Chapter 6

# Disease Management

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Disease damage to rice can greatly impair productivity and sometimes destroy a crop. The United States does not have any of the destructive viral diseases present in other rice-growing areas of the world, but fungal diseases are prevalent and very damaging to Louisiana rice. Several bacterial diseases have been found, but significant yield losses have only been associated with bacterial panicle blight.

Direct losses to disease include reduction in plant stands, lodging, spotted kernels, fewer and smaller grains per plant and a general reduction in plant efficiency. Indirect losses include the cost of fungicides used to manage disease, application costs and reduced yields associated with special cultural practices that reduce disease but may not be conducive to producing maximum yields.

The major diseases of rice in the United States are bacterial panicle blight (Figs. 6-2 and 6-3) caused by B*urkholderia glumae* and *Burkholderia gladioli*; fungal diseases including blast, caused by *Pyricularia grisea* (Figs. 6-5 to 6-8); stem rot, caused by *Magnaporthe salvinii (Sclerotium oryzae*) (Figs. 6-33 and 6-34); sheath blight, caused by *Thanatephorus cucumeris* (*Rhizoctonia solani*) (Figs. 6-25 to 6-28); brown spot, caused by *Cochiobolus miyabeanus* (Figs. 6-9 and 6-10); narrow brown spot, caused by *Sphaerulina oryzina* (*Cercospora janseana*) (Figs. 6-20 and 6-21); and kernel smut, caused by *Neovossia horrida* (Fig. 6-16). Seedling diseases caused by species of *Achlya* and *Pythium* (Figs. 6-35, 6-36 and 6-37) also are important in water-seeded rice.

Minor diseases include crown rot (Fig. 6-11), causal agent believed to be an *Erwinia* sp.; leaf scald, caused by *Gerlachia oryzae* (Figs. 6-17 and 6-18); leaf smut, caused by *Entyloma oryzae* (Fig. 6-19); sheath rot, caused by *Sarocladium oryzae* (Fig. 6-30); stackburn disease, caused by *Alternaria padwickii* (Fig. 32); white leaf streak, caused by *Mycovellosiella oryzae* (*Ramularia oryzae*) (Fig. 6-38); sheath blotch, caused by *Pyrenochaeta oryzae* (Fig. 6-29 ); sheath spot, caused by *Rhizoctonia oryzae* (Fig. 6-31); crown sheath rot, caused by *Gaeumannomyces graminis* var. *graminis* (Fig.s 6-12 and 6-13); black kernel, caused by *Curvularia lunata* (Fig. 6-4); seedling blights, caused by various fungi (Fig. 6-24); bacterial leaf blight (Fig. 6-1); false smut, caused by *Ustilaginoidea virens* (Fig. 6-14); root rots, caused by several fungi (Fig. 6-23); and several miscellaneous leaf, stem and glume spotting diseases. Several diseases caused by other sclerotial fungi are also found in Louisiana but are not significant. An undefined pathogen complex acting alone or with insect damage (feeding) also causes the grain and kernel discoloration called "pecky" rice (Fig. 6-15).

The physiological disorders straighthead (Fig. 3-2) and bronzing or zinc (Zn) deficiency (Fig. 3-6) occur throughout the southern rice area and are locally severe. Cold injury, salt damage and nutrient deficiencies can be confused with disease symptoms. Two minor diseases of rice in Louisiana are caused by small parasitic round worms called nematodes. These are white tip, caused by *Aphelenchoides besseyi* (Fig. 6-39), and root knot, caused by *Meloidogyne* species (Fig. 6-22).

The first step toward disease management is identification followed by careful field scouting to determine the extent of disease. Diseases known to occur in Louisiana and their causal agents are listed in Table 6-1. A guide for rapid identification of the major diseases is given in the following section (Table 6-2). Knowing the level of resistance of the variety to major diseases can be useful in determining the probability of having problems warranting preventive management measures. The list of available variety resistance can change over time, so consult LSU AgCenter publication 2270, "Rice Varieties and Management Tips." Scouting information or disease thresholds and management information are sum-

marized for the major diseases in the last section of this chapter.

Use of foliar fungicides to manage rice diseases is often justified under conditions where environmental factors favor development of severe disease. Some factors that affect the probability of fungicide use being warranted include disease history in the field, the resistance of the variety, the yield potential, intended use (seed or grain), date of planting and ratoon crop potential. Always follow label directions. As the list of labeled fungicides may change, contact your LSU AgCenter extension agent for current information on fungicides available for rice disease management. A rice disease content oriented webpage www.lsuagcenter.com/en/crops_livestock/rice/diseases has been setup to provide up to date rice disease control information and additional resources not available in this publication.

# Rice Disease Identification

Each year, the Louisiana rice crop is affected by many diseases. Severity of symptoms often varies because of varietal resistance, environmental conditions and plant growth stage. Also, not all symptoms typical of a disease occur on a single plant. It is important to look at several plants, from several areas of the field, to establish an accurate diagnosis. In the text, all symptoms known to occur are described but not all will be expressed. Use the guide for identification of rice diseases present in Louisiana to decide which diseases are present. The diseases are divided into sections based on what plant part is affected. Several diseases, however, may affect more than one part of a rice plant. When a disease is identified, information is provided in the text for managing the disease.

Table 6-1. Rice diseases and disorders in Louisiana.

| Common Name | Pathogen Name or Cause |
|---|---|
| **Bacterial diseases** | |
| Bacterial blight like disease | *Xanthomonas oryzae* pv. *oryzae* (Ishiyama) Swings et al. = X. *campestris* pv. *oryzae* (Ishiyama) Dye |
| Bacterial panicle blight | *Burkholderia glumae* and *Burkholderia gladioli (Severin) Yabuchi, et al.*) |
| Crown rot | *Erwinia chrysanthemi* Burkholder et al. |
| Pecky rice (kernel spotting) | Damage by bacteria (see also under fungal and miscellaneous diseases) |
| **Fungal diseases** | |
| Black kernel | *Curvularia lunata* (Wakk.) Boedijn (teleomorph: *Cochiobolus lunatus* R.R. Nelson & Haasis) |
| Blast (leaf, rotten neck) | *Pyricularia grisea* Sacc.=P. *oryzae* Cavara (teleomorph: neck, nodal and collar) *Magnaporthe grisea* (Hebert) Barr) |
| Brown spot | *Cochliobolus miyabeanus* (Ito & Kuribayashi) Drechs. ex Dastur (anamorph: *Bipolaris oryzae* (Breda de Haan) Shoemaker) |
| Crown sheath rot | *Gaeumannomyces graminis* (Sacc.) Arx & D. Olivier |
| Downy mildew | *Sclerophthora macrospora* (Sacc.) *Thirumalachar* et al. |
| False smut | *Ustilaginoidea virens* (Cooke) Takah. |
| Kernel smut | *Tilletia barclayana* (Bref.) Sacc. & Syd. in Sacc. = Neovossia horrida (Takah.) Padwick & A. Khan |
| Leaf smut | *Entyloma oryzae* Syd. & P. Syd. |

| Common Name | Pathogen Name or Cause |
|---|---|
| **Fungal diseases continued** | |
| Leaf scald | *Microdochium oryzae* (Hashioka & Yokogi) Samuels & I.C. Hallett = Rhynchosporium oryzae Hashioka & Yokogi |
| Narrow brown leaf spot | *Cercospora janseana* (Racib.) O. Const = *C. oryzae* Miyake (teleomorph: *Sphaerulina oryzina* K. Hara) |
| Pecky rice (kernel spotting) | Damage by many fungi including *Cochliobolus miyabeanus* (Ito & Kuribayashi) Drechs. ex Dastur, *Curvularia* spp., *Fusarium* spp., *Microdochium oryzae* (Hashioka & Yokogi) Samuels & I.C. Halett, *Sarocladium oryzae* (Sawada) W. Gams & D. Hawksworth and other fungi |
| Root rots | *Fusarium* spp., *Pythium* spp., *P. dissotocum* Drechs., *P. spinosum* Sawada |
| Seedling blight | *Cochliobolus miyabeanus* (Ito & Kuribayashi) Drechs. ex Dastur, Curvularia spp., *Fusarium* spp., *Rhizoctonia solani* Kuhn, *Sclerotium rolfsii* Sacc. (teleomorph: *Athelia rolfsii* (Curzi) Tu & Kimbrough), and other pathogenic fungi. |
| Sheath blight | *Thanatephorus cucumeris* (A.B. Frank) Donk (anamorph: *Rhizoctonia solani* Kuhn) |
| Sheath blotch | *Pyrenochaeta oryzae* Shirai ex Miyake |
| Sheath rot | *Sarocladium oryzae* (Sawada) W. Gams & D. Hawksworth = *Acrocylindrium oryzae* Sawada |
| Sheath spot | *Rhizoctonia oryzae* Ryker & Gooch |
| Stackburn | *Alternaria padwickii* (Ganguly) M.B. Ellis leaf spot) (Alternaria leaf spot) |
| Stem rot | *Magnaporthe salvinii* (Cattaneo) R. Krause & Webster (synanamorphs: *Sclerotium oryzae* Cattaneo, *Nakataea sigmoidae* (Cavara) K. Hara) |
| Water-mold (seed-rot and seedling disease) | *Achlya conspicua* Coker, A. *klebsiana* Pieters, *Fusarium* spp., *Pythium* spp., *P. dissotocum* Drechs., *P. spinosum* Sawada |
| White leaf streak | *Mycovellosiella oryzae* (Deighton & Shaw) Deighton |
| **Disorders** | |
| Bronzing | Zinc deficiency |
| Cold injury | Low temperatures |
| Panicle blight | Several causes – Wind damage, insect feeding, undetermined physiological factors |
| Pecky rice (kernel spotting) | Feeding injury by rice stink bug |
| Straighthead | Arsenic induced, unknown physiological disorder |
| **Nematodes** | |
| Root-knot | *Meloidogyne* spp. |
| White tip | *Aphelenchoides besseyi* Christie |

## Table 6-2. A guide to the identification of rice diseases present in Louisiana.

For identification of the major diseases, determine the part of the plant affected by the disease then refer to that section of Table 6-2. A list of the causal agents of all rice diseases known to occur in Louisiana is in Table 6-1.

### I. Planted Seeds and Seedlings

#### Water-seeded rice

| | |
|---|---|
| Seeds rotted after draining water from field; copper or greenish-brown spots on soil surfaces around or above rotted seeds; coarse, bristly mycelium radiating from seed (*Achlya* spp.) (Fig. 6-36) or gelatinous matrix surrounding each affected seed (*Pythium* spp.) (Fig. 6-37). | **Water Mold** |
| Seedlings 1-4 inches tall dying in seedling flood or after flushing seeded field. | **Pythium Seedling Blight** |
| Drill-seeded or dry broadcast rice: seedlings 1-4 inches tall dying: Brown spot on coleoptile or growing point (Fig. 6-24), seedlings suddenly dying. | **Seedling Blight** |
| Seedlings dying or turning white in patches or in short strips of drill row; fluffy white mycelium and small, round sclerotia (tan) may be present on soil surface at the base of affected seedlings after flushing seeded field. | **Sclerotium Seedling Blight** |
| Seedlings at the three- to five-leaf stage dying, often in patches, may have linear reddish-brown lesion on sheath of small seedlings, older seedlings with purple-brown blotches made up of small spots aggregating, leaves yellow or bronze (Fig. 3-6), lower leaves floating on surface of flood water, seedlings dying in deeper water and disappearing below surface of water. | **Bronzing** See also Salinity and Cold Injury. |

### II. Roots and Crown (Root-Stem Interface)

| | |
|---|---|
| Crown area decayed with soft rot, black or dark brown with streaks extending to the lower internodes of culms (Fig. 6-11), fetid odor of bacterial soft rot, tillers dying one at a time; roots dying and turning black, adventitious roots produced at node above crown area. A similar discoloration of the crown may be caused by applying hormonal herbicide such as 2,4-D too early. | **Crown Rot** |
| Roots turning black or brown, decayed, reduced root volume, roots dying (Fig. 6-23). | **Root Rot** |
| Roots with swollen areas, found only under dryland conditions (Fig. 6-22). | **Root Knot** |

### III. Leaf Blades

| | |
|---|---|
| Lesions varying from small round, dark brown spots, to oval spots with narrow reddish-brown margin and gray or white center with dark circular line (Fig. 6-5). Spots elongated, diamond-shaped or linear with gray dead area in center surrounded by narrow reddish-brown margin. | **Leaf Blast** |

| | |
|---|---|
| Round to oval, dark brown lesions with yellow or gold halo (Fig. 6-10); as lesions enlarge, they remain round, with center area necrotic, gray and lesion margin reddish-brown to dark brown. | **Brown Spot** |
| Long, narrow brown or reddish-brown lesion (Fig. 6-20, 6-21); lesions 0.5 to 3 cm long, parallel with leaf veins and usually restricted to the area between veins; lesions may occur on leaf sheaths. | **Narrow Brown Leaf Spot** |
| Lesions similar to narrow brown leaf spot, but wider and white in the center (Fig. 6-38). | **White Leaf Streak** |
| Lesions begin at base of blade, spreading from leaf sheath or from infection point on leaf blade (Fig. 6-27). Lesions consist of alternating wide bands of cream-colored, greenish-gray or tan with narrow bands of reddish-brown or brown. | **Sheath Blight** |
| Lesions consist of wide bands of gray, dying tissue alternating with narrow reddish-orange bands (Fig. 6-17); band pattern in chevrons from leaf tip or edges of the leaf, sometimes lesions are gray blotches at leaf edge with reddish-brown margin, advancing edge of lesion usually has a yellow or gold area (Fig. 6-18) between reddish-brown margin and green, healthy tissues. | **Leaf Scald** |
| Small 1-2 mm, black linear lesions on leaf blade (Fig. 6-19), usually more lesions on tip half of the leaf blade, lesions may have dark gold or light brown halo, leaf tip dries as plants approach maturity, lesions on sheaths of upper leaves. | **Leaf Smut** |
| Round or oval white or pale tan spot with a narrow, red or reddish-brown margin (Fig. 6-32); often two adjacent spots coalesce to form an oval double spot; lesions are from 0.5 to 1 cm in diameter, spots with small black fruiting structures in the center. | **Stackburn** |
| Leaf tips turn white with a yellow area between the white tip and the healthy green area (Fig. 6-39); white areas sometimes occur on leaf edges; flag leaf blade twisted with poor emergence of the panicle; kernels aborted or poorly filled; grain distorted or discolored. | **White Tip** |
| Symptoms consist of elongated lesions near the leaf tip margin that start out water-soaked in appearance; lesions may reach several inches in length, turn white to yellow and then to gray (Fig. 6-1). | **Bacterial Leaf Blight like disease** |

## IV. Leaf Sheath and Stem

| | |
|---|---|
| Water-soaked, gray-green lesions at water line (Fig. 6-28) during tillering or early jointing stages of growth, lesions becoming oval, white or straw-colored in center with reddish-brown edge (Fig. 6-26), lesions 1 to 2 cm wide and 3 to 4 cm long, lesions spreading up leaf sheaths and onto leaf blades, lesions discrete or forming a continuous band on sheath (Fig. 6-26) or leaf (Fig. 6-27) of alternating wide necrotic areas with narrow reddish-brown bands. | **Sheath Blight** |

Black, angular lesions on leaf sheaths at water line on plants at tillering or early jointing stages of growth (Fig. 6-33); at later stages outer sheath drying, inner sheath discolored or with black angular lesion; culms discolored with dark brown or black streaks; raised areas of dark fungus mycelium on surface; gray mycelium inside of culm or at maturity culm collapsed with small, round black sclerotia in dead sheath tissues and inside of culm (Fig. 6-34). **Stem Rot**

Lesions on sheaths midplant, oval, pale green, turning cream or white in the center with a broad dark reddish-brown margin (Fig. 6-31). Lesions remain separate, not forming continuous bands on the sheath. **Sheath Spot**

Black to brown diffuse lesions on the sheath near the water line (Fig. 6-12). Perithecia necks protruding from upper surface and a thick fungal mat between leaf sheath and culm (Fig. 6-13). **Crown Sheath Rot**

Reddish- or purple-brown, netlike pattern on sheath below the collar of lower leaf blades (Fig.6-21), lesion oval, 1 to 2 cm wide and 3 to 5 cm long, leaf blades turning yellow and drying. (See Narrow Brown Leaf Spot) **Cercospora Net Spot**

General reddish-brown discoloration of flag leaf sheath or reddish-brown or yellow-tan spots with dark, irregular ring pattern inside of spots (Fig. 6-30); panicles emerging poorly; stem of panicle twisted; white "frosting" of conidia on inside of leaf sheath, florets of panicles on affected tillers discolored a uniform reddish-brown or dark brown. Grain does not fill or kernels are lightweight. **Sheath Rot**

Oblong zonate reddish lesions with black fruiting structures (pycnidia) in the center areas of the lesion (Fig. 6-29). **Sheath Blotch**

Narrow red-brown lesions on flag leaf sheath or penultimate leaf sheath after panicles emerge; lesions 0.5 to 1.5 mm wide and up to 1 to 3 cm long; lesions run parallel with veins in sheaths, affecting the tissues between veins (Fig. 6-21). **Narrow Brown Leaf Spot**

Collar of flag leaf discolored brown or chocolate brown; leaf blade detaches from sheath as lesion dies and dries (Fig. 6-7). **Blast on Flag Leaf Collar**

Culm nodes turn black or nodes become shriveled and gray as plants approach maturity (Fig. 6-6); nodes purple to blue-gray with conidia of the pathogen; culms and leaves straw-colored above affected node; culms lodge at affected nodes. **Node Blast**

## V. Panicle, Florets and Grain

### Panicle

The panicle may have one to all of the florets blighted with grains not filling or aborted. Florets are initially white or light gray on the basal third with a reddish-brown margin separating this area from the rest of the floret, which becomes straw colored (Fig. 6-3). The florets eventually become gray with growth of saprophytic fungi on the surface. Floret stems (panicle branches) stay green after the unaffected grain matures. **Bacterial Panicle Blight**

| | |
|---|---|
| Node and surrounding area at base of panicle discolored brown or chocolate brown (Fig. 6-8); stem of panicle shrivels and may break; node purplish or blue-gray with conidia of the fungal pathogen; panicle white or gray; florets do not fill and turn gray; panicle branches and stems of florets with gray-brown lesions. | **Rotten Neck Blast** |
| Panicles upright, not falling over or slightly bent over because of sterility. Hulls distorted, parrot beak-shaped. Plants may not head at all (Fig. 3-1). | **Straighthead** |
| Internodal area above or below node at the base of the panicle turns light brown or tan-brown; affected area dies and shrivels; kernels in florets of lower portion of the panicle do not fill. (See Brown Spot and Narrow Brown Leaf Spot for more information.) | **Cercospora Neck Blight** |
| Single florets or several florets on a panicle branch turn light brown or straw-colored; floret stem with brown lesion; grain stops developing; florets turn gray. | **Panicle Blast** |
| Panicles twisted and deformed, unable to emerge from the leaf sheath and becoming twisted; the panicle is small, normally remaining green longer than usual; no seeds produced. | **Downy Mildew** |
| Panicles small, reduced number of spikelets and lemmas and paleas often absent on terminal portions of panicles. | **White Tip** |

### Florets and Grain

| | |
|---|---|
| Single florets or several florets per panicle with brown, reddish-brown, purple or white surrounded by purple-brown spots (Fig. 6-15). | **Grain Spotting or Pecky Rice** |
| Maturing grain partially filled with or without grayish cast; powdery black mass on surface of the kernel and at seam between palea and lemma (Fig. 6-16) (rubs off easily onto fingers). (See Black Kernel) | **Kernel Smut** |
| Single florets or more commonly several florets in a panicle turn reddish-brown to dark brown (Fig. 6-30). | **Sheath Rot** |
| Single florets or several florets on a panicle straw colored, branches of panicle remain green (Fig. 6-3). The grain stops developing, and the florets turn gray. | **Bacterial Panicle Blight** |
| Maturing grain partially filled, shriveled, chalky, fuzzy black mass covering surface of the grain or at seam between palea and lemma (will not easily rub off on fingertips). | **Brown Spot** |
| Large orange fruiting structure on one or two grains in maturing panicle. When orange membrane ruptures, a mass of greenish-black spores is exposed (Fig. 6-14). Grain replaced by one or more sclerotia. | **False Smut** |

# Rice Disease in Louisiana

## Bacterial Leaf Blight-Like

Bacterial leaf blight is caused by the bacterium *Xanthomonas campestris* pv. *oryzae*. It was first identified in the United States in Texas and Louisiana in 1987. Additional testing proved the bacterium was not the severe Asian strain. No major losses have been associated with this disease in the United States, but bacterial leaf blight in other parts of the world causes severe damage.

The blight bacterium overwinters in rice debris in the soil and on weed hosts. There is also a slight chance that seed may transmit the pathogen. The pathogen is spread by wind-blown rain, irrigation water, plant contact and probably on plant debris on machinery. High humidity and storms favor disease development. Watersoaked areas appear on the leaf margins near the tips, enlarge and turn white to yellow. As the lesions mature, they expand, turn white and then gray because of growth of saprophytic fungi (Fig. 6-1). The lesion may be several inches long. Contact your LSU AgCenter extension agent if you suspect this disease. Accurate identification is important since the symptoms can be confused with other diseases, especially leaf scald (Fig. 6-17), herbicide damage and other plant stress. Management practices include rotating to nongrass crops, tilling to destroy plant debris and avoiding contaminating the field through infected plant materials or irrigation water.

*Fig. 6-1. Bacterial leaf blight.*

## Bacterial Panicle Blight

Rice produced in the southern United States has a long history of loss to panicle blighting of unknown etiology. Epidemics of panicle blight occurred during the 1995, 1998, 2000 and 2011 seasons, years of record-high night temperatures, with yield losses in some fields estimated to be as high as 40 percent. Earlier panicle blighting was attributed to abiotic factors, including high temperatures, waters stress or toxic chemicals near the root zone, but in 1996-97, the cause of panicle blighting in the southern United States was identified as the bacterial plant pathogen *Burkholderia glumae*. This bacterium was first described in 1967 in Japan as the cause of grain-rotting and seedling blighting. The disease was later reported from other Asian and Latin American countries. The symptoms of bacterial panicle blight include seedling blighting, sheath rot, and panicle blighting with significant yield losses. The pathogen forms a linear lesion on the flag-leaf sheath extending down from the leaf-blade collar. The lesion is distinct and has a reddish-brown border with the lesion center becoming necrotic and gray. The lesion may reach several inches in length. The panicle may have one to all of the florets blighted with grains not filling or aborted.

*Fig. 6-2. Bacterial panicle blight.*

*Fig. 6-3. Bacterial panicle blight on kernels.*

Affected panicles develop in circular patterns in the field (Fig. 6-2). Florets are initially white or light gray on the basal third with a reddish-brown margin separating this area from the rest of the floret, which becomes straw-colored (Fig. 6-3). The florets eventually become gray with growth of saprophytic fungi on the surface. Floret stems (panicle branches) stay green after the unaffected grain matures. *Burkholderia gladoli* was recently reported as associated with this disease on rice in Japan and the southern United States. This disease can cause severe disease under conditions of extended high temperatures, especially nighttime temperatures, and is ranked with sheath blight and rice blast for its potential to cause loss.

The term "panicle blight" has been used in the United States for more than 50 years, and bacterial panicle blight has been retained as the name of this disease. The bacterium is seed-borne, and rice crops planted with infected seeds can suffer severe losses. The pathogen has also been detected from the soil, but the importance to disease development is not known. Use of pathogen-free seeds is an important practice to reduce or manage the incidence of bacterial panicle blight. A method for testing rice seed-lots with PCR has been developed. No pesticides are currently recommended for control of this disease in the United States. Several varieties have partial resistance (LSU AgCenter publication 2270, "Rice Varieties and Management Tips").

## Black Kernel

The fungus *Curvularia lunata* causes black kernel. The fungus causes severe grain discoloration (Fig. 6-4), and after milling, the kernels appear black. When infections are heavy, the fungus can cause seedling blights or weakened seedlings. This disease is rarely severe enough that management practices are recommended. Seed treatments to manage other diseases should reduce seedling damage. No other management measures are warranted.

*Fig. 6-4. Black kernel.*

## Blast

Rice blast is caused by the fungus *Pyricularia grisea*. The disease is also called leaf blast, node blast, panicle blast, collar blast and rotten-neck blast, depending on the portion of the plant affected. Blast has been one of the most important diseases in Louisiana, causing severe yield losses to susceptible varieties under favorable environmental conditions.

Blast can be found on the rice plant from the seedling stage to maturity. The leaf blast phase occurs between the seedling and late tillering stages. Spots on leaves start as small white, gray or blue tinged spots that enlarge quickly under moist conditions to either oval or diamond-shaped spots or linear lesions with pointed ends with gray or white centers and narrow brown borders (Fig. 6-5). Leaves and whole plants are often killed under severe con-

*Fig. 6-5. Leaf blast.*

*Fig. 6-6. Node blast.*

ditions. Lesions on resistant plants are small brown specks that do not enlarge.

On stem nodes (Fig. 6-6), the host tissue turns black and becomes shriveled and gray as the plant approaches maturity. The infected area may turn dark purple to blue-gray because of the production of fungal spores. Culms and leaves become straw-colored above the infected node. Plants lodge or break off at the infected point, or they are connected only by a few vascular strands. Some varieties are infected where the flag leaf attaches to the sheath at the collar (Fig. 6-7). The lesion turns brown or chocolate-brown to gray, and the flag leaf becomes detached from the plant as the lesion area becomes dead and dry.

Rotten-neck symptoms appear at the base of the panicle starting at the node (Fig. 6-8). The tissue turns brown to chocolate brown and shrivels, causing the stem to snap and lodge. If the panicle does not fall off, it may turn white to gray or the florets that do not fill will turn gray. Panicle branches and stems of florets also have gray-brown lesions.

*Fig. 6-7. Collar blast.*

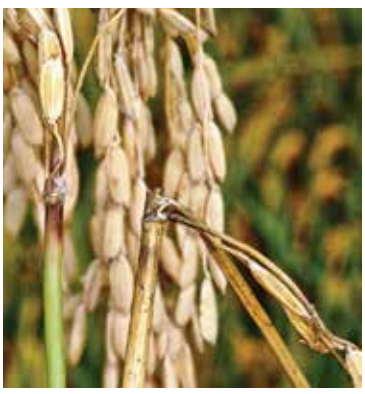

*Fig. 6-8. Rotten neck blast.*

Scouting a field for blast should begin early in the season during the vegetative phase and continue through the season to heading. Leaf blast will usually appear in the high areas of the field where the flood has been removed, lost or is shallow. Rice is most susceptible to leaf blast at the maximum tillering stage. Areas of heavy N fertilization and edges of the fields are also potential sites of infection. If leaf blast is in the field or has been reported in the same general area and if the variety is susceptible, fungicide applications are advisable to reduce rotten-neck blast.

The pathogen overwinters as mycelium and spores on infected straw and seed. Spores are produced from specialized mycelium called conidiophores and become wind-borne at night on dew or rain. The spores are carried by air currents and land on healthy rice plants. The spores germinate under high humidity and dew conditions and infect the plant. Generally, lesions will appear 4 to 7 days later, and additional spores are produced. Plants of all ages are susceptible. Medium-grain varieties are more susceptible to blast, especially during the leaf phase, than the long-grain varieties grown in Louisiana.

Environmental conditions that favor disease development are long dew periods, high relative humidity and warm days with cool nights. Agronomic practices that favor disease development include excessive N levels, late planting and dry soil (loss of flood). Several physiologic races of *P. grisea* exist, and disease development varies, depending on variety-race interactions.

The disease can be reduced by planting resistant varieties, maintaining a 4- to 6-inch flood, proper N fertilizer, avoiding late planting and by applying a fungicide at the rates and timings recommended by the Louisiana Cooperative Extension Service.

## Brown Spot

Brown spot, caused by the fungus *Cochiobolus miyabeanus*, was one of the most prevalent rice diseases in Louisiana. It is also called Helminthosporium leaf spot. When *C. miyabeanus* attacks the plants at emergence, the resulting seedling blight causes sparse or inadequate stands and weakened plants. Leaf spots are present on young rice, but the disease is more prevalent as the plants approach maturity and the leaves begin to senesce.

*Fig. 6-9. Brown spot, seedling.*

*Fig. 6-10. Brown spot.*

Yield losses from leaf infection or leaf spots are probably not serious. When the fungus attacks the panicle, including the grain, economic losses occur. Heavy leaf spotting indicates an unfavorable growth factor, usually a soil problem.

The pathogen also attacks the coleoptiles, leaves, leaf sheath, branches of the panicle, glumes and grains. The fungus causes brown, circular to oval spots on the coleoptile leaves of the seedlings (Fig. 6-9). It may cause seedling blight.

Leaf spots are found throughout the season. On young leaves, the spots are smaller than those on older leaves. The spots may vary in size and shape from minute dark spots to large oval to circular spots (Fig. 6-10). The smaller spots are dark brown to reddish-brown. The larger spots have a dark brown margin and a light, reddish-brown or gray center with a gold halo. The spots on the leaf sheath and hulls are similar to those on the leaves.

The fungus attacks the glumes and causes a general black discoloration. It also attacks the immature florets, resulting in no grain development or kernels that are lightweight or chalky.

Brown spot is an indicator of unfavorable growing conditions, including insufficient N, inability of the plants to use N because of rice water weevil injury, root rot or other unfavorable soil conditions. As the plants approach maturity, brown spot becomes more prevalent and the spots are larger on senescing leaves.

Damage from brown spot can be reduced by maintaining good growing conditions for rice by proper fertilization, crop rotation, land leveling, proper soil preparation and water management. Seed-protectant fungicides reduce the severity of seedling blight caused by this seed-borne fungus. Some varieties are less susceptible than others.

## Crown Rot

Crown rot is believed to be caused by a bacterial infection (possibly *Erwinia chrysanthemi*). This disease is rarely observed. Symptoms first appear during tillering. The crown area is decayed, with soft rotting, becoming black or dark brown with discolored streaks extending into the lower internodes of culms (Fig. 6-11). There is a fetid or putrid odor characteristic of bacterial soft rots, and tillers start dying one at a time. The roots also die and turn black. Adventitious roots are produced at the node above the crown area. A similar discoloration of the crown can be caused by misapplied herbicides. Control practices are not recommended.

## Crown Sheath Rot

Crown sheath rot is caused by the fungus *Gaeumannomyces graminis* var. *graminis*. Other names

*Fig. 6-11. Crown rot.*

*Fig. 6-12. Crown sheath rot.*

*Fig. 6-13. Crown sheath rot mycelium.*

for this disease include brown sheath rot, Arkansas foot rot and black sheath rot. It has been considered a minor disease of rice, but reports from Texas suggest severe damage can occur. The pathogen kills lower leaves, thus reducing photosynthetic activity, causing incomplete grain filling, and plants can lodge.

Symptoms appear late in the season, usually after heading. Sheaths on the lower part of the rice plant are discolored brown to black (Fig. 6-12). Reddish-brown mycelial mats are found on the inside of infected sheaths (Fig. 6-13). Dark perithecia are produced within the outside surface of the sheath. Perithecia are embedded in the sheath tissues with beaks protruding through the epidermis. This disease can easily be confused with stem rot (Fig. 6-33).

The fungus survives as perithecia and mycelia in plant residues. Ascospores are wind-borne in moist conditions. The fungus has been reported to be seed-borne. Management practices have not been worked out for this disease.

## Downy Mildew

Downy mildew is caused by the fungus *Sclerophthora macrospora*. In early growth stages, infected seedlings are dwarfed and twisted with chlorotic, yellow to whitish spots. Symptoms are more severe on the head. Because of failure to emerge, panicles are distorted, causing irregular, twisted and spiral heads that remain green longer than normal. This disease is extremely rare. No control measures are recommended.

*Fig. 6-14. False smut.*

## False Smut

False smut, caused by the fungus *Ustilaginoidea virens*, is a minor disease in the United States and is sometimes epidemic in certain areas. The disease is characterized by large orange to brown-green fruiting structures on one or more grains of the mature panicle (Fig. 6-14). When the silver covering ruptures, a mass of greenish-black spores is exposed. The grain is replaced by one or more sclerotia. Most varieties appear to have a high level of resistance, and disease control measures generally are not required. Fungicides used to manage other diseases may be active against this disease.

## Grain Spotting and Pecky Rice

Many fungi infect developing grain and cause spots and discoloration on the hulls or kernels. Damage by the rice stink bug, *Oebalus pugnax* F., also causes discoloration of the kernel. Kernels discolored by fungal infections or insect damage are commonly called

*Fig. 6-15. Peck rice.*

pecky rice (Fig. 6-15). This complex disorder involves many fungi, the white-tip nematode and insect damage. High winds at the early heading stage may cause similar symptoms. Proper insect control and disease management will reduce this problem.

## Kernel Smut

This fungal disease is caused by *Neovossia barclayana*. Symptoms are observed at or shortly before maturity. A black mass of smut spores replaces all or part of the endosperm of the grain. The disease is easily observed in the morning when dew is absorbed by the smut spores. The spore mass expands and pushes out of the hull, where it is visible as a black mass (Fig. 6-16). When this spore mass dries, it is powdery and comes off easily on fingers. Rain washes the black spores over adjacent parts of the panicle. Affected grains are a lighter, slightly grayish color compared with normal grain.

*Fig. 6-16. Kernel smut.*

Usually, only a few florets may be affected in a panicle, but fields have been observed in Louisiana with 20 to 40 percent of the florets affected on 10 percent or more of the panicles in a field. Smutted grains produce kernels with black streaks or dark areas. Milled rice has a dull or grayish appearance when smutted grains are present in the sample. Because fewer kernels break when parboiled rice is milled, kernel smut can be a severe problem in processed rice. Growers are docked in price for grain with a high incidence of smut.

This disease is usually minor in Louisiana, but it can become epidemic in local areas. Some varieties are more susceptible and should be avoided where smut is a problem. Spores of the fungus are carried on affected seeds and overwinter in the soil of affected fields. The pathogen attacks immature, developing grain and is more severe when rains are frequent during flowering. Fungicide applications at booting can be affective for controlling this disease. Please contact your local LSU AgCenter extension agent for fungicide recommendations.

## Leaf Scald

This disease, caused by *Gerlachia oryzae*, is present in the southern rice area of the United States and in Louisiana annually. It affects leaves, panicles and seedlings. The pathogen is seed-borne and survives between crops on infected seeds. The disease usually occurs on maturing leaves. Lesions start on leaf tips or from the edges of leaf blades. The lesions have a chevron pattern of light (tan) and darker reddish-brown areas (Fig. 6-17). The leading edge of the lesion usually is yellow to gold (Fig. 6-18). Fields look yellow or gold. Lesions from the edges of leaf blades have an indistinct, mottled pattern. Affected leaves dry and turn straw-colored.

*Fig. 6-17. Leaf scald.*

*Fig. 6-18. Leaf scald.*

Panicle infestations cause a uniform light to dark, reddish-brown discoloration of entire florets or hulls of developing grain. The disease can cause sterility or abortion of developing kernels. Control measures are not recommended, but foliar fungicides used to manage other diseases have activity against this disease.

## Leaf Smut

Leaf smut, caused by the fungus *Entyloma oryzae*, is a widely distributed, but somewhat minor, disease

*Fig. 6-19. Leaf smut.*

of rice. The fungus produces slightly raised black spots (sori) on both sides of the leaves (Fig. 6-19) and on sheaths and stalks. The blackened spots are about 0.5 to 5.0 mm long and 0.5 to 1.5 mm wide. Many spots can be found on the same leaf, but they remain distinct from each other. Heavily infected leaves turn yellow, and leaf tips die and turn gray. The fungus is spread by airborne spores and overwinters on diseased leaf debris in soil. Leaf smut occurs late in the growing season and causes little or no loss. Control measures are not recommended.

## Narrow Brown Leaf Spot

Narrow brown leaf spot, caused by the fungus *Cercospora janseana*, varies in severity from year to year and is more severe as rice plants approach maturity. Leaf spotting may become very severe on the more susceptible varieties and causes severe leaf necrosis. Premature ripening, yield reduction and reduced milling can occur. The disease is most severe on ratoon crop rice.

Symptoms include short, linear, brown lesions most commonly found on leaf blades (Fig. 6-20). Symptoms also occur on leaf sheaths, pedicels and glumes. Leaf lesions are 2 to 10 mm long and about 1 mm wide, tend to be narrower, shorter and darker brown on resistant varieties and wider and lighter brown with gray necrotic centers on susceptible varieties. On upper leaf sheaths, symptoms are similar to those found on the leaf. On lower sheaths, the symptom is a "net blotch" or spot in which cell walls are dark brown and intracellular areas are tan to yellow (Fig. 6-21).

*Fig. 6-20. Narrow brown leaf spot.*

*Fig. 6-21. Net blotch phase of narrow brown leaf spot.*

The primary factors affecting disease development are (1) susceptibility of varieties to one or more prevalent pathogenic races, (2) prevalence of pathogenic races on leading varieties and (3) growth stage. Although rice plants are susceptible at all stages of growth, the plants are more susceptible from panicle emergence to maturity. Differences in susceptibility among rice varieties are commonly observed, but resistance is an unreliable control method as new races develop readily. Some fungicides used to reduce other diseases also may have activity against narrow brown leaf spot. Low N levels favor development of this disease.

## Root Knot

Species of the nematode *Meloidogyne* cause root knot. Symptoms include enlargement of the roots and the

*Fig. 6-22. Root knot.*

formation of galls or knots (Fig. 6-22). The swollen female nematode is in the center of this tissue. Plants are dwarfed, yellow and lack vigor. The disease is rare and yield losses low. The nematode becomes inactive after prolonged flooding. No control measures are recommended.

## Root Rot

Root rots are caused by several fungi, including *Pythium spinosum*, *P. dissotocum*, other *Pythium* spp. and several other fungi. The rice plant is predisposed to this disorder by a combination of factors, including physiological disorders, insect feeding, especially feeding of rice water weevil larvae, extreme environmental conditions and various other pathogens.

Symptoms can be noted as early as emergence. Roots show brown to black discoloration and necrosis (Fig. 6-23). As the roots decay, nutrient absorption is disrupted, the leaves turn yellow and the plants lack vigor. With heavy root infections, plants lack support from the roots and lodge, causing harvest problems. Often, plants with root rot show severe brown leaf spot infection. The disease is referred to as feeder root necrosis when the small fine roots and root hairs are destroyed on seedling and young plants. When this happens, no lodging occurs and symptom development is not as apparent on the upper plants.

*Fig. 6-23. Root rot.*

Fertilizer usually reduces the aboveground symptoms although actual nutrient use is impaired. Rice water weevil control greatly reduces root rots. Draining fields stimulates root growth but can cause problems with blast, weeds or efficiency of nutrient use.

## Seedling Blight

Seedling blight, or damping off, is a disease complex caused by several seed-borne and soil-borne fungi, including species of *Cochiobolus*, *Curvularia*, *Sarocladium*, *Fusarium*, *Rhizoctonia* and *Sclerotium*. Typically, the rice seedlings are weakened or killed by the fungi. Environmental conditions are important in disease development. Cold, wet weather is most favorable to disease development.

Seedling blight causes stands of rice to be spotty, irregular and thin. Fungi enter the young seedlings and either kill or injure them. Blighted seedlings that emerge from the soil die soon after emergence. Those that survive generally lack vigor, are yellow or pale green and do not compete well with healthy seedlings.

Severity and incidence of seedling blight depend on three factors: (1) percentage of the seed infested by seed-borne fungi, (2) soil temperature and (3) soil moisture content. Seedling blight is more severe on rice that has been seeded early when the soil is usually cold and damp. The disadvantages of early seeding can be partially overcome by seeding at a shallow depth. Conditions that tend to delay seedling emergence favor seedling blight. Some blight fungi that affect rice seedlings at the time of germination can be reduced by treating the seed with fungicides.

Seeds that carry blight fungi frequently have spotted or discolored hulls, but seed can be infected and still appear to be clean. *Cochiobolus miyabeanus*, one

*Fig. 6-24. Seedling blight.*

of the chief causes of seedling blight, is seed-borne. A seedling attacked by this fungus has dark areas on the basal parts of the first leaf (Fig. 6-24).

If rice seed is sown early in the season, treating the seed is likely to mean the difference between getting a satisfactory stand or having to plant a second time. Little benefit is received from treating rice seed to be sown late in the season, unless unfavorable weather prevails.

The soil-borne seedling blight fungus, *Sclerotium rolfsii*, kills or severely injures large numbers of rice seedlings after they emerge when the weather at emergence is humid and warm. A cottony white mold develops on the lower parts of affected plants. This type of blight can be checked by flooding the land immediately.

Treatment of the seed with a fungicide is recommended to improve or ensure stands. Proper cultural methods for rice production, such as proper planting date or shallow seeding of early planted rice, will reduce the damage from seedling blight fungi.

Water- and soil-borne fungi in the genus *Pythium* attack and kill seedlings from germination to about the three-leaf stage of growth. Infected roots are discolored brown or black, and the shoot suddenly dies and turns straw-colored. This disease is most common in water-seeded rice, and the injury is often more visible after the field is drained. It may also occur in drill-seeded rice during prolonged wet, rainy periods.

Seed treatment, planting when temperatures favor rapid growth of seedlings and draining the field are the best management measures for seedling disease control.

## Sheath Blight

Sheath blight has been the most economically significant disease in Louisiana since the early 1970s. The disease is caused by *Rhizoctonia solani*, a fungal pathogen of both rice and soybeans. On soybeans, it causes aerial blight.

Several factors have contributed to the development of sheath blight from minor to major disease status. They include the increased acreage planted to susceptible long-grain varieties, the increase in the acreage of rice grown in rotation with soybeans, the increased use of broadcast seeding and the higher rates of N fertilizers used with the modern commercial rice varieties. The disease is favored by dense stands with a heavily developed canopy, warm temperature and high humidity. The fungus survives between crops as structures called sclerotia or as hyphae in plant debris. Sclerotia (Fig. 6-25) or plant debris floating


*Fig. 6-25. Sheath blight sclerotia on stem.*

*Fig. 6-26. Sheath blight lesions on sheath.*

*Fig. 6-27. Sheath blight lesions on leaves.*

on the surface of irrigation water serves as sources of inoculum that attack and infect lower sheaths of rice plants at the waterline.

Sheath blight is characterized by large oval spots on the leaf sheaths (Fig. 6-26) and irregular spots on leaf blades (Fig. 6-27). Infections usually begin during the late tillering-joint elongation stages of growth. Lesions about 0.5 to 1 cm in width and 1 to 3 cm in length are formed a little above the waterline on infected culms (Fig. 6-28). Fungus mycelium grows up the leaf sheath, forms infection structures, infects and causes new lesions. The infection can spread to leaf blades. The lower leaf sheaths and blades are affected during the jointing stages of growth. After the panicle emerges from the boot, the disease progresses rapidly to the flag leaf on susceptible varieties. With very susceptible varieties, the fungus will spread into the culm from early sheath infections. Infected culms are weakened, and the tillers may lodge or collapse.

The fungus can spread in the field by growing from tiller to tiller on an infected plant or across the surface of the water to adjacent plants. The fungus also grows across touching plant parts, for example from leaf to leaf, causing infections on nearby plants. Infected plants are usually found in a circular pattern in the field because the fungus does not produce spores and must grow from plant to plant.

*Fig. 6-28. Early, intermediate and late sheath blight lesions.*

The lesions have grayish-white or light green centers with a brown or reddish-brown margin. As lesions coalesce on the sheath, the blades turn yellow-orange and eventually die. As areas in the field with dead tillers and plants increase, they may coalesce with other affected areas to cause large areas of lodged, dead and

dying plants. Damage is usually most common where wind-blown, floating debris accumulates in the corners of cuts when seedbeds are prepared in the water.

Sheath blight also affects many grasses and weeds other than rice, causing similar symptoms. Sclerotia that survive between crops are formed on the surface of lesions on these weed grasses, as well as on rice and soybeans. The sclerotia are tightly woven masses of fungal mycelium covered by an impervious, hydrophobic coating secreted by the fungus.

Disease severity can be reduced by integrating several management practices. Dense stands and excessive use of fertilizer both tend to increase the damage caused by this disease. Broadcast seeding tends to increase stand and canopy density. Rotation with soybeans or continuous rice increases the amount of inoculum in field soils. Fallow periods, with disking to control growth of grasses, will reduce inoculum in the soil.

The pathogen also is known to infect sorghum, corn and sugarcane when environmental conditions are favorable for disease development.

Medium-grain rice varieties are more resistant to sheath blight than most of the long-grain varieties. Several recently released long-grain varieties are more resistant to sheath blight than the older long-grain varieties (see LSU AgCenter publication 2270, "Rice Varieties and Management Tips").

Fungicides are available for reducing sheath blight. Ask an Extension Agent for the latest information on fungicides for sheath blight management.

## Sheath Blotch

This fungal disease affects the leaf sheaths, especially the flag-leaf sheath near the collar. The lesion usually starts at an edge of the sheath and enlarges to form an oblong blotch that may increase in size until it covers the sheath, but the lesion is usually restricted and becomes zonate (Fig. 6-29). This distinguishes it from sheath rot caused by *Sarocladium oryzae*. Many black fruiting structures (pycnidia) are visible in the lesion. This disease is normally not severe or widespread enough to warrant control measures.

*Fig. 6-29. Sheath blotch.*

## Sheath Rot

This disease is caused by the fungal pathogen *Sarocladium oryzae*. Symptoms are most severe on the uppermost leaf sheaths that enclose the young panicle during the boot stage. Lesions are oblong or irregular oval spots with gray or light brown centers and a dark reddish-brown, diffuse margin (Fig. 6-30), or the lesions may form an irregular target pattern. On U.S. rice varieties, the lesion is usually expressed as a reddish-brown to purple-brown discoloration of the flag leaf sheath. Early or severe infections affect the panicle so that it only partially emerges. The unemerged portion of the panicle rots, turning florets to dark brown. Grains from damaged panicles are discolored reddish-brown to dark brown and may not fill. A powdery white growth consisting of spores and hyphae of the pathogen may be observed on the inside of affected sheaths. Insect or mite damage to the boot or leaf sheaths increases the damage from this disease.

*Fig. 6-30. Sheath rot.*

This disease affects most rice varieties. The disease is usually minor, affecting scattered tillers in a field. Occasionally, larger areas of a field may have significant damage. Control measures are not recomvmended. Fungicidal sprays used in a general disease management program reduce damage, but recent studies show that several bacterial pathogens commonly cause similar sheath rot symptoms on rice in Louisiana. Fungicides would have little effect on these pathogens.

## Sheath Spot

This disease is caused by the fungus *Rhizoctonia oryzae*. The disease resembles sheath blight but is usually less severe. The lesions produced by *R. oryzae* are found on sheaths midway up the tiller or on leaf blades (Fig. 6-31). Lesions are oval, 0.5 to 2 cm long and 0.5 to 1 cm wide. The center is pale green, cream or white with a broad, dark reddish-brown margin (Fig. 6-31). Lesions are separated on the sheath or blade and do not form the large, continuous lesions often found with sheath blight. The pathogen attacks and weakens the culm under the sheath lesion on very susceptible varieties. The weakened culm lodges or breaks over at the point where it was infected. Lodging caused by sheath spot usually occurs midway up the culm. This disease is usually minor on Louisiana rice. Some fungicides used to manage sheath blight also reduce sheath spot.

*Fig. 6-31. Sheath spot lesions.*

## Stackburn

This disease was first observed on rice growing in Louisiana and Texas. Stackburn or Alternaria leaf spot is caused by the fungal pathogen *Alternaria padwickii*. It is common on rice around the world.

The disease is present in most rice fields in Louisiana. Only occasional spots are observed, but the disease may be more severe in restricted areas of a field. The spots are typically large (0.5- to 1-cm in diameter), oval or circular, with a dark brown margin or ring around the spot (Fig. 6-32). The center of the spot is initially tan and eventually becomes white or nearly white. Mature spots have small dark or black dots in the center. These are sclerotia of the fungus. Grain or seeds affected by the disease have tan to white spots with a wide, dark brown border. The disease causes discoloration of kernels or the kernels stop development and grains are shriveled.

*Fig. 6-32. Stackburn.*

This fungus is the most common seed-borne fungus in Louisiana and may cause seedling blight. It is more common on panicles and grain than on leaves in Louisiana.

No specific control recommendations are available, but seed-protectant fungicides will help reduce the seedling blight caused by this pathogen and will reduce the number of spores available to cause leaf infections.

## Stem Rot

Stem rot, caused by the fungus *Sclerotium oryzae*, is an important disease in Louisiana. Often, losses are not detected until late in the season when it is too late to initiate control practices. Stem rot causes severe lodging, which reduces combine efficiency, increases seed sterility and reduces grain filling.

The first symptoms are irregular black angular lesions on leaf sheaths at or near the water line on plants at tillering or later stages of growth (Fig. 6-33). At later stages of disease development, the outer sheath may die and the fungus penetrates to the inner sheaths and culm. These become discolored and have black or dark brown lesions. The dark brown or black

*Fig. 6-33. Stem rot lesion.*

*Fig. 6-34. Stem rot scerotia.*

streaks have raised areas of dark fungal mycelium on the surface and gray mycelium inside the culm and rotted tissues. At maturity, the softened culm breaks, infected plants lodge and many small, round, black sclerotia develop in the dead tissues (Fig. 6-34).

The pathogen overwinters as sclerotia in the top 2 to 4 inches of soil and on plant debris. During water-working and establishment of early floods, the hydrophobic sclerotia float on the surface of the water and often accumulate along the edge of the field and on levees because of wind action.

After a permanent flood is established, the sclerotia float to the surface, contact the plant, germinate and infect the tissues near the waterline. The fungus then penetrates the inner sheaths and culm, often killing the tissues. The fungus continues to develop, forming many sclerotia in the stubble after harvest.

Most commercial varieties of rice are not highly resistant to stem rot. The disease is favored by high N levels. Early maturing varieties are usually less affected by stem rot. In addition, applications of K fertilizer reduce disease severity in soils where K is deficient. Stem rot is more serious in fields that have been in rice production for several years.

Suggested management measures include using early maturing varieties, avoiding very susceptible varieties, burning stubble or destroying by cultivation after harvest to destroy sclerotia, using crop rotation when possible, applying K fertilizer, avoiding excessive N rates and using foliar fungicides recommended by the LSU AgCenter.

## Water Mold and Seed Rot

When using the water-seeding method of planting rice, it is difficult to obtain uniform stands of sufficient density to obtain maximum yields. The most important biological factor contributing to this situation is the water mold or seed rot disease caused primarily by fungi in the genera *Achlya* and *Pythium*. Recently, certain *Fusarium* spp. also have been found associated with molded seeds. The disease is caused by a complex of these fungi infecting seeds. The severity of this disease is more pronounced when water temperatures are low or unusually high. Low water temperatures slow the germination and growth of rice seedlings but do not affect growth of these pathogens. In surveys conducted in Louisiana during the 1970s and 1980s, an average of 45 percent of water-planted seeds was lost to water mold.

In addition to the direct cost of the lost seeds and the cost of replanting, water mold also cause indirect losses through the reduced competitiveness of rice with weeds in sparse or irregular stands. Also, replanting or overseeding the field causes the rice to mature late when conditions are less favorable for high yields because of unfavorable weather and high disease pressure.

*Fig. 6-35. Water mold.*

*Fig. 6-36. Water mold caused by Achlya.*

*Fig. 6-37. Water mold caused by Pythium*

Water mold can be observed through clear water as a ball of fungal strands surrounding seeds on the soil surface (Fig. 6-35). After the seeding flood is removed, seeds on the soil surface are typically surrounded by a mass of fungal strands radiating out over the soil surface from the affected seeds. The result is a circular copper-brown or dark green spot about the size of a dime with a rotted seed in the center (Fig. 6-36). The color is caused by bacteria and green algae, which are mixed with the fungal hyphae.

*Achlya* spp. (Fig. 6-35) normally attack the endosperm of germinating seeds, destroying the food source for the growing embryo and eventually attacking the embryo. *Pythium* spp. (Fig. 6-37) usually attack the developing embryo directly. When the seed is affected by the disease, the endosperm becomes liquified and oozes out as a white, thick liquid when the seed is mashed. The embryo initially turns yellow-brown and finally dark brown. If affected seeds germinate, the seedling shoot and roots are attacked by *Pythium* spp. after the seedling is established, the plant is stunted, turns yellow and grows poorly. If the weather is favorable for plant growth, seedlings often outgrow the disease and are not severely damaged.

The disease is less severe in water-seeded rice when weather conditions favor seedling growth. Temperatures averaging above 65 degrees F favor seedling growth, and water mold is less severe. Seeds should be vigorous and have a high germination percentage. Seed with poor vigor will be damaged by water mold fungi when water seeded.

Treat seed with a recommended fungicide at the proper rate to reduce water molds and seed diseases. A list of recommended fungicides is available through LSU AgCenter extension agents. Most rice seed is treated by the seedsman and is available to the grower already treated. Seed-protectant fungicides differ in their effectiveness. Information on recent results from seed-protectant fungicide trials can be obtained from an extension agent or the Rice Research Station. In field tests, these fungicides have increased stands over those produced by untreated seeds from 25 to 100 percent.

## White Leaf Streak

White leaf streak is caused by the fungal pathogen *Mycovellosiella oryzae*. The symptoms are very similar to the narrow brown leaf spot symptoms caused by *Cercospora janseana* except that the lesions are slightly

*Fig. 6-38. White leaf streak symptoms.*

wider with white centers (Fig. 6-38). The disease is common on leaf blades some years but is not severe enough to warrant control measures.

## White Tip

This disease is caused by the nematode *Aphelenchoides besseyi*. Characteristic symptoms that appear after tillering include the yellowing of leaf tips, white areas in portions of the leaf blade (Fig. 6-39), stunting of affected plants, twisting or distortion of the flag leaf and distortion and discoloration of panicles and florets. Leaf tips change from green to yellow and eventually white. The tip withers above the white area, becoming brown or tan and tattered or twisted. Resistant varieties may show few symptoms and still have yield loss. The nematode infects the developing grain and is seed-borne. This disease is present endemically in Louisiana but is considered a minor rice disease. Fumigation of seeds in storage may reduce the nematode population. No other specific control measures are recommended.

*Fig. 6-39 White tip.*

# Scouting and management practices recommended for major rice diseases

## BACTERIAL PANICLE BLIGHT

### Scouting and Determining Need

Florets on young panicles become discolored and stay upright as the floret is sterile or aborts. Floret stems (panicle branches) stay green after the unaffected grain matures. Damage may vary from a single floret to all of the florets on a panicle. Damage is most severe during periods of unusually hot weather or unusually hot nights.

### Management Practices

Most commercial varieties are susceptible, but some show significant partial resistance. The pathogens are seed-borne and the pathogenic bacteria remain on leaves throughout the vegetative stages of the rice plant without showing symptoms. Panicles become infected as they emerge. No pesticides are currently recommended to control this disease. The best control measure is to not plant seed from fields that were seriously affected the previous year. A procedure has been developed to test seed lots for the pathogen and to quantify the pathogen. This procedure is not yet widely available. Avoiding excessive N rates and early planting can reduce disease.

## BLAST

### Scouting and Determining Need

Varieties with low levels of resistance should be scouted for leaf blast during the vegetative stages of growth. Leaf blast is more likely when the flood is lost, excessive N is used or rice is planted late in the growing season. Sandy soils and tracts near tree lines are areas where blast is likely to occur. Rotten neck blast has no predictive systems. Since significant damage is already done when rotten neck or panicle blast is first detected, preventive sprays are required on susceptible varieties when blast has been detected in the area.

### Management Practices

Plant varieties resistant to blast. Avoid late planting. Plant as early as possible within your recommended planting period. For leaf blast, reflood if field has been drained. Maintain flood at 4 to 6 inches. Do not overfertilize with N. Apply a fungicide if necessary. Contact your parish LSU AgCenter extension agent for the latest information on available fungicides and timing.

## SHEATH BLIGHT

### Scouting and Determining Need

Fields should be scouted for the presence of sheath blight symptoms at least once a week beginning at midtillering and continuing until heading. The field should be scouted by making periodic random stops throughout the field. Tillers should be examined for the presence of symptoms. When 5 to 10 percent of the tillers of a susceptible variety or 10 to 15 percent of the tillers of a moderately susceptible variety are infected, a fungicide application is justified.

### Management Practices

Avoid dense stands and excessive N fertilizer. Most long-grain varieties have little resistance to sheath blight. Medium-grain varieties are more resistant. Timing and rate of fungicide applications are critical for good sheath blight management. Check with your parish LSU AgCenter extension agent for the latest information on fungicides. Fallow periods, with disking to control grasses in the field (which serve as sources of inoculum) and break down crop residue, help reduce disease pressure.

## BROWN SPOT

### Scouting and Determining Need

Disease is most severe when plants are N deficient or under other stresses. Plants become more susceptible as they approach maturity.

### Management Practices

Maintain good growing conditions through proper fertilizer, land leveling, good soil preparation and other cultural practices. Use recommended seed protectant fungicides to reduce inoculum. Correct stress conditions in the field. All varieties are susceptible but some more than others.

## NARROW BROWN LEAF SPOT

### Scouting and Determining Need

Disease is most severe from panicle emergence to maturity. Several pathogenic races are present, and new races develop to affect resistant varieties.

### Management Practices

Some commercial varieties have acceptable levels of resistance to this disease. See LSU AgCenter publication 2270, "Rice Varieties and Management Tips Publication." Check with your parish LSU AgCenter extension agent for latest information on the use of available fungicides. Apply fungicides at the recommended rate and timing.

## STEM ROT

### Scouting and Determining Need

Most commercial varieties are susceptible. Infection takes place at the water line, and angular black lesions form. The number of infected tillers may reach 100 percent in areas of the field where debris and sclerotia from the previous crop have collected after being windblown on the water surface.

### Management Practices

Applying K will reduce disease severity where K is deficient. Early maturing varieties are less affected by stem rot. Destroying the sclerotia in stubble by crop rotation, tillage or burning can reduce disease pressure.

## WATER MOLD AND SEED ROT

### Scouting and Determining Need

The fungi causing this disease are soil- and waterborne. They occur in most rice fields. The seed rot and water mold diseases are most severe under flooded conditions when the water is cold.

### Management Practices

Seed should be treated with recommended fungicides. Check with your parish LSU AgCenter extension agent for recent information on effective seed-protectant fungicides. Draining the seeding flood and flushing as needed helps prevent water mold. The practice of pinpoint flooding helps reduce water mold damage. Seeding should not begin until the mean daily temperature reaches 65 degrees F.

## SEEDLING BLIGHT

### Scouting and Determining Need

The fungi causing this disease can be seed-borne or soil-borne. They are common and normally are present on seeds or in soil. Seedling blight is common in drill-seeded or dry- broadcast rice.

### Management Practices

Treating seed with seed-protectant fungicides effectively reduces seedling blight. Check with your parish LSU AgCenter extension agent for recent information on effective seed-protectant fungicides.

## GRAIN SPOTTING AND PECKY RICE

### Scouting and Determining Need

Since grain spotting and pecky rice diseases are normally associated with insect damage, scout for the rice stink bug. Monitor fields from immediately after pollination until kernels begin to harden. Sample with a sweep net and count the number of insects collected. Refer to LSU AgCenter publication 2270, "Rice Varieties and Management Tips" for current stinkbug control recommendations.

### Management Practices

Control of the stink bugs with insecticides is the only management measure for grain spotting and pecky rice.

## KERNEL SMUT, FALSE SMUT

### Scouting and Determining Need

No scouting is possible since disease does not appear until heading and control is ineffective after this stage.

### Management Practices

Excessive N increases diseases. Some varieties have resistance. Boot applications of certain fungicides reduce disease.

## LEAF SMUT, SHEATH ROT, SHEATH SPOT, LEAF SCALD, STACKBURN, ROOT ROT, ROOT KNOT, WHITE TIP, PANICLE BLIGHT, DOWNY MILDEW, BACTERIAL LEAF BLIGHT, BLACK KERNEL, CROWN ROT, CROWN SHEATH ROT, SHEATH BLOTCH, WHITE LEAF STREAK

### Scouting and Determining Need

These diseases rarely occur with enough severity to warrant control measures or scouting.

### Management Practices

Control measures are not available or recommended for these diseases. Varieties differ in their reaction to these diseases, but extensive evaluations have not been conducted.

Fungicides used to manage other major diseases reduce several of these diseases. Check with your parish LSU AgCenter extension agent for the latest information.