

Lumiscend™ Pro

FUNGICIDE SEED TREATMENT

Corn Technical Guide



Technical Guide

This technical guide represents a global overview of the technical attributes of Lumiscend™ Pro fungicide seed treatment relative to crop health, target pathogen, mode of action, and seed application.

This presentation is not intended to provide specific information relative to product use in different geographies.

This presentation is not a substitute for product labels. Consult your local country labels for specific product use.

Presentation Disclaimers

Lumiscend Pro is currently registered and available for sale in North America. Registrations in additional geographies are pending. This is not an offer for sale.

This educational material is provided for informational purposes only and is not intended to promote the sale of product.

Any sale of this product after registration is obtained shall be solely on the basis of approved product labels, and any claims regarding product safety and efficacy shall be addressed solely by the label.





Overview

Corteva Agriscience is proud to offer the latest advancement in fungicide seed treatment technology to provide state-of-the-art disease protection to growers.

Lumiscend™ Pro is a fungicide seed treatment formulated for control of corn damping-off, seedling blight, seed and root rot caused by *Pythium spp.*, *Rhizoctonia solani*, and *Fusarium spp.* Lumiscend Pro provides an effective mode of action against metalaxyl resistant *Pythium*.

Lumiscend Pro fungicide seed treatment formulation contains three active ingredients; ethaboxam, metalaxyl, and inpyrfluxam in a flowable liquid suspension to provide two robust modes of action for *Pythium*, protection against *Fusarium*-related seedling disease, as well as, industry leading seed treatment technology for control of *Rhizoctonia*-related disease. Lumiscend Pro provides robust resistance management while maintaining excellent crop safety and minimizing occupational exposure.

Noteworthy Features

- Provides two robust modes of action for *Pythium* control
- Includes ethaboxam, the active ingredient in Lumiante™ for control of metalaxyl-resistant *Pythium spp.*
- The active ingredient, inpyrfluxam, is a new FRAC Group 7 corn seed treatment fungicide for control of *Fusarium* and *Rhizoctonia*-related fungal diseases
- Specially formulated for use on corn with an excellent seed safety profile
- Seed treatment minimizes chemical exposure to the surrounding crop environment
- Excellent mixing partner with other seed treatment chemistries
- Favorable environmental profile when used according to label

Formulation

Lumiscend is a flowable suspension (FS) product that has been expertly formulated to protect the performance of different breeding technologies, transgenic traits, native traits, and genetics to provide optimal return on seed investment with excellent crop safety. Follow all directions found on product label for safe and proper use.

Registrations

Corteva Agriscience is seeking registration in several countries worldwide. This educational material is provided for informational purposes only and is not intended to promote the sale of product.



Corn Seedling Diseases

Seedling disease can cause significant yield loss in corn. In the five year period from 2016 to 2020, The United States reported a loss of more than 228 million bushels of corn due to seedling disease*. Seedling disease can be caused by several soil-borne organisms. *Rhizoctonia*, *Pythium*, and *Fusarium* are the most common causes of seedling disease. These soil-borne pathogens can cause many of the same symptoms, such as seed rot, seedling rot, discolored seedlings, stunting, and post or pre-emergence damping off. Soil-borne pathogens can overwinter in crop residue and grow when optimum environmental conditions are met.

Cultural practices such as crop rotation and improved drainage can help control the spread and impact of crop seedling disease. Genetic resistance to seedling disease is not available in corn. Therefore, fungicide seed treatments are critical to improve seed and seedling health to produce a robust corn stand. The choice of seed treatment is key towards a sustainable integrated crop system to not only control disease but to delay the development of pathogen resistance.

* www.loss.cropprotectionnetwork.org/crops/corn-diseases



Rhizoctonia: an early threat to maximum yield

Rhizoctonia solani is a soil-borne fungus that is the causal pathogen in a wide range of host crops, including but not limited to, corn, soybean, wheat, cotton, and canola. In corn, *Rhizoctonia* can attack all parts of the corn seedling that are below ground including the seed, mesocotyl, and developing roots. Warm and moist conditions tend to favor *Rhizoctonia* infection, which appear as reddish brown lesions on the roots and young stems. Infection can result in pre- and post emergence damping off and ultimately impact the health and yield of corn crops.

Rhizoctonia Life Cycle

Rhizoctonia disease begins with dormant vegetative portions of fungi, called mycelia, found in soil and plant debris or on seed. Masses of fungal mycelium can form a hardened mass called a sclerotium. Both mycelium and sclerotium are well suited to withstand environmental stressors, such as winter conditions, until temperature and moisture are optimal for fungal growth. When conditions are right, thread-like structures, called hyphae, begin to grow in search of nutrients in the soil and are attracted to seeds and root secretions. The *Rhizoctonia* hyphae then utilize potent enzymes to degrade and enter young root cells. As the fungus spreads in search of, nutrient-rich, actively growing root cells, it causes necrotic lesions that can lead to pre- and post-emergent plant death. After the host plant is dead, mycelia can lay dormant until the next growing season or spread to neighboring plants.



Rhizoctonia hyphae spreading towards an untreated corn seed in a petri dish assay. The top two seeds were treated with Lumiscend™.

Rhizoctonia Disease Management

Seedling health is key to *Rhizoctonia* management, which includes starting with high quality seed and following-up with good agronomic practices. Crop rotation and tillage have some benefit, however, *Rhizoctonia* has many host plants that can limit the impact of this strategy. Tilling is less frequently employed with sustainable farming practices designed to improve soil structure and health. Lumiscend™ Pro fungicide seed treatment supports sustainable farming practices by delivering targeted *Rhizoctonia* protection in diverse soil environments to promote healthy plant development and stand establishment.



Corn root and lower stalk damage from *Rhizoctonia solani*.

Pythium: a common cause of seedling disease

Pythium spp. is a complex of several species of oomycete pathogens and is a common causal source of corn seedling blight and damping off. *Pythium* affects a wide range of host plants and large crops such as corn and soybean. In corn, this pathogen can cause seed rot prior to germination or infect young seedlings. Low temperatures and wet soil conditions tend to favor growth of most *Pythium* species. Thus, earlier planting dates often increase the risk of corn crops to seedling blight and damping-off caused by *Pythium*.

Pythium Life Cycle

Pythium is often listed with crop fungal disease pathogens. However, *Pythium* is not a fungus and is an oomycete, a group more broadly known as water molds. As an oomycete, *Pythium* spreads by producing zoospores that have flagellar "tails" and can swim through small films of water to find host plants. In addition to mobile zoospores, *Pythium* can produce oospores, which are immobile resting spores that can overwinter to the following season. Both zoospores and oospores can lead to new infection, at which point, *Pythium* will produce hyphae (similar to fungi) that will produce enzymes to degrade roots and seed. Active *Pythium* hyphae then use the roots to rob growing plants of valuable nutrients. Infected seedlings frequently have shriveled and slimy roots.

Pythium Disease Management

Planting in warm temperatures and adequate drainage can help limit the onset and spread of *Pythium* seedling disease. Crop rotation has limited impact due to broad range of *Pythium* plant hosts. Protecting seeds and seedlings with seed treatments is a cornerstone to management of *Pythium*-related disease. Resistance in *Pythium* is well documented and of growing concern. Seed treatments with multiple modes of *Pythium* control, such as those found in Lumiscend™ Pro, are robust tools for sustainable farming and resistance management.



The majority of *Pythium* species prefer cool wet conditions. Infection can lead to damping-off and reduced plant size to result in severely reduced crop stands such as the one above.



Fusarium infection can result in severe stand loss.

Fusarium: a source of seedling and root rot

Fusarium root rot is caused by several different species of *Fusarium*. Like *Rhizoctonia* and *Pythium*, *Fusarium* can infect a wide range of plant hosts. Seedlings and developing root systems are most prone to *Fusarium* infection. Plant stress from weather or herbicide damage can promote infection. Seedling rot can lead to stunted plants, damping-off, and may progress as a stalk rot.

Fusarium Disease Cycle

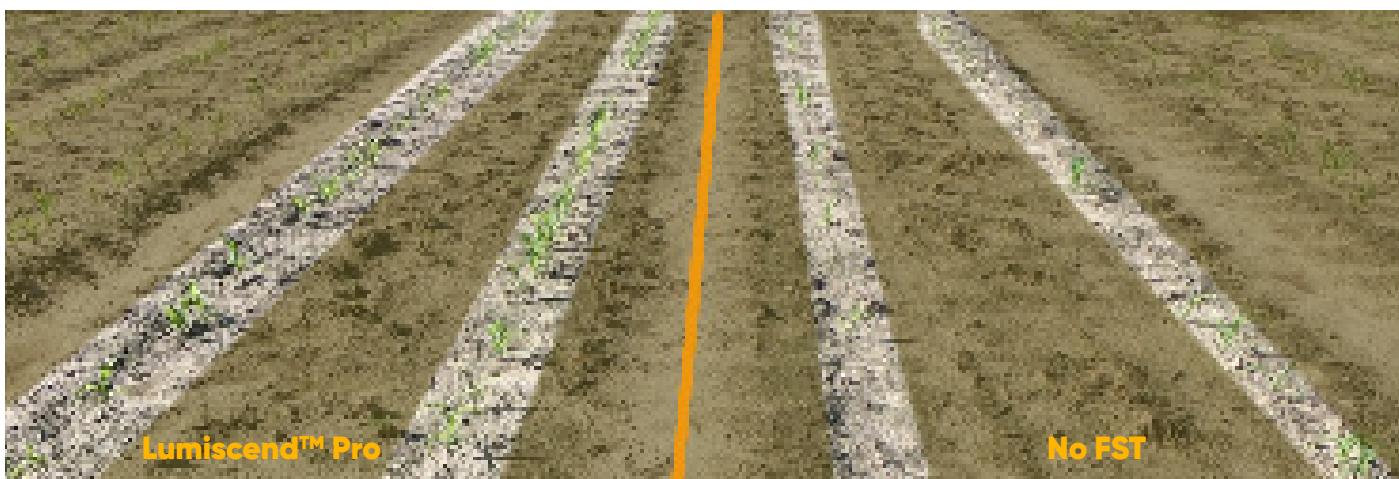
Fusarium overwinters as spores in crop residues and can survive in soil debris in favorable warm and wet conditions. Germinating spores will spread as mycelium composed of fine hyphae, similar to *Rhizoctonia*. Hyphae then use enzymes to penetrate young or weakened plant roots. As the pathogen enters the plant, infection can spread through the xylem to other parts of the plant. Growing *Fusarium* mycelia can extract nutrients from growing plant tissues and even clog upward xylem flow to ultimately block nutrient uptake from the growing plant. Roots appear dark brown or black prior to complete rot.



Corn seeds inoculated with *Fusarium graminearum* (right) display reduced germination, stunted growth, and reddish brown stunted roots compared to non-inoculated seeds (left).

Fusarium Disease Management

Cultural practices such as crop rotation and thoroughly cleaning crop equipment can help reduce the spread of *Fusarium* inoculum. Also, minimizing plant stress due to weather conditions or herbicide spray can limit susceptibility. Good sustainable farming and resistance management practices include utilizing multiple modes of action in seed treatment and foliar sprays to delay the onset and spread of resistant *Fusarium* strains.



Corn field trial in Georgia inoculated with *F. oxysporum* including seed treated with Lumiscend™ Pro (left) and seeds with no fungicide seed treatment (FST, right).

Lumiscend™ Pro Key Attributes

- Lumiscend™ Pro combines three active ingredients with different modes of action for effective control of major corn crop disease-causing pathogens; *Pythium*, *Rhizoctonia*, and *Fusarium spp.*
- Contains ethaboxam for excellent protection against *Pythium* with no cross-resistance to other fungicide chemistries outside of FRAC Group 22
- Contains inpyrfluxam, a state-of-the-art seed fungicide treatment for control of *Rhizoctonia* and *Fusarium* in corn
- Contains metalaxyl, a trusted and established seed treatment for broad-spectrum protection against *Pythium*
- Proven compatibility with other seed treatments to provide additional modes of action for robust resistance management
- Minimal effects to beneficial organisms when used according to label

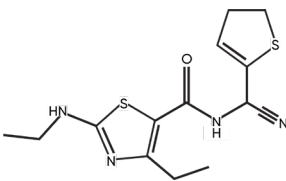
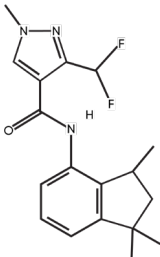
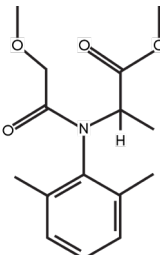


Modes of Action

Ethaboxam is the active ingredient in Lumiant[™], which interferes with cytoskeletal structures important for oomycete cell division and pathogen growth. On this basis, ethaboxam is listed as a FRAC Group 22 class fungicide that does not share cross resistance with other chemistries outside of this group, such as metalaxyl (FRAC Group 4). Resistance risk is considered low to medium.

Inpyrfluxam, the active ingredient in Lumiscend[™], inhibits the activity of succinate dehydrogenase, and important enzyme in fungal respiration. This mode of action is often referred to as an SDHI (Succinate Dehydrogenase Inhibitor) fungicide. Inhibition of this enzyme stops the metabolic process and inhibits the production of energy required for fungal growth and reproduction. It is classified as a FRAC Group 7 fungicide. Resistance risk is considered medium to high.

Metalaxyl is an established chemistry for control of oomycete pathogens. This active ingredient interferes with pathogen RNA synthesis and thereby disrupts growth of mycelium and the formation of reproductive spores. Resistance risk is considered high and is classified by FRAC as group 4.

Active Ingredient	IUPAC Name	Chemical structure	FRAC#	Mechanism	Target
Ethaboxam	N-[cyano(thiophen-2-yl)methyl]-4-ethyl-2-(ethylamino)-1,3-thiazole-5-carboxamide		22	Beta-tubulin assembly inhibitor of mitosis	Oomycete pathogens, <i>Pythium spp.</i>
Inpyrfluxam	3-(difluoromethyl)-1-methyl-N-[(3R)-1,1,3-trimethyl-2,3-dihydroinden-4-yl]pyrazole-4-carboxamide		7	Succinate dehydrogenase inhibitor (SDHI)	Fungal pathogens, <i>R. solani</i> and <i>Fusarium spp.</i>
Metalaxyl	Methyl 2-(N-(2-methoxyacetyl)-2,6-dimethylanilino)propanoate		4	RNA polymerase inhibition	Oomycete pathogens, <i>Pythium spp.</i>

Resistance Management

As with most fungicides, pathogen resistance can occur if proper resistance management strategies are not followed. These strategies include proper rotation with foliar fungicide modes of action for control of corn *Pythium*, *Rhizoctonia*, and *Fusarium* pathogens. Refer to product label for suggested modes of action to be used with Lumiscend™ Pro seed fungicide treatment.

Stewardship

Seed treated with Lumiscend Pro fungicide seed treatment must be labeled according to Federal Seed Act (FSA) treated seed labeling requirements. All Lumiscend Pro seed treatment application must be done so in accordance with product label guidelines. This includes the use of proper handling and transport procedures, planting practices, storage, and disposal procedures.

Environmental Hazards

Lumiscend Pro does not present a hazard to humans or domestic animals when used according to labeled directions. Lumiscend Pro does not have insecticidal activity and has minimal to no effects on beneficial arthropods. Lumiscend Pro is toxic to fish and aquatic invertebrates and should not be applied directly to water or where surface water is present. Exercise care not to contaminate water when rinsate is disposed.



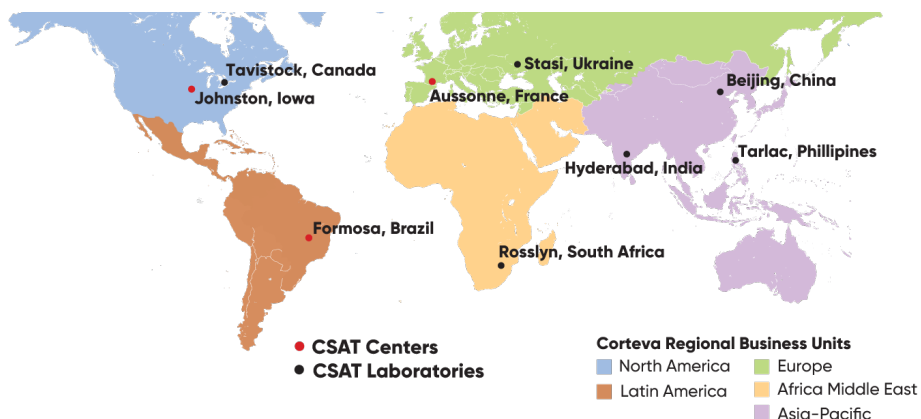
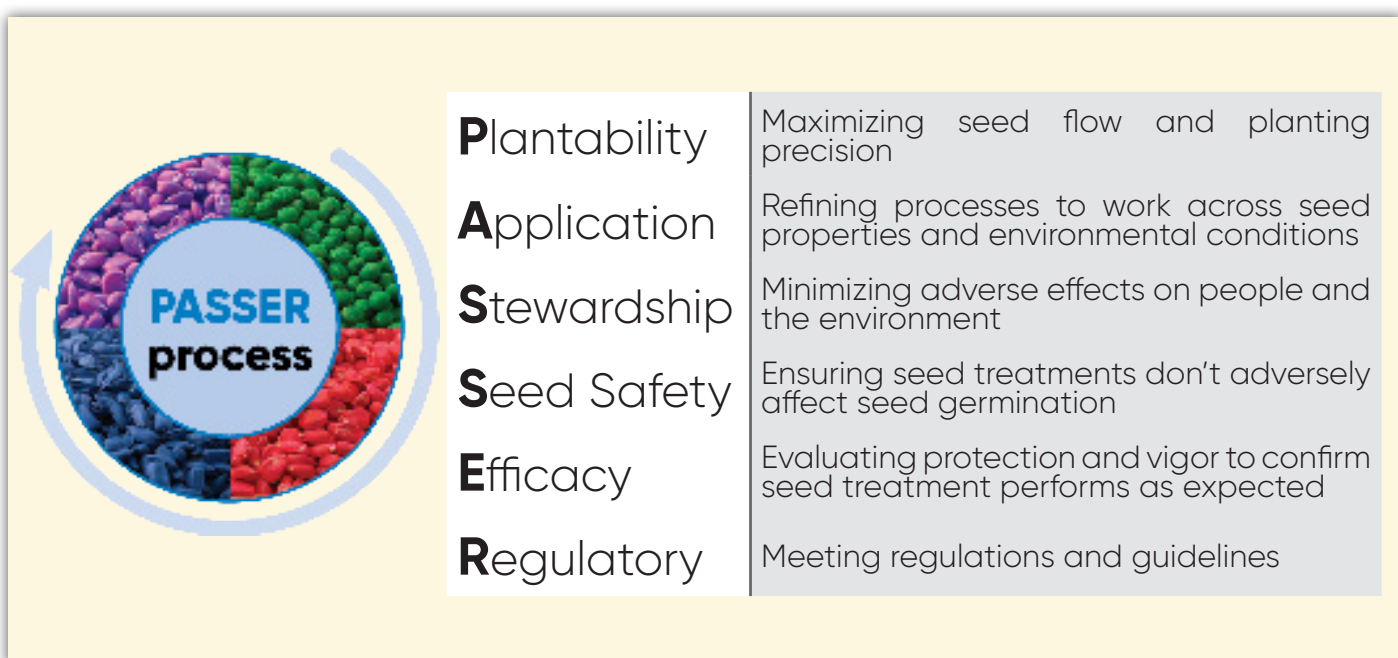


Application Information

- Lumiscend™ Pro is only for use in commercial seed treaters operating standard calibrated seed treatment equipment
- Corn seeds should only be treated in accordance with the label at a use rate of 0.9 fluid ounces per 80,000 seeds. This is equivalent to 0.019 mg ethaboxam, 0.013 mg inpyrfluxam, and 0.010 mg metalaxyl per seed
- Seed treatment equipment should be cleaned as described on product label and away from wells and other water sources

Seed Applied Technology Expertise

- Centers for Seed Applied Technology (CSATs) are worldwide resources for seed treatment expertise
- Expertise in recipe development, application, laboratory testing, and scale-up
- Exclusive PASSER evaluation process delivers customer confidence



Disclaimers

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