

# Cereals Seed Treatment Portfolio Brochure

syngenta®

 **Vibrance™ Extreme**

 **CruiserMaxx® Vibrance™**  
Cereals

 **Cruiser® 5FS**

Improved root health  
through enhanced  
disease and  
insect protection

TM

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## Syngenta Seedcare Leadership

Syngenta is deeply rooted in the seed treatment market. Our commitment starts with our early work with metalaxyl, likely the first active ingredient targeted to protect against *Pythium* and introduced by Ciba-Geigy, a Syngenta legacy company. More recently, we've identified physiological enhancements produced by Cruiser® 5FS seed treatment insecticide we call the Cruiser Vigor Effect. Our commitment extends beyond chemistries to creating global forums that bring together worldwide research leaders to exchange ideas and investigate new possibilities for research efforts.

Syngenta has expanded the leading position of its legacy companies and is again leading the industry by turning its focus to the importance of roots in providing a strong basis for high yields. Through its research efforts, Syngenta developed sedaxane as the first active ingredient from the company created specifically as a seed treatment.

As a member of the succinate dehydrogenase inhibitor (SDHI) class of fungicides, sedaxane delivers longer-lasting protection against difficult-to-control seedborne and soilborne pathogens while simultaneously improving overall root health and quality. As a result, crops experience Rooting Power™, the link between strong roots and higher yield potential. Wheat and barley growers are among the first to experience the benefits of sedaxane and its Rooting Power through the VIBRANCE™ fungicide family of cereals seed treatments, featuring VIBRANCE Extreme fungicide and CruiserMaxx® Vibrance Cereals insecticide/fungicide seed treatments.

## **Vibrance™ Extreme**

With VIBRANCE Extreme, cereal growers can rest easy knowing their seeds are protected with top-notch chemistries that work together to promote vigorous roots and strong stands. VIBRANCE Extreme contains the proven protection behind Dividend® brand seed applied fungicides, which safeguard cereal crops from more diseases than any other product on the market, plus the powerful active ingredient sedaxane. VIBRANCE Extreme promotes effective seedling germination, systemic disease protection, healthy roots, robust stands and more heads. It also offers the best-in-class *Rhizoctonia* activity available and enhanced protection against a broad spectrum of seedborne, soilborne and fall foliar diseases.

## **CruiserMaxx® Vibrance™** Cereals

CruiserMaxx Vibrance Cereals also brings a new level of unrivaled disease protection to the market. The heightened insect and disease protection in CruiserMaxx Vibrance Cereals ensures the crop gets off to a vigorous start and delivers consistent yield performance and stability from year to year. The four powerful chemistries in CruiserMaxx Vibrance Cereals enable superior performance and extended protection against early-season insects and diseases.

## **Cruiser® 5FS**

Cruiser insecticide continues to supply market-leading, early-season protection against some of the most destructive insects, including aphids, which can transmit barley yellow dwarf virus (BYDV), and wireworms. More than 9,000 trials prove that thiamethoxam, the active ingredient in Cruiser, provides higher yields in a direct comparison with other neonicotinoids, even under low insect pressure or in the absence of insect pests. This phenomenon, called the Cruiser Vigor Effect, helps plants to better withstand unfavorable environmental conditions and stresses to deliver higher and more consistent yields. When combined with VIBRANCE brand products, growers can protect cereal crops from insects and diseases with one application.



## Syngenta Seedcare Product Benefits

### **Vibrance™ Extreme**

- Provides longer-lasting, broad-spectrum performance with best-in-class *Rhizoctonia* activity to deliver better yields under stress
- Boosts Rooting Power through enhanced disease protection that leads to more powerful roots and improved crop performance
- Contains sedaxane, the first fungicide active ingredient from Syngenta developed specifically as a seed treatment
- Protects seed to stimulate quality root systems to deliver better emergence, stand establishment, nutrient uptake and stress tolerance
- Produces healthier, stronger stems and foliage better able to withstand stresses from weather, diseases and insects
- Provides a resistance management tool as it adds another seed treatment mode of action from the SDHI class of fungicides to the Syngenta Seedcare portfolio
- Delivers convenient protection of the seed's genetic potential to help maximize yield and quality, ensuring every seed counts
- Offers ideal systemicity and soil mobility to create a "halo of protection" around the seed and root system
- Fully compatible with Cruiser seed treatment insecticide to deliver superior disease and insect protection at the same time



- Combines best-in-class *Rhizoctonia* activity with industry-leading insect and broad-spectrum disease protection
- Boosts Rooting Power through longer-lasting disease protection that leads to more powerful roots and improved crop performance
- Contains sedaxane, the first fungicide active ingredient from Syngenta developed specifically as a seed treatment
- Offers consistency in performance through optimized, tailor-made formulation whether applied on-farm or via commercial, on-site seed treater or seed company
- Delivers the Cruiser Vigor Effect to help enhance germination, increase vigor, improve stand establishment and deliver better yield potential
- Provides a resistance management tool as it adds another seed treatment mode of action from the SDHI class of fungicides to the Syngenta Seedcare portfolio
- Offers ideal systemicity and soil mobility to create a “halo of protection” around the seed and root system



- Provides convenient, seed-delivered protection against early-season wireworms, aphids and Hessian fly
- Helps plants better withstand unfavorable environmental conditions and stresses to deliver higher and more consistent yields via the Cruiser Vigor Effect
- Reduces the risk of the crop transmitting BYDV by protecting against aphids that vector the disease
- Provides peace of mind by delivering consistent performance under a wide range of growing conditions
- Offers flexibility to tailor the rate to the specific pest spectrum needs of each field
- Promotes faster emergence, improved crop vigor and earlier canopies
- Helps achieve stronger stands, increased root mass, thicker stems and taller and greener plants
- Fully compatible with the superior performance of VIBRANCE brand seed treatment fungicides to protect against insects and a broad spectrum of diseases at the same time

## Seed Treatments Prove Value from Start to Finish

More and more research is pointing to root health as the key to increasing future crop productivity. To help ensure optimum root health and maximum yield potential in cereals, valuable seed protection is critical from the very beginning. In recent years, seed treatments have been proving their worth and are becoming standard. Not only do quality fungicide and insecticide seed treatments help prevent the spread of plant diseases and keep insects at bay, they also offer added convenience, ease of handling, increased root mass, lower use rates and proven defense from day one.

Innovative seed treatment products also safeguard the crop's genetic potential for the greatest potential return at the end of the season. Through extensive research, advanced technologies and numerous field trials, Syngenta introduces improved seed treatments, such as sedaxane, the active ingredient in VIBRANCE products that goes beyond ordinary seed protection to offer enhanced disease protection and the best-in-class *Rhizoctonia* activity, as well as increased root health and crop vigor. This revolutionary line of VIBRANCE seed treatment products arms crops with the unique Rooting Power benefits that take seed treatments to the next level.

By having seed treated with VIBRANCE Extreme, CruiserMaxx Vibrance Cereals or Cruiser, growers are equipping their crops with powerful tools that not only defend against pest-related yield reductions, but also deliver faster germination and emergence, increased stand establishment and more vigorous plants. In addition, the built-in Rooting Power of VIBRANCE brands and the Cruiser Vigor Effect behind Cruiser brands help develop robust root systems and vigorous plants that more efficiently absorb and utilize water and nutrients for a strong finish. As a result, stems and foliage are healthier and can better withstand environmental stress, which leads to enhanced and consistent yield performance.



## Pest Spectrum

### **Vibrance™ Extreme Protects Against:**

- Common bunt (seedborne and soilborne)
- Common root rot\*
- Covered smut
- Dwarf bunt (seedborne and soilborne)
- False loose smut
- Flag smut
- *Fusarium* (seedborne and soilborne seedling blight, root rot, damping off)
- Fusarium crown rot and foot rot\*
- Fusarium seed scab
- General seed rots caused by *Fusarium*, *Pythium*, *Rhizoctonia*, *Penicillium* and *Aspergillus*
- Karnal bunt
- Loose smut
- *Pythium* (soilborne seedling blight, root rot, damping off)
- Pythium damping off
- *Rhizoctonia* (seedborne and soilborne seedling blight, root rot, damping off)
- *Septoria* (seedborne)
- Septoria leaf blotch\*\*
- Take-all\*
- True loose smut

\*Suppression

\*\*Early-season foliar disease protection for the first four weeks after planting

### **CruiserMaxx® Vibrance™ Protects Against:** Cereals

#### Insect Protection

- European chafer
- Wireworms\*

#### Disease Protection

- Common bunt (seedborne and soilborne)
- Common root rot\*
- Covered smut
- Dwarf bunt (seedborne and soilborne)
- False loose smut
- Flag smut
- *Fusarium* (seedborne and soilborne seedling blight, root rot, damping off)
- Fusarium crown rot and foot rot\*
- Fusarium seed scab
- General seed rots caused by *Fusarium*, *Pythium*, *Rhizoctonia*, *Penicillium* and *Aspergillus*
- Karnal bunt
- Loose smut
- *Pythium* (soilborne seedling blight, root rot, damping off)
- Pythium damping off
- *Rhizoctonia* (seedborne and soilborne seedling blight, root rot, damping off)
- *Septoria* (seedborne)
- Septoria leaf blotch\*\* (four weeks after planting)
- Take-all\*
- True loose smut

\*Suppression

\*\*Early-season foliar disease protection for the first four weeks after planting

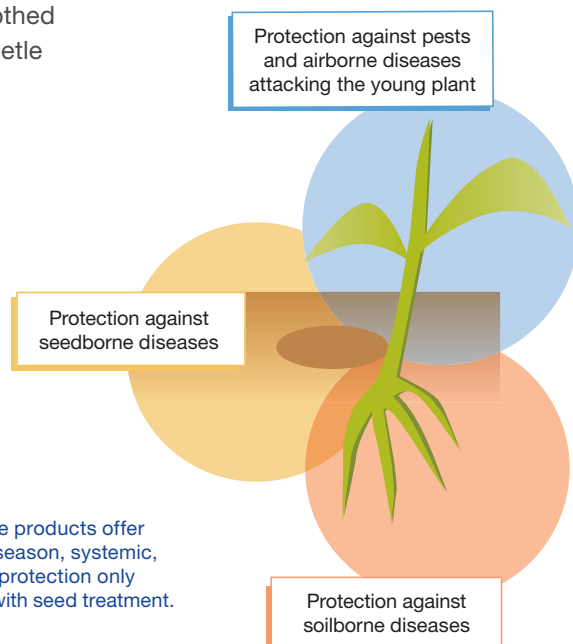
## Cruiser® 5FS Protects Against:

### Early-season Protection

- Bird cherry-oat aphid
- English grain aphid
- Grasshopper (reduces early-season damage)
- Greenbug
- Hessian fly
- Russian wheat aphid
- Wireworm

### Stored Grain Protection

- European corn borer
- Indian moth
- Lesser grain borer
- Red flour beetle
- Rice weevil
- Rusty grain beetle
- Saw-toothed grain beetle



All of these products offer the early-season, systemic, complete protection only available with seed treatment.

## Application Flexibility

Syngenta features cereals seed treatment solutions that meet the application needs of each farmer.

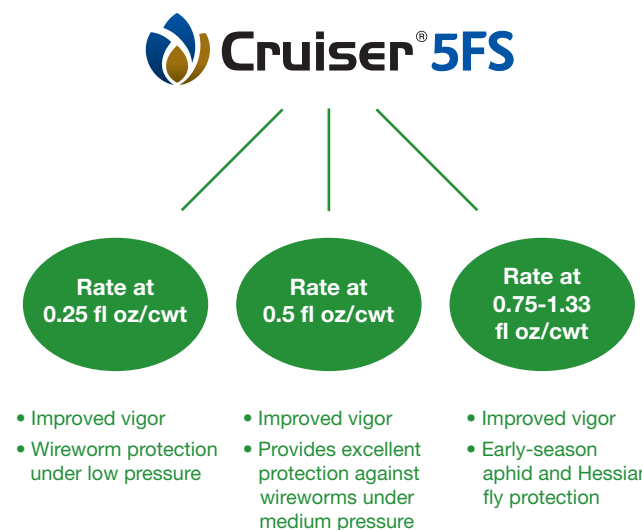
- VIBRANCE Extreme and Cruiser are applied only through commercial, on-site seed treater or seed company
- CruiserMaxx Vibrance Cereals can be applied on-farm or through commercial, on-site seed treater or seed company

### Vibrance™ Extreme

VIBRANCE Extreme offers excellent seed safety, optimal flowability, less dust-off and good adhesion to the seed, providing added convenience for treaters.

### Cruiser® 5FS

Cruiser provides a convenient replacement for soil and early foliar insecticide applications. The unique properties of thiamethoxam, the active ingredient in Cruiser, allow plants to absorb and effectively translocate the product through the seed into the plant to help achieve superior pest protection. **Cruiser has a flexible rate structure that can be tailored to the needs of each field:**





CruiserMaxx Vibrance Cereals is formulated specifically for wheat and barley as a ready-to-use, water-based product. CruiserMaxx Vibrance Cereals can be easily applied at **5-10 fl oz/cwt** through most conventional treatment technologies. Its cold-weather formulation can withstand sub-zero conditions, allowing for earlier treatment.

- Apply as a water-based slurry using standard slurry seed treatment equipment that provides uniform seed coverage. Uneven or incomplete seed coverage may not give the desired level of insect and disease protection. Continuous agitation or mixing of the slurry mixture is necessary to maintain suspension and ensure complete seed coverage. Allow seed to dry before bagging or adding to the planter.
- Seed treated with CruiserMaxx Vibrance Cereals must be visually identifiable from untreated seed by using an approved colorant/dye.



## Active Ingredients Explained

The Syngenta Seedcare cereals line-up includes proven and innovative fungicide and insecticide active ingredients. Each one has unique qualities that help set Syngenta products apart from the rest of the industry.

### Fungicides

**Sedaxane**, the first fungicide active ingredient from Syngenta designed specifically as a seed treatment, helps improve root health while delivering the best-in-class activity against *Rhizoctonia*. A member of the SDHI class of fungicides, sedaxane is most active at stages of the fungal life cycle that are particularly energy-demanding. Sedaxane moves from the seed into surrounding soil, forming a protective “cloud” around the seed roots and stem base.

Additionally, sedaxane offers ideal soil mobility, effective root and plant uptake, and adds a novel mode of action to the seed treatment fungicide market for proactive resistance management. Its Rooting Power delivers enhanced disease protection to protect roots and provide better yields under stress.

**Mefenoxam**, also an active ingredient in Apron XL® and Dividend Extreme® seed treatment fungicides, provides protection against diseases caused by soilborne *Pythium*, one of the most prevalent diseases in cereal fields. Damping-off, seedling blight and seed rots caused by *Pythium* species delay emergence, restrict nutrient uptake, stunt plant growth and steal yield. The technology of mefenoxam prevents spore production and inhibits the mycelial growth of *Pythium* species.

**Difenoconazole**, the other active ingredient in Dividend Extreme, inhibits the development of subcuticular growth of mycelium and prevents the development of several key cereal diseases. This active ingredient acts as a barrier between the disease in the soil and the developing root system of the crop, reducing the chance of infection.

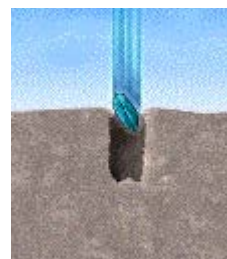
## Insecticide

**Thiamethoxam** is rapidly translocated throughout the plant to provide complete protection and is active through both contact and ingestion. Insects that come in contact with seed or plants treated with thiamethoxam show unique behavioral responses after exposure, and feeding is irreversibly stopped. Therefore, insect damage stops shortly after treatment.

Due to its water solubility, thiamethoxam requires less soil moisture for activation than other seed treatment insecticides, allowing the active ingredient to move quickly into roots and emerging seedlings to provide protection. In dry conditions, water solubility is critical. However, during wet conditions, it is important that the product remain in the root zone. Thiamethoxam binds to soil particles surrounding the seed for uptake by the plant.

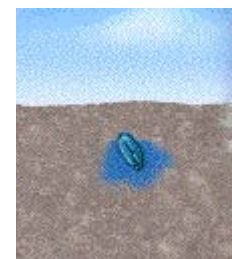
More than 9,000 trials prove that thiamethoxam provides higher yields in a direct comparison with other neonicotinoids, even under low insect pressure or in the absence of insect pests. This phenomenon, called the Cruiser Vigor Effect, helps plants to better withstand unfavorable environmental conditions and stresses to deliver higher and more consistent yields.

## How the Systemic Protection Grows with the Plant

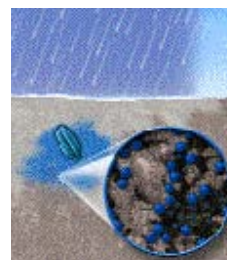


Cruiser is on the seed as it is planted:

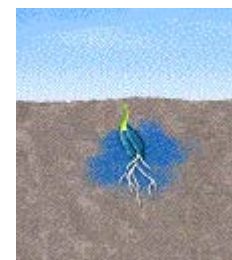
- Convenient delivery system to protect your wheat and barley from pests.



Cruiser has the right water solubility to secure optimum uptake under diverse growing conditions.



Once dispersed into the root zone, Cruiser binds to soil particles to remain available for uptake.



Protection starts from day one. Seeds and young plants are protected.



As Cruiser is absorbed by the roots, it moves systemically throughout the growing plant.



Since Cruiser is absorbed into new plant tissue, it provides continuous protection so pests do not have a chance to damage young plants.



## Impact of Key Pests



### Best-in-class Activity Against *Rhizoctonia*

*Rhizoctonia* lives as a fungus in soil, infecting seeds and young seedlings after water absorption. Capable of causing 20 to 40 percent yield loss, *Rhizoctonia* destroys the cells in roots, resulting in brown lesions or decay on the outer root cortex and/or shortened roots with darkened tips. If seedling rot has extended through to the soil surface, seedlings may fall over and die due to a decayed, weak root system.

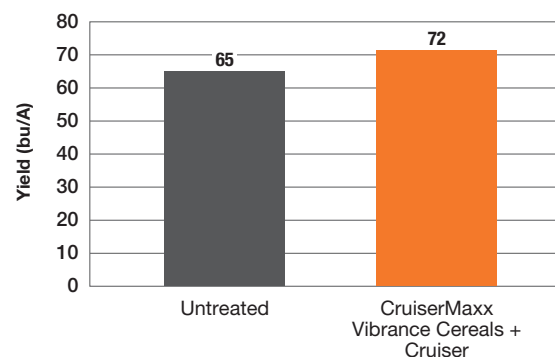
*Rhizoctonia* is classified into several anastomosis groups (AGs), which vary in prevalence based on soil types, crops and geographies, to differentiate the various strains of *Rhizoctonia*. The AGs allow scientists to understand the interactions of these strains and the potential impact to the crops.

### Impact of *Rhizoctonia*

- Failure of seeds to germinate (seed decay)
- Failure of seedlings to emerge (pre-emergence damping-off)
- Stunted crops and uneven stands
- Bare patches in the field
- Reduced moisture and nutrient absorption
- Reduced crop growth, development and vigor
- Reduced yield and in severe cases can destroy entire field

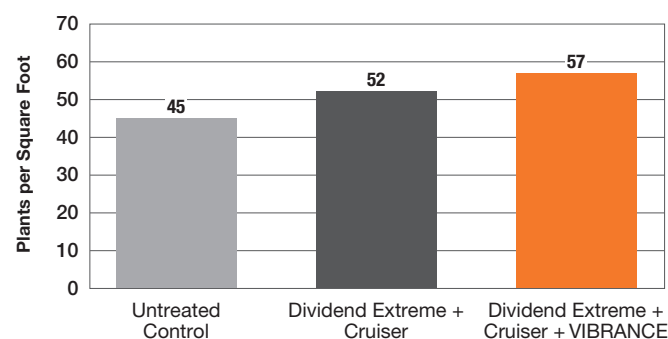
VIBRANCE products supply cereal growers with the best-in-class *Rhizoctonia* activity on the market. They also deliver enhanced protection against a broad spectrum of seedborne and soilborne diseases. In addition to elevated disease protection, these products deliver enhanced Rooting Power to help cereal crops optimize root health and produce consistent yield performance year to year.

**Yield Results: *Rhizoctonia solani* Protection in Barley**



Trial in Bozeman, Mont., 2010.

***Rhizoctonia solani* Protection in Wheat**



Non-inoculated *Rhizoctonia* trial in Pullman, Wash., 2009. Paulitz.



*Rhizoctonia* bare patch in wheat. Paulitz.



## Tough Shield Against True Loose Smut

*Ustilago nuda*, more commonly known as true loose smut, is a fungus that infects the seed embryo and later continues to attack the entire crop head to produce smutted heads. True loose smut primarily affects barley.

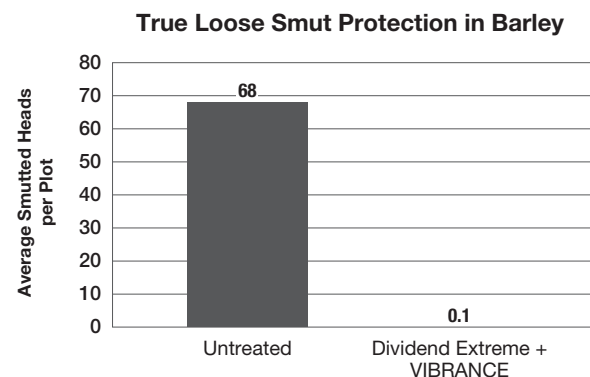
### Impact of True Loose Smut

- Reduced grain quality
- Lower yield
- Spores from smutted heads can infect crop next season

The active ingredient sedaxane in VIBRANCE Extreme and CruiserMaxx Vibrance Cereals defends seeds against quality-reducing true loose smut in barley. The VIBRANCE products help thwart the fungus from infecting the crop, while simultaneously boosting root health.



True Loose Smut in barley



Rosalia, Wash., 2011. 67 days after planting.  
All seed was also treated with Cruiser.



## Defense Against Fusarium Seed Scab

*Fusarium* attacks the outside of the seed and the seed embryo. These infection points act as inoculum for a new round of infection in the next crop when conditions are favorable. However, the immediate threat is to the seed. If infected with *Fusarium*, the seed may die, germinate poorly or encounter seedling blight as it germinates.

### Impact of *Fusarium*:

- Fewer seeds germinate
- Seedlings frequently die before becoming established
- Stands are spotty and uneven



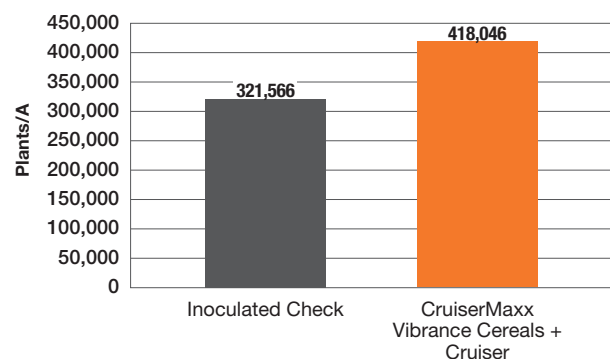
Wheat seed infected with *Fusarium* seed scab

VIBRANCE Extreme and CruiserMaxx Vibrance Cereals defend seeds against inoculum in the soil and reduce the chance of new infections. While seed treatments cannot protect wheat and barley plants from windborne inoculum that may infect the plant later in the season, both VIBRANCE Extreme and CruiserMaxx Vibrance Cereals are integral for managing seed scab, showing excellent activity against several *Fusarium* species, including seed scab, root rot and crown rot. As a result, disease risk is lowered, germination and stand establishment are greatly improved, and yield potential is protected.

### Benefits of a VIBRANCE Extreme and Maxim 4FS Program:

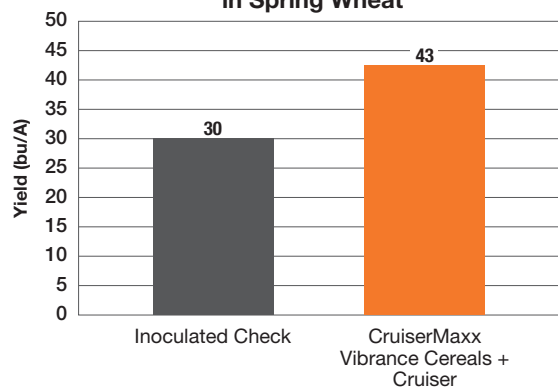
- Delivers excellent seed germination by protecting against seed scab and seedling blight
- Excellent seed safety and disease protection results in optimal seedling development and root growth
- Adding 0.06 oz/cwt of Maxim® 4FS seed treatment fungicide to VIBRANCE Extreme boosts seed germination

### *Fusarium* Protection in Spring Wheat



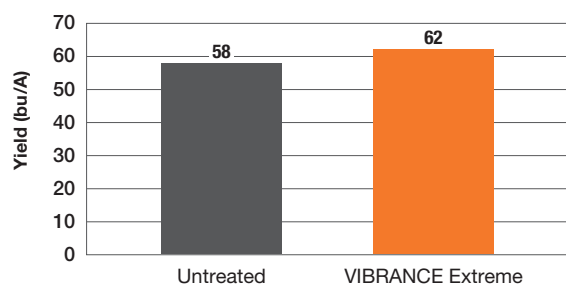
Average of 4 inoculated trials in N.D. and Minn., 2010. Plants per acre recorded 27-33 days after planting.

### Yield Results: *Fusarium* Protection in Spring Wheat



Average of 4 inoculated trials in N.D. and Minn., 2010.

### Yield Results: *Fusarium* Protection in Barley



Inoculated trials in Bozeman, Mont., 2010.



## Unsurpassed Dwarf Bunt Protection

*Tilletia controversa* Kuhn, also known as dwarf bunt, is a fungus or smut infecting wheat by dwarfing plants and destroying kernels. Higher elevations and long periods of snow cover in the Pacific Northwest create ideal conditions for dwarf bunt in winter wheat fields, as the disease requires 60 to 90 days of continuous snow cover, sustained low temperatures and diffused light. Due to the need for cool weather and snow cover during germination, spring cereals are not affected.



Dwarf Bunt

## Impact of Dwarf Bunt:

- Reduced yield and test weight
- Plants develop heads with black bunt spores rather than healthy wheat kernels
- Smut balls from dwarf bunt stain kernels and produce a very distinct, unpleasant odor
- Restrictions prevent elevators from accepting and exporting grain with high bunt levels

VIBRANCE Extreme and CruiserMaxx Vibrance Cereals set the standard for dwarf bunt protection. When growers plant seed treated with VIBRANCE Extreme or CruiserMaxx Vibrance Cereals, they know their winter wheat fields are protected from dwarf bunt, plus a broad spectrum of other seedborne and soilborne diseases right from the start. This protection helps maximize their grain marketing options.



## Excellent Protection Against *Pythium*

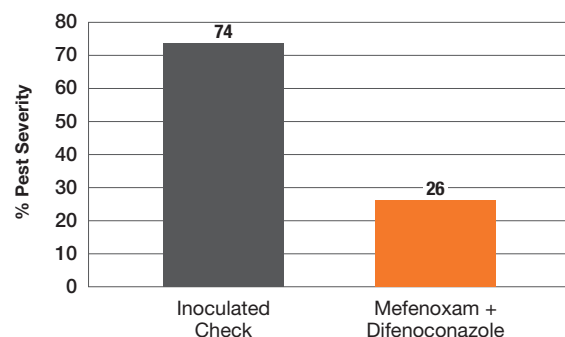
*Pythium* is one of the most prevalent disease pathogens attacking cereal crops. It is so common that it is often misdiagnosed as winter injury, poor soil fertility or toxicity from crop residue. *Pythium* feeds on the root system and results in spindly plants with shortened or distorted leaves, fewer tillers and smaller heads.

### Impact of *Pythium*:

- Significant yield loss
- Delayed emergence
- Damping off
- Restricted nutrient uptake due to disintegrated root tips
- Stunted plant growth
- Uneven plant development
- Thin plant stands

Research from Washington State University indicates that wheat seeds left unprotected are likely to become infected by *Pythium* within the first 24 to 48 hours after planting in moist soils. VIBRANCE Extreme contains Apron XL at a labeled rate three times the norm for excellent, built-in protection against *Pythium*. Both VIBRANCE Extreme and CruiserMaxx Vibrance Cereals protect seeds and young seedlings from day one, while aiding the development of a strong, uniform stand; increased plant vigor; and enhanced yield potential.

***Pythium* Protection with Seed Treatments**

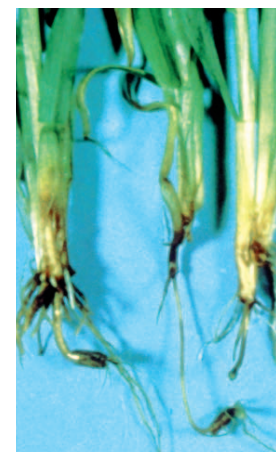


Results recorded 6 days after treatment.



## Guard Against Common Root Rot

Lingering in cereal fields, easily misidentified and often undiagnosed, common root rot can cause severe damage. Also known as *Cochliobolus sativus*, common root rot survives as spores in the soil or among infected debris from previous crops. Common root rot, seedling blight and prematurity blight of cereals are caused by the same species of soil-inhibiting fungi.

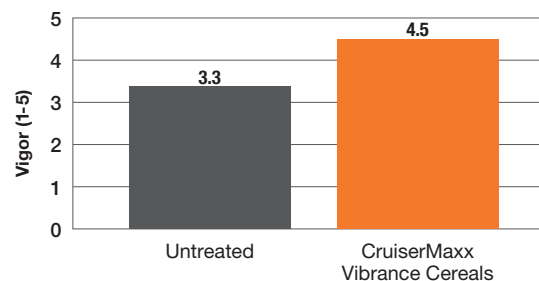


Common Root Rot

Symptoms include subtle, elongated brown spots or lesions, and plants typically break off easily near ground level when pulled. With severe infections, the entire crown, sub-crown internode and root system may turn dark brown and die. Prematurity blight, a severe manifestation of common root rot, can occur when acute infections are aggravated by spells of hot weather following a period of cool weather. With prematurity blight, plants appear white and bleached, and can cause either shriveled seeds or sterile heads.

VIBRANCE Extreme and CruiserMaxx Vibrance Cereals safeguard the root system from common root rot, and act as barriers between the disease in the soil and the developing root system—thereby lowering the disease risk and improving stand establishment.

**Common Root Rot Protection in Winter Wheat**



Plant vigor index with 1 = very poor growth and 5 = very vigorous growth

Inoculated trial in Bozeman, Mont., 2010. Results recorded 212 days after planting.



## Systemic Protection Against Wireworms

Many growers are discovering wireworms in their fields, in part due to the phase-out of lindane and the increased popularity of reduced tillage programs. The shiny yellow larvae of click beetles, wireworms prefer cool, moist soils in fields with high organic matter. They feed on roots, seeds and seedlings and can reduce stands up to 80 percent. Yields start to decline after a field reaches 20 percent stand loss.

### Impact of Wireworms:

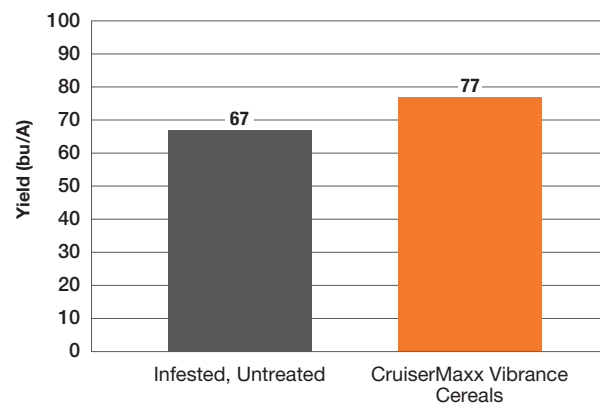
- Reduced plant vigor
- Feeding causes open wounds for potentially greater disease infection
- Reduction in plant stand
- Patches of dead plants

### Conditions Favored by Wireworms:

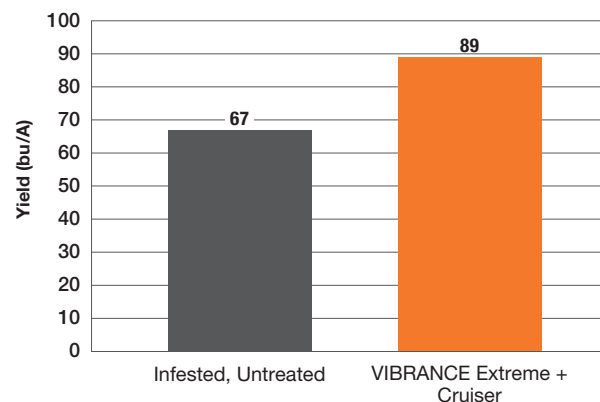
- Cool, moist soils
- Fields just put into production after being in pasture or sod
- Long-term legume or grass-cropped fields
- Reduced tillage fields because of their high organic matter and ample supply of plant roots and seeds

Due to the increased presence and pressure from wireworms, the Syngenta cereals team recommends a range of Cruiser seed treatment solutions to match grower needs. Cruiser and CruiserMaxx Vibrance Cereals offer the most cost-effective and proven options for reducing wireworm damage. This gives plants a chance to develop root systems capable of taking up necessary nutrients and moisture, which allows them to better sustain any later attacks by wireworms. Although seed treatment insecticides are recognized as the best option for managing wireworm damage, they will only provide some level of suppression rather than complete control.

**Yield Results: Wireworm Protection in Spring Wheat**



**Yield Results: Wireworm Protection in Spring Wheat**



Wireworm-infested trials in Grandview, Wash., 2010.



Wireworms



## Aphids and Barley Yellow Dwarf Virus Protection

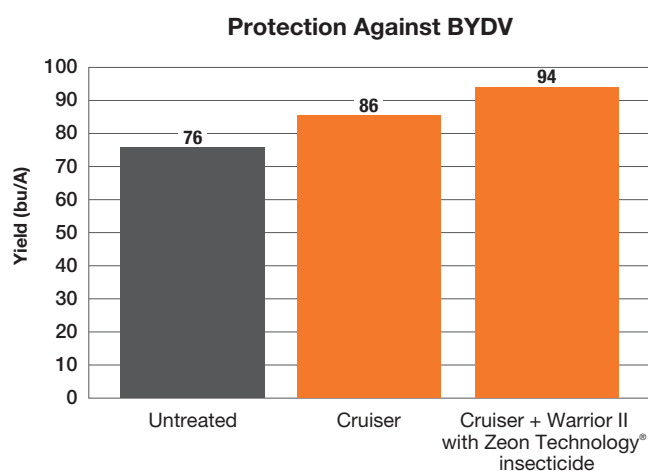
BYDV is a potentially devastating disease that is spread by aphids, and even a small population of these tiny insects can wreak havoc in a field. Many researchers have identified fall attacks as most damaging and the source of a majority of the BYDV that is evident in the spring. Cruiser protects cereal crops from these sporadic fall aphid attacks and serves as the first line of defense against BYDV.

### Visible Symptoms:

- Winterkill
- Plant stunting
- Yellow to red-purple leaf discoloration

### Impact of Aphid-transmitted BYDV:

- Underdeveloped root systems
- Decreased tillering
- Delayed maturity
- Nutritional disorders
- Reduced grain quality and yield



Trial conducted by Miles Farm Supply, Owensboro, Ky., 2004.

## Aphids

*Rhopalosiphum padi*,  
*Rhopalosiphum maidis*,  
*Sitobion avenae*



Aphid, bird cherry-oat

### Description:

**Adult:** Adult aphids are about 0.1 inch long; roughly pear-shaped; may be winged or wingless; are slow moving and soft-bodied. Pair of tubular structures (cornicles) project like tail pipes from end of bodies. Adult aphids may fly or walk from host to host. **Bird cherry-oat aphid (BCOA)** is dark green to almost black with rounded body; red-brown area on back of abdomen; antennae nearly as long as body. **Corn leaf aphid (CLA)** is blue-green with a fuzzy appearance; body is flatter and longer than BCOA; cornicles are short and black. **English grain aphid (EGA)** is green to brown to pink with long black cornicles that reach past the end of the body; legs are long and black. **Russian wheat aphid** is small, lime-green with an elongated, spindle-shaped body; projection above the tail, which gives it a “double tail” appearance when viewed from the side; rather short antennae. Absence of prominent cornicles distinguishes it from other aphids.

### Life Cycle:

Most aphids overwinter as eggs on various plants. Life cycles may involve more than one host plant. In spring, females emerge from eggs and give birth to live young, which remain wingless or become winged for dispersal. A new generation is produced every three to four weeks. In fall, males are produced and mated females lay overwintering eggs. Most species of grain aphids migrate each year on southerly winds.

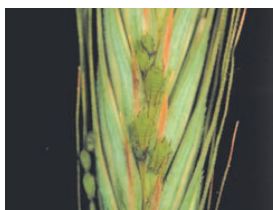
### Damage:

Aphids cause damage by sucking plant juices; damaging roots, stems, leaves or fruit; causing abnormal growth, wilting or flower drop. In large numbers, the EGA can shrivel developing grain kernels. Aphids can also transmit BYDV; and in this case, a single aphid can infect and stunt several plants. In turn, other aphids acquire the virus from infected plants then move to and infect healthy plants, quickly increasing disease level.

## Aphids, continued

### Scouting/Control Measures:

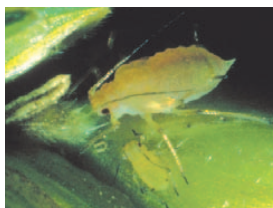
Cool, moist conditions favor aphid development. Fields should be inspected following a period of this type of weather. Make several counts throughout fields before heading. Counts should be at least 50 paces apart and observations should be made well into center of field. Carefully examine 20 stems in each of five areas of field. Examine at least 100 stems per field. Consult your extension service for threshold levels. Foliar treatments should be made before aphid feeding curls leaves. Lady beetles, syrphid fly larvae, green lacewing larvae (aphid lions) and parasitic wasps are natural predators of aphids.



Aphid, English grain



Aphid, corn leaf



Aphid, Russian wheat

### Distribution:

Most species of aphids can be found throughout the United States.

### Seed Treatment Product Recommendation:



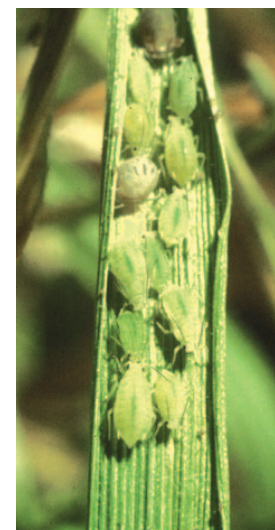
## Greenbugs

*Schizaphis graminum*

### Description:

**Nymph:** Similar to adult, but smaller in size.

**Adult:** Small, pale green aphids; winged or wingless females; about 1/16 inch long; very distinct darker green band down the middle of the back. Mostly black antennae are shorter than the body; relatively short cornicles (tailpipes) have black tips. Legs are green with joints and ends black. Colonies will occur on undersides of leaf blades, in crowns and occasionally on stems.



Greenbugs

Photo by Brian D. Hudelson

### Life Cycle:

Some greenbugs overwinter as far north as Missouri; in northern regions, they migrate as winged females with prevailing southwesterly winds during March and April. Eggs generally hatch during late winter or early spring, producing wingless females. Within seven to 18 days of hatching, females begin giving birth to live young, and rate of reproduction is enormous.

### Damage:

Damage may occur in fall or spring. Unlike other cereal aphids, greenbugs inject a toxin into the plant causing that tissue to die. Feeding injury first appears as a yellow ring around the puncture into which toxin has been injected and plant sap withdrawn. Injured leaf tissue turns red and then brown as the tissue dies. Infested fields usually show deadened, yellow or red areas in late winter or early spring. Greenbugs also transmit BYDV.

## Greenbugs, continued

### Scouting/Counting Measures:

Wheat varieties differ in tolerance to greenbugs. Seed treatment insecticides offer early-season protection in areas where risk of greenbug infestation is high. If 50-100 greenbugs are counted per linear row-foot, control may be needed. If these numbers are reached during early fall, treatment is generally advisable, unless an unusually high number of beneficial insects are present. Greenbug populations tend to naturally decline during December and January. Overwintering populations can increase rapidly during warm periods in February and March. Maintain close surveillance of fields if greenbugs are present. Greenbugs in some areas have developed resistance to some insecticides. Contact local advisers concerning threshold levels and best control measures.

### Distribution:

Throughout the United States, though most damaging in CO, KS, NE, OK and TX.

### Seed Treatment Product Recommendation:



## Hessian Fly

*Mayetiola destructor*



Hessian Fly

### Description:

**Egg:** Red; laid in lines of 10 or 12 in grooves on upper side of leaves

**Larvae:** Small, white, legless maggots

**Pupae:** Also known as “flaxseed” stage because puparia resemble flaxseeds

**Adult:** Very small black fly, smaller than the common mosquito (less than 1/8 inch long). Abdomen of female is dull red

### Life Cycle:

Two generations annually. Fall generation maggot completes its growth and overwinters under leaf sheaths in a brown pupal form known as “flaxseed.” Small black flies emerge in March, mate and lay eggs for another generation, with egg and maggot activity in May or early June. Second generation larvae change into “flaxseed” pupae before grain harvest and remain in that stage on stubble throughout summer. Flies emerge in September and early October, lay eggs and larvae emerge to begin the fall/winter generation.

### Damage:

Maggots (larvae) are the destructive stage. Maggots of fall generation work their way under leaf sheaths near crowns and feed by rasping the plant and sucking the exuding sap. Such feeding weakens and stunts plants and subjects them to abnormal winter kill. Larval feeding in late spring results in poorly filled heads and lodged straws.

## Hessian Fly, continued

### Scouting/Counting Measures:

Scout wheat fields, especially in late October or November after first frost, looking for areas with poor stands and stunted plants. Also check plants in spring. Examine the base of plants by pulling back sheaths of several leaves and look for the “flaxseed” pupae. Use resistant varieties (although varieties are not resistant to all biotypes of the fly) and plant after the “Hessian fly-free date.” Once an infestation of Hessian fly has developed, there is no effective rescue treatment. Parasitic wasps can sometimes reduce Hessian fly populations in spring. Some seed treatment insecticides can provide partial, early-season control, but the key is to plant after the fly-free date. If you are not sure of that date, contact local advisers.

### Distribution:

Throughout all wheat growing states; not found in arid wheat growing areas of the Plains States, but is found in irrigated areas.

### Seed Treatment Product Recommendation:



## Wireworms

*Melanotus spp.* or *Agroites spp.*  
or *Limoniuss spp.*



Wireworm

### Description:

**Egg:** Generally pearly white, round and difficult to see in the soil.

**Larvae:** Wireworm is the common name for the larval stage of several species of beetles.

Newly hatched wireworms are white with dark jaws. After feeding and molting several times, these larvae become hard, slender, jointed and shiny; and generally orange, brown or yellow. They can be 0.4–1.6 inches long; legs are present on the first three body segments behind the head.

**Pupae:** Generally white and soft-bodied.

**Adult:** Adults of some species are called “click” beetles because of their habit of snapping or clicking when placed on their backs. Adults are normally 0.06–1.5 inches long; tapered toward both ends; brown to nearly black with loose, flexible joint just ahead of wings.

### Life Cycle:

Four stages of growth consisting of egg, larva, pupa and adult; most species require two or three years to complete development. Adults emerge in spring. Shortly after mating, female beetles lay up to 300 eggs in the soil, generally around the roots of grass plants. Larvae emerge from eggs. Depending on environmental conditions, some larvae require two to six years to reach full size of approximately 0.8–1.5 inches, so numerous stages and sizes of larvae may be found at any one time. Pupal stage is also spent in the soil. Some species of wireworm can overwinter in any of the stages, but most do so in the larval and pupal stages.

## Wireworms, continued

### Damage:

Wireworms can attack the crop as soon as the seed is planted into the soil. Injury includes boring into the seed and young seedlings. Usually, seedlings are not completely severed as with cutworm, but suffer severe scarring which weakens the plant. Open wounds also provide paths for other plant diseases. Larvae feed on roots and underground shoots of small grains, especially those planted on land previously in sod.

### Scouting/Counting Measures:

Through crop rotation, tillage, soil-applied insecticides and seed treatment insecticides, wireworms can usually be managed. Infestations are most severe on land not previously in row crops, especially following sod. Wireworms are difficult to control, partially because they usually live and do their damage several inches deep in the soil. There are no known thresholds to estimate economic damage to plants. Sometimes baits can be used to determine population levels. If wireworm infestations are high, talk to your local advisers for recommendations in your area.

### Distribution:

Throughout the United States.

### Seed Treatment Product Recommendation:



## Barley Yellow Dwarf Virus

*Luteovirus, BYDV*

**AKA:** Red leaf (in oats)

**Principle Crops Affected:**  
Wheat, barley, oats, triticale

**Symptoms:** BYDV is evidenced by stunting and yellowing of wheat plants. Leaves may turn yellow along leaf margins or in blotchy patterns. Heads may be whole or partially sterile. Leaf yellowing begins at leaf tips and along midribs; infected leaves tend to be more erect. Flag leaves may have red-purple tips.



Barley Yellow Dwarf Virus

**Disease Cycle:** Although plants infected early in fall may be flat or weak and may winter-kill, symptoms are usually not seen until late spring, near jointing time. BYDV is complicated with many strains and is transmitted by more than 20 aphid species, some of which are windborne from more southern regions. The virus is very persistent in aphid vectors, but cold and dry conditions slow aphid activity and virus transmittal. It is not transmitted by seed nor soil.

**Damage:** Reduces tillering, causes sterility and fails to fill kernels, which lowers yields.

**Scouting/Control Measures:** Most important time for controlling aphids to prevent BYDV is during the first 30 days following emergence. Delay planting using the Hessian fly-free date. Plant varieties that are not highly sensitive to BYDV. Consult local advisers concerning threshold levels and best control measures. In some regions, as few as three aphids per row-foot during the first 30 days after emergence may justify using an insecticide.

**Distribution:** Throughout the United States.

**Seed Treatment Product Recommendation:**



## Common Bunt

*Tilletia spp.*

**AKA:** Covered bunt

**Principle Crops Affected:**

Wheat

**Symptoms:** Heads affected by this fungal disease have a blue cast when they emerge from the boot. Heads are smaller, with spreading glumes. Infected kernels are transformed into smut balls — masses of foul-smelling, dark brown powder, which are the spores of the fungus. Smutted heads generally stand more erect than healthy heads because of being lighter weight.

**Disease Cycle:** Most commonly found on fall-sown wheat. Infection occurs from smut spores on seed and from spores in soil close to the seed. Soilborne spores can last for decades. Spores germinate in cool conditions, attacking seedlings before emergence.

**Damage:** Loss in yield is directly related to the percentage of diseased tillers. There can be loss in quality with downgrading smutty grain.

**Scouting/Control Measures:** Appropriate seed treatment fungicides will provide good control. Also rotate crops and plant resistant varieties. Contact local advisers if infection occurs.

**Distribution:** Throughout the United States.

**Seed Treatment Product Recommendation:**

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals



Common Bunt

## Common Root Rot

*Cochliobolus Sativus*  
(*Bipolaris sorokiniana*)

**Principle Crops Affected:**

Wheat, barley, oat

**Symptoms:** First symptoms are stunting and sometimes wilting of infected wheat seedlings. Later these plants turn yellow and die. Brown lesions develop on subcrown internodes and primary roots. Roots of diseased seedlings are rotted, red-brown and may be covered with a mass of white, gray or pink mold. If only part of the root system is involved, the plant does not tiller and sends up only a single stem with a small seed head. Dead plants often have a bleached appearance.

**Disease Cycle:** This disease can be especially important in areas where wheat is planted following corn. Infection results from spores that are soilborne or seedborne, or from crop residues of corn or other cereal crops. These fungi are common in soil. Favorable conditions for this disease include dry, cool soils and drought stress during seed filling.

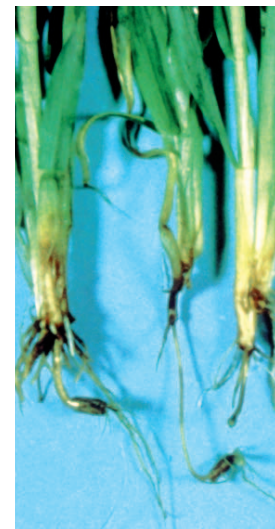
**Damage:** Main loss is due to a reduced number of heads per plant by kernel weight. The number of kernels per head are also reduced.

**Scouting/Control Measures:** Thoroughly plow or burn infected stubble, straw, corn stalks, grass weeds, etc. Rotate crops, and do not follow corn with wheat. Remove light and shriveled seeds from seed wheat. Plant resistant or tolerant varieties that are treated with appropriate seed treatment fungicides. If this disease has been observed, contact local advisers for best control options.

**Distribution:** Throughout the United States.

**Seed Treatment Product Recommendation:**

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals



Common Bunt

## Dwarf Bunt

*Tilletia controversa*

### Principle Crops Affected:

Winter wheat

**Symptoms:** Dwarf bunt looks like common bunt but affects only winter wheat, not spring wheat. Infected plants are shorter, with an increased number of tillers. Seed heads are full of green-brown “bunt balls” instead of kernels. Dwarf bunt has a strong, fishlike odor.

**Disease cycle:** Dwarf bunt can survive in soil for more than 10 years. At harvest, the bunt balls release black spores, which stay in the soil or on the seed. Spores on the seed are the most common source of inoculation. Spores germinate slowly at low temperatures under snow or frozen ground. Once a plant is infected, the fungus grows as the plant grows, filling the heads with bunt balls.

**Damage:** Yields are reduced because the bunt balls replace wheat kernels. As the spores are released, healthy grain can also be contaminated.

**Scouting/Control Measures:** Infected plants may be hard to find under a canopy of taller, healthy plants. Infection is most apparent later in the season as the bunt balls open to expose spores. Very early or very late fall planting and planting resistant varieties reduce yield losses caused by dwarf bunt, but these practices do not control the disease or prevent grain contamination. Fungicides and seed treatments that specify dwarf bunt control can be used.

**Distribution:** Mainly Pacific Northwest in areas with winter snow cover.

### Seed Treatment Product Recommendation:

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals



Dwarf Bunt

## Flag Smut

*Urocystis agropyri (U. tritici)*

### Principle Crops Affected: Wheat

**Symptoms:** Flag smut is recognized best at heading, when dusty, black and diseased heads appear. Leaves may also appear twisted, giving the appearance of hormone-type herbicide injury. Typically, at or near heading, the infected heads emerge one to three days earlier than those of healthy plants. The chaff and grain in an affected head are completely transformed into a black powder or sori, which are dispersed by wind, rain or insects during the flowering period of healthy plant heads.

Infections that occur near heading cause sheaths and leaves to form long, gray-black streaks, typically between leaf veins. Leaves will curl, and may become shredded as tissue between veins breaks down.

**Disease Cycle:** Maximum infection occurs during flowering. The black spores form a smutted head, infecting before emergence. When temperatures are between 50° and 70°F, the spores germinate and invade the seed. Flag smut then becomes dormant until an infected seed is sown and begins to sprout. The smut becomes active and grows, keeping pace with the wheat plant's development.

Infection is favored by dry soil conditions, typically 10 to 15 percent moisture levels. Flag smut may be seedborne or soilborne, with soil resting stage lasting up to four years. Thus, crop rotations are only somewhat effective.

**Damage:** The fungus affects the wheat leaves and stems. Most infected plants will not produce seeds. Fields with heavy flag smut produce high levels of spores that can cause spread of smut for future crops. Seed held back from fields containing flag smut are at risk for developing early season symptoms, including stand losses and yield reductions.

**Scouting/Control Measures:** Use certified seed varieties from smut-free fields that are resistant to flag smut, along with a fungicide seed treatment. Crop rotation may be beneficial.

**Distribution:** Most winter wheat areas and cool, fall-sown spring wheat areas.

### Seed Treatment Product Recommendation:

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals

## Loose Smut

*Ustilago tritici*

### Principle Crops Affected:

Wheat

**Symptoms:** Easily recognized by characteristic dusty black appearance of diseased heads. Generally, glumes and grain are completely transformed to black powder spore masses which shatter off, leaving a bare, blackened spike at harvest. Infected plants are difficult to detect before heading.



Loose Smut

**Disease Cycle:** Seedborne fungal mycelium establishes itself in the embryo of the seed at flowering. As seed matures, mycelium becomes dormant. When infected seed germinates the following spring, mycelium begins to grow and penetrates the growing point.

**Damage:** Loss in yield is directly related to the percentage of diseased tillers. Also can be loss in quality with downgrading of smutty grain.

**Scouting/Control Measures:** Plant clean, certified seed from smut-free fields. Plant resistant varieties. Use appropriate systemic seed treatment fungicides. Rotate crops. Discuss control options with local advisers.

**Distribution:** Throughout the United States.

### Seed Treatment Product Recommendation:

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals

## Pythium

### Principle Crops Affected:

Wheat, many others

**Symptoms:** *Pythium* is one of the most common soil pathogens found in nature. *Pythium* infects the seed at or before germination, attacking the young seedling before or after emergence. Disease symptoms may include any of the following: seed decay; decay of the seedling before emergence; seedling root rot characterized by a soft, watery rot; root tips that are brown and dead in appearance; brown tissue on the outer portion of the root that easily pulls off; and/or root cells containing fungus spores. Plants that do emerge are pale, stunted, become yellow and die within a few days. Surviving plants are less vigorous and competitive during early-season growth development.



*Pythium* damping off

Early-season symptoms are commonly called damping-off. Compacted soils and water-soaked conditions cause anaerobic conditions that are favorable for the development of *Pythium*. Low soil oxygen levels cause plants to exude oxygen forming sugars that *Pythium* thrive on and cause rapid increase in soil levels.

Cool conditions slow down plant development, increasing the exposure and time needed for infections to develop.

**Disease Cycle:** The fungus can be found in soil, sand, pond and stream water and their sediments, as well as dead roots of previous crops. *Pythium* is a particular problem in poorly-drained soils. The fungus prefers wet and especially cool conditions for releasing spores. *Pythium* can develop most easily in seedlings, as plants become more resistant as they age. The plant's root tips are attacked and killed first, causing root loss and poor growth. Several species of *Pythium* are known to infect wheat seed and seedlings.

## *Pythium*, continued

**Damage:** *Pythium* root rot is difficult to control once rot has begun and rapid death of crops occur when infected. Economical impact can occur from stand loss, poor vigor, delayed emergence and poor plant development.

**Scouting/Control Measures:** Most soils contain some level of *Pythium*, ensuring the potential for infections in fields if environmental conditions become favorable. Plant good quality seed, free from cracks and splits, in well-drained soils. Use seed treatment fungicides to prevent infection during the most susceptible early-season development period.

**Distribution:** Throughout the United States.

**Seed Treatment Product Recommendation:**



## Rhizoctonia Root Rot

*Rhizoctonia solani*

**Principle Crops Affected:**

Wheat, barley, many others

**Related Species:** *Rhizoctonia* stem rot



*Rhizoctonia*

**Symptoms:** This fungus can cause pre-emergence or post-emergence damping-off of seedlings and wilting. It can cause brown or red-brown lesions on larger seedlings and young plant stems down to the soil line and on the tap root. Infected stems often break in the lesioned area. Roots may die from a firm, dry, brown or red-brown decay.

**Disease Cycle:** The fungal structures overwinter in the soil and in crop residue. Stressful conditions favor infection. Warm and dry soil before planting, followed by warm and wet conditions after planting, favor this disease. This fungus can survive indefinitely.

**Damage:** Brown lesions or decay on the outer root cortex and/or shortened roots with darkened tips. *Rhizoctonia* can also cause seed decay, pre-emergence damping-off, reduced crop growth and/or uneven stands.

**Scouting/Control Measures:** Use systemic fungicide seed treatments, avoid seedling stresses, such as planting too deeply and compacting soil. Promote good soil conditions that favor rapid seedling development.

**Distribution:** Throughout the United States.

**Seed Treatment Product Recommendation:**



## Septoria Leaf Blotch

*Septoria tritici* or  
*Mycosphaerella graminicola*

### Principle Crops Affected:

Wheat, barley

**Symptoms:** Small yellow to brown flecks occur on leaves. These expand to irregular yellow to brown lesions, sometimes with gray to brown centers and yellow edges. Small black dots or spores appear in diseased areas and distinguish this leaf disease from others.

**Disease Cycle:** Fungal pathogens overwinter on crop residue. Disease is primarily dispersed short distances by rain splash. Wet, warm weather favors the disease, which can also be seedborne.

**Damage:** Shriveled seed and reduced seed set, which lowers yield.

**Scouting/Control Measures:** Allow a one- or preferably two-year break between wheat and/or barley. Use varieties with some resistance. Burying residue may reduce disease incidence. Foliar-applied fungicides will reduce losses, but crops should be monitored closely around flag leaf emergence and sprayed when only small spots are present on upper leaves. Seed treatment fungicides will reduce seed transmission but will not protect plants from spores spreading from crop residue, which is typically where the disease originates.

**Distribution:** Throughout the United States.

### Seed Treatment Product Recommendation:

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals



Septoria leaf blotch

## Take-all

*Gaeumannomyces graminis*

### Principle Crops Affected:

Barley, wheat

**Symptoms:** Diseased plants usually occur in localized areas up to several feet in diameter.

Affected plants are severely stunted, lose their green color and rapidly become bleached. A black, scruffy mold appears on lower stems and roots. Roots, crowns and stem bases have brown to black dry rot. A dark brown or black mat of coarse fungus hyphae may be found under lower leaf sheaths. Infected plants die prematurely with unfilled white heads.

**Disease Cycle:** Severity of this disease, especially crown and basal rots, varies greatly from year to year in the same field. It lives in the soil on diseased straw and root residues. Runner hyphae grow from the residue to roots of wheat plants. When certain forage grasses are grown in rotation (especially brome grass and wheatgrass), this fungus builds up in the soil. Nitrate fertilizers favor the build-up of this disease, as does cool and moist soil in fall and spring.

**Damage:** Planting wheat after grasses where fungus has built up can result in severe crop loss.

**Scouting/Control Measures:** Remove affected crop residues, grassy weeds and volunteer grains. Do not plant wheat after brome grass, wheatgrass or barley. If this fungus builds up in the soil, rotate to crops other than cereals and forage grasses for at least three years. Maintain balanced soil fertility levels and use ammonium forms of N for spring top-dress.

Avoid early planting. Appropriate seed treatment fungicides may be beneficial. If this disease becomes a problem, contact local advisers regarding best control measures.

**Distribution:** Throughout the United States.

### Seed Treatment Product Recommendation:

 **Vibrance™ Extreme**  **CruiserMaxx™ Vibrance™**  
Cereals



Take-all

## True Loose Smut

*Ustilago nuda*

### Principle Crops Affected:

Barley

**Symptoms:** When true loose smut attacks barley plants, the entire crop head is replaced by an airborne mass of powdery, dark brown spores covered by a thin, fragile membrane. The result is loose, dark brown or black smutted heads.



True Loose Smut in barley

**Disease Cycle:** Often considered the most common and damaging disease in barley, true loose smut is caused by a fungus that grows within the crop with the potential to overwinter. Infections occur at flowering, causing a slower, prolonged flowering period. This disease is typically found when temperatures range between 61° and 72°F, and the crop is planted into warm soils. As the infected barley seed germinates, the embedded smut mycelium grows systemically within the plant. Spores from smutted heads can lay dormant within the embryo of the diseased seed, surviving between crop cycles and likely infecting crops the following season.

**Damage:** True loose smut not only lowers yield, but the diseased grain leads to inferior crop quality as well. If mixed in with healthy heads, true loose smut has the capability of contaminating an entire crop at harvest.

**Scouting/Control Measures:** To help prevent true loose smut, plant resistant, smut-free, certified seed varieties. Use effective systemic seed treatment fungicides for better control at germination and be sure to rotate crops whenever possible. Scout crops shortly after head emergence. Discuss control options with local advisers.

**Distribution:** Throughout the United States.

### Seed Treatment Product Recommendation:

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