

# Management of Seedling Diseases of Cotton

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Several species of fungi can infect cotton seeds or seedlings, causing a disease known as damping-off. These pathogens grow best under environmental conditions that are sub-optimal for the germination and growth of cotton seed. Disease is favored by cool, wet weather conditions during the first three weeks after planting that keep the soil temperature less than 68° F and the soil moisture at or near saturation. As seedlings develop, they become naturally resistant to infection as root systems become more extensive and root cells are lignified. Pre-emergence damping-off occurs when seeds are killed before germination or germinating seeds are killed prior to emergence from soil. Post-emergence damping-off occurs when the germinating seed has emerged from soil, but then dies.

## Seedling Disease Pathogens

There are three major fungal pathogens causing seedling disease in Texas. The most prevalent pathogen is *Rhizoctonia solani*, which is a post-emergence pathogen. This fungus produces brown or black lesions on the stems. The lesions may be sunken, which is a symptom known as “soreshin”, or the lesions may girdle and pinch the stem at the soil surface, which is known as “wirestem”.

Several *Pythium* species cause seed decay and pre-emergent damping-off. The symptom on emerged seedlings is hypocotyl rotting below the soil surface. The hypocotyl has a water-soaked or light brown appearance.

*Thielaviopsis basicola* is a post-emergence pathogen that does not usually cause mortality, but may stunt plants and delay flowering. The fungus blackens the tap root and cortex (exterior) of the hypocotyl. Lateral roots are killed, particularly on older plants. This fungus is primarily a problem in the High Plains of Texas. It has been occasionally observed on plants from other growing areas of Texas.

Other fungal species have been reported to cause seedling disease in cotton, but their occurrence is infrequent and their impact relative to the three major pathogens is slight, unless they interact with the major pathogens. These pathogens tend to cause disease in plants growing under severe environmental stress. A prevalent, minor seedling pathogen is *Fusarium* spp.

## Management Approaches

The goal is to prevent losses occurring from a stand failure and the added expense and delay from replanting. A combination of approaches can be used to reduce the impact of seedling diseases:

- ★ Avoid planting fields that were in cotton the previous season.
- ★ Plant high-quality seed for faster germination and better vigor.
- ★ Plant when soil temperatures are greater than 68° F.
- ★ Plant on raised beds helps to increase soil temperatures and improve drainage.
- ★ Plant seed treated with fungicides.
- ★ Use hopper box or in-furrow fungicides as well as seed treatments when there is a history of seedling disease or a previous stand failure.

## Seed Treatment Fungicides

Combinations of fungicides are used as seed treatments, as there is no one fungicide that adequately controls all pathogens. Fungicides are either systemic, i.e. they are absorbed by the plant and translocated within it, or non-systemic (also known as contact fungicides). Systemic fungicides can protect the growing seedling for a longer period of time than non-systemic fungicides, but they target one or two of the pathogens. Contact fungicides have a broader spectrum of activity, but they are only effective in the

area near where they are applied. The two types of fungicides can serve a complementary role in protecting the seed and the seedling. These fungicides are listed in Tables 1 and 2.

A living bacterium, *Bacillus subtilis*, is available as a seed treatment to be used in conjunction with chemical fungicides and not as a substitute for them. Its purpose is to extend the length of control beyond the point where chemicals lose their effectiveness.

Purchased seed is usually pretreated with fungicides. In some instances, when ordering seed, the grower has the option of specifying the fungicides to be applied to black seed. The grower may also choose to treat seed himself. Mixtures of the fungicides shown in Table 1 may be used, or commercial mixtures shown in Table 2 may be used, or some other combination of formulations from both tables. It should be emphasized that some of the commercial mixtures shown in Table 2 may not be sufficient by themselves to provide adequate protection against seedling disease. For example, while all the mixtures provide protection against *Rhizoctonia*, some mixtures do not protect against *Pythium* or *Thielaviopsis*. The range of protection can be increased by using additional seed treatments, or by applying fungicides at planting as a hopper box treatment or an in-furrow application.

### **Which Seed Treatment to Use**

To decide which fungicides to use, growers should try to determine which pathogens are present in their fields. This is most easily determined in the years that disease problems occur. Seedlings with damping-off symptoms should be sampled and sent to a plant disease diagnostic clinic to identify the pathogen. This is particularly useful to know if either *Pythium* or *Thielaviopsis* are present.

In the absence of such specific information about which pathogen is present in a field, the ideal preventative seed treatment mix includes systemic and protectant fungicides that are active against *Pythium* and *Rhizoctonia*. When *Thielaviopsis* is also present, the addition of triadimenol or myclobutanil (at the appropriate rate) is beneficial. Triadimenol has been reported to delay seedling emergence under cool, wet growing conditions.

The aim of using seed treatments is not to completely control damping-off, but to sufficiently suppress disease so that a good, uniform stand is obtained. The seed treatment is successful if there are no large gaps left within rows. In many years and locations, a seed treatment is sufficient for disease control.

### **When to Supplement Seed Treatments**

When there is an increased risk of seedling disease, seed treatments need to be augmented with fungicides applied as a hopper (planter) box treatment, or as granules or liquid sprays applied to the soil surrounding the planted seed. Both systemic and contact (non-systemic) fungicides are labeled for cotton and these supplemental fungicides are listed in Table 3.

Risk factors for increased seedling disease include: an early planting date, planting in soils with a frequent history of seedling disease problems, replanting a field with a stand failure, planting into a field previously cropped to cotton, or, in some growing areas, planting into a no-till or reduced tillage field.

### **Types of Supplemental Fungicide Treatments**

The hopper box method of application is considered to be least effective means of ensuring effective distribution of fungicide, while in-furrow granule applications are better and in-furrow liquid applications are considered to be the best method. Hopper box formulations are easy to apply. Hopper box dusts stick to fuzzy cottonseed, but may settle to the bottom of the planter box when acid-delinted seed is used. Additionally, planting seed deeper than 1½ inches may result in a non-uniform distribution of a hopper box fungicide.

A living fungus, *Trichoderma harzianum*, is available as a hopper box treatment. It is labeled for control of general damping-off fungi and is compatible with chemical fungicides. Like *Bacillus subtilis*, this fungus is intended to supplement and extend the activity of chemical fungicides. However, its benefits have not been consistently demonstrated.

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**Table 1. Seed Treatment Fungicides Available for Seedling Disease Control.**

Target Pathogen*	Chemical Name	Systemic	Trade Name(s)	Company
R	azoxystrobin	Yes	Protégé FL	Gustafson
T**, R	triadimenol	Yes	Baytan 30 Flowable	Gustafson
P, R, F, G	TCMTB (benzothiazole)	Yes	Argent 30 Nusan 30 EC Nu-Flow T	Gustafson Wilbur-Ellis Wilbur-Ellis
R	chloroneb	Yes	Nu-Flow D Demosan 65 W	Wilbur-Ellis Kincaid Enterprises
G	captan	No	Nu-Gro Captan 4000 Captan 30-DD Captan 400	Wilbur-Ellis Gustafson Gustafson
R	PCNB	No	PCNB Flowable PCNB Seed-Coat PCNB 2-E RTU-PCNB	Wilbur-Ellis Wilbur-Ellis Wilbur-Ellis Gustafson
G	mancozeb	No	Dithane DF Dithane F-45 Dithane M-45 Dithane WSP Penncozeb 75 DF Penncozeb 80 WP	Dow Dow Dow Dow Cerexagri Cerexagri
R, F, G	fludioxonil	No	Maxim 4 FS	Syngenta
T**, R	myclobutanil	Yes	Nu-Flow M	Wilbur-Ellis
P	metalaxyl “ ” ” “ mefenoxam (metalaxyl- m)	Yes	Allegiance-LS Allegiance FL Allegiance Dry Apron TL Apron Flowable Apron XL-LS	Gustafson Gustafson Trace Chemicals Wilbur-Ellis Wilbur-Ellis Syngenta
G	thiram	No	Thiram 42-S Thiram 50 WP	Gustafson Gustafson
R	carboxin	Yes	Vitavax 30 C Vitavax 34	Gustafson Gustafson
F, R, G	<i>Bacillus subtilis</i> (a bacterium)	No	Kodiak Flowable Kodiak Concentrate Kodiak HB	Gustafson Gustafson Trace Chemicals

\*T = *Thielaviopsis basicola*; R = *Rhizoctonia solani*; P = *Pythium* spp.; F = *Fusarium* spp.; G = General damping-off pathogens.

\*\*Effective against *Thielaviopsis basicola* when used at the higher label rate.

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**Table 2. Mixtures of Seed Treatment Fungicides Available for Seedling Disease Control.**

Target Pathogen*	Chemical Name	Systemic	Trade Name(s)	Company
R, T, F, P	azoxystrobin + triadimenol + metalaxyl	Yes + Yes + Yes	Protégé XT	Gustafson
T**,R	triadimenol + thiram	Yes + No	RTU Baytan Thiram	Gustafson
P, R, F, G	TCMTB (benzothiazole) + chloroneb	Yes + Yes	Nu-Flow ND	Wilbur-Ellis
R, P	carboxin + metalaxyl + PCNB	Yes + Yes + No	Prevail	Trace Chemicals
R, P	chloroneb + metalaxyl	Yes + Yes	Catapult; Delta-Coat AD	Agrilience
R, P	chloroneb + mefenoxam	Yes + Yes	Catapult XL; Delta-Coat XL	Agrilience
R, F, G, P	azoxystrobin + fludioxonil + mefenoxam	Yes + No + Yes	Dynasty CST	Syngenta
R, P	PCNB + metalaxyl + <i>Bacillus subtilis</i>	No + Yes + No	System 3	Helena
R	carboxin + thiram carboxin + PCNB	Yes + No	RTU Vitavax Thiram Vitavax-PCNB Flowable Fungicide	Gustafson Gustafson

\*T = *Thielaviopsis basicola*; R = *Rhizoctonia solani*; P = *Pythium* spp.; F = *Fusarium* spp.; G = General damping-off pathogens.

\*\*Effective against *Thielaviopsis basicola* when used at the higher label rate.

**Table 3. Fungicides Available to Supplement Seed Treatment Fungicides for Seedling Disease Control.**

Target Pathogen*	Chemical Name	Systemic	Trade Name(s)	Company
<b>Hopper Box Formulations</b>				
R, P	PCNB + metalaxyl + <i>Bacillus subtilis</i>	No + Yes + No	System 3	Helena
R, P	carboxin + metalaxyl + PCNB	Yes + Yes + No	Prevail	Trace Chemicals
R, P	chloroneb + metalaxyl	Yes + Yes	Delta-Coat AD	Agrilience
R, P, G	chloroneb + TCMTB	Yes + Yes	Nu-Coat	Wilbur-Ellis
G	<i>Trichoderma harzianum</i> (fungus)	No	T-22 Planter Box	BioWorks
<b>In-furrow Granule Formulations</b>				
R	PCNB	No	PCNB 10 Granular Terraclor 15 G Terraclor 6.5% + Di-Syston 6.5%	Wilbur-Ellis CK Witco CK Witco
P	mefenoxam (metalaxyl-m)	Yes	Ridomil Gold GR	Syngenta
R, P	PCNB + etridiazole	No + Yes	Terraclor Super X 18.8G Terraclor Super X with Di-Syston	CK Witco CK Witco
R, P	PCNB + mefenoxam (metalaxyl-m)	No + Yes	Ridomil Gold PC GR	Syngenta
<b>In-furrow Liquid Formulations</b>				
R	PCNB	No	Terraclor 2E	CK Witco
R	iprodione	Yes	Rovral Brand 4 Rovral Brand 75 WG Rovral Fungicide	Aventis Aventis Aventis
P	mefenoxam (metalaxyl-m)	Yes	Ridomil Gold EC	Syngenta
R, P	azoxystrobin	Yes	Quadris Flowable	Syngenta
R, P	PCNB + etridiazole	No + Yes	Terraclor Super X EC	CK Witco
R, P	PCNB + mefenoxam (metalaxyl-m)	No + Yes	Ridomil Gold PC Liquid	Syngenta

\*R = *Rhizoctonia solani*; P = *Pythium* spp.; G = general damping-off pathogens

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