



Lumialza™

Technical Information





Lumialza™ Key Features

- Biological nematicide seed treatment that protects yield potential through reduction of nematode injury and increased root biomass
- Creates a living bio-barrier that provides protection against key crop-damaging nematodes for 80+ days
- Robust tool for sustainable farming with minimal impact on beneficial soil microorganisms such as arbuscular mycorrhizal fungi
- Provides protection against key yield-robbing, parasitic nematodes while cooperating with beneficial organisms for improved soil health
- Creates a large zone of protection, encompassing the entire expanding area of root growth including lower, mid and upper root zones
- Proven compatibility with other seed treatment technologies
- Effective nematode control at low use rates
- Safe and effective option for nematode management strategies
- Favourable environmental and seed safety profile



What are nematodes?

Nematodes are an extremely large and diverse family of non-segmented round worms. Estimates indicate the existence of more than one million different species of nematodes that are either free-living or parasitic worms. Free-living nematodes play an important role in soil health and facilitate recycling of nutrients, while parasitic nematodes feed on other organisms, including plants, animals, and other microorganisms for survival. Thus, crop-damaging plant-parasitic nematodes compose a relatively small component of the overall soil nematode population. Lumialza™ is a robust tool for sustainable nematode management of plant-parasitic nematodes with minimal impact on surrounding soil fauna.



Despite being a small subset of the total nematode population, plant-parasitic nematodes are composed of several thousands of different species. Some nematodes, such as the root lesion nematode (*Pratylenchus spp.*) feed on a variety of plant species, which can reduce the impact of crop rotation strategies on nematode infestation. Lumialza seed treatment protects corn crops in both scenarios by creating a living bio-barrier that provides early season protection from a wide range of nematodes that extends more than 80 days into the growing cycle.

Most plant-parasitic nematodes live below ground with a life cycle that typically lasts about 30 days. Juvenile worms hatch from eggs and progress through several larval stages before reaching a reproductive adult stage. This allows plant-parasitic nematodes to quickly reproduce and infest crops with multiple generations within a single growing season. In addition, nematode eggs are able to withstand cold environments to permit overwintering in some geographies. This makes early-season crops particularly vulnerable to nematode damage. As spring soils begin to warm, eggs hatch and juveniles begin feeding on young plant roots. Lumialza provides early season nematode protection at planting with extended protection into the growing season.



Lance nematodes (*Hoplolaimus geleatus*) feeding on corn root.



Corteva Agriscience™ is proud to introduce Lumialza™ nematicide seed treatment. Lumialza is a biological seed treatment that provides protection against plant-parasitic nematodes. Lumialza contains an aggressive root zone colonizing bacteria, *Bacillus amyloliquefaciens* strain PTA-4838, which creates a biological barrier that shields roots from harmful nematodes for more than 80 days. This mode of nematode protection is not only extremely effective, but is safe to other soil organisms, including arbuscular mycorrhizal fungi. Backed by Corteva's seed application expertise, Lumialza provides excellent protection to vulnerable seedlings.

Plant-parasitic nematodes: unseen pathogens

Nematodes are often overlooked as yield-robbing crop pests due to their small size and patchy distribution patterns. Nematodes are colorless roundworms and are the most abundant multicellular organisms on earth. While most nematodes play a beneficial role by recycling organic matter, some species feed on plant roots and cause significant yield loss in crops.

Nematode damage usually occurs in small patchy patterns that are often confused with other crop stressors such as nutrient deficiency or drought. Yield losses are frequently due to direct mechanical injury of the root system and subsequent loss of nutrient and water uptake. However, nematodes can also facilitate transmission of plant diseases that weaken plants, making them more susceptible to other diseases. In all cases, above ground symptoms such as wilting, chlorosis, and stunted plants are difficult to visually attribute to nematode damage.

Nematodes prefer to feed on new succulent tissues such as young roots. Nematodes are not confined by soil type or geography and can thrive in coarse sandy soils as well as finer textured soils. In 2020, 1.9 million metric tons of corn loss was estimated to be due to nematode activity in the United States*. Nematode management is a key consideration for corn producers to protect yield and return on investment.



Root lesion nematode (*Pratylenchus* spp.)

* cropprotectionnetwork.org/resources



Symptoms of Nematode Damage

Feeding patterns divide plant parasitic nematodes into 3 different groups of crop-damaging pests. Nematodes such as the **dagger nematode** (*Xiphinema spp.*) feed from the outside of corn roots using a specialized mouth part, called a stylet, to penetrate and extract material from plant roots. These nematodes belong to a group called ectoparasites as they feed from outside (ecto meaning "outside") of the host plant and are forced to move along root system to find new food material. Endoparasites fully penetrate the root and feed within (endo meaning "internal" or "within") the root. **Root-knot nematodes** (*Meloidogyne spp.*) are prolific endoparasites of many crops and cause galls on the roots of infected plants. Lastly, semi-endoparasites, like the **root lesion nematode** (*Pratylenchus spp.*) feed on the outside and inside portions of the plant root to cause below ground damage.

All of the three groups of nematodes produce below ground damage that can deprive plants of water, nutrients, and make plants more vulnerable to disease. Therefore, above ground plant symptomology can be quite diverse and difficult to accurately identify in crops, making protection from nematode infestation a key strategy to nematode management. Lumialza provides a physical biological barrier that creates a healthy environment for plant roots and shields from nematode feeding.



A comparison of a nematode damaged corn plant **on the left** versus a healthy plant **on the right**.








Below ground symptoms can be more indicative of nematode feeding such as this **stubby root nematode** damage.

Nematode Pathogens

Lumialza™ nematicide seed treatment is effective against a wide range of common plant-parasitic nematodes. Because Lumialza creates a living biological barrier, it offers a mode of root protection that grows with the root system and is distinct, yet compatible, with chemical nematicide treatments. This makes Lumialza seed treatment a robust tool for broad spectrum integrated nematode management strategies.

Lumialza nematicide seed treatment is also effective against several other corn nematode pests, including sting (*Belonolaimus longicaudatus*), lance (*Hoplolaimus galeatus*), and reniform (*Rotylenchulus reniformis*) nematodes. See product label for full details on spectrum and use rates.

	Common Name <i>(Scientific Name)</i>	Feeding and Symptomology
	Root-knot Nematode <i>Meloidogyne spp.</i>	<ul style="list-style-type: none"> • Multiple crop hosts, including corn and soybean • Endoparasitic, spending the majority of their life inside roots • Form characteristic small galls or knots on roots
	Root-lesion Nematode <i>Pratylenchus spp.</i>	<ul style="list-style-type: none"> • Multiple crop hosts, including corn and soybean • Make roots prone to fungal and oomycete infection • Pruned roots and necrotic roots below ground • Stunted and discolored plants above ground
	Stubby-root Nematode <i>Trichodoridae</i>	<ul style="list-style-type: none"> • Prefer corn roots, but will feed on soybean and other crops • Cause shortened roots from feeding on growing root tips • Damage can resemble herbicide burn (yellowing, stunting)
	Needle Nematode <i>Longidoridae</i>	<ul style="list-style-type: none"> • Prefer corn roots, but will feed on other grassy crops • Cause shortened and pruning of finer roots • Migrate deeper into soil as temperature rises
	Dagger Nematode <i>Xiphinema spp.</i>	<ul style="list-style-type: none"> • Multiple crop hosts, including corn and soybean • Some species have one generation per year, can live for 4-5 years • Feeding leads to root damage, stunting, and chlorosis • Known viral vectors for mosaic and wilting diseases

* Photo credits: Tim Thoden and Becky Dickenson



The need for innovative nematode management

There is a widely recognized need for nematode management solutions to protect investment and maximize yield in corn crops. However, crop-damaging nematodes are ubiquitous soil organisms found in nearly every soil type with a wide range of plant hosts. Considering the enormous soil volume that is home to nematodes, curative measures are not realistic. Preventative measures that protect crops at their most vulnerable stages are key. Lumialza™ nematicide seed treatment provides protection to seeds and seedlings at the earliest stages as well as later into the growing season.

When selecting nematode management solutions, it is important to recognize that plant-parasitic nematodes are a small subset of soil organisms, including beneficial fungi and nematodes, which are critical to nutrient cycling pathways that preserve soil health. Many effective nematicide fumigants have been withdrawn from the market due to their long-term impact on soil health as well as other detractors such as cumbersome and expensive application. Therefore, protection from plant-damaging nematodes while preserving soil fauna is important for sustainable nematode management practices. The bacteria found in Lumialza addresses this unique challenge by forming a living biological barrier that shields plant roots from parasitic nematodes without disruption of beneficial soil organism activities.

Nematodes are also difficult to manage because of their below-ground location. This presents issues in a few different ways. First, traditional chemical nematicide applications can be hard to deliver to underground environments and may require special equipment prior to planting. Once nematicides are delivered below ground, the mobility of the nematicide will have direct impact on the ability to be retained within the soil or move to deeper root zones. Lumialza seed treatment avoids these challenges by growing with plant roots for more than 80 days after planting.

Nematodes are small translucent roundworms that cannot be seen by the unaided eye. Below ground feeding results in root damage and nutrient loss, but rarely kills the entire plant. Therefore, above ground symptomology, such as stunted growth and discoloration can be easily confused with environmental stress, low fertility, or other pest pressure. Nematode feeding is usually localized and does not affect the entire field, often giving rise to "hot spots" of stunted or discolored plants.

Nematode control challenges

- Control of all parasitic nematodes is not possible
- Nematodes cannot be seen without a microscope
- Non-targeted control measures are not sustainable and most have been withdrawn from the market
- Most plant-parasitic nematodes spend their lifecycle below ground, making treatment difficult
- Maintaining protection throughout the root zone is difficult with chemical nematicides



Lumialza™ Description

Corteva Agriscience is proud to bring forward Lumialza™ nematicide seed treatment. Lumialza is a biological seed treatment that protects early season corn from a wide range of crop-damaging nematodes to improve plant performance and protect crop yield.

The active component in Lumialza nematicide seed treatment is *Bacillus amyloliquefaciens* (PTA-4838), a naturally occurring soil bacteria that aggressively colonizes plant roots to create a living biological barrier that grows with the plant and protects roots from nematode damage to provide an optimal environment for root growth.

Lumialza nematicide seed treatment recipes are developed using the strength and expertise of Corteva field science and seed application technologies to ensure optimal viability and performance of active ingredient as well as compatibility with additional seed treatment recipe components.



CORTEVA
Centre for Seed Applied Technologies

Lumialza™ Mode of Action

A living biological nematode barrier

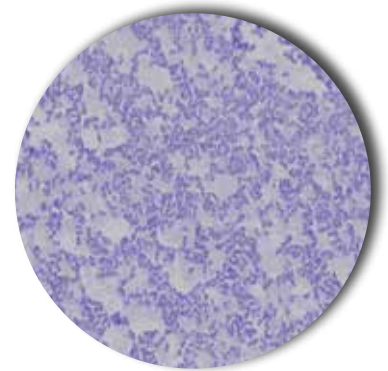
Lumialza contains *Bacillus amyloliquefaciens*, strain PTA-4838, which is a naturally-occurring gram-positive soil bacterium selected for the ability to form a physical barrier between growing roots and the soil environment. Seeds are coated with active spores that germinate and grow after seed is planted, providing early protection against plant-parasitic nematodes.

Symbiotic growth

Bacillus amyloliquefaciens strain PTA-4838 is a symbiotic rhizobacteria. Rhizobacteria depend on root secretions for survival and form an optimal local environment for root growth by preventing the intrusion of plant parasitic nematodes, while preserving the activities of arbuscular mycorrhizal fungi and other beneficial organisms. In addition, this means Lumialza will not readily move from the root zone and will provide extended protection for at least 80 days of the growing season.

Root zone colonization

Bacillus amyloliquefaciens strain PTA-4838 is an aggressive root-colonizing bacteria. This allows for low use rates relative to other seed treatment products. Also, because these bacteria are dependent on active growing roots, Lumialza protection grows with the root system into lower root zones to protect from nematode species that will migrate to deeper soil as temperatures change.



B. amyloliquefaciens strain PTA-4838 spores.



Petri dish assay demonstrating the aggressive symbiotic growth of *B. amyloliquefaciens* bacteria on new roots germinating from a single treated corn seed (red).



The active ingredient in Lumialza, *B. amyloliquefaciens*, grows with roots deep into the soil profile. This creates a biological barrier that provides nematode protection and an optimal growth environment for plants for more than 80 days into the growing season.

Lumialza™ Protection

Plant-pathogenic nematodes have the greatest impact on corn early in the growing season. However, nematodes can attack corn at any time. A wide array of nematodes cause root damage that can limit the plant's uptake of water and nutrients from the soil. This often results in stunted plants that appear stressed or deprived of nutrients. Lumialza creates a living biological barrier that reduces nematode damage below the soil to allow optimal root development and stand establishment. Importantly, Lumialza continues to grow with corn roots late into the season to provide sustained benefit and protection from nematode damage. Above the ground, plants are visually healthier and more likely to reach their productive potential.



Untreated



Lumialza™

Roots from corn plants infested with root lesion nematode (*Pratylenchus brachyurus*) 42 days after emergence.



Untreated



Lumialza™

Pictures from corn plants in Brazil infested with root lesion nematode (*Pratylenchus brachyurus*). Above ground photos of plants from untreated corn seed infested with *Pratylenchus spp.* 42 DAE, (right) corn plants from seed treated with Lumialza at 10 ml/ha. **Seed treatment with Lumialza in the presence of root lesion nematode results in plants with larger root mass below ground and taller plants above ground.**

Resistance Management

As of 2021, there are no validated examples of nematode resistance as the primary source of commercial synthetic nematicide failure in field use applications. Challenges seen with traditional nematicides are often due to the low frequency and area of application, the broad plant host range for plant parasitic nematodes, and rapid degradation and elimination from the local soil environment. The active ingredient in Lumialza™ avoids challenges seen with some synthetic nematicides by creating an active growing biological barrier that protects roots for more than 80 days.

Lumialza Grows with Roots

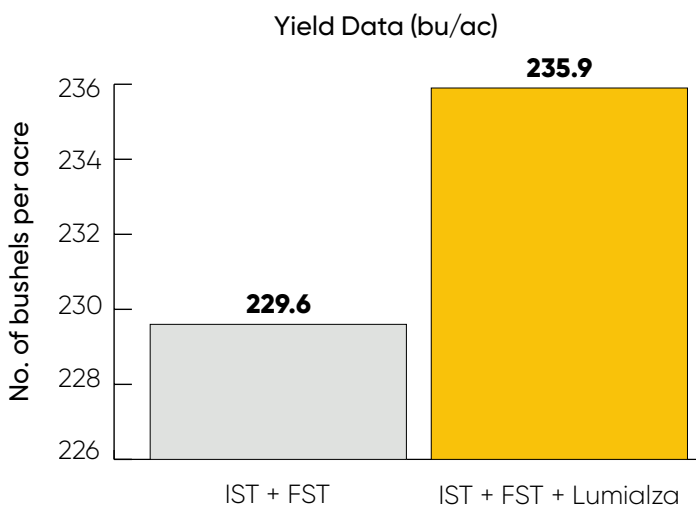
The *B. amyloliquefaciens* found in Lumialza grows with roots to provide protection deep into the soil profile. This not only provides an extended zone of protection, but also allows prolonged growth benefits extending late into the corn growing cycle (>80 days).

Environmental Safety

- Lumialza is a biological nematicide seed treatment that contains *Bacillus amyloliquefaciens* PTA-4838
- *Bacillus amyloliquefaciens* PTA-4838 is a naturally occurring organism that has not been genetically modified in any way
- Lumialza has a favourable environmental profile with limited to no activity on non-target organisms

Formulation

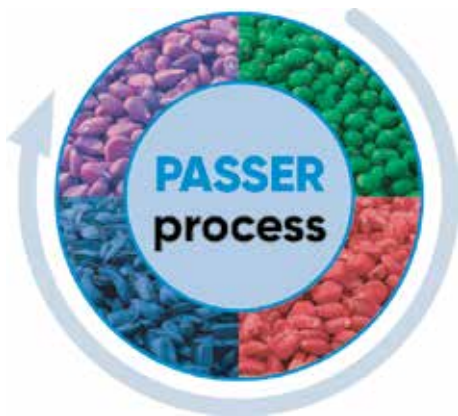
Lumialza is a biological seed treatment nematicide product that contains a minimum of 6.1×10^{10} spores of active ingredient, *Bacillus amyloliquefaciens*, bacteria per ml. This is equivalent to more than 60 billion colony forming units (CFUs) per milliliter. This highly concentrated formulation translates to a low use rate.



Source: 2021 IMPACT Trials

Seed Applied Technology Expertise

- Corteva's Centres 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



Plantability

Maximizing seed flow and planting precision

Application

Refining processes to work across seed properties and environmental conditions

Stewardship

Minimizing adverse effects on people and the environment

Seed Safety

Ensuring seed treatments don't adversely affect seed germination

Efficacy

Evaluating protection and vigor to confirm seed treatment performs as expected

Regulatory

Meeting regulations and guidelines

