Chapter 11

Management of Rice Diseases

Yeshi Wamishe, Rick Cartwright and Fleet Lee

Despite advances in rice production technology, diseases remain a major cause of yield loss and lower profits on Arkansas rice farms. Diseases reduce yield and quality and increase production costs.

Disease impact on Arkansas rice production has increased over time. Use of high-yielding cultivars with less overall disease resistance and greater nitrogen (N) fertilizer requirements has increased rice yields but has also increased disease incidence. Rice is also now grown in shorter rotations, or no rotations, on increasingly less fertile soils and with decreasing irrigation capacity – all contributors to more severe disease.

The development of plant disease (epidemics) is governed by three factors over time, illustrated by the "Plant Disease Triangle"(Figure 11-1). These factors – susceptible cultivar, virulent pathogen and favorable environment – result in severe disease epidemics if all factors are present for a substantial period of time. If one of the factors is not present or if not all three are maintained long enough, then disease will be less severe or nonexistent.

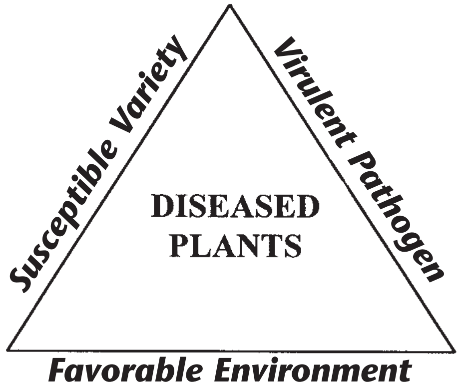


Figure 11-1. The Disease Triangle.

An example in rice is where a producer plants Francis (blast-susceptible variety) late in the spring in a field with a history of blast. Frequent light rains are experienced in June and early July, and the blast fungus (virulent pathogen) attacks the leaves, causing leaf blast. During the boot to early heading stages, the grower is unable to - maintain a deep (4 inches or greater) flood due to inadequate pumping capacity and/or poor water-holding capacity of the soil (blast-favorable stress on the plants). Frequent light rains return during this critical period, and temperatures are warm in the day and mild at night, resulting in heavy, extended dew when not raining (additional favorable environment). The result is a neck blast epidemic during heading and early grain fill and up to 80 percent yield loss (Photo 11-1).

Photo 11-1. Severe neck blast leads to blank panicles.

On the other hand, if hot, dry weather was present during the booting stage and/or if N application was not excessive and a deep flood maintained after mid-season, the same field suffers little yield loss from neck blast. This is because the environment was not favorable for spore infection and plants were more field-resistant to neck blast during the time when the cultivar was most susceptible (panicle emergence). Blast still remains an economically important disease when conditions are favorable (Photos 11-2a and 11-2b).

Photo 11-2a. **Severe leaf blast lesions on blast-susceptible cultivar in 2015.**

Photo 11-2b. Severe leaf blast causing plant death in 2014.

Sheath Blight

Sheath blight has been the most important rice disease in Arkansas and in the southern United States. Sheath blight is present in nearly every Arkansas rice field and causes a consistent level of damage each year. The disease is caused by a fungus called *Rhizoctonia solani* AG1-1A. Other crops grown in rotation with rice, including soybeans (Photo 11-3), corn, grain sorghum and various weedy grasses, also serve as host plants for the fungus – but rice and soybeans are most often damaged.

Photo 11-3. **Aerial blight of soybean symptoms caused by the sheath blight fungus of rice.**

The fungus survives between crops as "sclerotia" – hard, brown structures ⅛ inch or more in diameter that can lie dormant in the soil for at least two to three years (Photos 11-2 and 11-3). The fungus can also survive in infected rice straw or other crop residue but does not survive as long. In rice, the sclerotia (or infected debris) float out of the soil and may be moved around the field with irrigation water, rainfall or soil work. After the permanent flood is established, sclerotia infect the rice sheath at or just above the waterline in the late tillering to early reproductive growth stages. Sheath blight causes long, oval, purple-bordered lesions (spots) on infected sheaths (Photo 11-4) and bands of dying tissue in the leaf blades as it grows up infected plants (Photo 11-5). It spreads throughout the rice tissue by microscopic threads called hyphae and can grow at least an inch a day (24 hours) under favorable conditions. The fungus forms sclerotia on dying or dead tissue during the latter half of the rice-growing season. Sclerotia fall off the straw before or during rice harvest, assuring continued survival of the fungus in the field. Other sheath diseases are often confused with sheath blight, and careful identification is necessary to avoid unnecessary fungicide applications (Figure 11-2) (See Figure 11-3 for the disease cycle of sheath blight.)

Photo 11-4. **Young sheath blight lesions 10 days past ½" internode elongation.**

Photo 11-5. **Sheath blight damage later in the season with lesions and sclerotia.**

Conditions that encourage sheath blight include short, leafy rice cultivars (e.g., CL161 and Cocodrie); high N rates (>150 pounds N per acre) and hot, humid weather with temperatures between 80° to 92°F during

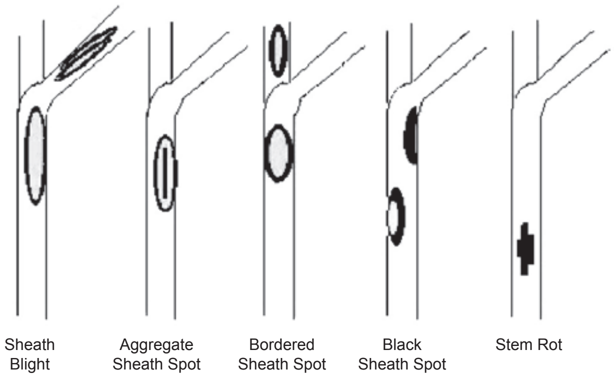


Figure 11-2. Early lesion types for various sheath diseases of rice – at or shortly after mid-season.

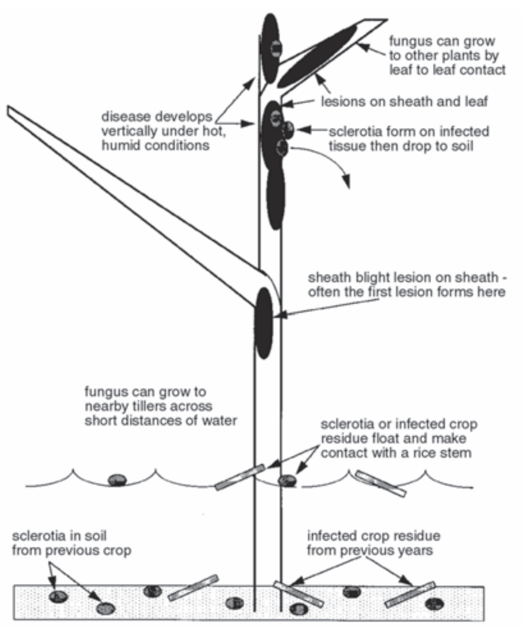


Figure 11-3. Disease cycle of sheath blight of rice.

the day and 74°F and above at night. Either hot, dry weather or cool temperatures can dramatically reduce the incidence and severity of sheath blight. Significant yield and grain quality losses result from widespread death of leaves in the mid to upper canopy prior to completion of grain fill or (rarely) direct infection of emerging panicles. Yield losses can reach 50 percent in heavily damaged areas of fields with highly susceptible semi-dwarf cultivars. However, yield losses of 5 to 30 bushels per acre are more common in "bad sheath blight" fields, depending on the cultivar. Quality (milling) losses of 1 to 3 percent of head rice have been documented in areas of fields where sheath blight reached the top two leaves prior to heading. Milling quality losses are less from sheath blight than from severe neck blast or kernel smut.

Management

- Plant less susceptible cultivars (Table 11-1), on fields with a history of sheath blight.
- Avoid thick stands; use a seeding rate that results in no more than 15 to 20 plants per foot.
- Use no more than the recommended N rate for the field and cultivar, especially at the preflood N timing. Research has shown that excessive N rates at preflood increase sheath blight activity.
- Scout fields from panicle initiation (Figure 11-4) to 50 percent heading. While scouting methods vary, remember that sheath blight is often a problem only in certain fields or parts of a field (Photo 11-7). Growers can lose money applying fungicides to fields or field areas that do not have a sheath blight problem.

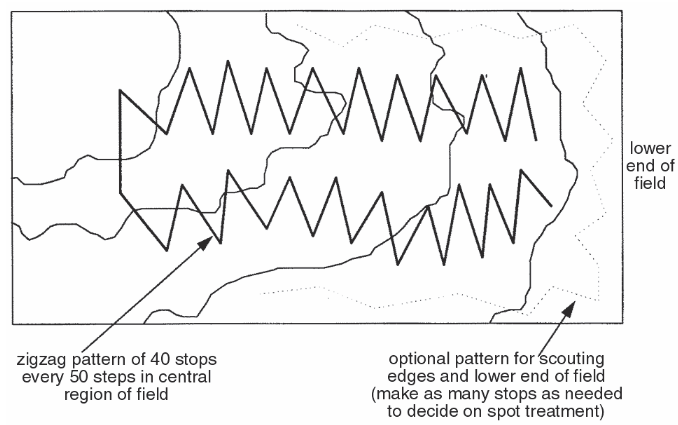


Figure 11-4. Recommended scouting pattern for sheath blight in a rice field.

Photo 11-6. Sclerotia of the sheath blight fungus on rice late in the season.

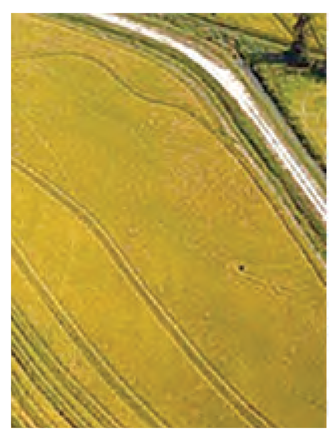


Photo 11-7. Patchy nature of sheath blight in the lower part of an Arkansas rice field. Light spots are small patches of sheath blight about three feet across.

- Use available effective fungicide if sheath blight is widespread in the field and threatening the upper two to three leaves before 50 percent heading. See Table 11-2 for sheath blight treatment thresholds and Table 11-3 for fungicide recommendations.

Table 11-1. Rice cultivar reactions to diseases, 2017.

Cultivar	Sheath Blight	Blast	Straight head	Bacterial Panicle Blight	Narrow Brown Leaf Spot	Stem Rot	Kernel Smut	False Smut	Lodging	Black Sheath Rot	Sheath Spot
CHENIERE	S	MS	VS	MS	S	S	S	S	MR	MS	--
CL111	VS	MS	S	VS	S	VS	S	S	MS	S	MS
CL151	S	VS	VS	VS	S	VS	S	S	S	S	MS
CL153	S	MS	--	MS	S	--	S	S	MR	--	MS
CL163	VS	S	--	MS	R	--	MS	--	MS	--	MS
CL172	MS	MS	--	MS	S	--	MS	S	MR	--	--
CL272	S	MS	--	VS	S	--	MS	--	MR	S	MS
COCODRIE	S	S	VS	S	S	VS	S	S	MR	S	--
DELLA-2	S	R	--	MS	MS	--	--	--	--	--	--
DIAMOND	S	S	--	MS	--	S	S	VS	MS	--	S
JAZZMAN-2	S	MS	--	VS	S	--	S	S	--	--	--
JUPITER	S	S	S	MR	MR	VS	MS	MS	S	MR	--
LAKAST	MS	S	MS	MS	MS	S	S	S	MS	MS	S
MM14	--	--	--	S	--	--	--	S	--	--	--
PVL01	S	S	-	S	-	-	-	VS	-	-	-
ROY J	MS	S	S	S	R	S	VS	S	MR	MS	MS
RT 7311 CL	MS	R	-	-	-	-	S	S	MS	-	-
RT CL XL729	MS	R	MS	MR	R	S	MS	S	S	S	--
RT CL XL745	S	R	R	MR	R	S	S	S	S	S	--
RTGemini214 CL	S	R	-	-	-	-	MS	VS	MS	-	MS
RT XP753	MS	R	MS	MR	R	--	MS	S	MS	S	--
RT XP760	MS	MR	--	MR	R	--	MS	VS	S	--	--
TAGGART	MS	MS	R	MS	MS	S	S	S	MS	MS	--
THAD	S	S	S	MS	-	-	S	VS	MR	-	MS
TITAN	S	MS	-	MS	-	-	MS	MS	MS	-	-
WELLS	S	S	S	S	S	VS	S	S	MS	MS	-

Reaction: R = Resistant; MR = Moderately Resistant; MS = Moderately Susceptible; S = Susceptible; VS = Very Susceptible (cells with no values indicate no definitive Arkansas disease rating information is available at this time). Reactions were determined based on historical and recent observations from test plots and in grower fields across Arkansas and other rice states in southern USA. In general, these ratings represent expected cultivar reactions to disease under conditions that most favor severe disease development.

Table prepared by Y. Wamishe, Assistant Professor/Extension Plant Pathologist.

Table 11-2. **Sheath blight treatment thresholds.**

Cultivar Reaction	Treatment Threshold (See Comments) Percent Positive Stops	Percent Infected Tillers	Comments
VS	35	5-10	Scout early, starting at PI and be prepared to treat as soon as canopy closes or shortly thereafter, but before upper leaves are infected.
S	35	5-10	Start scouting about mid-season (PD) and treat when positive stop threshold is reached AND when the upper canopy is being threatened (often early boot).
MS	50	10-15	Scout from 7 days after midseason (PD) to 50% heading. Treat when positive stop threshold is reached AND the upper 2-3 leaves are being threatened (often mid to late booting).
MR			Spraying is not usually warranted.
VS = very susceptible; MS = moderately susceptible; MR = moderately resistant			
SCOUTING: The entire field should be scouted for symptoms in a zigzag pattern stopping every 50 steps (Figure 11-3). Only a 3-ft long section of rice should be inspected at each stop for sheath blight symptoms. If symptoms are present the stop is positive. A minimum of 50 stops per field should be made or one per acre to determine the level of sheath blight for the field. If sheath blight is not widespread in the field but concentrated in certain areas, then treating only those areas with the fungicide may be more economical. While experience may be substituted for scouting in fields with a history of sheath blight, the economic use of fungicides depend on adequate knowledge of the distribution of the disease in a field and its intensity between ½" internode elongation and early heading.			

Table 11-3. **Fungicides recommended for rice sheath blight, kernel smut and false smut control/suppression.**

Disease	Fungicide	Active Ingredient	Rate/Acre	Comments[1]
Fungicides to control sheath blight should be applied when effective scouting indicates more than 35% positive stops in susceptible to very susceptible varieties or more than 50% positive stops in moderately susceptible varieties between panicle differentiation and early heading. Maximum benefit from a single fungicide application will be achieved when made before the disease has damaged the upper 3 leaves of the canopy.				
Sheath Blight	Quadris 2.08 SC	azoxystrobin	8.5 - 12.5 fl oz	Lower rates may not provide adequate control under some conditions. Do not apply near fishponds or apple orchards. Read and follow label application directions carefully. Use higher rates or two applications for severe sheath blight conditions on highly susceptible varieties – SEE LABEL FOR RESTRICTIONS.
	Stratego	trifloxystrobin + propiconazole	16 - 19 fl oz	
	Quilt Xcel 2.2 EC	azoxystrobin + propiconazole	14 - 27 fl oz	Tested rates for Quilt Xcel were 17.5 fl oz (contains about 10 fl oz Quadris and 5 fl oz Tilt) and 21 fl oz (contains 12 fl oz Quadris and 6 fl oz Tilt) in Arkansas.
	GEM	trifloxystrobin	3.8 - 4.7 fl oz	SEE LABEL FOR RESTRICTIONS AND DIRECTIONS.
	Sercadis	fluxapyroxad	4.5 - 6.8 fl oz	SEE LABEL FOR RESTRICTIONS AND DIRECTIONS.
	Elegia	flutolanil	32 fl oz	SEE LABEL FOR RESTRICTIONS AND DIRECTIONS.
	Artisan	flutolanil + propiconazole	40 fl oz	SEE LABEL FOR RESTRICTIONS AND DIRECTIONS.
Kernel Smut and False Smut	Tilt 3.6 EC	propiconazole	6 fl oz	Apply at early to late boot but before heading begins as a preventive treatment for kernel smut and/or to suppress false smut. Propiconazole fungicides can be tank-mixed with certain sheath blight fungicides or follow them as needed. Fields most likely to benefit will be those planted to a susceptible variety and fertilized heavily with nitrogen. SEE LABEL FOR RESTRICTIONS AND DIRECTIONS.
	Propimax	propiconazole	6 fl oz	
	Stratego	trifloxystrobin + propiconazole	19 fl oz	
	Quilt Xcel 2.2 EC	azoxystrobin + propiconazole	15.75 - 27 fl oz	

[1] Assumes proper application and typical weather. Adverse conditions may decrease the performance of fungicides. Fungicide performance is greatly enhanced when plants are grown using proper cultural practices including maintaining continuous deep flood (especially after the very early boot stage of growth) and use of recommended N rates for the variety. Proper cultural practices greatly enhance the field resistance of rice cultivars.

Disclaimer: The mention of proprietary products does not constitute an exclusive endorsement of their use and the label should always be consulted prior to use. Changes in labels and use recommendations often occur yearly, so you should consult the county extension agent or other knowledgeable person each year for the latest fungicide information.

Blast

Blast is an unpredictable disease which can cause severe yield losses under favorable environmental conditions. An airborne fungus called *Pyricularia oryzae* causes blast and is a worldwide problem in rice production. The fungus survives between crops on infected rice straw or on seed (Photo 11-8). As far as is known, rice blast only infects rice. Other forms of the blast fungus may attack certain grassy weeds, but these forms are unable to affect rice. The fungus can infect leaves, collars, nodes and panicles of rice plants. Distinctive, airborne spores (Photo 11-9) spread the disease. The blast fungus exists as a number of races; that is, genetically distinct biological variants infect certain rice cultivars but not others. New races emerge from time to time, in response to the planting of particular resistant cultivars and may overcome this resistance. For example, Pi-ta resistance, originally found in Katy rice and used extensively in new varieties since 1989, can now be overcome by a race of the blast fungus known as IE-1k – first noted in 1994 and that has since caused field damage on certain cultivars considered resistant.

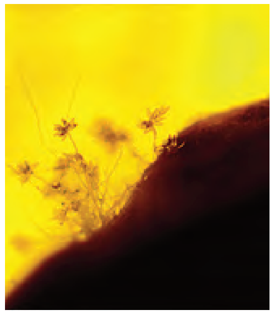


Photo 11-8. Rice blast fungus sporulating on surface of infected rice seed.

Photo 11-9. Spores of the rice blast fungus, highly magnified.

Photo 11-10. Leaf blast lesions on a blast-susceptible cultivar.

Blast lesions typically are spindle- to diamond-shaped spots on leaves. Lesion size varies from small to large depending upon plant susceptibility, with the most commonly observed field lesion having a reddish brown border and off-white to tan center (Photo 11-10). These lesions produce numerous airborne spores under favorable conditions. At heading, spores can infect the node below the panicle, resulting in "neck blast" (Photo 11-11) – the most damaging type of blast. (See Figure 11-5 for the disease cycle of rice blast disease.) Because blast spores need free moisture on the plant to cause infection, the disease is favored by long dew periods (9 plus hours) – increased by fog, shade or frequent light rains.

External Environmental Conditions

Blast is usually worse when temperatures are slightly cooler than those mentioned for sheath blight and in selected fields where environmental conditions promote long dew periods. Late seeding dates increase the likelihood of blast infection.

Photo 11-11. Neck blast symptoms on a blast-susceptible rice cultivar.

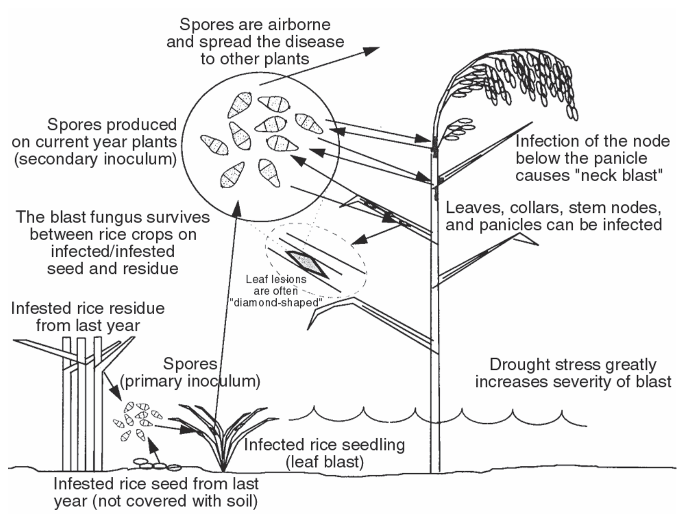


Figure 11-5. Disease cycle of rice blast disease.

Management

- Plant resistant cultivars, especially in fields with a history of blast or difficult to irrigate – but keep in mind that all cultivars may become susceptible over the years, should the fungus adapt and overcome the resistance in a particular cultivar – so all cultivars should be spot-checked for symptoms.
- Use clean, fungicide-treated seed.
- Plant early (April) to avoid the likelihood of heavy blast pressure late in the season.
- Use the recommended N fertilizer rate. Avoid high N rates or high organic matter soils, especially with susceptible cultivars in blast-prone fields.

- Maintain a consistent, deep flood (≥ 4 inches), especially after the drain and dry period for straighthead prevention. Avoid losing the flood or shallow floods, especially on susceptible cultivars.
- Periodically scout fields for leaf blast symptoms on all cultivars, even cultivars considered resistant. The best time to scout has historically been during June as leaf lesions tend to disappear once the plants enter the booting stages. If leaf blast is detected, increase the flood depth in the field for the rest of the season and prepare for preventative fungicide applications at early heading (Figure 11-6). See Table 11-4 for blast fungicide guidelines. Fungicides are not 100 percent effective but can limit lesion spore production and infection if combined with proper flooding practices.

For reasons not fully understood, several cultural practices greatly impact plant metabolic processes associated with blast resistance. High organic matter soils and/or use of high N rates increase susceptibility. Plants grown under consistent, deeper irrigation floods (≥ 4 inches) are much less susceptible to blast than plants that are grown under more shallow floods, moist soil or drought-stressed conditions (Figure 11-7). This flood response, which impacts

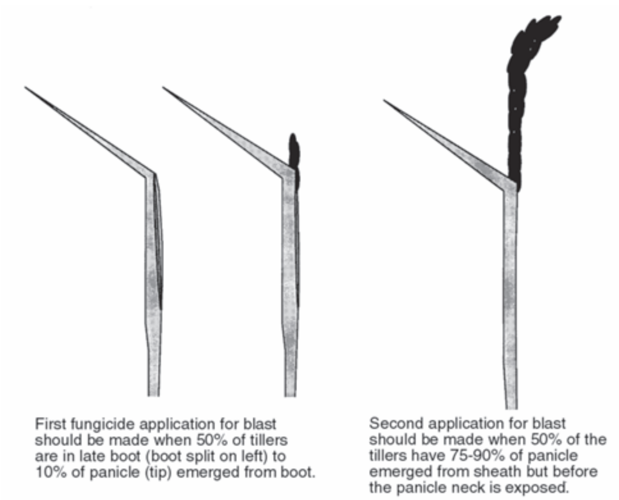
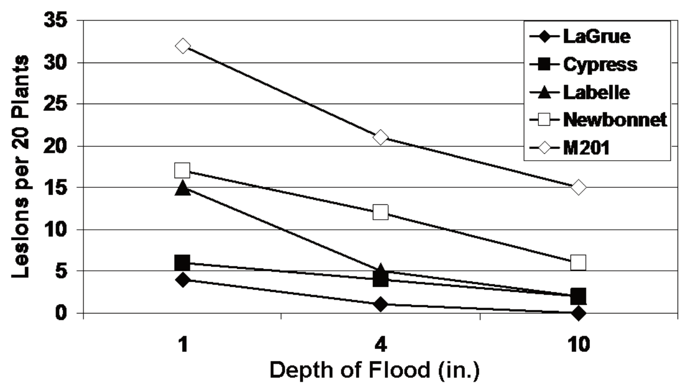


Figure 11-6. Growth stages of rice for proper application of fungicides to control neck blast.



Source: Lee et al. 1996. p. 139-144. *B.R. Wells Rice Res. Studies 1995.* Ark. Agr. Exp. Sta. Res. Ser.

Figure 11-7. Influence of flood depth on rice blast lesion development in five rice cultivars.

Table 11-4. Fungicides recommended for use in management of rice blast disease.

Disease	Fungicide	Active Ingredient	Rate/Acre†	Comments[1]
Neck Blast[2] (susceptible varieties – see notes and comments)	Quadris 2.08 SC	azoxystrobin	12.5 fl oz	Keep permanent flood depth of at least 4 inches to suppress early leaf blast and neck blast. Fungicides for neck blast work best if applied twice, the 1st at late boot and the 2nd when panicles of the main tillers are 50%-75% heading but when the neck is still in boot. SEE LABELS FOR RESTRICTIONS AND DIRECTIONS.
	GEM	trifloxystrobin	3.1 - 4.7 fl oz	
	Stratego	trifloxystrobin + propiconazole	19 fl oz	
	Quilt Xcel 2.2 EC	azoxystrobin + propiconazole	21-27 fl oz	

[1] Assumes proper application and typical weather. Adverse conditions may decrease the performance of fungicides. Fungicide performance is greatly enhanced when plants are grown using proper cultural practices including maintaining continuous deep flood (especially after the very early boot stage of growth) and use of recommended N rates for the variety. Proper cultural practices greatly enhance the field resistance of rice cultivars.

[2] No thresholds have been developed for blast. The presence of leaf, collar and/or neck lesions in the field or nearby fields of susceptible varieties triggers consideration of a fungicide treatment. Water management and flood depth greatly influence the development of blast. Refer to the latest variety ratings available through the county Extension office for further information. All varieties should be inspected occasionally prior to heading as the blast fungus can adapt and attack resistant varieties.

NOTE ON FUNGICIDES AND OTHER RICE DISEASES: We do not currently recommend fungicides for control of other rice diseases in Arkansas. Current fungicides used in rice are not recommended for bacterial panicle blight. Please consult the latest fungicide label for information on control of other rice diseases if deemed necessary.

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infection, lesion development and sporulation, is better manifested in poorly drained soils than in soils with an excessive internal percolation.

Stem Rot

Stem rot is a historically important rice disease in Arkansas and has recently become more so due to low levels of available potassium (K) in our silt and sandy loam rice soils. Fields with severe stem rot usually have low soil test K as a result of inadequate K fertilization.

Stem rot is caused by the fungus *Sclerotium oryzae*, which survives in the soil between crops as long-lived, tiny, black sclerotia. Like sheath blight, sclerotia of the stem rot fungus are moved around with soil and water. Sclerotia float on the surface of flood water, contact a rice stem and infect the sheath, causing a small, black, blocky lesion at or just above the water line (Photo 11-12). After sheath infection, stem rot grows primarily inward. If the fungus reaches the culm before grain fill is completed, the tiller dies, resulting in partially filled or blanked grains (Photo 11-13).

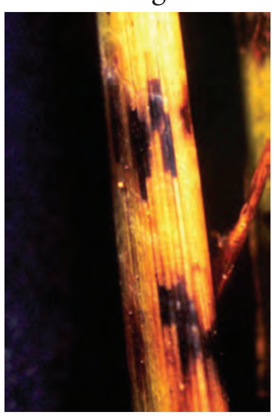

Photo 11-12. Stem rot lesion on rice.

Stem rot has been documented to cause up to 70 percent yield losses and 100 percent lodging in fields with severe disease (Photo 11-14). While slower to develop than sheath blight, stem rot can move rapidly into plants that have high levels of N or low levels of K in sheath and stem tissue. A tissue N:K ratio of 3:1 and above after mid-season strongly favors severe stem rot. All current cultivars of rice are susceptible to stem rot when grown on soils deficient in K.

Photo 11-13. Severe stem rot of rice (left) versus healthy rice stem (right). Photo taken during late grain fill period.

Management

- Soil sample on a regular basis (preferably in February before each rice crop), especially for silt and sandy loam soils.
- Apply K fertilizer as recommended by the soil test. On soils where salt injury to seedlings is a concern, K fertilizer can be applied immediately before or after flooding when plants are more mature and stable.
- Use the recommended rate of N fertilizer. Avoid excessive N rates.

Photo 11-14. Field of rice severely infected by stem rot. Rice was deficient in potassium.

Crown (Black) Sheath Rot

Crown sheath rot is a common sheath disease in Arkansas rice fields, especially where rice has not been planted on a consistent basis or on new rice fields. Once sheath blight and stem rot become common, black sheath rot is less noticed. Black sheath rot is caused by the fungus *Gaeumannomyces graminis* var. *graminis* and survives between crops on other grasses and infected rice straw.

The disease cycle on rice is not well understood, but symptoms are usually first noticed on sheaths from the green ring to ½ inch internode elongation (midseason) stages. A grayish-black to dark brown/black lesion up to 1 inch long and irregular in shape usually forms on the sheath just above the waterline (Photo 11-15). The inner part of the lesion is often lighter in color and has off-white to greenish-gray color. A distinguishing characteristic of the black sheath rot fungus is

Photo 11-15. Early crown (black) sheath rot of rice symptoms. Note irregular shape of gray-black lesions with lighter interiors.

the production of fan-shaped strands of dark brown hyphae called a mycelial mat that develops under the sheath (Photo 11-16). The mycelial mat can be observed on the underside of infected sheaths with a hand lens. Later symptoms include rotted sheaths and numerous black dots within older lesions (Photo 11-17). The black dots are tiny beaked spheres containing spores of the fungus (Photo 11-18). While yield losses up to 20 percent have been measured in inoculated research plots, losses in commercial fields are usually minor. Heavier yield loss may occur on highly susceptible varieties that have been overfertilized with N, planted extremely thick or grown on new rice fields.

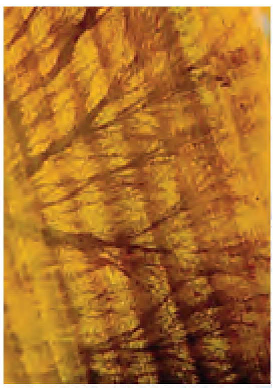

Photo 11-16. Mycelial mat of the black sheath rot fungus magnified with a hand lens. This is an identifying characteristic for this disease and can often be found on the underside of the infected sheath.

Photo 11-17. Rotted sheaths containing tiny black specks caused by black sheath rot later in the season.

Photo 11-18. Highly magnified view of one of the black specks from Photo 11-17 – perithecium of the black sheath rot fungus.

Management

- Plant a less susceptible cultivar in fields with a consistent history.
- Use a seeding rate that results in 15 to 20 plants per square foot. Avoid thick stands.
- Use only the recommended N fertilizer rate. Avoid excessive N rates.
- Fungicides at higher rates and earlier timings have provided some control of the disease but are generally not needed.

Kernel Smut

Kernel smut or black smut of rice became increasingly important during the 1990s. It has been considered an emerging disease since 2010. Yield losses of 10 to 30 percent have been measured on highly susceptible cultivars on occasion. Head rice yield losses of more than 6 points have been documented in severe cases. Smutted rice is undesirable for parboiling because it turns parboiled rice gray.

The kernel smut fungus is currently known as *Neovossia horrida* or *Tilletia barclayana*. The fungus survives as tough, microscopic black teliospores that replace the rice kernel during grain fill (Photos 11-19 and 11-20). The spores are extremely common in Arkansas rice areas, found in soil, equipment and water. The spores can literally be found in every field where rice has been grown.

Like stem rot, the spores of the kernel smut fungus float on water. Kernel smut spores germinate on the water surface and expel other spores (sporidia) into

Photo 11-19. Kernel smut on heavily fertilized rice.

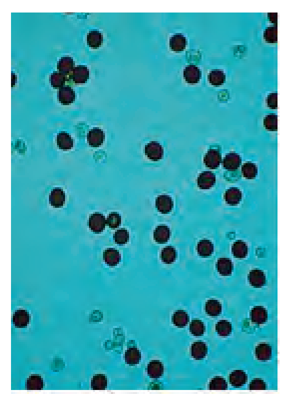

Photo 11-20. Heavily magnified spores of the kernel smut of rice fungus. These spores survive in the soil.

the air. The sporidia enter the flowers, infect and eventually replace the endosperm of the rice kernel with numerous black teliospores. During grain fill, alternate wetting and drying of the infected grain results in kernel rupture and release of the teliospores. Combines used to harvest heavily smutted fields often have a black, sooty coating of kernel smut spores (Photo 11-21).

Photo 11-21. Combine harvester covered with spores of the kernel smut fungus in a heavily diseased rice field.

Management

- Plant less susceptible cultivars in fields with a history of severe kernel smut (Table 11-1).
- Use only the recommended rate of N fertilizer. Avoid excessive N rates, especially at the preflood timing.
- Apply a fungicide containing propiconazole at the labeled rate and timing (booting stages preferred) to minimize kernel smut in fields seeded with a susceptible cultivar and that have had historical smut problems (Table 11-3).

False Smut

False smut disease, also known as orange or green smut, was first reported in Arkansas during 1997 but has been reported elsewhere in the United States for some time. False smut caused widespread concern in 1998, especially in northeast Arkansas, when environmental conditions apparently favored disease development. False smut is caused by the fungus *Ustilaginoidea virens* and survives in the soil or in contaminated rice grain as spore balls (galls). False smut results in the replacement of the rice kernel with an unsightly gall or in blanking of kernels under certain conditions.

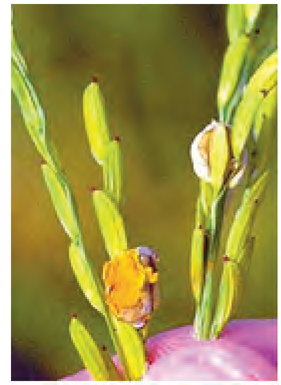

Photo 11-22. Very young spore balls of the false smut of rice fungus – note silvery white covering.

Galls rapidly develop within the infected kernel, emerging from between the glumes first as a silvery-white structure (Photo 11-22). When mature, the spore balls are ¼ to ½ inch in diameter and appear bright orange but later darken to olive-green or brown (Photo 11-23). When disturbed, the mature spore balls release tiny airborne spores that appear as orange dust. These spores likely infect later panicles, continuing the disease cycle late into the grain-fill season.

Factors that delay maturity seem to encourage false smut. For this reason, levees, herbicide-damaged areas, replanted areas and other problem spots may have a higher incidence of false smut than the rest of the field. False smut is primarily a quality problem in rice and has not caused heavy yield losses to date. The presence of large numbers of spore balls in harvested rice (Photo 11-24) is of concern to seed dealers and grain processors, since the spore balls must be removed before use of the rough rice. False smut is also a problem for rice intended for export as importing countries may reject rice due to phytosanitary concerns.

Photo 11-23. “Orange” spore ball stage of false smut. Uncountable microscopic spores are released during this stage and infect surrounding immature rice panicles.

Photo 11-24. Spore balls for false smut mixed with rice grain.

Management

- Plant less susceptible cultivars in fields with false smut history (Table 11-1).
- Plant early, before May 10 if possible. Late May and June plantings usually have a greater incidence of false smut.
- Avoid high N rates as this greatly increases disease.

Fungicides containing propiconazole suppress false smut if applied from boot to boot split stages; however, control is not as effective as for kernel smut. Fungicides applied after boot split are only about one-half as effective as boot applications and these later applications are currently illegal.

Bacterial Panicle Blight

Bacterial panicle blight (panicle blight) is caused by the bacteria *Burkholderia glumae* and *B. gladioli*. The bacteria are known to cause seed and seedling rot. However, the panicle symptoms appear at heading without prior warning. During grain fill, depending on disease severity, clusters of panicles do not fill out and turn over because they are blanked (Photo 11-25). Color of the blanked grain is uniformly tan at first, but it later turns a grayish color as other microorganisms invade. Sometimes there are aborted (tiny) kernels inside the hulls of affected grains. Also, there is often a large, reddish-brown lesion on the flag leaf sheath that may result in the death of the flag leaf (Photo 11-26).

Photo 11-25. Bacterial panicle blight on a very susceptible rice cultivar.

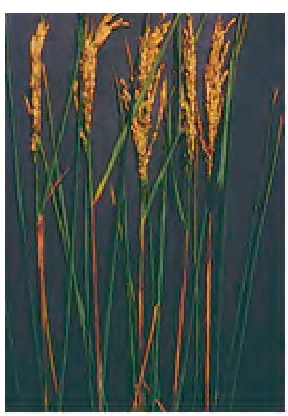

Photo 11-26. Brown flag sheath lesions of bacterial panicle blight that sometimes are observed, but not always.

Bacterial panicle blight has primarily been a problem on Bengal rice in Arkansas. This disease has been notably worse in very hot years like 1995, 1998 and 1999 in Arkansas, resulting in yield losses of up to 18 percent. However, in 2010 and 2011, the disease became widespread, causing yield losses up to 50 percent. *Burkholderia glumae* appeared to be the major bacterium and has been isolated from affected rice panicles and seed lots in Louisiana, Texas and Arkansas. The disease has likely been in the U.S. as an unidentified problem for many years. Conditions such as high night temperature, water stress, high nitrogen fertility, high seeding rate and late planting appeared to increase its incidence and severity. To date there are no labeled chemicals for use against bacterial panicle blight disease. Most of the commercial cultivars are susceptible to the disease (Table 11.1). Jupiter and some hybrid rice are moderately resistant.

Management

- Plant cultivars moderately resistant in areas where the disease has been consistent. A medium-grain variety, Jupiter, and some hybrids have shown some level of resistance in Louisiana and Arkansas field trials.
- Plant early (April) as late-planted rice has been more affected in the past.
- Avoid water stress (low) and excessive N rates.

Brown Spot

Brown spot is a historical rice disease that occasionally causes problems in Arkansas. The fungus *Bipolaris oryzae* (formerly *Helminthosporium oryzae*) causes brown spot. The fungus persists on infected rice seed and probably on infected crop debris. It has traditionally been a seedling disease problem under Arkansas growing conditions but can also attack the leaves and panicles of stressed rice plants. Rice suffering from N, K or P deficiency is especially susceptible to brown spot.

Photo 11-27. Highly magnified view of spores of the brown spot fungus.

The fungus has airborne spores (Photo 11-27) that infect the plant when free moisture is available. Infection causes oval-shaped lesions on rice leaves and grains. On resistant, healthy rice leaves, the spots are small and dark brown, staying less than ⅛ inch across (Photo 11-28). On susceptible cultivars or nutritionally deficient rice, the spots enlarge to ¼ inch or larger with a tan center and dark border (Photo 11-29) and may also damage the panicles (Photo 11-30). Brown spot lesions are occasionally confused with leaf blast lesions.

Photo 11-28. Typical brown spot leaf lesions on healthy rice.

Photo 11-29. Severe brown spot leaf lesions on potassium-deficient rice.

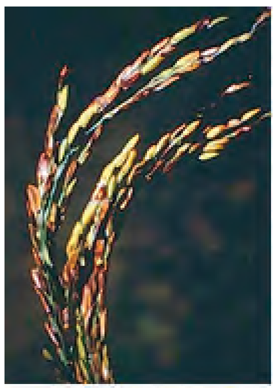

Photo 11-30. Severe brown spot disease of potassium-deficient rice panicle during 1994.

Management

- Plant cultivars that are resistant to brown spot.
- Use clean, fungicide-treated seed.
- Routinely sample and test soil for nutrients and apply the recommended fertilizers, especially K.
- Use the recommended rate and timing for N fertilization.
- Fungicides are not recommended for brown spot control, although several have activity against the fungus. On most cultivars, severe brown spot indicates a nutritional problem that fungicides cannot correct. Therefore, fungicide application to reduce disease incidence will not prevent yield reductions. Correction of the underlying nutritional problem(s) is essential for management of brown spot on rice.

Straighthead

Straighthead is a physiological disorder of unknown cause. Similar symptoms can be induced with arsenic under artificial conditions; however, various soils may result in straighthead symptoms. Straighthead is an old problem, usually on lighter textured rice soils of Arkansas. "Drain and dry" irrigation strategies currently used to control straighthead were developed by farmers in the early 1900s.

Symptoms are blanked or partially blanked panicles, often with some distorted (parrot-beaked) or only partially formed grains (Photo 11-31). **[Glyphosate (Roundup) herbicide drift on rice during reproductive growth stages can result in similarly distorted panicles, as well.]** In severe straighthead cases, the panicles may not emerge from the boot, and new tillers may emerge from nodes below the panicle. Affected plants may remain dark green through grain maturity in the field. Severely affected plants are often more common where the flood is deepest and most consistent, such as in barrow ditches. Although straighthead may be worse in some years than others, it generally reappears in the same fields or areas of fields each time rice is grown.

Photo 11-31. Straighthead of rice. Note the distortions (parrot-beaking) of the grains.

Management

- Plant less susceptible cultivars. Cocodrie, CL131, CL151, Cheniere and Mermentau are especially susceptible to straighthead, and water management for straighthead prevention is very difficult. Do not plant highly susceptible cultivars on fields with a history of straighthead.
- Drain the field to aerate the soil and roots according to the DD50 predicted time frame. Draining and drying of the soil must be thorough for maximum control but may increase the chances of blast disease later. For this reason, blast-resistant cultivars with good straighthead resistance should be considered for fields with severe straighthead histories.

- Fields with silt or sandy loam soils high in organic matter (i.e., freshly cleared ground) or a history of cotton production favor straighthead.

Autumn Decline or Akiochi

This is another physiological disorder of rice thought to be caused by hydrogen sulfide (H_2S) toxicity to rice roots grown in highly anaerobic flooded soils. Rice roots turn black and eventually die and rot, resulting in wilting, yellowing, stunting and sometimes death of the plant. Eventually, the crown rots internally (Photo 11-32) and adventitious roots develop from nodes in the flood water as plants try to survive the loss of the roots and crown. Traditionally, fields diagnosed with this disorder had very high levels of sulfate in the soil and irrigation water, and rotten egg odor (H_2S gas) was noticed. In recent years, other fields have shown symptoms, especially in cold water areas. A large quantity of undecomposed crop residues present at the time of flooding can increase the sulfur reduction process and aggravate this disorder.

Photo 11-32. Rice roots with autumn decline possibly caused by hydrogen sulfide toxicity compared to healthy roots.

Management

- Scouting of historical problematic fields should be conducted starting 10 days after permanent flood. For fields with known history of black root rotting problem, follow preventative strategy, i.e., "drain and dry," as is done for straighthead and at same timing. Once roots start to discolor, draining the field for aeration is the recommended option. The field does not have to be thoroughly dried. As soon as healthy, white roots appear, a shallow flood can be established. For fields with no history, follow rescue strategy. Drain to allow oxygen into the soil. Draining the flood can be risky late in the growing season, when symptoms are often noticed, due to the chance of possible blast infection or drought damage when water is limited. However, only a short time is needed for new root growth, which helps prevent or minimize potential blast or drought damage from flood removal.
- If the water is the source of sulfur, a different water source should be used. Have the water source tested if in doubt.
- Short-season rice cultivars may escape some damage and should be considered for fields with a history of this problem.

Narrow Brown Leaf Spot

Narrow brown leaf spot has been a minor, late-season disease of rice in Arkansas. Traditionally, it has little effect on yield or quality loss, but it caused problems late in 2006. Narrow brown leaf spot is caused by the fungus *Cercospora oryzae* and can infect leaves, sheaths and panicles. The fungus is airborne and probably survives between crops in residue and on seed.

Photo 11-33. Narrow brown leaf spot lesions on Kaybonnet rice.

Symptoms on leaves are usually first noticed as very narrow, reddish-brown lines (less than ¼ inch long) on the leaf (Photo 11-33). Later, the fungus invades the aging sheaths, forming netted reddish-brown discolored areas that may resemble the collar rot symptom of blast (Photo 11-34). Affected sheath lesions are irregularly shaped and can be several inches long. Lastly, the fungus can infect the node area just below the panicle or tissue just above the node, causing a dark brown discoloration

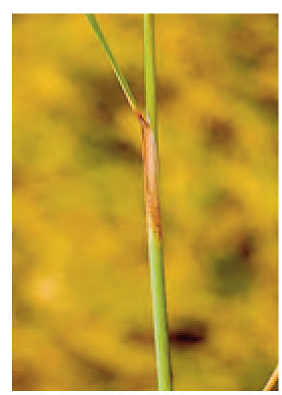

Photo 11-34. **Narrow brown leaf spot lesion on sheath of Kaybonnet rice late in the season.**

that appears similar to neck blast. Although their appearances are similar, blanking from narrow brown leaf spot is minimal, and the described symptoms usually develop only near the completion of grain fill. Some spikelets and individual flowers may be blanked by this disease, especially in no-till fields or in years with repeated light rainfall or other moisture during heading.

Management

- Where known, avoid highly susceptible cultivars (Table 11-1) if this disease becomes a consistent problem.
- Maintain a good fertility program based on routine soil testing.
- Plant early to escape late-season disease buildup.
- If a concern, fungicides containing propiconazole can be used during the booting stages to prevent or minimize this disease, according to the experience of Drs. Groth and Krausz of LSU and Texas A&M.

Other Minor Diseases

There are several other diseases of rice in Arkansas. None cause routine problems but may occasionally cause yield loss in specific circumstances or may be confused with more important diseases.

Bordered sheath spot, caused by the fungus *Rhizoctonia oryzae*, and **aggregate sheath spot**, caused by the fungus *Rhizoctonia oryzae-sativae*, are commonly found in Arkansas rice fields but do not cause yield losses on current cultivars. Sheath lesions caused by *R. oryzae* are similar to sheath blight lesions but usually stay only on the sheath, are smaller and more rounded and have a thick, dark brown border (Photo 11-35). Sheath lesions caused by *R. oryzae-sativae* are usually small and circular or long and oval but almost always have a thin, brown vertical line in the center of the lesion – especially if viewed when held up to the light (Photo 11-36). While these diseases alone are not important, both diseases have caused unnecessary fungicide applications for growers who believed the diseases to be sheath blight.

Photo 11-35. Bordered sheath spot of rice, sometimes confused with sheath blight lesions.

Leaf smut, caused by the fungus *Entyloma oryzae*, is often observed on the upper leaves of rice overfertilized with N. It is increased by the same factors that favor kernel smut, and often the two diseases are noticed on the same plants. Leaf smut symptoms include small, rectangular black spots on the leaves (Photo 11-37). Leaves with a large number of lesions may have a dark appearance. While fungicides are not recommended for control, leaf smut is very sensitive to propiconazole and has been used in the past to demonstrate fungicide activity in treated fields.

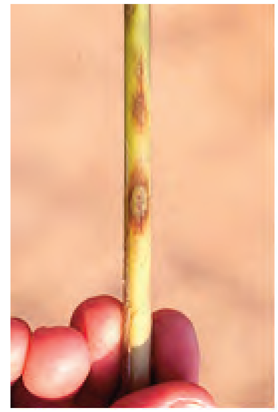

Photo 11-36. Aggregate sheath spot of rice. Note brown vertical line in the center of the lesion.

Sheath rot, caused by the fungus *Sarocladium oryzae*, is sometimes confused with sheath blight, a major rice disease in Arkansas. Under our growing conditions, sheath rot is almost always associated with panicles injured in the boot stage by insects, herbicides or other factors. Thus, affected plants are often found near the edges of fields. Affected panicles are blanked or partially blanked, and infected kernels turn a characteristic chocolate brown after the panicle emerges. Panicles that do not emerge from the boot often rot and have dark brown lesions on the flag leaf sheath (Photo 11-38).

Photo 11-37. Leaf smut of rice. Note tiny black, rectangular leaf spots. Photo by M.C. McDaniels.

Scab, caused by the fungus *Fusarium graminearum*, is the same disease as head scab of wheat. Individual grains or spikelets are typically infected

Photo 11-38. Sheath rot of rice, usually found around the edges of field or where rice has been injured.

and killed by the scab fungus, which produces bright orange spore masses on the dead grains (Photo 11-39).

Scald, caused by the fungus *Microdochium oryzae* (*Gerlachia oryzae*), can produce spores. The disease shows up occasionally in wet summers in Arkansas. The fungus invades the ends or sides of leaves, producing characteristic bands of discolored tissue, with different shades of brown (Photos 11-40 and 11-41).

While none of these minor diseases are of much concern now, as cultivars and cultural production practices change to increase yields and production efficiency, conditions may become favorable for these diseases to be more threatening.

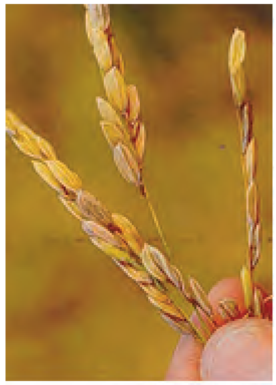

Photo 11-39. Head scab of rice – note the orange color on infected kernels (spore masses of the fungi) and the brown lesion at the base of the kernel.

Photo 11-40. Scale of rice.

Photo 11-41. Highly magnified view of spores of the scald of rice fungus.