

# FACT SHEET

## THE COTTON SEEDLING DISEASE COMPLEX AND ITS CONTROL

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Whenever cotton is planted, seedling disease is a threat to the crop. In fields where seedling disease is not controlled, it is more difficult to make a profit. Whether seedling disease is controlled determines success or failure from early season plantings. Early maturity is necessary to reduce damage from *Verticillium* wilt, *Phymatotrichum* root rot, boll weevils, boll and budworms and boll rots.

Production agronomists and plant pathologists agree that cotton farmers who plant early in the season and establish adequate stands of healthy plants are the ones who make money. For this reason, seedling disease control is the key to successful cotton production.

**Cause of seedling disease.** Seedling disease of cotton is caused by a relatively complex interaction of young cotton plants, disease causing organisms, and environment. Certain causal pathogens are carried either on the seed or inside the seed of the young plant. Other disease causing organisms live on from season to season in the soil and can attack the seed or seedlings. Seed rots, seedling death before or after emergence, and root rots are the results of infections by fungi. Preemergence damping-off refers to the death of cotton seedlings after seed germination, but before emergence. Post-emergence damping-off is seedling death after emergence, which is caused by infections that often occur near the soil surface.

The pathogenic organisms causing seedling disease are found in all soils used for producing cotton in Texas. Several causal organisms are carried in a

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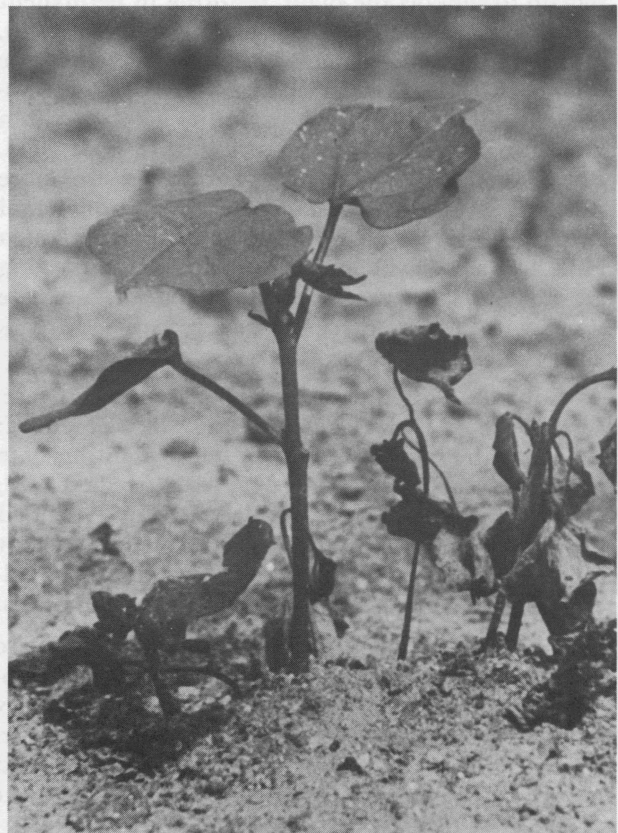


Figure 1. Postemergence seedling disease on young cotton plants.

dormant state on or in the seed. For example, organisms causing bacterial blight, *Ascochyta* blight, and anthracnose are seedborne. Although the populations of inciting organisms differ from area to area, the soilborne pathogens most commonly in-

volved in this disease complex in Texas are species of *Rhizoctonia*, *Pythium*, *Thielaviopsis* and nematodes.

**Symptoms.** Seed deterioration can result from improper harvesting of seed cotton, from storing cotton seed under unfavorable conditions, or from certain chemical changes that occur in the seed. Such seed tends to be low in viability and more susceptible to seed rotting organisms.

Seedling disease has many different effects on the young plants. Infections before emergence are often characterized by soft, watery rots of the seed or on the developing seedling. Infected seedlings that emerge are pale, stunted, slower growing, and usually die in a few days. Examination of infected seedlings reveals dark, rotted areas (lesions) on the lower stem and roots. Often the tap root will be destroyed, and only shallow growing lateral roots remain to support the plant, resulting in permanent stunting. On older surviving plants, reddish-brown, sunken lesions at or below the ground line are typical of the "soreshin" phase of *Rhizoctonia* infections. Plants that survive initial damage often are unthrifty and late in maturing, with poor yield. Plants damaged by seedling pathogens are more susceptible to other diseases and to environmental stresses. Losses resulting from having to replant a field and associated losses from delayed harvesting are obvious. However, a field having an adequate stand with a high percentage of plants with damaged roots is just as devastating.

**Control.** To reduce losses from seedling disease, five primary measures should be practiced: (1) Plant high-quality seed, (2) select planting date relative to soil temperature, (3) plant treated seed, (4) use a soil fungicide at planting for extended protection and (5) plant multi-adversity resistant (MAR) varieties which have seed-seedling cold tolerance and partial resistance to seedling pathogens.

1. *Plant high-quality seed.* High-quality seed are more tolerant to low temperatures and less susceptible to attack by soilborne organisms. Poor-quality seed have reduced germination rates and result in spotty, uneven stands with weak seedlings and plants that are more susceptible to disease, insect damage, and adverse weather conditions. Poor-quality cotton seed are the result of deterioration, either in the field or in storage, where improper temperatures and humidity levels cause deleterious chemical changes in the seed. Primary factors causing deterioration are high moisture, delayed or improper harvest and mechanical injury during the delinting process. Germination tests often are not sufficient to determine the extent to which planting seed have deteriorated, or the stand that can be expected. Dual temperature germination tests, free fatty acid, or other vigor tests can be used to deter-

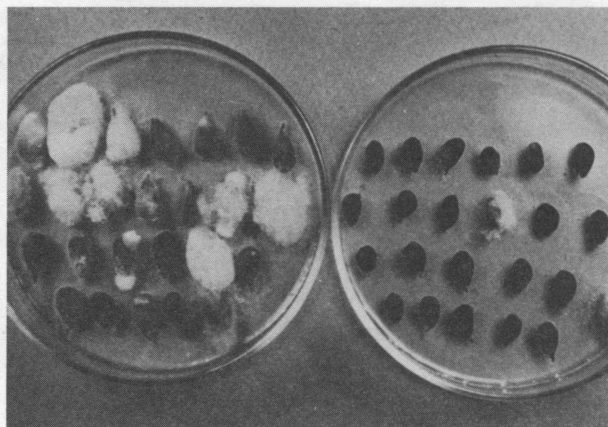


Figure 2. Fungal organisms growing on deteriorated poor quality seed (left) compared to high quality seed (right).

mine more precisely the extent of seed deterioration and the degree of infection by pathogenic organisms.

2. *Select planting date relative to soil temperature.* Effective cotton production occurs when farmers plant on the same relative date each year. The planting date should be early in the season when soil temperatures are marginal (less than 65° F.) for cotton. High-quality seed must be used in the early plantings. These seed will perform at average seed depth temperatures of 60-65° F. Soil temperatures of less than 68° F. are unfavorable for activity of soilborne pathogenic fungi. For this reason, early planting also helps to reduce seedling disease.

When reduced quality seed must be used, planting should be delayed until soil temperatures are at least 68° F., preferably higher. The effects of seed and seedlings predisposed to disease, combined with favorable temperatures for pathogens, can be devastating. Under these conditions, seed treatment and soil fungicides must be relied upon.

3. *Plant treated seed.* All cotton planting seed should be treated with an effective fungicide or combination of fungicides. Combinations of two to three fungicides are superior to one because the likelihood of the treatment being effective against all potential pathogens is increased. Seed treatment is the most important and most economical method for controlling disease. Seed-applied fungicides help to prevent damage caused by organisms carried on the seed surface (seedborne). They also reduce seed rot from seedborne pathogens and from organisms in the soil (soilborne) that are adjacent to the seed. The insurance level in combating seed rots and initial seedling infections has been well established by research and Extension programs, but seed treatment fungicides do not provide significant

extended protection against seedling diseases. Seed treatment is not a substitute for high-quality seed but, rather, is a supplement. Seed treatment cannot make up for adverse environmental conditions. Unless soil temperatures and moisture are appropriate for germination, no amount of seed treatment material will help.

Seed are said to be *infested* when disease organisms are carried on the outside of the seed. Acid delinting of cotton seed removes all organisms from the surface of the seed. If the seed has infections under the seed coat or in seed tissues, it is *infected*. Seed treatment materials serve as *disinfestants* or *disinfectants*, depending upon their ability to destroy organisms on the surface or those harbored under the surface, or to prevent reinfestation of acid-delinted seed. Seed treatment materials used to protect the seed from organisms in the soil are called *protectants*. Practically all effective cotton seed fungicides are disinfectants and many, in addition, have protective qualities. These materials may be used in the form of dusts that can be applied by commercial applicators or in the hopper box, as powders or flowables used for making slurries in commercial applicators or as liquids applied commercially as spray mists. Table 1 lists some seed treatment fungicides or fungicide combinations that are labeled for cottonseed.

4. *Use a soil treatment fungicide for extended protection.* In furrow, soil fungicides are effective for extended protection against seedling pathogens. They are not a substitute for seed treatment fungicides but, rather, enhance and extend the protection of young seedlings. As roots of the young plant grow through the soil, several species of soil fungi can attack the roots or lower stems. If fungicides are not present to kill or slow down their activity, losses from seedling disease can be serious, especially under adverse weather conditions. Use of soil fungicides has produced significant increases in stands, more uniform plant populations, and faster maturity in fields that have a history of seedling diseases.

Two general methods are suggested for incorporating soil fungicides into the furrow and covering soil: (A) In-furrow granules and (B) In-furrow sprays. Table 2 contains suggestions for in-furrow granule and spray applications.

A. In-furrow granules are applied to the soil in a 4-inch band over the open furrow and covering area. Fungicides in granular form can be applied by using any gravity-flow type granular applicator similar to those used for applying granular insecticides. These are commonly available for cotton planters. The granules are metered through a distribution tube, which is placed between the seed drop tube and covering disks. Advantages to using

Table 1: Cotton seed treatment materials.

Suggested material	Rate
TCMIB —Busan 72	3.0-3.5 fl. oz./100 gals. water on acid- or machine-delinted seed
captan —Orthocide 4-Flowable —Captan SP	Acid-delinted— 3 fl. oz./100 gals. water Machine-delinted— 4½ fl. oz./100 gals. water Fuzzy-delinted— 4½ fl. oz./100 gals. water
chloroneb —Demosan 65 W	6 oz./100 gals. water "Overcoat" treatments with other seed protectants such as Arasan 70 S or Arasan 42 S at same rate
captafol —Difolatan 4 F	3 fl. oz./100 gals. water on acid-delinted seed 4½ fl. oz./100 gals. water on machine-delinted seed
fenaminosulf —Lesan (formerly Dexon)	2-3 oz./100 gals. water
PCNB + terrazole —Terra-coat L 21	12 fl. oz./100 gals. water acid-delinted seed 16 fl. oz./100 gals. water machine-delinted seed
PCNB —Terra-coat L 205 —Terra-coat LT 2	12-16 fl. oz./100 gals. water 12 fl. oz./100 gals. water acid-delinted seed 16 fl. oz./100 gals. water machine delinted seed
PCNB + captan —Soil Treater 3 X —Captan-Terraclor 30-30	1 lb./A as hopper box
carboxin —Vitavax 17	16 fl. oz./100 gals. water
carboxin + captan —Vitavax 300	8 fl. oz./100 gals. water
thiram —Arasan 70 S —Arasan 42 S	Acid-delinted only— 3 oz./100 gals. water Fuzzy- and acid-delinted seed— 4½ fl. oz./100 gals. water

Table 2: Cotton soil fungicides.

Chemical	Rate	Application
Chloroneb —Demosan 65W	2-3 #/A	In-Furrow Spray
PCNB —Terraclor 75 WP	1½-2¾ #/A	In-Furrow Spray
PCNB + terrazole —Terraclor Super X EC	2-3 qts./A	In-Furrow Spray
PCNB —Terraclor 24% EC	½-1 gal./A	In-Furrow Spray
PCNB —Terraclor 10% G	10-20 #/A	In-Furrow Granule
PCNB + terrazole —Terraclor Super X	10-15 #/A	In-Furrow Granule

a granular fungicide are: easy handling, the applicator can work off the drives on a planter or can have a simple electric drive, and the equipment is readily available and less expensive than that needed for sprays.

B. In-furrow sprays are usually wetttable powders or emulsifiable concentrates that are sprayed into the furrow and covering soil. In-furrow sprays of fungicides have proven very effective in providing extended protection. The disadvantages of this method are: more complicated equipment is needed, the necessity of refilling tanks of water and mixing the fungicide materials can be time consuming and the competition for use of the power take-off can create problems if a grower wishes to apply a preemergence herbicide at the time of planting.

It is important that granules or sprays be directed in a manner to assure that (1) the seed furrow is coated, and (2) the treatment is mixed with the soil that covers the seed.

5. *Plant multi-adversity resistant (MAR) cotton varieties.* MAR cotton varieties have been improved genetically to have seed which resist deterioration, have seed-seedling cold tolerance and resist soil-borne pathogens. Thus, MAR varieties have several traits not possessed by non-MAR varieties which aid in controlling seedling disease. Seed of MAR varieties greatly increase the probability of success in early plantings when temperatures are lower. The seeding ratings for MAR varieties should be one-fourth less than rates for non-MAR varieties. This is because about 75 percent of seed of MAR varieties produce surviving plants, compared with 50 to 60 percent for non-MAR varieties.

Good seed processing and seed treatment also should be used with MAR cottons. In fields known for having difficulties in establishing stands of healthy plants, soil fungicides will be helpful also. The use of MAR varieties plus the use of treatments will give a high probability of success.

### RECOMMENDATIONS FOR SEEDLING DISEASE CONTROL

1. **Know your problems.** There are several ways in which losses due to cotton seedling diseases can

be reduced or eliminated. Be sure to know the cause of not getting and keeping a stand of healthy cotton plants.

2. **Crop rotation** is necessary to prevent the build-up of certain cotton disease organisms in the soil. Where feasible, allow at least two years or longer between plantings of cotton on the same land. Seedling disease will be more severe in fields where a legume was the previous crop. Thus, try to avoid planting cotton following legumes.

3. **Prepare seedbeds** early so crop residues can decay properly. Deep plowing of cotton land may be desirable to break up hard pans and allow deeper penetration of cotton roots.

4. **Choose quality seed.** Use the highest quality seed available. Know the origin and at least the percentage germination of cotton seed to be used for planting.

5. **Plant only treated seed.** Use only treated seed to help reduce losses from seed and soilborne disease organisms.

6. **Only when soil temperatures** are right relative to the quality of planting seed being used and relative to the desired planting date should cotton seed be planted.

7. **Make sure** that other factors, such as nutritional difficulties, nematodes, insects, and mechanical injuries, are not involved in stand losses.

8. **Use soil fungicides** at the time of planting only if a history of seedling disease due to soilborne pathogens is known. Only certain fields and areas within fields may need to be treated. The use of a soil fungicide is good insurance for getting and holding a stand of cotton from the start.

9. **Use of multi-adversity resistant (MAR) varieties** will help in establishing stands early in the season and in controlling seedling disease.

10. **Early crop residue disposal.** Destroy cotton stalks immediately after harvest in a manner designed to achieve quick decomposition. This practice will reduce the amount of carry-over of certain cotton disease-causing organisms.

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