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# Peanut Disease Control Alternatives

## A Guide for Producers

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## CONTENTS




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# PEANUT DISEASE CONTROL ALTERNATIVES — A GUIDE FOR PRODUCERS —

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## INTRODUCTION

Peanut producers face new and different problems each year in addition to those that occur annually. Often a new problem is a variation of an old one that comes back in unpredictable ways. This publication is designed to help producers prevent disease losses and improve production consistency.

Peanut diseases are caused by organisms that act in predictable ways and respond to the same conditions that influence the crop. By understanding conditions that lead to disease development, appropriate control practices can be selected and timed to fit exact needs of a specific production system.

This publication is a reference manual which can help in making the most profitable decisions on matters of disease control. Some of the more profitable practices do not cost much and have the potential for good returns.

| Disease | Type of organism and scientific name | Location of infection source | Usual time of occurrence |
|---|---|---|---|
| Southern blight | Fungus *(Sclerotium rolfsii)* | Soil | Mid to late |
| Early leaf spot | Fungus *(Cercospora arachidicola)* | Soil-airborne spores | Early to late |
| Late leaf spot | Fungus *(Cercosporidium personatum)* | Soil-airborne spores | Mid to late |
| Web blotch | Fungus *(Phoma arahidicola)* | Soil-airborne spores | Late |
| Rust | Fungus *(Puccinia arachidis)* | Airborne spores (Carribean) | Late |
| Seedling disease | Fungi principally *(Rhizoctonia solani, Pythium* spp., *Fusarium* spp., etc.) | Soil | Early |
| Pod and root rots | Fungi *(Pythium myriotylum, Rhizoctonia solani, Sclerotium rolfsii,* etc.) | Soil | Late |
| Root knot and root lesion | Nematodes *(Meloidogyne arenaria, M. hapla* and *Pratylenchus brachyurus)* | Soil | Mid to late |
| Ring and sting | Nematodes *(Criconemoides* spp. and *Belonalimus* spp.) | Soil | Mid to late |
| Aflatoxin | Fungi *(Aspergillus flavus* and *Aspergillus parasiticus)* | Soil-airborne spores | Late |

*Resting bodies (sclerotia) of the southern blight fungus. The bodies are white when first formed and change to a dark brown upon maturity.*

## SOUTHERN BLIGHT

Southern blight is a soilborne disease that occurs throughout peanut-producing regions and is a major factor limiting production. Major yield losses occur where conditions favor southern blight development.

### Disease Characteristics

A white fungal growth first develops on decaying plant material and then spreads to healthy tissue. The fungal strands become denser until a matted growth develops. Small, white tufts of the fungus form into small, tightly wound balls. These increase until they are about the size of mustard seed. These overwintering structures, which become dark brown with age, are called sclerotia. Other fungi with white strands occur in the peanut field, so these sclerotia must be found before the disease can be positively identified as southern blight.

After starting its development on decaying crop residue, the fungus rapidly develops on plant parts in contact with the soil surface. Any plant part in contact with the fungus is susceptible. Pegs, pods and stems are the most commonly damaged parts. Healthy leaves pressed to the soil surface by tractor tires can be affected. Pegs attaching the pods to stems are most often affected, causing significant pod loss in the soil at digging time.

*White strands of southern blight fungus attacking stems of a peanut plant.*

### Characteristics of Southern Blight Fungus

The fungus produces a white, fan-like growth on soil or plant surface when optimum conditions exist.

Seedlike, overwintering structures called sclerotia form in the fungal growth (mycelium). Their color changes from white to light tan to dark brown or black.

The fungus has a high oxygen requirement and develops on or near the soil surface, depending on soil type. Sclerotia are killed when buried more than 5 inches.

The fungus needs organic matter to grow and attack growing plants.

Sclerotial germinations and fungal growth are

stimulated by alternate wet and dry periods. Continuous excesses, either wet or dry, slow development.

Moderate to high soil temperatures encourage fungal activity. The potential for damage decreases in late season when cooler temperatures prevail.

The southern blight fungus is capable of developing on residue from most crops and associated weeds.

The fungus can persist in the soil in the sclerotial form for indefinite periods.

The organism attacks plants by secreting oxalic acids and enzymes that dissolve plant tissue.

The fungal population increases when susceptible crops are grown and decreases when more resistant ones are present.

The disease is most prevalent in the south where there are long, warm growing seasons.

**Factors Influencing the Occurrence and Control of Southern Blight**

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Rotating with unrelated crops such as corn or sorghum reduces disease incidence if crop residue is removed from the soil surface. | Moderate | Low—depending on profitability of crop grown in rotation. |
| Residue management | Any crop residue on or near the soil surface supports the organism and increases damage. Deep burial is advocated. | High | Moderate—cost of deep plowing. |
| Variety selection | Florunner is slightly more susceptible than most Spanish varieties but its higher yield potential may compensate. | Low | Low |
| Chemical use | Effective in loss reduction when southern blight is the limiting production factor and suggested chemicals are used as recommended. | High | High—but cost reduced by using only when and where need exists. |
| Raised bed planting | Four- to 6-inch raised beds on irrigated peanuts and slightly raised beds on dryland help, particularly in avoiding fallen leaves around the crown. | Moderate to high | Low |
| Planting dates | Southern blight damage usually peaks in mid to late August. Damage can occur before and after this period, but subsides in cooler weather. Peanuts maturing during the peak disease period may be more vulnerable. | Low to moderate | Low |
| Cultivation | Most aspects of cultivation increase the potential for southern blight development. These include pushing soil around stems (dirting), mechanical injury and soil aeration, which may increase the depth of fungal development. Weeds and grasses controlled by cultivation add to the surface organic matter load. (See chemical weed control.) | Moderate | Low |
| Foliar disease control | Leaf infection usually causes early leaf drop. Accumulation of fallen leaves that serve as a food source for the southern blight fungus is almost always associated with severe damage. Keep all leaves | High | High—but return on investment is usually better than two to one. |

| | | | |
|---|---|---|---|
| | healthy and on the plant during the entire growing season. | | |
| Weed control | Effective preemergence herbicides prevent development of grasses and weeds that serve as a food source for the southern blight fungus. | Moderate | Moderate to high with most value accruing from reduced weed competition. |

**Environmental factors influencing disease development**

| | |
|---|---|
| Plant canopy cover | Foliar development reduces soil temperature by shading and prevents the rapid wetting and drying cycle that stimulates sclerotial germination. |
| Soil moisture | Consistent soil moisture levels decrease losses. Dry periods condition sclerotia for more rapid germination when the next moisture is received. |
| Soil type | Southern blight develops in any soil type but may penetrate more deeply in coarse, sandy soil. |
| Field differences | Some fields have southern blight more consistently than others. Targeting such fields for special treatment, such as use of suggested fungicides, may be profitable. |
| Previous crop | High residue crops grown before peanuts can cause problems if residue remains on the soil surface. Handle crop residue properly. |
| Disease potential | If southern blight develops each growing season, the fungus population in the soil will increase. Losses generally become more severe each year unless positive control measures are taken. |
| Atmospheric temperature | Southern blight development is much more rapid when the temperature is high. Development slows with cool temperatures. Soil temperatures below 70° F. are less favorable for fungal development. |
| Plant injury | Any form of plant injury increases the possibility of southern blight development. Avoid physical or biological injury. |
| Surface crop residue | Surface crop residue is essential for initial development of the disease. After the fungus becomes established, it can affect healthy plant tissue. |

**Factors Influencing the Occurrence and Control of Southern Blight**

| **Most important** | **Individual grower ranking** |
|---|---|
| Residue management | _____ |
| Foliar disease control | _____ |
| Raised bed planting | _____ |
| Fungicide use | _____ |
| Rotation | _____ |
| Cultivation | _____ |
| Soil cover | _____ |
| Weed control | _____ |
| Disease potential (disease history) | _____ |
| Soil moisture | _____ |
| Field differences | _____ |
| Planting dates | _____ |
| Atmospheric temperature | _____ |
| Atmospheric moisture | _____ |
| Plant injury | _____ |
| Previous crop | _____ |
| Variety selection | _____ |
| Soil type | _____ |
| _____ | |
| Least important | |

## EARLY LEAF SPOT

Early leaf spot is one of the most common and destructive peanut diseases. While it usually occurs early in the growing season, it can cause defoliation at the end of the growing season. Either leaf surface can be infected, with visible spots forming 10 to 12 days after infection.

The amount of infection and subsequent damage is dependent on favorable conditions and the date of infection. The infection process is a function of the fungal organism, high relative humidity and warm temperatures.

### Disease Characteristics

Any above-ground portion of the plant can become infected. In addition to causing leaf drop, the disease can infect and weaken pegs so that pods are left in the soil at digging. Large, dark brown spots that develop on stems restrict the

flow of water and nutrients. Heavily infected plants become determinant with new fruit production ceasing. This is why many years ago producers thought that leaf spotting was a sign of maturity. It is true that defoliated plants will never mature more than they are at that time.

Spots caused by the early leaf spot fungus usually are surrounded by a yellow halo. This characteristic is not always reliable, however, in accurately distinguishing early leaf spot from late leaf spot damage. A more reliable characteristic is the light brown color of spots on the lower leaf surface. Spots caused by late leaf spot are dark brown to black.

The early leaf spot fungus probably produces a toxin similar to the late leaf spot fungus. This, in conjunction with naturally occurring plant hormones, causes defoliation after infection. Such toxins also reduce the level of plant activity and result in a less productive crop.

## Characteristics of Early Leaf Spot Fungus

Early infection occurs from spores produced on peanut crop residue carried over in the soil.

Secondary infection occurs throughout the growing season from spores produced in infected growing plants.

Germ tubes produced by spores penetrate the stomata, or breathing spores of the leaf and can also directly penetrate the surface cells.

The fungus has its fastest growth rate at 86° F. in laboratory cultures.

Spore concentrations are greatest in the air downwind from a heavily infected peanut field.

The fungus is host specific to peanuts and does not increase on other crop or weed plants.

The infection process occurs in 4 to 12 hours when the relative humidity is 95 percent or more at the leaf surface.

Infection is most rapid when humidity and temperatures are high (around 80° F.)

Infection takes place more readily when there is high relative humidity at the leaf surface as opposed to free moisture.

Leaf spot occurs earlier and usually develops faster on peanuts grown in a field following peanuts.

Leaf spots resulting from soilborne spores may be smaller and more irregularly shaped than those caused by leaf-produced spores.

The leaf spot fungus requires high oxygen levels and survives poorly when crop residue is buried 6 inches or deeper.

Leaf spots become visible to the unaided eye approximately 10 to 12 days after the infection occurs.

The fungus produces or causes the leaf to produce compounds that initiate the leaf-drop process. The amount of time required for leaf drop to occur depends on several conditions.

Inoculum potential or spore population increases with time and the amount of infection present. When spore populations become extremely high, control is difficult if not almost impossible.

**Factors Influencing the Occurrence and Control of Early Leaf Spot**

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Rotation with other crops reduces early infection. | High | Low—depending on profitability of other crops. |
| Residue management | Deep burial of peanut crop residue effectively reduces fungal population where peanuts follow peanuts. | High | Moderate—depending on cost of deep plowing. |
| Variety selection | Runner types are more tolerant than Spanish types; however, they remain in the field 2 to 3 weeks longer. | Moderate | Low |
| Fungicide use | Fungicides are necessary for preventing damage in most areas. Schedule applications based on weather factors. | High | High |
| Planting date | Earlier planted peanuts are more likely to escape damage than those planted late. | Moderate | Low |

| | | | |
|---|---|---|---|
| | Moisture availability influences disease occurrence as it does yield. | | |
| Planting rate | High plant populations and an increase in plant canopy cover may increase disease incidence. | Low | Low |
| Weed control | Weed growth may increase disease incidence by retaining high humidity in vines. | Moderate | No extra cost |
| Nematode control | Tests show that peanuts infected with root nematodes have leaf spot more severely, probably because of reduced plant vigor. | Low | Cost charged to nematode control. |

## Environmental factors influencing disease occurrence

| | |
|---|---|
| Area differences | Production areas with higher rainfall and relative humidity have an increased potential for damage from early leaf spot. |
| Previous crop | This is not a factor unless the previous crop was peanuts. |
| Disease potential | When spore numbers are high from overwintering crop residue or leaf spot occurrence in the field, there is a rapid increase in disease if environmental conditions are favorable. |
| Relative humidity | Prolonged high relative humidity is more conducive to infection than free moisture on the leaf surface. See figure 1 for relationship of relative humidity and temperature on disease development. |
| Atmospheric temperature | Increases in atmospheric temperature cause increased fungus activity. The higher the temperature, the less time is required for infection to occur. See figure 1. |
| Atmospheric moisture | Falling moisture from irrigation or rain may increase disease incidence if it has a prolonged effect on relative humidity. Irrigation in arid production areas may have little or no effect on disease development. |

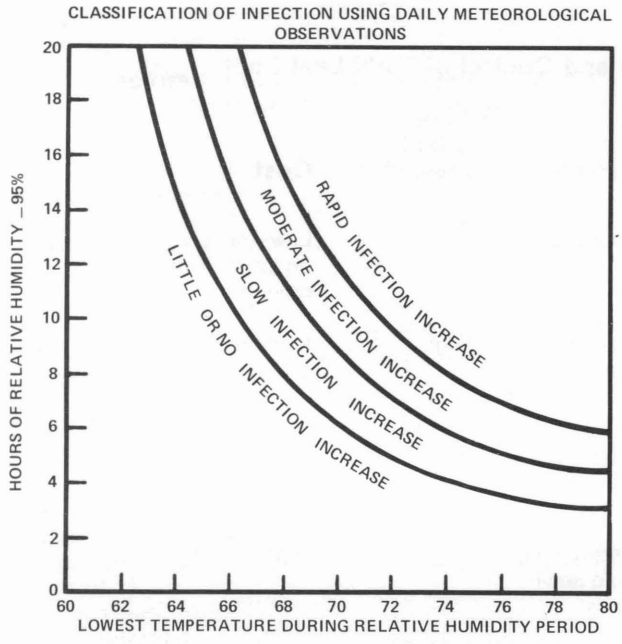


*Figure 1. Use this chart to plot information obtained and determine potential for leaf spot development.*

## Factors Influencing the Occurrence and Control of Early Leaf Spot

| **Most important** | **Individual grower ranking** |
|---|---|
| Chemical use | |
| Relative humidity | |
| Residue management | |
| Disease potential | |
| Rotation | |
| Previous crop | |
| Area difference | |
| Variety selection | |
| Atmospheric temperature | |
| Irrigation | |
| Atmospheric moisture | |
| Weed control | |
| Planting date | |
| Planting rate | |
| Nematode control | |

Least important

## LATE LEAF SPOT

Late leaf spot is considered more destructive than early leaf spot. It usually occurs later in the growing season but can occur at any time from the seedling stage to maturity. Late leaf spot usually occurs along with early leaf spot. Conditions favorable for the development of one seem to be similar, if not identical, for the other.

### Disease Characteristics

Late leaf spot is distinguishable from early leaf spot by observing the undersides of infected leaves. Spots produced by the late leaf spot fungus are dark brown to black, while those of early leaf spot are light brown. This determination is more easily made when a single leaflet is infected by both organisms.

The late leaf spot fungus produces a toxin called cercosporin. This compound reduces leaf efficiency and is partially involved in the process called abscission, which causes the leaf to fall from the plant.

The yellow halo that surrounds spots caused by the early leaf spot fungus is usually not associated with late leaf spot. However, the halo characteristic is not always reliable and should not be used for making critical determinations. In most cases, producers are not especially interested in making the determination since damage from the two fungi occurs in essentially the same way. Control measures are also the same.

### Characteristics of the Late Leaf Spot Fungus

Late leaf spot is more irregular in occurrence than early leaf spot. It may be severe during some growing seasons and hardly occur at all in others.

The late leaf spot fungus produces haustoria (sucker-type structures) that penetrate individual plant cells, whereas the early leaf spot fungus does not.

Leaves infected with the late leaf spot fungus show a marked increase in respiration.

Spores of the late leaf spot fungus germinate best when temperatures are slightly lower than those favorable for the early leaf spot fungus.

When late leaf spot occurs with early leaf spot, there is a cumulative effect.

See the section entitled "Characteristics of the Early Leaf Spot Fungus" for additional information on the late leaf spot organism. Characteristics are similar except for optimum temperatures.

#### Factors Influencing the Occurrence and Control of Early Leaf Spot

See the section on early leaf spot.

#### Factors Influencing the Occurrence and Control of Late Leaf Spot

See the section on early leaf spot.

## MINOR LEAF DISEASES

No disease is minor if it is causing a problem, but the term used here refers to the fact that these diseases do not occur consistently over a major portion of the peanut-growing area. The following diseases are included:

- Web blotch
- Pepper spot
- Phyllosticta leaf spot
- Atmospheric scorch

Any disease that damages leaf tissue may reduce leaf function and, finally, peanut yield to differing degrees. This is especially true if several of these factors occur together. Some of the spots found on peanuts result from parasitic organisms that affect leaves in a weak condition. Seek proper identification for any leaf condition that occurs consistently throughout the field.

### Characteristics of the Organisms or Conditions Causing Minor Leaf Spots

Most minor leaf spots are caused by fungi that must increase in population before significant effects are visible. Fungi that cause minor leaf spots respond to the stimuli of atmospheric moisture and optimum temperature conditions just as other fungi. These organisms are minor because they are not adapted for existing conditions as well as some of the more important disease organisms. In some cases, very specific conditions must exist before they can develop.

Atmospheric scorch is caused by ozone in the atmosphere generated by lightning during thunderstorms or by sunshine penetrating smog associated with large cities. Ozone levels increase markedly in Houston during the summer months.

Minor leaf spots have become less destructive with increased planting of the Florunner variety. This variety is more resistant to leaf disease than Spanish varieties. Minor leaf spots change and are variable in their occurrence. Pepper spot was common several years ago and can hardly be found now. Web blotch was once highly destructive over a large portion of the peanut-producing area and occurs now only in certain

locations. New and uncommon leaf spots occur periodically and sometimes cause damage.

Leaf diseases require a susceptible host, a favorable environment and presence of the pathogen. All three factors must be present at the same time, or the disease will not occur. Minor leaf spots are more severe when peanuts follow peanuts each year. The exception is with conditions such as atmospheric scorch where the cropping sequence has no bearing.

The opportunity for minor leaf spots to become major is greater when one peanut variety is grown exclusively and consistently in an area. For example, if only Spanish peanuts are grown over a large area on a continuous basis, chances of a single pathogen becoming severe is theoretically greater than if Spanish, Florunner and other types are grown in alternate fields. Unusual leaf spots may be more common when plants are weakened by any stress-producing conditions. Weak tissue is more susceptible to diseases than healthy tissue.

See section on early leaf spot for control practices.

## PEANUT RUST

Peanut rust is a devastating disease where it occurs. Fortunately, it is not as widely distributed as most of the other serious peanut diseases. In Texas, its effect usually is limited to peanuts grown in Frio, Atascosa, LaSalle and Wilson counties. Some rust can be found during some years in areas north of that location, but it usually is limited.

If rust comes in early and is not controlled with protectant fungicides, serious damage can result. Growers in the counties most often affected should constantly observe fields for the first evidence of disease occurrence. Once it is found, use fungicides regularly to avoid serious losses.

### Disease Characteristics

Peanut rust is characterized by rust colored, raised spots on leaves (usually on the lower leaf surface). Infected leaves usually are lighter in color, and a small, yellow area on the top of the leaf may correspond with the bump or pustule on the under surface. To confirm the identity of this disease, take a white handkerchief and rub the red spores from the leaf. Spots may be so numerous that the entire leaflet turns brown and dies in a short time.

Do not confuse true peanut rust with other leaf abnormalities that sometimes occur. A browning of the leaf surface by ozone, called atmospheric scorch, is sometimes referred to as rust. This designation is incorrect, however, and should not be confused with true rust caused by a specific fungus.

Rust usually first appears in defined spots within fields. These spots may be 3 to 4 feet in diameter initially and grow rapidly as new infection occurs. Producers often call these "hot spots."

### Characteristics of the Peanut Rust Fungus

The fungus causing peanut rust does not overwinter in the continental United States.

Spores of the rust fungus are thought to be airborne from islands in the Carribean.

Infection by the fungus is often more widespread and severe after episodes of tropical disturbance resulting in hurricanes.

Spores produced on peanut leaves can reinfect other peanut leaves without infecting an alternate host. No alternate hosts of the peanut rust fungus are known.

Periods of high humidity and warm temperatures are required for spore germination and leaf infection to occur.

Spores are readily windborne to other fields and other plants in the field. Distribution is dependent on direction of wind current.

The fungus does not overwinter in peanut crop residue.

The disease also occurs in Florida and the Southeastern peanut-growing states.

Spores usually arrive in the latter part of June in South Texas. Earliest observation of disease was July 3.

Rust-infected leaves die, cling to the plant and may appear as though they were exposed to a blowtorch.

**Factors Influencing the Occurrence and Control of Rust**

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Chemical use | In vulnerable areas apply suggested foliar fungicides as soon as first rust is noticed. | High | Moderate—due to usual late season occurrence. |

| | | | |
|---|---|---|---|
| Planting date | Earlier planted peanuts are more likely to escape damage. | Moderate | Low |
| Variety selection | Florunner is less susceptible than Spanish. Serious damage can occur, however, when the disease is severe. | | |

**Environmental factors influencing disease development**

| | |
|---|---|
| Area differences | Growers in Frio, Atascosa, LaSalle, Wilson and Bexar counties are alerted to the potential need for preventing damage from rust on an annual basis. The rust fungus does not overwinter in this country so the first spores of the season must be blown in from the Carribean area. |
| Disease potential | Spores produced on peanuts are capable of reinfecting peanuts. When high spore numbers develop in a field or area, chances for severe damage increase. |
| Relative humidity | High relative humidity in the vine area is necessary for spore germination and infection. This condition must persist for a few hours for infection to develop. |
| Atmospheric temperature | The infection process is faster at higher temperatures and slower with cooler conditions. |
| Atmospheric moisture | Rainfall or irrigation increases the relative humidity in the vine canopy, which may in turn increase rust development if spores are present. |

**Factors Influencing the Occurrence and Control of Peanut Rust**

| **Most important** | **Individual grower ranking** |
|---|---|
| Disease potential | _____ |
| Chemical use | _____ |
| Area differences | _____ |
| Planting date | _____ |
| Relative humidity | _____ |
| Atmospheric temperature | _____ |
| Atmospheric moisture | _____ |
| Variety selection | _____ |

Least important

## SEEDLING DISEASE

Seedling disease can have a devastating effect on the prospects for a successful crop. First, there is the loss of expensive seeds that decay before producing plants; and secondly, there is the loss of young seedlings that have emerged. Yield potential is tied directly to uniform stands. Peanuts do not compensate for skippy stands as well as some other crops.

There are several stages of seedling disease, including seed rot, preemergence damping-off of seedlings and post-emergence damping-off of seedlings. Seedling disease can occur up to the time that stem tissue hardens.

### Disease Characteristics

Infected seeds become water-soaked, and the germination process stops. The organisms involved utilize the seed tissue as food material at a rapid rate. Seed may be completely decomposed in 5 to 10 days.

Infected seedlings may be partially damaged or completely killed by invading organisms. If the hypocotyl area is girdled, the conductive tissue between the root system and above-ground portion becomes inoperative.

The organism travels from one seedling to another, so several seedlings may die in sequence in a row.

An episode of seedling disease may occur when the air and soil are cold or overly wet. After these conditions pass, seedling death may decline as rapidly as it started.

Seedling disease may be more severe if undecomposed crop residue is present in the soil surrounding the seedlings.

Seed quality can play a role in the occurrence of seedling disease. Seeds weakened by any factor before, during or after planting are more susceptible to attack by soilborne organisms.

Finally, remember that soilborne pathogenic organisms cause seedling disease. Cold, wet soils and weak seed may be contributing factors, but they do not cause the problem.

## Characteristics of Seedling Disease Organisms

Seedling disease is caused by one or more of several pathogenic soilborne fungi. Fungus activity is increased by conditions that are not favorable for rapid seed germination and seedling development.

Organisms that cause seedling disease are increased by undecomposed crop residue near the soil surface.

Most seedling disease organisms are favored by cool soil conditions.

Some organisms that cause seedling disease are water molds and thrive under very wet conditions.

Seedling disease organisms cause the least amount of damage when high-quality seed are planted and conditions are favorable for rapid germination and seedling growth.

### Factors Influencing the Occurrence and Control of Seedling Disease

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Planting peanuts after low residue crops should result in less seedling disease. | Moderate to low | Low |
| Residue management | Keep crop residue away from areas where seed germinate and seedlings develop. | Moderate | Low |
| Raised beds | Raised beds usually are warmer and better drained. Oxygen is more available. | Moderate to low | Low |
| Planting dates | Seedling disease is greatly reduced if planting is withheld until the soil temperature at 6 inches reaches 70° F. at 7 a.m. for 3 consecutive days. | Moderate to high | Low |
| Planting rates | Seedling disease may be more severe where high planting rates are used. | Moderate to low | Low |
| Seed quality | Seedling disease will be greatly reduced by using high-quality seed. | Moderate to high | Low |
| Seed treatment | Treat seed with a suggested fungicide. In-furrow fungicides may be needed in specialized situations. | Moderate to high | Low |
| Seeding depth | Plant seeds at the proper depth to permit quick emergence. | Moderate | Low |
| Seed handling | Treat seed carefully. Avoid exposure to direct sun. | Moderate | Low |
| Weed control | Use caution in chemical application. Achieve proper rates and good mixing with soil. | | |

| Environmental factors influencing disease occurrence | |
|---|---|
| Soil moisture | Excessive soil moisture reduces oxygen to the seed and seedling and increases the activity of certain seedling disease organisms. |
| Soil type | Lighter, sandy soils often permit better oxygen movement. See soil moisture section. |
| Soil temperature | Avoid cold or very hot soils. Plants become weakened and more susceptible. |

| | |
|---|---|
| Field differences | Some fields and some soils harbor higher populations of soilborne organisms than others. |
| Previous crop | More seedling disease problems are likely to occur following high residue crops. |
| Disease potential | High populations of soilborne disease organisms that affect seedlings can cause losses even under good growing conditions. |

### Factors Influencing the Occurrence and Control of Seedling Disease

| Most important | Individual grower ranking |
|---|---|
| Soil temperature | |
| Planting date | |
| Seed quality | |
| Fungicide seed treatment | |
| Seed handling | |
| Seeding depth | |
| Residue management | |
| Weed control | |
| Rotation | |
| Previous crop | |
| Disease potential | |
| Field differences | |
| Soil type | |
| Soil moisture | |
| Raised beds | |
| Planting rates | |

Least important

## POD AND ROOT ROTS

Pod and root rots often cause loss of the crop or portions of the crop after pods are produced. Since pods and roots are in direct contact with the soil, they are vulnerable to attack by a wide range of organisms.

One or more of the pod-rotting organisms may occur at any time, depending on the circumstances. Overly wet soils may damage root and pod tissue and encourage development of Pythium pod rot, which is caused by a water mold-type fungus. Poorly drained areas in the field are more affected by this organism. Such damage is enhanced if the salt content of irrigation water is high or if the soil has a high salt content.

The Rhizoctonia fungus also causes pod rot. It generally thrives in cool, wet soils and is one of the early season damping-off organisms. It attacks the root system, as well as the pods, at any time during the growing season. Its presence usually is noted very early or very late in the season.

The southern blight fungus can also cause root and pod rots at any time during the growing season. Since it is a hot weather organism, its damage usually is noted in the latter part of the growing season. Its occurrence slows with cooler autumn weather.

### Characteristics of the Organisms Causing Pod and Root Rots

All pod and root rot organisms are soilborne. They build up in numbers when a satisfactory food source is available. Usually this is living host tissue.

Soil conditions hostile to developing plant tissue may enhance infection and disease development. Extreme soil temperatures or excess moisture are the most common forms of stress.

High salt content in the soil or irrigation water increases the incidence of Pythium pod rot. Commercial fertilizer may also increase the salt content of the soil. Problems with commercial fertilizers are more likely to occur when higher potassium levels are applied near the pod-developing zone.

Pod rot organisms increase more in some fields than others. Such fields may require a longer rotation.

### Factors Influencing the Occurrence and Control of Pod and Root Rot

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Longer rotation is required in fields where pod rots are severe. | Moderate to high | Low—depending on profitability of crops in rotation. |

| | | | |
|---|---|---|---|
| Residue management | Undecomposed crop residue in the pod-forming area may increase pod rot. | Moderate | Low |
| Variety selection | Toalson is a Spanish variety with resistance to pod rot fungi. | Moderate to high | Low |
| Chemical use | Soil fungicides are cleared for southern blight but not other forms of root rot. | Moderate to high | High—but there may be a high economic return. |
| Raised beds | Aeration and water drainage are improved on raised beds. | Moderate | Low |
| Fertilization | Avoid concentrating commercial fertilizer in root and pod area. Apply to previous crop broadcast. | Moderate | Low |

**Environmental factors influencing disease occurrence**

| | |
|---|---|
| Soil moisture | Excessive soil moisture stimulates development of the water mold fungi and increases Pythium pod rot. |
| Soil type | Heavy, poorly drained soils are more likely to contribute to pod rot problems. |
| Field differences | Fields that are uneven and have areas that hold excess moisture are more likely to develop problems. |
| Area differences | In areas where rotation is not practiced, pod rot problems are more likely to develop. |
| Previous crop | Unrelated previous crops may reduce the population of pod-rotting organisms. Excessive crop residues near the surface may cause problems. |
| Disease potential | If pod rot is severe during a given year, it is more likely to be serious the following year. |

**Factors Influencing the Occurrence and Control of Pod and Root Rots**

| **Most important** | **Individual grower ranking** |
|---|---|
| Rotation and previous crop | _____ |
| Soil moisture | _____ |
| Field differences | _____ |
| Residue management | _____ |
| Disease potential (disease history) | _____ |
| Variety selection | _____ |
| Chemical use | _____ |
| Fertilization | _____ |
| Raised beds | _____ |
| Soil type | _____ |
| Area differences | _____ |

Least important

## NEMATODES

Plant parasitic nematodes can severely limit peanut production when the most damaging species occur in large numbers. After their introduction, nematodes increase in numbers as long as a susceptible host crop is grown.

Damage is caused by nematodes feeding on roots and pods of the peanut plant. Some burrow in the root and pod tissue while others feed on surface cells. Those that penetrate and enter the root tissue usually are more destructive because they physically damage tissue and leave it vulnerable to infection by common soil organisms.

Nematodes feed on plants by inserting their stylet-like feeding devices into individual cells. They first inject digestive enzymes and then withdraw the digested food material. Some also secrete substances that contain or promote the formation of growth-regulating compounds. The root knot nematode, for example, causes distorted roots reduced in mass.

### Disease Characteristics

Nematode damage often is overlooked or attributed to other causes. Plants affected by nematodes are often stunted and chlorotic, symptoms which may be confused with nutrient deficiency or adverse soil conditions.

Root knot nematodes cause distorted and galled roots. Knots or galls may appear on any underground part of the peanut plant, including pegs, pods and nitrogen nodules. The nematodes inside a galled tissue cause cells to divide more rapidly and become larger than usual in size. Infected plants are smaller and weaker and produce fewer pods than healthy plants.

Root lesion nematodes penetrate underground tissue and cause darkened areas to form on roots, pegs and pods. These tissues are weakened and may become infected with damaging fungal organisms. Pod spots caused by the root lesion nematode have a small dark center bordered by a tan outer portion. In addition to pod damage, affected pegs become weak and cause pods to slough from the plant before and during harvest.

Sting nematodes feed on the root system as do root knot and root lesion nematodes. However, sting nematodes are more effective in limiting root growth and secondary root formation. Badly infected plants are severely stunted and produce few pods.

Ring nematodes feed on roots and pods but seem to do little damage. When large numbers occur, it is thought that they slow plant growth slightly and possibly reduce yield. No plant symptoms are known to be caused exclusively by the ring nematode.

## Characteristics of Plant Parasitic Nematodes

### *Root Knot Nematodes*

Only two species of root knot nematodes affect peanuts. These are the northern root knot nematode and the peanut root knot nematode. The root knot species that generally occurs in home gardens and on cotton does not affect peanuts.

Root knot nematodes affecting peanuts do not occur in all of Texas. Producers should be extremely careful not to introduce them into areas where they have not been a problem.

Root knot nematodes are most often transported to new fields on farm equipment.

Root knot nematodes hatch from eggs into a larval or worm-like form that penetrates underground plant tissue. They find a feeding site, where they grow and remain through the egg-laying stage.

Nematodes are aquatic animals that require a water film for their active life processes. They are killed by rapid drying or high soil temperatures.

Plant parasitic nematodes are "obligate parasites," requiring a host plant to live. They can live and reproduce on certain types of weeds.

Plant parasitic nematodes are too small to see without magnification. In general, they are about one-fiftieth of an inch long.

Root knot nematodes can be transported in infected plant hulls or roots, but not on shelled seed.

### *Root Lesion Nematodes*

Root lesion nematodes are more widely distributed in Texas than root knot nematodes.

**Pods, pegs and root systems are damaged by this nematode, and they often become more susceptible to root and pod-rotting organisms.**

Some fields are more prone to have root lesion nematode damage than others.

Annual damage appears linked to factors not well understood at this time. Heavy damage may not occur every year in a continuous cropping system.

### *Sting Nematodes*

Sting nematodes are important in the Southeastern United States, but seldom occur in Texas. When they do, it is in isolated fields usually having coarse, sandy soils.

High populations of sting nematodes can have a devastating effect on peanuts.

### *Ring Nematodes*

Ring nematodes are widely distributed in Texas and occur in all production regions.

Ring nematodes get their name from ring-like indentions in the body cuticle.

Little apparent damage is caused by this species, except when occurring in extremely high numbers.

**Factors Influencing the Occurrence and Control of Plant Parasitic Nematodes**

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Results depend on the type of nematode. Rotation with unrelated crops is helpful. | Moderate to high | Low—depending on value of crop in |

| | | | |
|---|---|---|---|
| | Some crops may maintain root lesion nematodes. | | rotation. |
| Residue management | Deep burial of crop residue may dilute the nematode population with more soil and place them in a less favorable environment. It may also spread the nematode to other parts of the field. | Low | Moderate—depending on cost of deep plowing. |
| Chemical use | Nematicides are highly effective when properly applied. Good profit return where plant parasitic nematodes represent the limiting production factor. | High | High—but good economic returns result when nematodes represent the limiting production factor. |
| Summer tillage | Very effective if soil is left idle during summer and tilled occasionally to increase exposure to hot temperatures and control weeds. | Moderate | High—because of field passes required and loss of production during the year. |
| Summer fallow | Nematode populations are generally reduced substantially. Amount of reduction is dependent on the degree of susceptibility of weeds and grasses present. | Moderate | High—due to loss of of crop during growing season. |
| Cleaning of equipment | Root knot nematodes especially are moved from area to area or field to field on farm equipment. Clean all equipment moving from known infested fields. | High if root knot occurs. | Low |

**Environmental factors influencing disease occurrence**

| | |
|---|---|
| Soil moisture | Nematodes are aquatic animals and must have soil moisture. The amount required for plant growth is adequate. |
| Soil type | Nematodes do best in coarse, sandy soil but may occur in clay soil. |
| Field differences | Nematode populations vary within a field. Some spots are more heavily infested. |
| Area differences | Some production areas do not have the species of root knot nematodes that affect peanuts. It is simply a matter of their not having been introduced. |
| Previous crop | If plant parasitic nematodes are present, they can be expected to be worse on peanuts following peanuts. |

**Factors Influencing the Occurrence and Control of Nematodes**

| **Most important** | **Individual grower ranking** |
|---|---|
| Nematicide use | _____ |
| Summer fallow | _____ |
| Summer tillage | _____ |
| Cleaning of equipment | _____ |
| Rotation | _____ |
| Residue management | _____ |
| Previous crop | _____ |
| Area differences | _____ |
| Field differences | _____ |
| Soil type | _____ |
| Soil moisture | _____ |

Least important

## AFLATOXIN — SEGREGATION III — MYCOTOXINS

The world became aware of aflatoxin in 1960 after 100,000 turkey poults died in England from eating contaminated peanut meal. Since that time, measuring procedures have become more refined, and programs have been developed to prevent the toxin from entering the human food supply. While protecting the food supply, farmers have been called upon to deal with yet another problem among the many they already have.

The amount of producer losses depends upon the marketing program being used at the time. In

recent years, however, growers have experienced economic loss from the problem.

It is essential that growers do everything possible to prevent the Segregation III problem. First, there is the threat of economic loss to the producer; and secondly, there is the stigma of peanuts on hand that are unfit for feed or food uses. The latter has the potential for influencing the image of the peanut industry and creating adverse publicity about industry support.

## Disease Characteristics

Increased activity occurs when peanuts are under drought stress and pods are maturing.

Infection can occur on kernels when they are in the soil or during harvest, transporting or storage.

Kernels in sound pods showing no visible signs of injury can become infected while in the soil, in the windrow, in transit or in storage.

Pods damaged mechanically or biologically are more likely to become infected than healthy pods.

Fungal infection of pods and kernels in the soil is more likely to occur when plants are suffering severe drought stress.

Fungal infection is most likely to occur in the windrow when weather conditions do not favor rapid drying.

Fungal infection is most likely to occur during harvest, transporting or storage when kernel moisture is higher than recommended for storage. This is especially true if air movement is not aided or enhanced by properly ventilated trailers or forced air systems.

Cooler temperatures near the end of the growing season lessen the degree of Segregation III occurrence.

## Characteristics of the Disease-Causing Fungus

The toxin is produced by a common fungus known as *Aspergillus flavus*.

The fungus is a common soil inhabitant and may increase in population on certain crop residues, including peanuts. Research documentation shows that fungal population increases in certain soils where peanuts followed peanuts.

The fungus is a prolific producer of airborne spores. They are borne in a clustered head-type structure that looks like a ping pong ball suspended by a stem or stalk when observed under magnification. In mass, the fungus has a yellowish-green color. High temperatures increase fungus activity.

**Factors Influencing the Occurrence and Control of the Disease**

| Cultural practices influencing disease development | Descriptive comments | Expected effect level | Cost |
|---|---|---|---|
| Rotation | Using crops other than peanuts or corn helps reduce the population of the fungus in the soil. | Moderate to high | Low—depending on profitability of crop in rotation. |
| Crop residue management | Peanut or corn residue on the surface favors increase of the organism. Deep burial is advocated. | High | Moderate—depending on cost of deep plowing. |
| Variety selection | All presently grown varieties are susceptible. | None | None |
| Raised beds | Use raised beds but avoid excessive heights that may increase drought susceptibility. | Moderate | Low |
| Weed control | Weeds and grasses compete and increase drought stress. They also complicate digging and prevent rapid drying. | Moderate | Cost charged to weed control. |
| Insect control | Lesser cornstalk borers may cause kernel damage and increase detection. | Low | Cost charged to insect control. |

| | | | |
|---|---|---|---|
| Digging procedures | Do not place more than two rows together in a windrow unless vines are very small. | Moderate to high | Low |
| Duration in windrow | Leave peanuts in the windrow only long enough to achieve the desired combining moisture of 18 to 25 percent. | Moderate to high | Low |
| Drying | Proper drying procedures should immediately follow harvesting without undue delays in transportation equipment. | Moderate to high | Low |
| Handling | Rough handling may injure pods and kernels and increase the potential for aflatoxin development. | Moderate to high | Low |
| Loading trailers or trucks | Do not blend or mix damaged or lower-quality peanuts with high-quality ones in the same truck or trailer. Remember that it only takes one kernel to condemn an entire load. | Moderate to high | Low |

### Environmental Factors Influencing Disease Occurrence

| | |
|---|---|
| Soil moisture | Adequate supplies of soil moisture during the pod maturity season reduce aflatoxin potential. |
| Soil type | Shallow, drought-susceptible soils may be more likely to have the problem. |
| Field differences | Some fields carry higher populations of the organism than others. |
| Previous crop | The likelihood of aflatoxin occurrence is greater when peanuts follow corn or peanuts. |
| Relative humidity and/or atmospheric moisture | Moisture occurrence when peanuts are in the windrow enhances fungal development. Fungicide sprays directed to the windrow have not been effective. |

### Factors Influencing Disease Occurrence and Control

| Most important | Individual grower ranking |
|---|---|
| Soil moisture | _____ |
| Crop residue management | _____ |
| Rotation | _____ |
| Field differences | _____ |
| Previous crop | _____ |
| Digging procedures | _____ |
| Duration in windrow | _____ |
| Relative humidity and/or atmospheric moisture | _____ |
| Drying | _____ |
| Handling | _____ |
| Loading trailers and trucks | _____ |
| Insect control | _____ |
| Raised beds | _____ |
| Weed control | _____ |
| Soil type | _____ |
| Variety | _____ |
| _____ Least important | |

## FACTORS TO CONSIDER WHEN SELECTING DISEASE CONTROL CHEMICALS

- Disease or diseases controlled (including nematodes)
- Level of disease control achieved
- Length of time effective when applied
- Ease of application with available equipment
- Availability when needed
- Clearance for livestock to utilize hay
- Possibility of allergenic reaction to applicator
- Potential for developing resistant strains of organisms through persistent use
- Cost versus benefit received through use
- Convenience of container size and type
- Weight or bulk in relation to transportation and storage
- Compatability with other fungicides or pesticides

## CONCLUSIONS

Disease control procedures ultimately have to be tailored to an individual production system before they produce the intended benefits. The author hopes that the concepts discussed in this publication will serve the grower's interests well in planning individual programs.

If past experience is an indication of things to come, the peanut producer always will be faced with uncertainty. This does not mean, however, that producers are powerless to counter the uncertainty. An understanding of the principles of disease development and selection of appropriate control practices help prevent losses. In most cases cultural practices that require little out-of-pocket expense can be used to prevent much of the damage.

## APPENDIX

| Cultural practices influencing disease development | Southern blight | Early leaf spot | Late leaf spot | Minor leaf disease | Rust | Seedling disease | Pod and root rots | Nematodes | Aflatoxin |
|---|---|---|---|---|---|---|---|---|---|
| Rotation | X | X | X | X | | X | X | X | X |
| Residue management | X | X | X | X | | X | X | X | X |
| Variety selection | X | X | X | X | | | X | | |
| Chemical use | X | X | X | X | X | | X | X | |
| Raised beds | X | | | | | X | X | | |
| Planting dates | X | X | X | X | X | X | | | X |
| Soil cover | X | | | | | | | | |
| Cultivation | X | | | | | | | | |
| Foliar disease control | X | X | X | X | X | | | | |
| Weed control | X | X | X | X | X | | | | |
| Insect control | | X | X | X | | | | *X | X |
| Planting rate | | X | X | X | | | | | |
| Seed quality | | | | | | | | | |
| Seed treatment | | | | | | X | | | |
| Seeding depth | | | | | | X | | | |
| Fertilization | | | | | | | X | | |
| Summer tillage | X | | | | | | | X | |
| Summer fallow | X | | | | | | | X | |

*Some insecticides also have nematicidal properties.

| | Southern blight | Early leaf spot | Late leaf spot | Minor leaf disease | Rust | Seedling disease | Pod and root rots | Nematodes | Aflatoxin |
|---|---|---|---|---|---|---|---|---|---|
| Equipment cleaning | | | | | | | | X | X |
| Digging procedures | | | | | | | | | X |
| Duration in windrow | | | | | | | | | X |
| Drying | | | | | | | | | X |
| Handling | | | | | | | | | X |
| **Environmental factors influencing disease occurrence** | | | | | | | | | |
| Soil cover | X | | | | | | | | |
| Soil moisture | X | | | | | X | X | X | X |
| Soil type | X | | | | | X | X | X | |
| Soil temperature | | | | | | X | X | | X |
| Soil fertility | | | | | | | X | | |
| Field differences | X | | | | | X | X | X | X |
| Area differences | | X | X | X | X | | | X | |
| Previous crop | X | X | X | X | | X | X | X | X |
| Disease potential | X | X | X | X | X | X | X | X | X |
| Relative humidity | | X | X | X | X | | | | |
| Atmospheric temperature | X | X | X | X | X | X | | | X |
| Atmospheric moisture | X | X | X | X | | | | | X |
| Air pollution | | | | | | | | | |
| Plant injury | X | | | | | | | | |
| Surface crop residue | X | | | | | | | | |

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