Management of Rice Sheath Blight and Blast in Arkansas

Sheath Blight

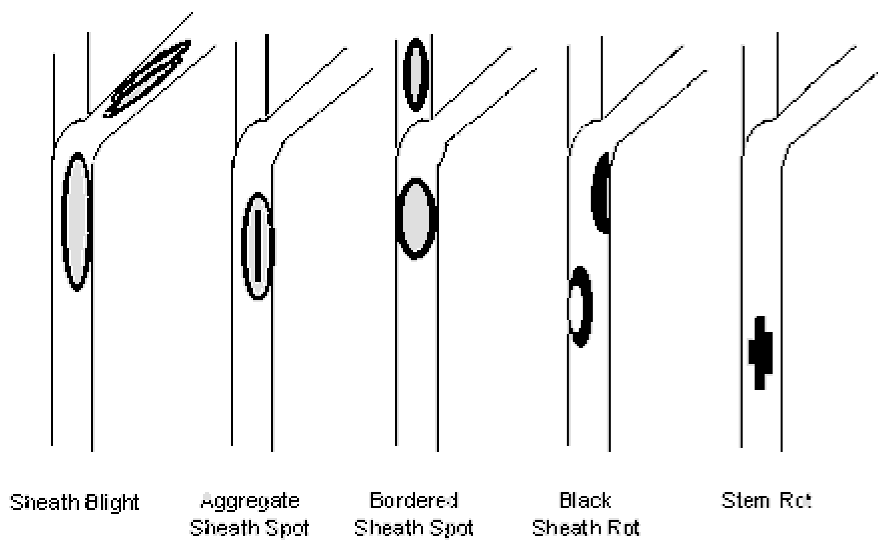
This important disease of rice is very widespread in Arkansas and easily found in 50-66% of rice fields. It can reach to damaging levels in most long term rice fields growing highly susceptible semidwarf long grain rice varieties. Actual yield loss to sheath blight appears to have lessened somewhat with the development of more tolerant varieties and improved cultural practices employed by many farmers. However, yield losses of 5-15% are still fairly common in many fields. Losses of 50% and greater, reported in the 1980's on Lebonnet and other very susceptible varieties, are now only rarely observed and in most cases are confined to smaller areas of fields. Before 1970, sheath blight was only a curiosity in Arkansas, but with the introduction of shorter and more susceptible varieties during the 1970's - 1980's, the increased use of nitrogen fertilizer for higher grain yields on these varieties, alternate year rice rotations, and reduced tillage practices, sheath blight rapidly became the most widely established rice disease in the state. Sheath blight is more consistent but much less dramatic than blast, causing routine problems and losses in many fields each year. Weather can affect the severity of the disease with hot, humid years resulting in greater damage state-wide than years with cooler summers.

Symptoms - Sheath blight is usually not noticed until late tillering to midseason (panicle differentiation). Early symptoms include oval sheath spots (lesions) at or just above the water line, often at the junction of the leaf and sheath. Early lesions are pale green to off-white with a narrow purple-brown or brown border, usually 2" or less wide and 1-2" long on most varieties. Lesions may join as the disease moves up the plant. Both sheaths and leaves are commonly attacked and killed as the disease grows upward (**Picture 1**).

Picture 1. Sheath blight disease lesions

Other sheath spot diseases sometimes confused with sheath blight include black sheath rot *(Gaeumannomyces graminis* var *graminis*), stem rot (*Sclerotium oryzae*), aggregate sheath spot (*Rhizoctonia oryzae-sativae*), and bordered sheath spot (*Rhizoctonia oryzae*) (Fig.1). The first two diseases have black or gray-black lesions on the leaf sheaths. Aggregate sheath spot lesions are very similar to sheath blight lesions but have a narrow, brown vertical line in the center of the lesion, do not tend to overlap, and the disease rarely attacks the leaf blades. Bordered sheath spot lesions also tend to be separate and distinct, be more brown in color, have wide dark brown borders, and usually only appear on the sheaths (Fig.1).

Fig. 1. Early lesion types for various sheath diseases of rice - at or shortly after mid-season.



Sheath blight can grow from plant to plant, either across narrow stretches of water or from leaves touching other leaves. The disease may move 1" per day up the plant under ideal conditions of cloudy weather, high temperatures (82 - 90 F), and high humidity (95%+) in the rice canopy. Sclerotia of the fungus are formed on the sheaths and leaves as early as a week after leaf and sheath lesions are seen, but are more typically observed on infected rice in the boot to heading stages. Sclerotia are initially white and slightly fuzzy, rapidly turning brown with an irregular shape. They average about 1/8" in diameter, resembling tiny potatoes with the side next to the plant being flat or concave, and eventually fall to the ground where they survive until the next host crop. On current varieties, the bottom portion of panicles on heavily infected tillers will blank if the disease destroys the flag leaf before grain fill is complete. Sheath Blight can infect the panicle under severe conditions, destroying all grain fill, and stick the panicle together into a vertical "spike" with its hyphae (microscopic fungal threads).

Cause - Sheath blight is caused by the fungus *Rhizoctonia solani* AG1-1A, also called *Thanatephorus cucumeris*. This fungus is very widespread in agricultural crops, but exists as many forms under this one name. The form attacking rice can also attack soybeans, causing aerial blight, and persist on other summer crops like corn or grain sorghum. It can also attack many grassy weeds in and around fields under the right environmental conditions. While it can infect these other hosts, the fungus causes the most damage to rice. *R. solani* overwinters in the soil as long-lived and tough sclerotia, and grows on infected plants as microscopic hyphae (threads). It also forms a sexual stage on rice, which appears as a thin white layer on the lower plant stems that looks like frost, shortly after midseason and then disappears. Little is known about the role of this stage in nature.

Disease Cycle - Sheath blight is a modified single cycle disease. This means that the fungus infects a plant and does not produce a new generation on that plant which will attack other plants the same season. This differs from blast, a multiple cycle disease, which infects then produces several generations of spores that in turn infect other plants in the field the same season. Sheath blight grows from plant to plant, however, so an initial infection can spread short distances (usually 3 ft. or less) in the same growing season. Thus, sheath blight is the type of disease that tends to build up via accumulated sclerotia in the same fields or areas of fields, attacking the plants in these areas each time rice is planted, but usually does not spread to uninfected field regions during a single growing season.

Sheath blight starts when a sclerotium or a piece of infected plant stem from a previous season floats to the surface of the flood water and comes into contact with a rice stem (Fig.2). The fungus grows out onto the sheath at the flood line and begins growing upwards on the plant, occasionally penetrating the sheath and causing a lesion or spot, and to nearby plants in the row. As the rice plant shifts to the reproductive stage (panicle differentiation or midseason) the disease becomes more aggressive, causing larger lesions and damage and growing upwards more rapidly. The fungus eventually reaches the upper leaves or panicles (blows out the top) resulting in damaged "circles" or patches up to several feet in diameter in the field. These are readily observed from the combine during harvest and are often congregated in lower ends of fields or near levees and field edges where sclerotia and infected plant debris are congregated over time by rainwater between crops or flushing and initial flooding of each rice crop. Factors that increase the disease include consistent use of highly susceptible semidwarf long-grain rice varieties, short rotations (rice each year or every other year), overuse of nitrogen fertilizer, and reduced tillage practices that encourage the survival of the fungus.

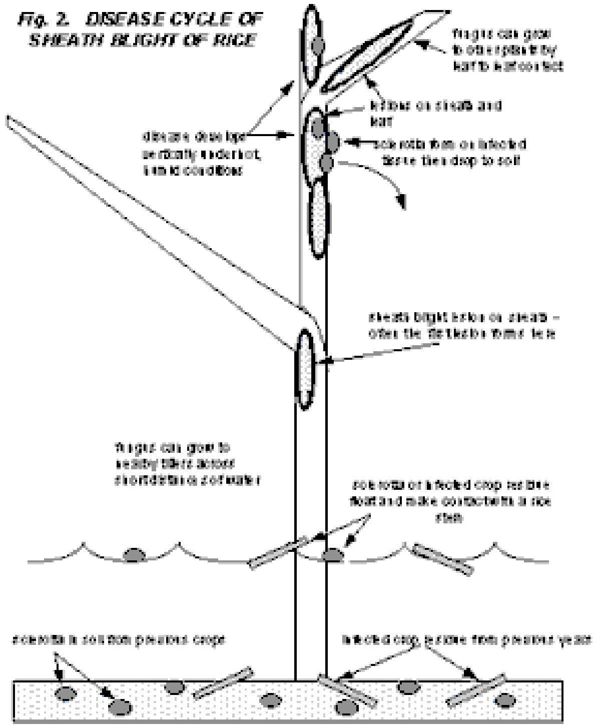


Fig. 2. DISEASE CYCLE OF SHEATH BLIGHT OF RICE

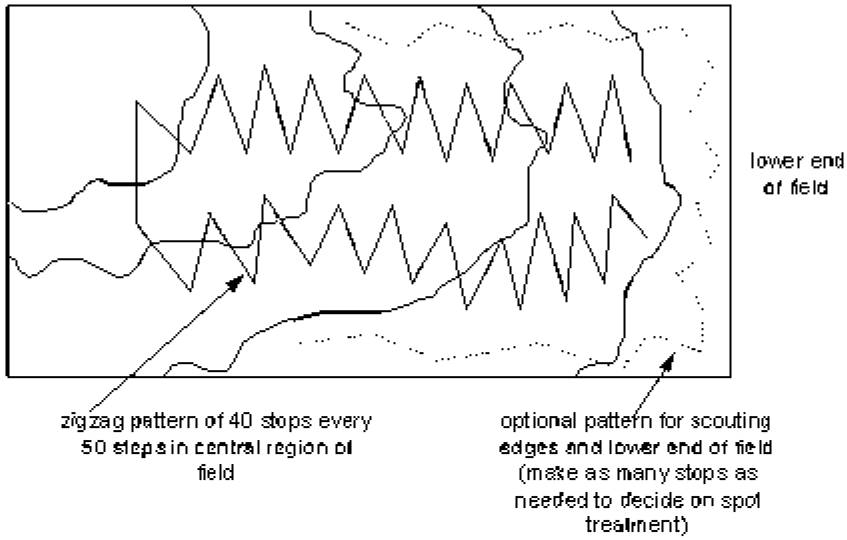
Management - There is no "silver bullet" control method for sheath blight. Control is largely based on adopting a rice production system that allows one to "live with" the disease, reducing the inevitable loss as much as possible. We recommend a three-pronged attack against the disease: 1) growing more tolerant varieties; 2) using cultural practices not favorable to the disease; and 3) fungicides when disease levels exceed a threshold level in a particular field. Tolerant varieties are the first option that should be considered. While all varieties are somewhat susceptible to damage under the right conditions, taller, open-canopied types have much less yield loss from sheath blight than the semidwarf varieties. This is probably due to several factors, but the simple fact is that damage is mostly due to the disease destroying the upper two leaves before grain fill is complete - and this is harder for sheath blight to accomplish on a 40-42" tall variety than on one 36" tall or less. The taller types also tend to have a more open canopy for more sunlight penetration and lower humidity than the shorter versions, slowing the disease. Also, long grain varieties are more susceptible than medium grain varieties, so if medium grains can be grown on historical sheath blight fields, so much the better. Many county agents, consultants and farmers have recognized the value of rotating tolerant varieties on sheath blight problem fields for several years now and, when combined with other appropriate cultural practices, this has resulted in more consistent and higher rice yields than before, without the need for fungicides.

Cultural practices greatly influence long and short term sheath blight problems. Rice grown each year or every other year will quickly develop more widespread and severe sheath blight than when grown every third year. This is because the fungus does not survive at high levels more than two years in the soil without a susceptible host, whether as sclerotia or infected debris. On the other hand, once introduced into a field, some of the fungus -

however small the percentage - will survive long periods and is almost impossible to eliminate solely with rotation out of rice. Seed producers routinely rotate out of rice for two years to control red rice, and their fields have much less sheath blight than commercial rice fields in every other year production. Reduced tillage also increases sheath blight in the long term because the fungus survives better when infected debris and sclerotia remain undisturbed between crops. Both tillage and burning destroy at least some of the fungus in infested fields and while the disease may still be a noticeable problem, it could be even worse without these practices. During the growing season, two cultural practices greatly influence sheath blight. The first is thickness of stand and the other is the amount of nitrogen fertilizer used on the crop. Most modern rice varieties tiller very well and do not need to be planted that thick in order to have enough tillers for maximum yield potential. Research has consistently shown that an initial uniform stand of 15 - 20 plants per square foot (9-12 per row ft on 7" drill spacing or 13-17 per row ft for 10" drill spacing) results in the most consistent and highest yields. Lower or higher populations than this are less consistent and have increased risks either from more weed and insect problems (low populations) or disease problems (high populations) and will more often result in reduced yields. In the case of sheath blight, high plant populations result in less vigorous tillers due to plant competition and a denser canopy earlier, which favors the disease through increased humidity and less air circulation.

Excess nitrogen fertilizer is the single biggest cultural practice favoring more severe sheath blight during the growing season. This can often be observed at the edges of fields where the disease is much higher on plants where nitrogen is "lapped" than in areas receiving a normal nitrogen rate. Sheath blight appears to explode upward on plants receiving too much nitrogen fertilizer because plants are more lush and free nitrogen in the cells can be used by the fungus for rapid growth. While it is critical to use adequate nitrogen on modern cultivars to obtain high yields, higher rates than recommended for the variety, especially during tiller elongation, can mean much more damage. While less is known about the effect of other nutrients on sheath blight, it is likely that potassium deficient rice plants are more susceptible to the disease - as is the case for other rice diseases like stem rot and brown spot. It is always wise to soil test frequently in today's intensive cropping systems and fertilize accordingly.

Fig. 3. Recommended scouting pattern for sheath blight in a rice field.



Fungicides are the last weapon in our sheath blight control arsenal and have tended to be the weakest link historically. Consistent control and especially economic return from the use of currently registered fungicides has been very difficult to demonstrate in commercial fields. This is due to several factors including the patchy nature of the disease in most fields, limited effectiveness of currently registered fungicides at labeled rates, difficulty in applying the fungicides evenly in the rice canopy with airplanes, and the high cost. The patchy nature of the disease can be easily seen in aerial photographs and often shows the disease congregated in lower ends of fields or near edges. When considering a fungicide, this means that a large portion of a field may have few or no infected plants while a smaller area may have many. The point is, a farmer pays to treat the whole field, but only the infected areas will get any benefit. Common sense says that this 'patchiness' makes it very difficult for the fungicide to pay for itself, much less result in profitable control, unless sheath blight is widespread in the field. Another characteristic of the disease is that it causes yield loss only if it is able to destroy the upper two leaves of infected plants before grain fill is complete. All tillers can be infected at midseason, but if the disease does not move to the upper leaves, little or no loss can be measured. In years where temperature and humidity are lower after tiller elongation starts, such as in 1994, 1996 and recently in 2012, most fungicide applications for sheath blight were probably wasted, since weather slowed the disease dramatically. The above factors mean that a farmer must make the best guess possible as to whether or not a fungicide application will be profitable, so it is critical to scout the fields to be treated. Not only is it important to scout, but it is essential to scout effectively. With a disease like sheath blight - and given the size of modern rice farms and the limited number of people available to scout - scouting properly is difficult. The number of samples needed and man-hours required are just too great. We recommend the following system that is barely adequate but better than nothing. Scouting a rice field should be done in a zigzag fashion through the central and largest part of the field. Lower ends and edges should be scouted separately. We recommend the positive stop method because it is faster and easier to use than other methods while still providing useful information. Our definition of a positive stop is any infected tillers within a 3 ft long section of rice that you have bent over to inspect at or after midseason. The 3 ft section can be a row length, if drilled, or merely a 3 ft length bent over if broadcast. A "tee-stick" made of PVC pipe with a 3 ft horizontal length and 4 ft handle is of great help in scouting. Construction is simple and cheap and every rice county agent or rice consultant can advise on how to make them. When scouting, the human eye will naturally try to focus on diseased areas in the field, because these stand out from healthy rice. For this reason, we recommend walking a zigzag pattern stopping every 50 steps to check for sheath blight. When walking, it is important not to look for the disease so the eyes should be focused in the distance. At 50 steps, stop and bend over a random length of rice and look at that 3 ft section and only that section. If any sheath blight is found, count the stop as positive. Make 40 stops minimum in a normal rice field of 40 acres or more and keep up with the number of positive stops. Divide the number of positive stops by the total number of stops to determine the percent positive stops for the field. On susceptible semidwarf varieties, we suggest not treating unless the field has at least 35% positive stops in the scouted area. Even then, a decision to actually spray should be delayed until the disease is moving aggressively up the plant and threatening the upper 2-3 leaves. While we recommend beginning scouting at panicle differentiation or mid-season, it is usually better to wait to apply a fungicide until the upper leaves are being threatened by the disease. In other words, if you have enough positive stops to treat, wait until the disease has moved up the plant to the flag minus 2 leaf on average. The idea is that, considering everything, it is better to protect the upper canopy as long as possible at the least expense. Since the average cost for a single fungicide application is $20 - $35 per acre, it is imperative to do it right.

In Arkansas, Quadris, has been used for a while to manage sheath blight in rice. A single 0.2 lb/ac active ingredient rate (12.3 fl oz of Quadris Flowable per acre) suppressed sheath blight vertical development between 21 and 30 days in 1996 field trials. No surfactant was used. The average length of suppression appeared to be 24 or so days. This should protect the upper canopy in most cases through much of the grain fill period if applied at 10-14 days after midseason, which is a normal recommended timing for a single application of a fungicide to suppress sheath blight. An effective fungicide should improve control of this difficult disease. However, the economics of any fungicide need to be determined, and no matter how effective, there are many fields that will not need to be treated. Simply put, if there is not enough sheath blight in a field to justify treatment or if weather does not favor vertical development, fungicides will not be profitable. Fungicides that are currently used for sheath blight control are listed below (Table 1.) with their recommended rates.

Table 1: Fungicides recommended to managing rice sheath blight

Fungicide	Active Ingredient	Rate/Acre	Comments
Quadris 2.08 FL®	azoxystrobin	8.5 – 12.3 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
GEM®	trifloxystrobin	8-9.8 fl oz	
Stratego®	trifloxystrobin +	16 – 19 fl oz	

	propiconazole		applications for severe sheath blight conditions on highly susceptible varieties like Clearfield CL161 – SEE LABELS FOR RESTRICTIONS.
Quilt®/Quilt Xcel	azoxystrobin + propiconazole	14 – 34/14 - 27 fl oz	Also helps suppress kernel smut and false smut with proper timing. Highest rates should be used earlier in the season and lower rates should be tank-mixed with Quadris to increase sheath blight control under certain circumstances. Read label for instructions.

Blast

This is the other major rice disease in Arkansas, causing sometimes dramatic yield losses on susceptible varieties, altering what a farmer can or cannot grow, and costing large amounts in breeding for resistance and other control options. Blast is important world-wide and known since ancient times as a devastating problem in Asia. It is traditionally a bigger problem on lighter soils with poor irrigation and less a problem in water-seeded or properly irrigated rice.

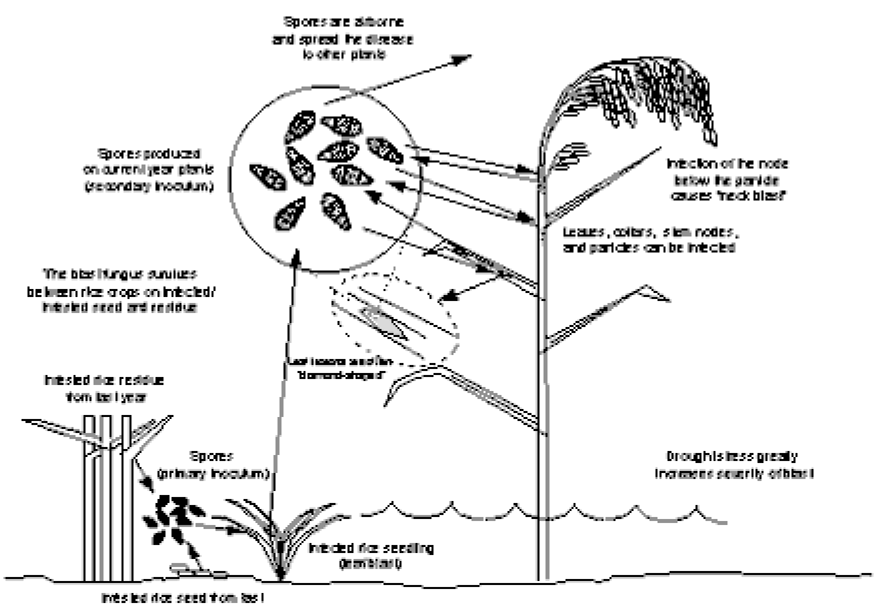
Symptoms - Blast is a foliar disease (**Picture 2**), attacking above-ground plant parts but most commonly found on leaves (leaf and collar blast) or the panicles (neck and panicle blast) (**Picture 3**). On the leaves, very early lesions (spots) are off-white to gray-green in color with a dark green border and only 1/16 - 1/8" across. These spots rapidly turn gray or gray-white in the center with a brown to reddish brown border and typically enlarge to 1/2" - 1" long by 1/8 - 1/4" wide. They are often wider in the middle than at the ends and diamond-shaped, although they may appear as narrow oval-shaped or irregular on some varieties. On highly susceptible varieties, such as the California types, lesions may be several inches long or the entire leaf may die within a week. About a week after infection, the fungus sporulates within the lesion producing a dark, gray powdery appearance, especially in the early mornings or on the underside of the lesion during the day. It is very common for blast to attack the base of the flag leaf (collar blast), prematurely killing it, and infecting the sub-panicle node as it exerts through this infected area. Other leaves on the plant can also be afflicted with collar blast on certain varieties. Lower nodes can also be infected, turning dark gray or black, and resulting in lodging. At heading, blast attacks the node just below the panicle (neck blast) killing the entire panicle before grain fill is complete. This sub-panicle node is darkened and often covered with spores of the fungus and the panicle will remain upright and bleach off-white, resulting in a characteristic "white-head" symptom when seen from a distance. In some cases, blast attacks only parts of the panicle, killing individual spikelets or flowers.

Picture 1. Leaf blast (left); **Picture 2**. Neck blast (right)

Cause - Blast is caused by the fungus, *Pyricularia grisea* (formerly *Pyricularia oryzae*). The fungus has a sexual state known as *Magnaporthe grisea*, which has only been observed in the laboratory. The fungus commonly produces three-celled, bowling pin - shaped microscopic spores, called conidia, that are moved by wind and blowing rain (Fig.4).

Fig. 4. Disease Cycle of Rice Blast Disease



Disease Cycle - As far as is known, the rice blast fungus only attacks rice and has no other plant host. Closely-related forms of the blast fungus infect wild grasses and some turf grasses but do not infect rice. The rice blast fungus survives between rice crops in infested rice residue or on seed. Although not precisely known in Arkansas, seedborne blast probably helps begin potential epidemics in some circumstances, but not always (Fig.4). Because the spores are airborne, movement between fields during the season is common and rapid. Once blast is established on plants, spores spread the disease within a field throughout the season. Infection is influenced by many factors. Leaf wetness (free water) is essential so rainy periods increase blast infection as do long dew periods. The latter is more common in shaded field areas near tree lines and can result in early epidemics in these areas. Plants that are drought-stressed are especially susceptible to blast, and for this reason, epidemics are often associated with field areas that dry easily or have been poorly irrigated. Cooler temperatures than normal, cloudy, and rainy weather increase blast incidence and severity in susceptible or moderately susceptible varieties.

Management - Control of blast in Arkansas relies most heavily on two factors, resistant varieties and irrigation. Resistant varieties are readily available from our breeding program and should be grown if blast is a potential problem in the area. Most of our strongly resistant varieties use 1 or 2 resistance genes obtained from Katy, a long-grain cultivar released in 1989. Unfortunately, the type of resistant varieties available can lead to development of new and damaging races of the blast fungus, especially if planted on large acreages. A new race known as IE-1k was discovered in 1993 and has been capable of attacking Katy or related varieties. Proper flood depth is a critical factor in managing blast. On moderately resistant and moderately susceptible varieties, blast damage can be prevented or greatly reduced by proper irrigation. A flood depth of at least 2" and preferably 4" must be maintained from green ring through heading for this to be most effective. Even a temporary loss of flood caused by inadequate pumping capacity (trying to water too large a rice field, for example) or diverting water for soybeans can be disastrous with regard to blast. If blast lesions are found in a field, a deep flood should be maintained if at all possible, as this will reduce the disease potential and improve fungicide results when they are used. Where conditions favor blast late in the season, both flood depth and fungicides will most likely be needed.

Other cultural practices that can reduce blast damage include use of adequate but not excessive nitrogen fertilizer rates, use of cleaned, high quality seed, adequate soil coverage of planted seed, and destruction of previous rice residue.

As before, the final alternative to control blast is the use of foliar fungicides. We have no minimum threshold levels for deciding whether or not to spray- it is largely a judgment call. If blast lesions are observed on leaves prior to heading, a single fungicide application should be made at late boot (when at least 50% of the main tillers are splitting the boot or have the very tips of the panicles beginning to emerge) (Fig. 5). An additional application should be made about a week later if conditions favor blast or blast pressure is severe. This second application should be made when at least 50% of the main tillers have the panicles about 3/4 of the way out of the boot (Fig. 5). The above timing of applications was for Quadris applied at 12.3 fl oz/ac of Quadris Flowable for each application for blast. This is a very expensive treatment and many growers may find themselves debating the necessity of using this fungicide or making the second application.The first application is usually the most critical, although past data has shown both to be needed, especially when disease pressure is moderate or above. Consult the local county extension agent for advice on particular field situations.

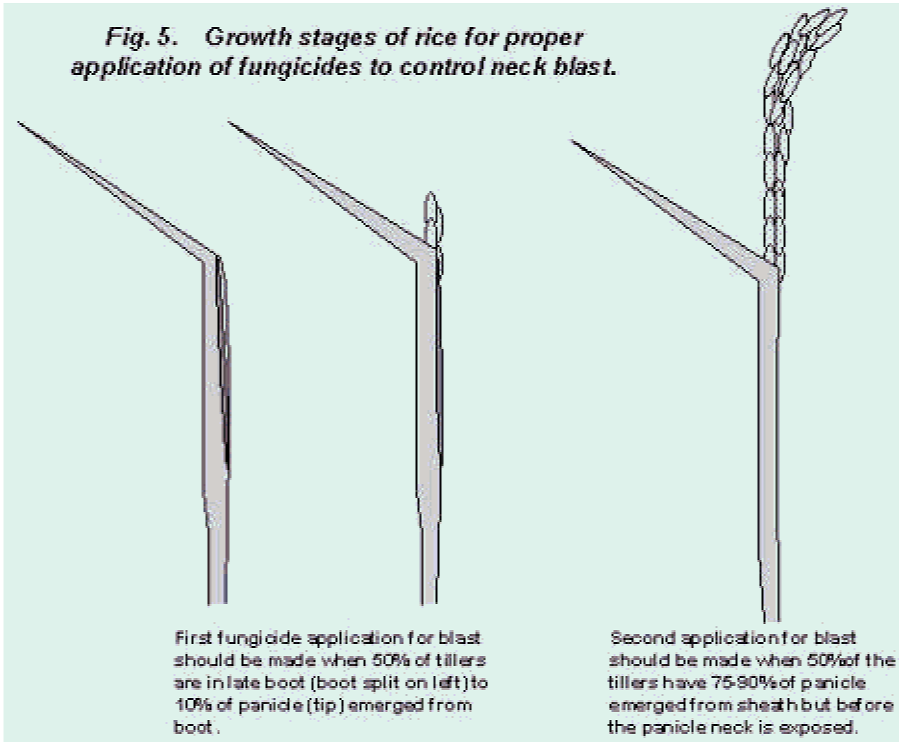


Fig. 5. Growth stages of rice for proper application of fungicides to control neck blast.

As always, producers should follow all label directions when using fungicides - whether for blast, sheath blight, or any other disease.

Table: Fungicides recommended to control rice blast disease.

Disease	Fungicide	Active Ingredient	Rate/Acre	Comments
Neck Blast	Quadris 2.08 FL®	azoxystrobin	12.3 fl oz	Use on susceptible varieties if leaf or collar blast is present or in fields with a history of rice blast. Apply at late boot to 10% heading (when 50% of the main tillers are cracking the boot). A second application is recommended about 5-7 days after the first when half of the main tillers have 70-90% of their panicles emerged, but the bases of the panicles are still in the boot. Lower rates than on
	GEM®	trifloxystrobin	6.4 – 9.8 fl oz	
	Stratigo	triflooxystrobin+propiconazole	19fl oz	
	Quilt Xcel	azoxystrobin+propiconazole	21 -27 fl oz	

				the label are not recommended. SEE LABELS FOR FURTHER DIRECTIONS

* 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.

[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 using recommended N rates for the variety. Proper cultural practices greatly enhance the field resistance of rice.

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.

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