# MANAGEMENT OF COTTON ROOT ROT

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## Abstract

This article will briefly review aspects of cotton root rot, caused by the soil borne fungus, *Phymatotrichopsis omnivora*, as well as current methods of management.

## Introduction

Phymatotrichopsis root rot (also known as cotton root rot, Phymatotrichum root rot, Texas root rot and Ozonium root rot) is a major fungal disease of cotton occurring within large areas of Texas and Arizona, causing annual losses in Texas alone of up to $29 million. The causal fungus is soil borne and has a host range of more than 1800 dicot plants. This disease only occurs in the southwestern United States and several northern states of Mexico. There has been no expansion of geographic range of the disease within North America.

## Diagnosis and Impact

The disease develops late in the spring or early summer, as soil temperatures approach 82°F. About a day before the onset of visible symptoms, the leaves of infected plants feel noticeably hotter than surrounding, non-infected plants. The first visible symptom is wilting (Figure 1), which becomes permanent by the third day,

Figure 1. Wilting and plant death caused by the cotton root rot fungus.

followed quickly by death of the plant. The leaves remain attached to the plant and have no other distinguishing symptoms, while the roots, including the main root, are rotted (Figure 2), and plants can be pulled easily from soil.

Figure 2. Root rot caused by cotton root rot fungus.

There is white to brown fungal growth on the surface of main roots near the lower stem, consisting of strands and a loose, cottony growth just below the soil surface (Figure 3).


Figure 3 Growth of cotton root rot fungus on root and base of stem.

Wilt is usually seen when plants are flowering, sometimes earlier in the season, but not when plants are seedlings. A large number of plants may wilt simultaneously, but even within an affected area, wilting among plants is not simultaneous, sometimes occurring weeks apart. It is also possible to see non-symptomatic plants surrounded by diseased plants.

As the disease progresses, distinct dead spots can be seen within the field **(**Figure 4**)**.


Figure 4. Appearance of cotton root rot in a field.

The number and size of these spots vary and do not follow a pattern, except that they are somewhat circular, unless different spots coalesce. There may be one spot in the field, or possibly, nearly the whole field is affected. Affected areas of the field increase in size following rain or irrigation. Where this disease occurs, the soils are not uniformly infested. A unique feature of the disease is its consistent recurrence within discrete areas of the field, which changes slightly, from year to year, depending upon crop rotation and weather. In dry years, diseased areas may be smaller, or even absent.

In addition to a direct loss in yield because of premature plant death, the disease reduces lint and seed quality and decreases harvest efficiency. In fields with extensive root rot, harvest may require a picker rather than a stripper, which can clog frequently because rotted plants are easily pulled from the ground.

In the vicinity of diseased plants, the fungus may produce spore mats on the surface of soil, usually following rain or irrigation during the summer. Mats are 2 to 12 inches in diameter and 1/8 to ½ inch thick and are initially white (Figure 5), becoming creamy white to tan, as they dry out. The fungus also produces sclerotia, which are seed-like


Figure 5. Fresh spore mat of cotton root rot fungus.

survival structures, produced in soil, away from the host roots.

## Factors Affecting the Disease and Fungal Survival

This fungus can survive many years in soil as sclerotia, which can occur at depths of 7 feet. Sclerotia germinate and produce strands that grow through soil and eventually contact roots. The strands colonize the root. When there is extensive rot near the base of the stem, wilt can be seen. The fungus uses nutrients from the rotting roots to produce more sclerotia in soil. New strands will grow to infect other plants, usually within a row rather than between rows. The spore mats have no role in disease or fungus survival.

The disease is confined to alkaline soils, particularly calcareous, montmorillonitic clays. Although strands can grow through acidic soils, sclerotia are not formed in them. The disease is prevalent where the annual mean temperature is 60°F or higher and is not found in areas where the air temperature goes below -9°F. Sclerotia are killed by exposure to 9°F for 24 hours. These soil and temperature factors probably limit where the disease can occur.

The growth of the fungus and disease development is favored by moist soil conditions (field capacity or slightly drier) and high temperatures (60 to 95°F).

The fungus is a poor saprophyte and it does not persist in dead plants. In addition to causing disease in an extremely broad host range of dicots, the fungus can also infect roots of monocots and use them as food for sclerotia production. Although monocot infection may result in some root rot, plants survive because of the extensive root system associated with monocots.

## Management

Until recently, there has been no effective control for this disease. There is no known host resistance in any type of cotton. There have been many cultural approaches evaluated for managing the pathogen, but they have been ineffective or marginally effective for providing temporary disease reduction. With the exception of flutriafol, chemical approaches, including soil fumigants, have been ineffective or impractical.

Current control approaches are as follows:

• Flutriafol, a triazole fungicide sold in the United States as Topguard Terra, is applied to the soil at planting, either as a T-band or in-furrow application. The fungicide is most economical if it is applied only to areas of the field where the disease consistently occurs. The fungicide treatment requires water, either through irrigation or rain, within one to three weeks after planting in order to be most effective. On the other hand, heavy rain prior to seedling emergence can result in phytotoxicity, either as delayed or reduced emergence. Ironically, the effectiveness of the fungicide can be demonstrated in fields where clogged nozzles prevent the application of the fungicide to soil (Figure 6).


Figure 6. Clogged nozzles prevented the application of fungicide, resulting in no disease control and illustrating the effectiveness of the fungicide.

There are additional application options that can mitigate phytotoxicity problems. The Texas Department of Agriculture has approved a FIFRA 2ee supplemental label for additional methods of application. The fungicide can be applied up to 30 days before planting 2-4 inches directly below where the seed is to be planted. The use of equipment with GPS guidance systems is recommended to ensure proper placement.

The fungicide can also be applied pre-emergence in a 3-4 inch band behind the planter press wheel, it can be applied over the top to 1-2 leaf cotton, and it can be applied as a directed spray to the base of 2-4 leaf cotton. With these methods, rain or overhead irrigation is needed afterwards to activate the fungicide. Additionally, the Environmental Protection Agency recently approved an amendment of the Section 3 label to allow application through the drip tape. The tape must be directly below the cotton and run in the same direction of the row and should be no deeper than 12 inches below the soil surface.

These alternative methods are intended to minimize the risk of phytotoxicity that sometimes occur when Topguard Terra is applied at planting and are based on field experiments. Growers should consider doing a small trial of their own to compare the new method of application with the method they currently use, and also leave a small, non-treated area in the field to compare performance.

• Crop rotation with resistant crops such as corn or sorghum can help prevent the increase in size of infested areas of the field in subsequent years, but it will not eliminate the infestation. Crop rotation is recommended to prevent mitigate other potential problems from cotton monoculture, such as the buildup of nematodes.

• Deep tillage (6 to 8 inches) during the summer or early fall when soil is dry. This is more likely to have a benefit when most of the sclerotia occur in the upper 12 to 16 inches of soil, rather than deeper. This approach has limited utility and is not useful for dryland farms, reduced tillage operations and in soils with shallow A horizon.

• Organic matter incorporation, either manure (up to 5 tons dry weight per acre) or green manures such as Hubam clover or Papago pea.

• Disease escape by planting early-maturing cotton, or by delaying planting so that cotton flowers and matures with lower soil temperatures.

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