



# Seed Treatment Fungicides for Soybeans

Loren J. Giesler, Extension Plant Pathologist

Joshua J. Miller, Doctor of Plant Health

Seedling diseases frequently cause economic yield losses for soybean farmers across the Midwest. These most often manifest as damping off and seed rot, which result in poor emergence, loss of stand, and reduced yield. The most common pathogens that cause seedling diseases are species of *Fusarium*, *Phytophthora*, *Pythium*, and *Rhizoctonia*. All four are capable of killing soybean seedlings or at least causing damage sufficient to reduce the yield potential of infected plants.

The chance of seedling diseases increases when conditions are cool and wet. Planting date recommendations continue to move earlier in the season to maximize yield, and this increases the risk of favorable conditions for pathogens to cause seedling diseases. When growers plant soybeans early in the season, seed treatment fungicides may be an effective way to reduce the risk of early seedling diseases. However, as soybeans are planted later in the season and conditions are less likely to be cool and wet, the chance of an economic benefit from using a seed treatment fungicide declines.

In addition to planting date, field history is a key component of the decision-making process for managing soybean seedling diseases. In most cases, problem fields will have a history of seedling emergence or post-emergence problems. The distribution of the problem area within a field, however, can increase significantly in a wet year and may have a substantial impact on stand throughout the field or particularly in low, poorly drained or compacted areas in the field.

An early season disease that manifests later in the season is sudden death syndrome (SDS) caused by *F. virguliforme*. This fungus infects the soybean host early in the season during cool, wet conditions. Typically, after mid-July the fungus infects the vascular system of the plant and releases toxins. Symptoms first appear after heavy rains when plants increase water uptake from the soil and, consequently, move the toxin up the plant, as well. Until recently, the only management options for SDS control were delayed planting, extended rotations out of soybeans, and tolerant variety selection. However, in 2014 Bayer CropScience released ILeVO(R) seed treatment for SDS control. Field trials have shown positive yield responses when significant amounts of SDS were present, but more research is needed to conclude what percentage of the field must be infected and how severe the disease must be for the seed treatment to be economically beneficial.

The correct fungicide seed treatment is critical for effective disease control. Fungicides used as protectants (contacts) are effective only on the seed surface, while systemic fungicides are absorbed by the emerging seedling and inhibit or kill the fungus inside host plant tissues. Contact fungicides usually have shorter residual activity than systemic fungicides. Contact fungicides used for soybean seed treatment include captan, fludioxonil, PCNB, and thiram. Systemic fungicides used for soybean seed treatment include azoxystrobin, carboxin, mefenoxam, metalaxyl, trifloxystrobin, and thiabendazole. When selecting a fungicide, make sure to use products with activity against the

pathogen in question as activity will not be the same across all pathogen types. *Fusarium* and *Rhizoctonia* are both fungi, but *Phytophthora* and *Pythium* are actually water molds referred to as fungus-like.

Fields with a history of *Phytophthora* require additional management. The compounds labeled for control are ethaboxam, metalaxyl, and mefenoxam, and increased rates may be required (Table 3). Mefenoxam is one of the chemical compounds that has been isolated from metalaxyl and is the most active part of metalaxyl products. As a result of isolating the active component, products containing mefenoxam are typically used at half the active ingredient rate of metalaxyl products.

Seed treatment fungicides are available in a variety of formulations. Some products are labeled for commercial use in slurry- and mist-type seed treaters. Other products are labeled for on-farm application and commonly are referred to as hopper-box or planter-box treatments. Thorough seed coverage is required for maximum benefit in all cases. To attain good seed coverage with on-farm application, most seed treatment companies recommend adding half of the seed to the planter box, then adding half of the seed treatment product and mixing thoroughly. Repeat this with the remaining seed and fungicide. Good coverage can also be obtained by mixing the seed and treatment in a suitable container before adding the treated seed to the planter box. Always read and follow label directions before making any chemical applications. A list of common single

active ingredient (Table 1) and multiple active ingredient (Table 2) seed treatments and application information, as well as disease ratings for each active ingredient component, are provided below.

If you need assistance with seedling disease identification, samples can be submitted to the Plant and Pest Diagnostic Clinic at UNL. Refer to <http://cropwatch.unl.edu/plantdisease/pest-samples> on how to prepare and submit samples.

### Disclaimer

Reference to commercial products or trade names is made with the understanding that no discrimination is intended of those not mentioned and no endorsement by Nebraska Extension is implied for those mentioned.

### Disclosure

In accordance with the University of Nebraska-Lincoln's Conflict of Interest policy, the Conflict of Interest Review Committee has determined that it must be disclosed that Dr. Giesler has financial interest in Field Screen, LLC, which receives funding from agricultural companies for pesticide testing in southeast Missouri. For more information on this disclosure, please see his CropWatch biography at <http://cropwatch.unl.edu/author/loren-giesler-extension-plant-pathologist#anchor>.

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Table 1. Common Single Active Ingredient Seed Treatment Fungicide Products and Application Information. Disease Ratings Provided Are Based on General Ratings for Active Ingredient Components.<sup>1</sup>

Class	Fungicides		Pythium spp. <sup>2</sup>	Phytophthora Root Rot <sup>3</sup>	<i>Rhizoctonia</i> spp.	<i>Fusarium</i> spp. <sup>4</sup>	Sudden Death Syndrome (SDS) ( <i>F. virguliforme</i> )	<i>Phomopsis</i> spp.
	Trade Name	Active Ingredient(s)						
MBC Benzimidazoles (Group 1)	Mertect® 340-F	Thiabendazole	NR	NR	NS	NS	P	U
	Acceleron® DX-309	Metalaxyl	E	E	NR	NR	NR	NR
	Acquire®	Metalaxyl	E	E	NR	NR	NR	NR
PA Acylalanines (Group 4)	Allegiance® Dry	Metalaxyl	E	E	NR	NR	NR	NR
	Allegiance® FL	Metalaxyl	E	E	NR	NR	NR	NR
	Allegiance® LS	Metalaxyl	E	E	NR	NR	NR	NR
	Apron® XL	Mefenoxam	E	E	NR	NR	NR	NR
	Acceleron® DX-612	Fluxapyroxad	U	U	E	G	NR	G
SDHI Carboxamides (Group 7)	Kickstart® VP	Carboxin	U	U	G	U	NR	U
	ILeVO®	Fluopyram	NR	NR	NR	NR	VG	NR
	Vibrance®	Sedaxane	NR	NR	E	NS	NR	G
	Acceleron® DX-109	Pyraclostrobin	P-G	NR	F	F	NR	G
QoI Strobilurins (Group 11)	Dynasty®	Azoxystrobin	P-G	NS	VG	F-G	NR	P
Phenylpyrroles (Group 12)	Maxim® 4FS	Fludioxonil	NR	NR	G	F-VG	NR	G
Aromatic Hydrocarbons (Group 14)	Rizolex®	Tolcofos-methyl	U	U	U	U	U	U

1. The members of the Identification and Biology of Seedling Pathogens of Soybean project funded by the North Central Soybean Research Program and plant pathologists across the United States have developed the following ratings for how well fungicide seed treatments control seedling diseases of soybeans in the United States.

2. Products may vary in efficacy against different *Fusarium* and *Pythium* species.

3. Addition or higher rates of mefenoxam may be needed for Phytophthora control.

4. Ratings listed for *Fusarium* species are not efficacy ratings for *F. virguliforme*, the causal agent of sudden death syndrome (SDS).

Table 2. Common Multiple Active Ingredient Seed Treatment Fungicide Products and Application Information. Disease Ratings Are Provided Based on General Ratings for Active Ingredient Components.<sup>1</sup>

Class (Mixed Modes of Action)	Fungicides		<i>Pythium</i> spp. <sup>2</sup>	Phytophthora Root Rot <sup>3</sup>	<i>Rhizoctonia</i> spp.	<i>Fusarium</i> spp. <sup>4</sup>	Sudden Death Syndrome (SDS) ( <i>F. virguliforme</i> )	<i>Phomopsis</i> spp.
	Trade Name	Active Ingredient(s)						
3+4	Inovate® / Inovate® Pro	Ipconazole	P	NR	F-G	F-E	NR	G
		Metalaxyl	E	E	NR	NR	NR	NR
4+M3	Protector™-L-Allegiance®	Metalaxyl	E	E	NR	NR	NR	NR
		Thiram	F	P	G	F	U	F
4+11	Trilex® 2000	Metalaxyl	E	E	NR	NR	NR	NR
		Trifloxystrobin	P	P	F-E	F-G	NR	P-F
4+12	ApronMaxx® Products <sup>5</sup> / CruiserMaxx® Products <sup>6</sup> / Warden® RTA / UpShot™ Soybean Seed Treatment	Fludioxonil	NR	NR	G	F-VG	NR	G
		Mefenoxam	E	E	NR	NR	NR	NR
3+4+7	EverGol® Energy SB	Metalaxyl	E	E	NR	NR	NR	NR
		Penflufen	NR	NR	G	G	NR	G
		Prothioconazole	NR	NR	G	G	NR	G
3+4+22	Intego™ Suite Soybeans	Ethaboxam	E	E	U	U	U	U
		Ipconazole	P	NR	F-G	F-E	NR	G
		Metalaxyl	E	E	NR	NR	NR	NR
4+7+M4	Bean Guard® / Allegiance®	Captan	G	P	G	F	U	F
		Carboxin	U	U	G	U	NR	U
		Metalaxyl	E	E	NR	NR	NR	NR
4+7+12	CruiserMaxx® Vibrance®	Fludioxonil	NR	NR	G	F-VG	NR	G
		Mefenoxam	E	E	NR	NR	NR	NR
		Sedaxane	NR	NR	E	NS	NR	G
4+7+14	Prevail®	Carboxin	U	U	G	U	NR	U
		PCNB	NR	NR	G	U	NR	G
		Metalaxyl	E	E	NR	NR	NR	NR

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2. Products may vary in efficacy against different *Fusarium* and *Pythium* species.

3. Addition or higher rates of mefenoxam may be needed for Phytophthora control.

4. Ratings listed for *Fusarium* species are not efficacy ratings for *F. virguliforme*, the causal agent of sudden death syndrome (SDS).

5. Includes ApronMaxx RFC, ApronMaxx RTA, and ApronMaxx RTA + Moly.

6. Includes CruiserMaxx, CruiserMaxx Advanced, CruiserMaxx EX, and CruiserMaxx Plus.

Table 3. Seed Treatment Fungicides Labeled for *Phytophthora Sojae* Control on Soybean.<sup>1</sup>

Product Name	Active Ingredients (%)	Rate (oz per 100 lb) <sup>2</sup>	Comments
Acceleron® DX-309	Metalaxyl 28.35%	0.75–1.5	Insecticide and additional treatments can be added to base fungicide
Acquire®	Metalaxyl 29.99%	0.75–1.5	Acquire comes with Charter seed treatment
Allegiance® FL	Metalaxyl 28.35%	0.75–1.5	
Apron XL®	Mefenoxam 33.3%	0.16–0.64	Use higher rate for Phytophthora control
ApronMaxx® RFC	Fludioxonil 2.31% + Mefenoxam 3.46%	1.5	Add 0.16–0.48 fl oz Apron XL to improve Phytophthora control
ApronMaxx® RTA*	Fludioxonil 0.73% + Mefenoxam 1.1%	5.0	Add 0.16–0.48 fl oz Apron XL to improve Phytophthora control
ApronMaxx® RTA + Moly	Fludioxonil 0.68% + Mefenoxam 1.02%	5.0	Add 0.16–0.48 fl oz Apron XL to improve Phytophthora control
Bean Guard®/ Allegiance®	Captan 24.45% + Carboxin 12.5% + Metalaxyl 3.75%	3.3	
Catapult™ XL	Chloroneb 30.0% + Mefenoxam 1.95%	5.5–7.0	
CruiserMaxx®	Fludioxonil 1.12% + Mefenoxam 1.7% + Thiamethoxam 22.61% (I)	3.0	Add 0.16–0.48 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
CruiserMaxx® Advanced	Fludioxonil 1.15% + Mefenoxam 3.46% + Thiamethoxam 23.1% (I)	3.2	Add 0.16–0.32 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
CruiserMaxx® EZ	Fludioxonil 1.15% + Mefenoxam 3.46% + Thiamethoxam 23.1% (I)	3.15	Add 0.16–0.32 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
CruiserMaxx® Plus	Fludioxonil 1.07% + Mefenoxam 3.21% + Thiamethoxam 21.5% (I)	3.2	Add 0.16–0.32 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
CruiserMaxx® Vibrance®	Fludioxonil 1.04% + Mefenoxam 3.13% + Sedaxane 1.04% + Thiamethoxam 21.5% (I)	3.22	Add 0.16–0.32 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
EverGol® Energy SB	Metalaxyl 5.74% + Penflufen 3.59% + Prothioconazole 7.18%	1.0	Add Allegiance FL to supply a total metalaxyl amount of 15 to 30 g a.i./ 100 kg seed in high Phytophthora pressure areas
INOVATE®	Ipconazole 0.72% + Metalaxyl 1.153% + Clothianidin 14.34% (I)	4.74	Add additional metalaxyl or mefenoxam in high Phytophthora pressure areas. Contains insecticide (Group 4A)
INTEGO™ SUITE Soybeans	Ethaboxam 2.97% + Ipconazole 0.99% + Metalaxyl 0.79% + Clothianidin 20.0% (I)	3.37	Contains insecticide (Group 4A)
Prevail®	Carboxin 15.0% + PCNB 15.0% + Metalaxyl 3.12%	2.0–4.0 oz per bushel	
Protector™-L-Allegiance®	Metalaxyl 1.61% + Thiram 14.29%	6.7	
Trilex® 2000	Metalaxyl 5.69% + Trifloxystrobin 7.12%	1.0	
UpShot™ Soybean Seed Treatment	Fludioxonil 1.15% + Mefenoxam 3.46% + Thiamethoxam 23.1% (I)	2.94	Add 0.16–0.32 fl oz Apron XL to improve Phytophthora control Contains insecticide (Group 4A)
Warden® CX	Fludioxonil 1.0% + Mefenoxam 5.99% + Sedaxane 1.0% + Thiamethoxam 20.0% (I)	3.38	Contains insecticide (Group 4A)
Warden® RTA*	Fludioxonil 0.72% + Mefenoxam 2.21%	5.0	Add 0.32 fl oz Apron XL to improve Phytophthora control

1. Table adapted from 2017 Guide for Weed, Disease, and Insect Management, Nebraska Extension.

2. Application rates on the high end of the labeled amount are generally necessary for adequate *P. sojae* control.