features of the agricultural films

UV Absorber

- Chimassorb® 81
- Tinuvin® 326
- Tinuvin® 329



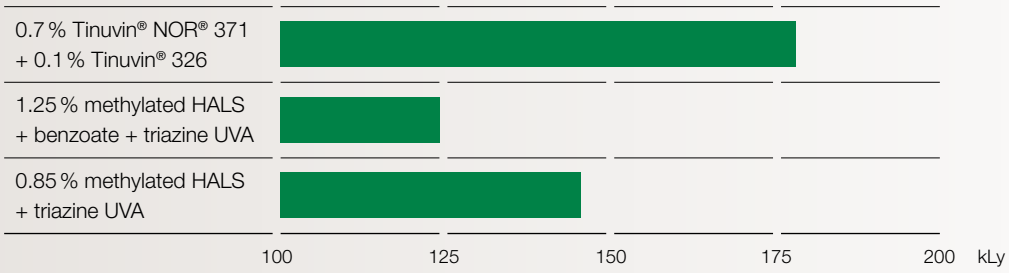
High-performance plastic stabilizers

BASF Tinuvin® light stabilizers help to increase crop yields, save resources and reduce costs.

Tinuvin® NOR® 371 is a high-performance light stabilizer designed to provide long-lasting protection for your agricultural plastics. It is particularly resistant to strong solar radiation and very high concentrations of agro-chemicals.

- Long-lasting protection against strong solar radiation
- Enduring protection against heat build-up on greenhouse supports
- Very high resistance to agro-chemicals, even with elemental sulfur
- Suitable for Integrated Pest Management (IPM)
- Optimum light for crops
- Reduced costs thanks to increased durability of agricultural plastics
- Extensive field records since 1998

High-performance light stabilizer Tinuvin® NOR® 371



Energy to 50 % retained elongation with elemental sulfur applied daily in the greenhouse

Mechanical test: elongation at break in accordance with ISO 527

150 µ LDPE film

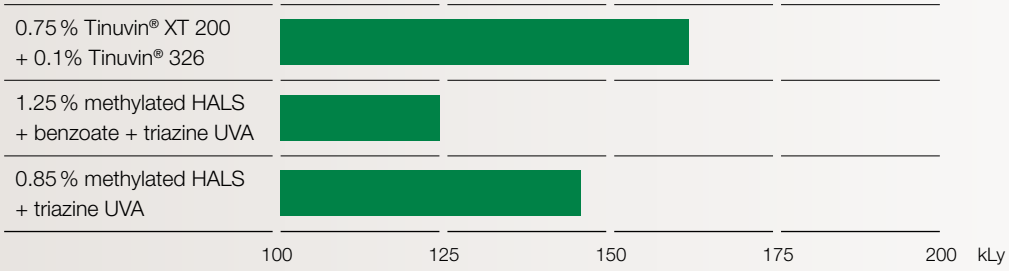
Outdoor weathering at BASF Italy (115 kLy p. a.)

(1 kLy = 41.84MJ/m²)

Tinuvin® XT 200 light stabilizer enables cost-effective production of agricultural plastics while providing resistance to strong solar radiation and high concentrations of agro-chemicals.

- Long-lasting protection against strong solar radiation
- High resistance to agro-chemicals, even with elemental sulfur
- Enduring protection against heat build-up on greenhouse supports
- Reduced formulation costs
- Suitable for Integrated Pest Management (IPM)
- Optimum optical properties for the crops
- Extensive field records since 2006

Cost-effective production with high resistance to agro-chemicals



Energy to 50 % retained elongation with elemental sulfur applied daily in the greenhouse

Mechanical test: elongation at break in accordance with ISO 527

150 µ LDPE film

Outdoor weathering at BASF Italy (115 kLy p. a.)

(1 kLy = 41.84MJ/m²)

Mulch films

Mainly used for growing fruit and vegetable crops over extensive areas, mulch films offer the following advantages:

- Improved crop quality
- Water retention
- Minimization of weed spread
- Soil temperature control
- Soil disinfection before sowing

Durability
To secure crop yield, mulch films need to be durable. BASF light stabilizers provide protection against solar irradiation and agro-chemicals.

Recommended BASF additives for mulch film:

Light stabilizers	Tinuvin® XT 200, Tinuvin® 111, Chimassorb® 944, Tinuvin® 783

Silage (stretch film, silo bags and silage sheets) and other plasticulture applications

Stretch film, silo bags and silage sheets of PE, EVA and EBA protect a fermented high-moisture fodder that can be fed to livestock. Silage must be firmly packed to minimize oxygen content and prevent spoilage. This makes durability a key requirement.

Other agricultural applications, such as drip irrigation pipes, nettings, nonwovens, twines and hydroponics, require an appropriate stabilization package in order to serve their purpose.

Recommended BASF additives for silage (stretch film, silo bags and silage sheets) and other plasticulture applications:

Light stabilizers	Tinuvin® 111, Chimassorb® 2020, Chimassorb® 944, Tinuvin® 783

BASF competencies

BASF offers the following light stabilizers, UV absorbers and antioxidants for agricultural plastic applications mainly made of PE, PP, EVA, EBA and PA.

Recommended BASF additives for agricultural plastic applications:

Effect	Brand	Benefit
Light stabilizers and UV absorbers	Tinuvin® NOR®	Extend the life of plastic applications sensitive to UV light and agro-chemicals. Control the occurrence and spread of pests.
	Tinuvin® XT	
	Tinuvin®	
	Chimassorb®	
Thermal stabilizers	Irganox®	Thermal protection and long-term durability. Maintain the integrity of polymer properties during processing.
	Irgafos®	

Terminology:

EBA: Ethylene Butyl Acrylate
EVA: Ethylene-Vinyl Acetate
LDPE: Low-Density Polyethylene
PE: Polyethylene
PP: Polypropylene
PA: Polyamide

For more information on BASF plastic additives for agricultural plastics, please contact your account manager or visit **www.plasticadditives.basf.com**.

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