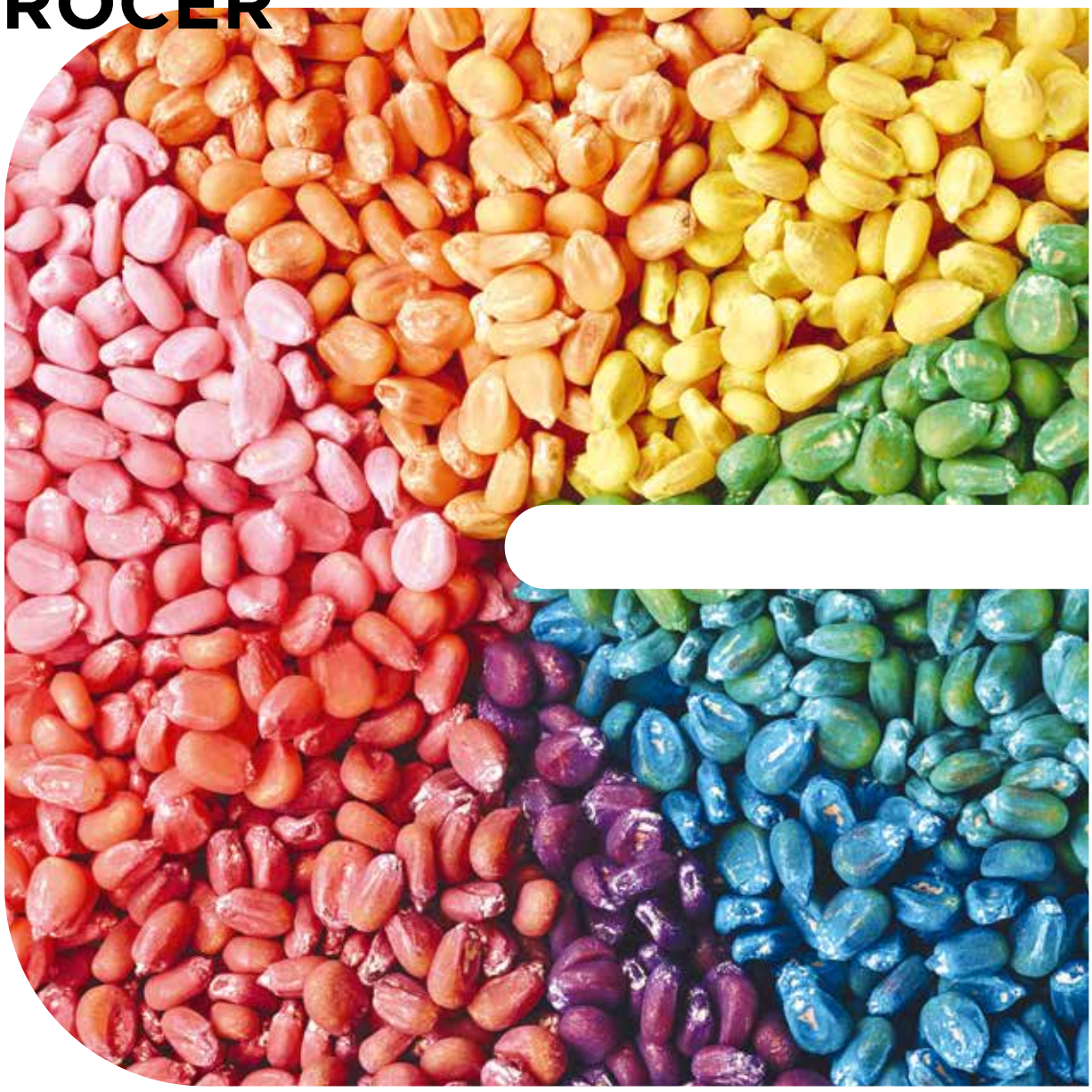
CLARIANT

Colorants for Seed Treatment and Fertilizers

AGROCER™



what is precious to you?

Clariant is a global leader in the field of specialty chemicals. Strong business relationships, commitment to outstanding service and wide-ranging application know-how make Clariant a preferred partner for its customers.

Clariant, which is represented on five continents with over 100 group companies, is headquartered in Muttenz near Basel, Switzerland. Clariant's world-class products and services play a key role in its customers' manufacturing processes and add value to their end products. The company's success is based on the know-how of its people and their ability to identify new customers' needs at an early stage and to work together with customers to develop innovative, efficient solutions.

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Introduction

Clariant is a leading manufacturer of organic pigments, pigment preparations, and dyes. Pigment preparations are aqueous dispersions based on pigments. We have more than 100 years of experience in pigment production and customers can rely on our vast knowledge when using pigments in various applications. Clariant now offers a dedicated range of pigments and aqueous pigment dispersions for seed coloration under the Agrocer brand name. The range is based on the six most globally significant color indices used in this application field and all products are exempt from the requirement of a tolerance by U. S. EPA. The products are also compliant with the European REACH Regulation.

Seed Coloration

The coloration of seeds which have been treated with pesticides is mandatory according to most legislations in order to prevent the misuse of treated seeds. Besides this important safety feature, there are other important aspects related to the coloration of seeds.

- Coloration according to legal regulations to prevent consumption of treated seeds
- Use of individual colors and color shades for branding
- Value perception and cosmetic appeal for high-value seeds
- Identification of a specific treatment or distinction between different seed varieties
- Easy monitoring of uniformity and consistency of seed treatments
- Better monitoring of seed depth and spacing during sowing
- Identification of original seeds via tagging with distinct colorants

In general, a colorant can already be included in the seed treatment pesticide formulation. Alternatively, it may be added to a seed coating slurry based on one or more uncolored pesticide products and a suitable binder system (polymer).

It is important to understand the basic features of the different types of colorants in order to identify the most suitable product. One needs to distinguish between pigments (insoluble in the application medium) and water-soluble dyes. In principle, both types can be used in seed treatment applications, but because of various advantages, pigments have almost completely replaced dyes in this application field. Pigments are unlikely to show signs of phytotoxicity (which can be an undesired side effect when using dyes), exhibit a much higher stability and are not prone to staining and bleaching.

Regulatory Background

Various regulations are in place to ensure that treated seeds are colored in order to avoid human or animal consumption. One example is the U.S. Code of Federal Regulations, 40 CFR §153.155, which requires that "pesticide products intended for use in treating seeds must contain an EPA-approved (United States Environmental Protection Agency) dye to impart an unnatural color to the seed". Certain products are exempt from this requirement if they are "labeled for use solely by commercial seed treaters and that the label bears a statement requiring the user to add an EPA-approved dye with the pesticide during the seed treatment process".

This means that either a pesticide formulation used for seed treatment must contain a colorant or that it must be added prior to application on the seed. From a regulatory point of view, colorants in seed treatment pesticide formulations are considered as "co-formulants" or "inert ingredients". With the requirement of adding only "EPA-approved dyes", the same strict inert ingredient requirements also apply for colorants added separately to seed coating formulations.

EPA Inert Exemption Status

The U. S. EPA has set specific requirements for co-formulants (inert ingredients), which have become a limiting factor for global compliance.

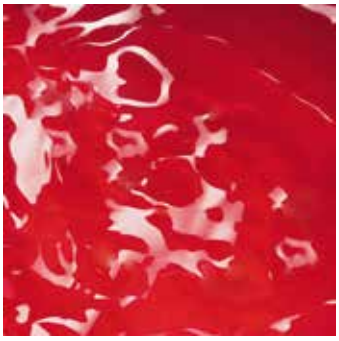
All Agrocer products in this brochure are exempt from the requirement of a tolerance according to 40 CFR §180.920 and have been cleared to be used on crops for food use. Clariant has recently obtained new EPA exemptions for C. I. Pigment Red 112 and C. I. Pigment Yellow 1, introducing the first new organic pigments since many years. The broader choice now enables formulators to develop many more color options than there were before. By combining two or more pigments or pigment preparations, new color shades can be generated. One simple example is Orange, which is obtained by mixing Red with Yellow. Clariant offers all six organic pigments, which are EPA compliant, as a powder and as an aqueous pigment preparation.

Besides the obvious prerequisite of complying with EPA regulations when developing a product for the U. S. market, more and more companies are leaning towards global formulations in order to reduce complexity. Therefore, EPA compliant inert ingredients have become a must for many players, even for use outside the U. S.

All Agrocer products in this brochure are also compliant with the European REACH Regulations.

PRODUCT OVERVIEW

The Agrocer pigments and pigment preparations are globally available through Clariant's worldwide production and warehousing network. With production facilities in the Americas, Europe, Asia, and Africa, we are always close to our customers. One of our aims is to optimally serve our multinational customers, who are increasingly focused on globally harmonized formulations and standardized raw materials. All Agrocer products in this brochure have uniform global compositions and specifications.

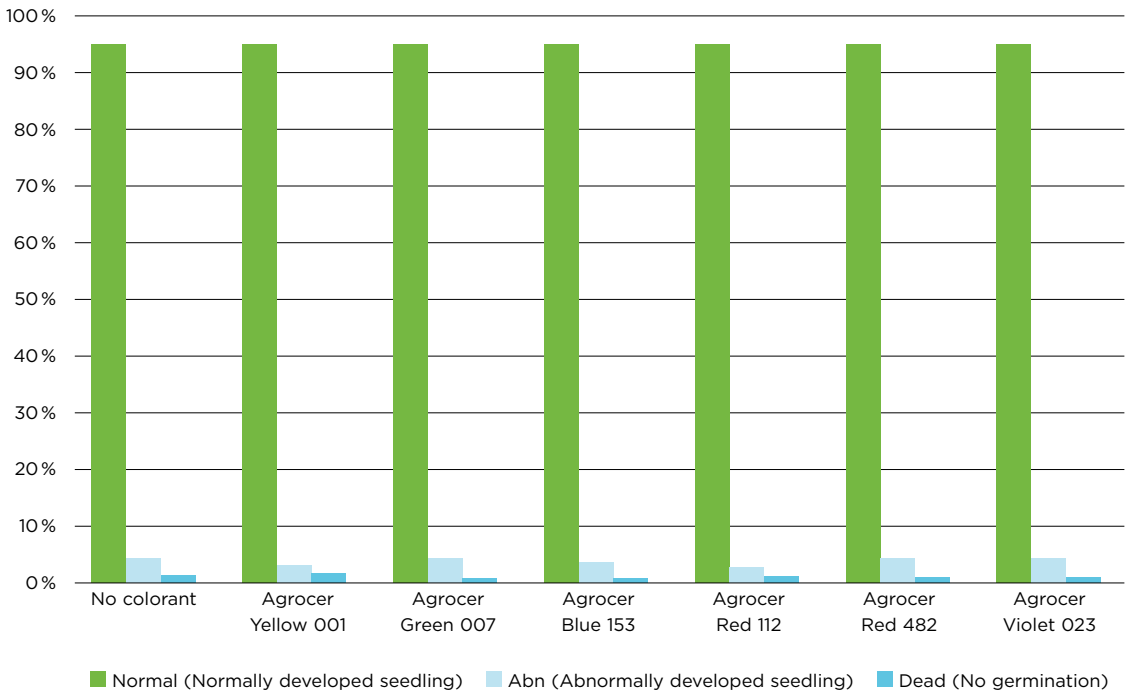


Agrocer – A Safe and Sustainable Solution

All Agrocer products in this brochure are exempt from hazardous labeling requirements. The products meet Clariant's strict purity requirements for low heavy metal and primary aromatic amine content, i. e. they comply with European Resolution AP (89) 1 for colorants in plastic materials which come into contact with food. All products are manufactured without using nonylphenol ethoxylates (NPE) and alkylphenol ethoxylates (APEO). The powder pigments and pigment preparations are EPA approved as inert ingredients in pesticide formulations applied to growing crops, including food crops, and are exempt from the requirement of a tolerance according to 40 CFR §180.920. The products have been tested for seed safety and do not show a negative impact on germination.

SEED SAFETY AND GERMINATION TESTS

GERMINATION RATES OF SOYBEAN TREATED WITH SEED TREATMENT PESTICIDES AND AGROCER DISP. PIGMENT PREPARATIONS

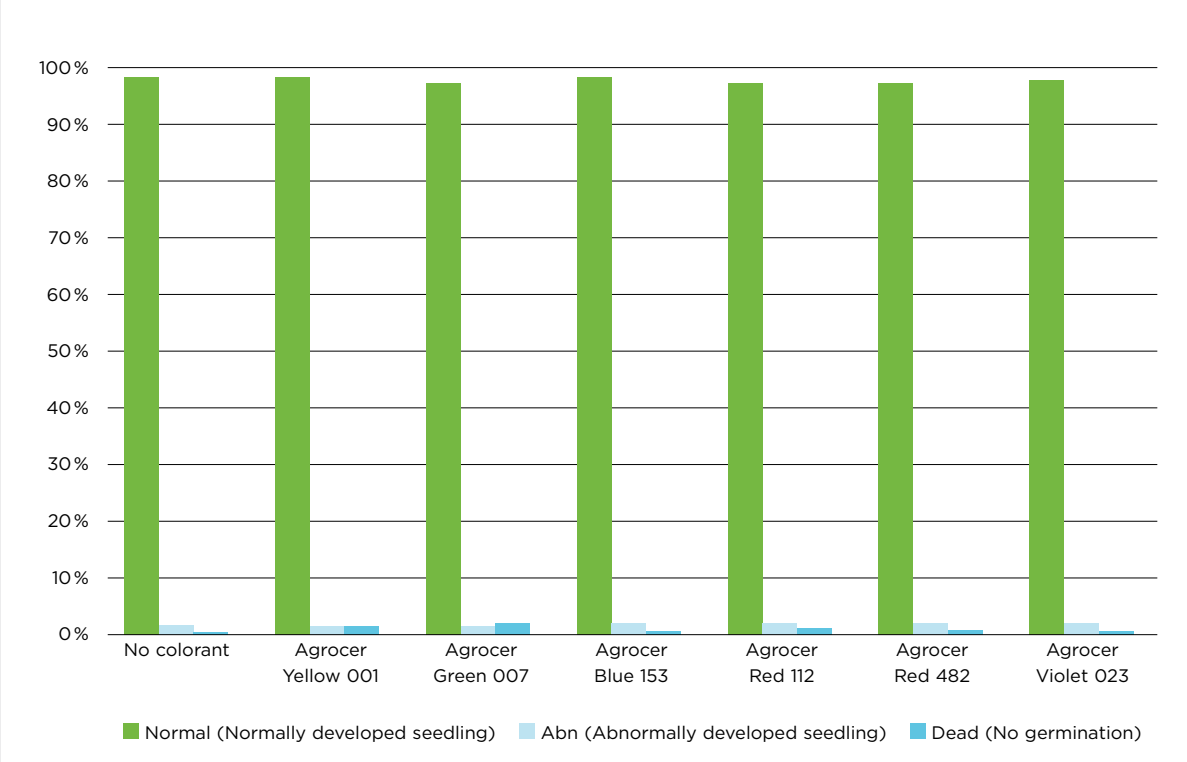


Seed safety is a primary concern for seed companies and seed coaters in order to protect their valuable seeds. It is imperative that no ingredient in a seed coating formulation has a negative impact on germination. While pigments are unlikely to exhibit phytotoxic properties due to their insolubility and non-bioavailability, pigment preparations which contain wetting and dispersing agents can generally become an area of concern.

All Agrocer pigment dispersions have been tested in germination tests according to international seed testing standards and have shown no signs of phytotoxicity.

However, it is the responsibility of the user to verify the acceptability of germination for their desired treating mixture and process.

GERMINATION RATES OF CORN TREATED WITH SEED TREATMENT PESTICIDES AND AGROCER PIGMENT DISP. PREPARATIONS



Agrocer pigments and pigment preparations have a successfull track record of several years of global commercial usage without seed safety issues.

This includes germination tests after long-term storage up to 9 months for soybeans, and 18 months for corn and wheat.

Germination trials were carried out at the seed testing lab of Iowa State University, USA, and SGS laboratories.

There was no difference between the germination behavior of seeds treated with Agrocer Disp. pigment preparations and seeds without colorant.

Agrocer Powder Pigments

Agrocer powder pigments are easily dispersible, exhibit a high color strength and show good hiding power, which is important in achieving good coverage on various types of seeds. The brand names of the Agrocer products include the color and a three-digit figure based on the underlying color index.

Agrocer powder pigments are the preferred solution for seed treatment pesticide formulations in which a high pigment loading is required and where no additional water can be introduced into the formulation. In order to utilize the full potential of these products, the pigments need to be dispersed properly using appropriate equipment.

The commonly used wetting and dispersing agents in crop protection formulations (suspension concentrates) are also suitable for the dispersion of Agrocer pigments.

AGROCER POWDER PIGMENTS
PRODUCT OVERVIEW

PRODUCT	COLOUR INDEX
Agrocer Red 112	Pigment Red 112
Agrocer Red 482	Pigment Red 48:2
Agrocer Blue 153	Pigment Blue 15:3
Agrocer Green 007	Pigment Green 7
Agrocer Violet 023	Pigment Violet 23
Agrocer Yellow 001	Pigment Yellow 1

PIGMENT RED 112 – THE BETTER CHOICE

With the EPA exemption of C. I. Pigment Red 112, a new option in the red color space is available for formulators who rely on EPA compliant products. Agrocer Red 112 has several advantages over C. I. Pigment Red 48:2. One important aspect is the intrinsically higher color strength of C. I. Pigment Red compared to C. I. Pigment Red 48:2, which means that less pigment is required to obtain the same color intensity.

Furthermore, P. R. 112 has more hiding power, which helps to improve the coverage on seeds. Agrocer Red 112 has been engineered particularly for superior hiding power. In terms of color shade, Agrocer Red 112 exhibits a more yellowish color shade, which makes the product particularly suitable for combinations with Agrocer Yellow 001 to design various yellowish Reds and Orange shades.

From a technical standpoint, the main disadvantage of C. I. Pigment Red 48:2 is the solubility, which is relatively high for an organic pigment and which can lead to recrystallization and stability issues during storage such as viscosity increase and gelation. Due to its chemical nature (C. I. Pigment Red 48:2 is a classic lake pigment, which means that it is derived from a water-soluble dye that is precipitated by the addition of calcium ions), P. R. 48:2 products unavoidably contain free calcium ions which can cause undesired interactions and stability issues with certain surfactants and active ingredients.

Finally, the Agrocer Red 112 Disp. pigment preparation has a 14 % higher pigment content compared to Agrocer Red 482 Disp., which means that less of the dispersion is required to deliver the same color intensity. Consequently, less water is introduced into the formulation, leaving more space for other formulation ingredients.

Agrocer Disp. Pigment Preparations

Pigment preparations are aqueous dispersions based on pigments. Increasingly, aqueous pigment preparations are replacing powder pigments in seed coloration applications. Pigment preparations are easy-to-handle products which can be simply added to pesticide or seed coating formulations without a costly and tedious dispersion process. Instead of dispersing the pigment in the presence of wetting and dispersing agents in a pearl mill, pigment dispersions can be added at end of the production process and only require appropriate mixing. Therefore, these products are the preferred solutions for professional seed coaters and are also suitable for on-farm seed treatment.

All Agrocer Disp. pigment preparations show excellent compatibility with seed treatment pesticide formulations as well as seed coating products. The preparations are based on wetting and dispersing agents as well as other additives which are commonly used in seed treatment pesticide formulations. Agrocer dispersions contain neither a binder nor sticker nor polymer, thus increasing flexibility for formulators. The products can be combined with the different binder systems typically used in the industry as well as additional fillers or pearlescent pigments, giving formulators the freedom needed to develop the best performing product.

PIGMENT PREPARATIONS – ADVANTAGES

- No dust for a cleaner and more hygienic production environment
- No milling equipment needed
- Higher flexibility and production efficiency, faster changeover times
- Reduced cleaning efforts
- Easy handling due to simple dosage (readily pumpable)
- High solid content and optimum dispersion to yield maximum color strength

Clariant is a leading supplier of pigment preparations. We rely on decades of pigment dispersing expertise thus ensuring that all Agrocer Disp. pigment preparations utilize the maximum color strength of the pigment. Our pigment preparations are state-of-the art products with optimum storage stability (minimum shelf-life of 2 years) and proven seed safety.

In order to distinguish Agrocer dispersions from the powder pigments, each product carries the suffix "Disp." at the end of the trade name. In addition to our standard range of products, we also offer tailor-made solutions upon request.

AGROCER DISP. PIGMENT PREPARATIONS PRODUCT OVERVIEW

	PRODUCT	COLOUR INDEX	PIGMENT CONTENT	SHELF LIFE IN YEARS
	Agrocer Red 112 Disp.	Pigment Red 112	40 %	3
	Agrocer Red 482 Disp.	Pigment Red 48:2	35 %	2
	Agrocer Blue 153 Disp.	Pigment Blue 15:3	33 %	3
	Agrocer Green 007 Disp.	Pigment Green 7	40 %	3
	Agrocer Violet 023 Disp.	Pigment Violet 23	30 %	3
	Agrocer Yellow 001 Disp.	Pigment Yellow 1	46 %	3
	Agrocer White 006 Disp.	Pigment White 6	55 %	3

TYPICAL USAGE RATES OF AGROCER DISP. PIGMENT PREPARATIONS

The required usage rates of Agrocer Disp. pigment preparations on seeds depend on various parameters including the type and size of seed, thousand kernel weight and the desired color intensity. The table below shows recommended usage rates for various seeds.

	ml per 100 kg	fl. oz. per 100 lb
CORN	15–50	0.20–0.80
SOYBEANS	15–50	0.20–0.80
CEREALS	15–65	0.20–1.00
SUNFLOWER	130–260	2.00–4.00
COTTON	60–200	1.00–3.00
CANOLA (OSR)	400–800	6.00–12.00

STORAGE STABILITY UNDER CHALLENGING CONDITIONS

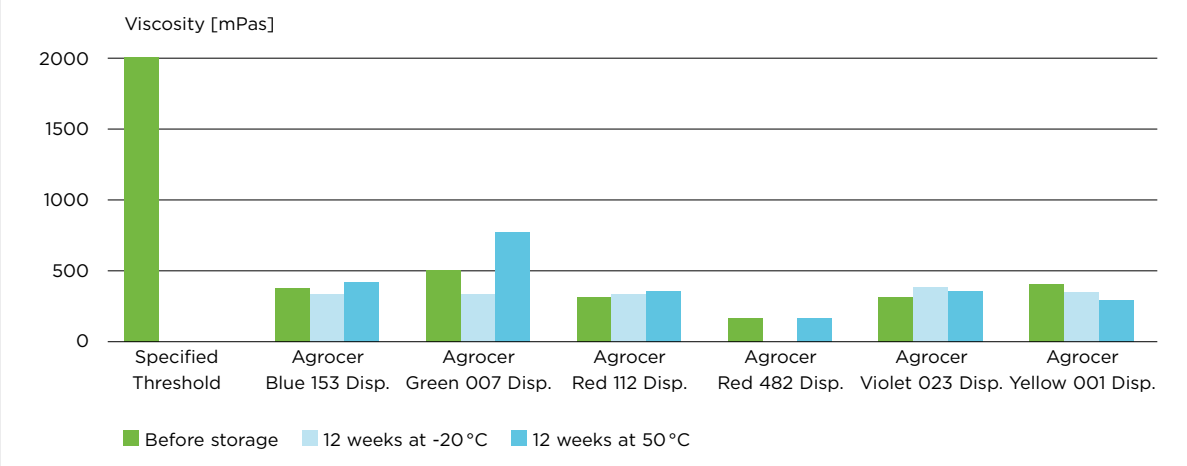
Even under extreme conditions, storage stability is typically not an issue for powder pigments, provided that humidity is avoided. However, storage stability for aqueous pigment preparations is generally more critical. All Agrocer Disp. pigment preparations exhibit a very good long-term storage stability with a minimum shelf-life of two years at ambient temperature.

Storage at very high or very low temperatures, which might occur when products are exposed to sun or are stored in poorly ventilated warehouses during summer, particularly in hot regions, can be more demanding. Extremely low temperatures can also be challenging, e. g. in northern regions during the winter.

All Agrocer Disp. pigment preparations include humectants which prevent the dispersions from freezing even below 0 °C. Freezing cannot be avoided below a certain temperature due to the inherent water content, but this is typically not a problem because the products thaw once the temperature rises again.

All Agrocer Disp. pigment dispersions have been tested for storage stability under extreme conditions, e. g. at an elevated temperature (50 °C) for 12 weeks and repetitive freeze-thaw cycles at -20 °C for 12 weeks. The most critical issue when storing pigment dispersions over a prolonged period of time is an increase in viscosity up to gel-formation or separation.

VISCOSITY CHANGE OF AGROCER DISP. PIGMENT PREPARATIONS AFTER WARM/COLD STORAGE



All Agrocer Disp. pigment preparations underwent only minor viscosity changes, even after storage under extreme conditions. Only Agrocer Red 482 Disp. failed in the extended freeze/thaw test at -20 °C, which led to separation.

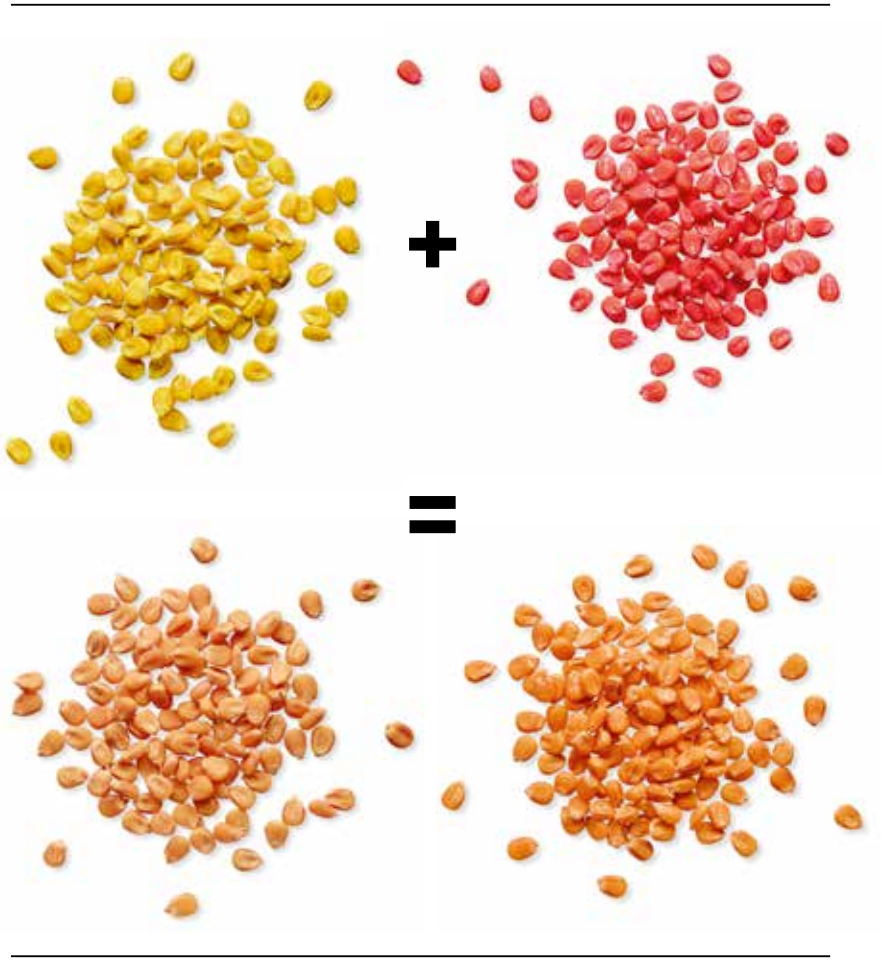
The coloristic properties of the pigment preparations also remained unchanged under these challenging conditions. Color strength and other coloristic properties, such as hue and hiding power, remained within the specified range.

Attractive Colors for High-Value Seeds

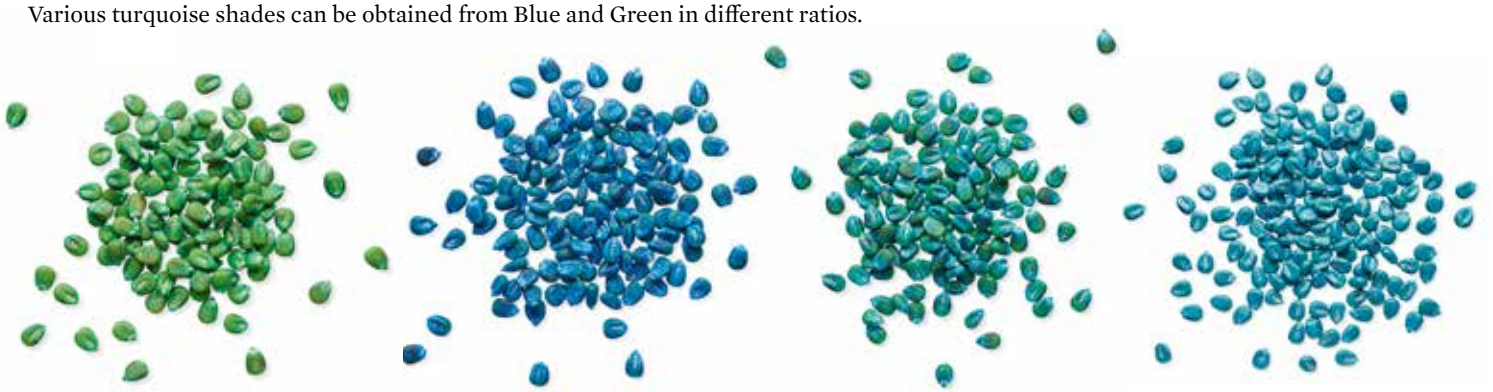
Color has always been used as a branding and marketing tool in various application fields. Seeds have become more and more valuable as the result of the growing dominance of genetically engineered and hybrid seeds. High-value seeds also require state-of-the art seed treatment options to safeguard the investment of farmers.

More and more seed companies and professional seed coaters are therefore looking for new color options to visually differentiate their products. Now, Clariant's Agrocer colorants offer more color options and a broader choice based on new EPA compliant pigments, which gives formulators a new toolbox to further utilize color as a tool for marketing and branding. All Agrocer products are compatible with each other and can be mixed in any ratio. Combinations of the different pigments or pigment preparations enable formulators to create individual color shades to avoid repetitions.

The addition of white, black or pearlescent pigments adds further options to fine-tune the appeal of a seed coating. White (titanium dioxide) for example, increases hiding power and helps cover darker seeds. Black is an additional option to generate attractive color shades, particularly in combination with pearlescent pigments. Probably the simplest and most striking example of how this concept can be utilized is the combination of Yellow and Red which results in Orange.

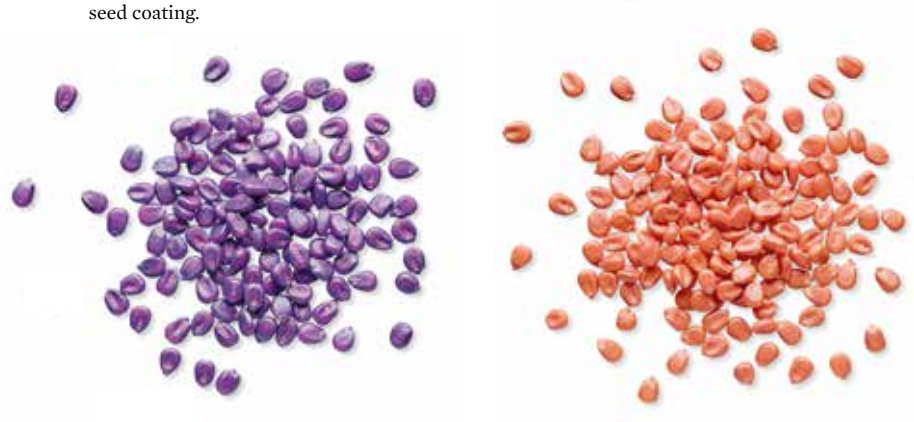


Various turquoise shades can be obtained from Blue and Green in different ratios.



The addition of a white pigment (here added to a red pigment) adds further options to fine-tune the appeal of a seed coating.

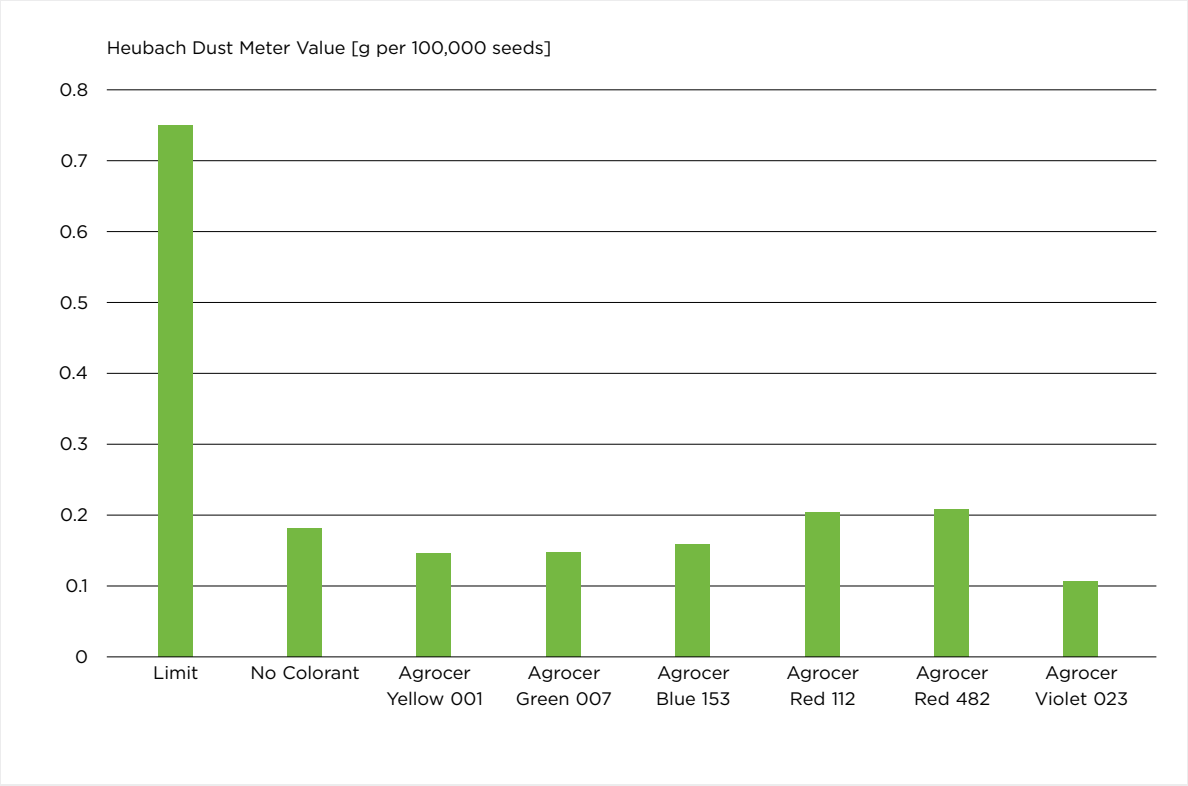
The addition of a pearlescent pigment adds further options to fine-tune the appeal of a seed coating.



Yellow can be used as a shading component to generate yellowish Reds or Greens. These are only a few examples of how the concept can be utilized. The key message is that only six basic colors can be blended into custom colors to enable the generation of a virtually infinite number of individual shades.

HEUBACH TESTS (DUSTING)

HEUBACH VALUES OF SEED TREATED WITH AGROCER DISP. PIGMENT PREPARATIONS



The formation of pesticide containing dust from treated seeds during the sowing process and its consequence for pollinators has become an issue. Hence, regulatory bodies are taking action and have defined limits for dust. The quality of the seed treatment process is also monitored more closely and certified applicators follow a quality assurance system to assure that seed treatment and the resulting treated seed meet requirements defined by legislators and industry.

The amount of dust generated primarily depends on the binder system which is used in the seed coating. Although nontoxic, pigments in their dry state are powdery materials, and can contribute to dusting when not dispersed properly. In order to evaluate the influence of Agrocer Disp. pigment preparations on dusting, treated seeds with and without colorant were evaluated in the so-called “Heubach test” (dustmeter).

The Agrocer Disp. pigment preparations were applied as part of a common seed coating formulation based on an industry-typical binder system. In order to identify a possible effect of the pigment on dust generation, measurements were compared to a comparative treatment without colorant.

The values in the diagram show the means of dust collected from five Heubach dust meter measurements (100 gram corn seed samples agitated for 2 minutes at 30 rpm in a rotating flask while simultaneously aspirated at 20 L/minute using a Heubach dust meter). Seeds were treated with coatings containing an average of 80 ml per 100 kg (1.2 fl. oz. per 100 lbs) of pigment preparation.

All treated seeds were significantly below the limit of 0.75 g per 100,000 seeds (dust reference values according to the European Seed Treatment Assurance Industry Scheme, ESTA).

It is the responsibility of the user to verify the acceptability of dust levels for their desired treating mixture and process.

Technical Service

Clariant's Technical Service Team will be happy to assist you if you require more information. Please contact our Technical Application Centre in your region. You can also contact the Special Applications Color Team via spa@clariant.com. Your request will be forwarded to the person responsible in your region.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