Rice Narrow Brown Leaf Spot and Its Management

The rice disease narrow brown leaf spot (NBLS), which is also called Cercospora leaf spot, is caused by the fungus Cercospora janseana (Hollier, 1992). The disease was first described in Japan (Miyake, 1910). NBLS has since been reported to occur in the major rice-growing areas in Asia, Africa, Australia, North, and Central and South America (Hollier, 1992). NBLS is a common disease of rice in the Southern U.S. rice-growing areas of Arkansas, Louisiana, Mississippi, Missouri and Texas. The disease occurs every year in almost every rice field, especially on susceptible varieties. In Texas, NBLS has become a prevalent disease during both the main and ratoon crops (Zhou, 2010). NBLS can cause premature ripening, grain yield reduction, and reduced milled rice quality. It has been reported that severe yield losses of more than 40% can occur under the favorable conditions for disease development (Overwinter, 1960).

Symptoms of Narrow Brown Leaf Spot Disease

The pathogen attacks the leaves (Fig. 1a), leaf sheaths (Fig. 1b), internodes (Fig. 1c), panicle branches, and glumes (Fig. 1d) of rice plants. The disease symptoms may take up to 21 to 25 days to develop after infection (Biswas, 2003). Symptoms normally appear at the late or maturing growth stages and are characterized by many short, linear, brown lesions about 2 to 10 mm long and 1 mm wide usually on the leaves. On resistant varieties, the lesions are relatively narrower, shorter, and darker brown. As the infected rice plants mature, leaf spotting can become more severe on susceptible varieties, resulting in leaf blighting and premature death. At the late stages of symptom development, a net blotch-like pattern frequently appears on leaf sheaths, in which the cell walls are dark brown and the intracellular areas turn

Fig. 1 Symptoms of narrow brown leaf spot on a) leaf, b) leaf sheath, c) internode - ‘neck blight’, d) glumes, and e) on leaf sheath – ‘net blotch’.

Continued on page 6
From the Editor ...

Research on Disease and Nutrient Management

Welcome to the April issue of Texas Rice. This issue contains two articles; the first provides an overview of narrow brown leaf spot, which is an increasing disease of rice in Texas, while the second article provides a general overview of nitrogen fertilizer utilization efficiency.

It is hard to believe that prior to hiring Dr. Shane Zhou nearly two years ago, Texas had been without a rice plant pathologist for 8.5 years, beginning in early January, 2001, when Dr. Toni Marchetti retired, and continuing through late June, 2009. In the short period of time since Shane began work with Texas A&M, he has done a yeoman’s job in establishing research trials across the Texas ricebelt and collaborations with rice scientists in Texas and other rice producing states. Late last year, Shane was successful in obtaining a nationally competitive grain focusing on rice disease management. Nationally competitive agricultural research grants have about a 10% success rate, which points out just how successful Shane has been. I am very hopeful that Shane will remain with Texas A&M for years to come, developing improved disease management programs for our rice producers.

The nitrogen utilization efficiency article was written by Fugen Dou, with Lee Tarpley and Kirill Kostyanovskiy as co-authors. Fugen was also hired two years ago and fills the void left vacant by Dr. Fred Turner’s retirement 6 years ago. Fugen’s research focuses on the nutrient management side of rice cropping system management. The more applied aspects of his research have the goal of increasing the efficiency with which nitrogen is managed. This area is particularly important given the recent volatility of nitrogen fertilizer prices. Currently, the costs involved with fertilizer applications in rice rival or exceed those associated with weed and water management, and are usually greater than the costs associated with insect management. In addition to his fertilizer research, Fugen will participate next week with a group of researchers at the Beaumont Center to do a long overdue update of the rice varieties included in our web-based Rice Developmental Advisory (RiceDevA) program. A particular challenge is maintaining updated parameters for hybrids since RiceTec does not allow their varieties to be studied prior to their commercial release.

One thing is certain about rice production in Texas and the U.S. Methods that increase production efficiency are paramount to maintaining producer profits. Either be it through improvements in disease management, improvements in the timing and rates of fertilizer applications, or a myriad of plant breeding, insect, and agronomic management improvements, research by Shane, Fugen, and the rest of our scientists will continue to play an important role in rice production and management.

Please remember to send us your ideas and suggestions.

Sincerely,

L.T. Wilson
Professor & Center Director
Jack B. Wendt Endowed Chair in Rice Research
Nitrogen Use Efficiency in Rice Production: Data Reanalysis

Nitrogen has a unique position in rice nutrient management compared to other essential macronutrients. The main reason is that most or all soils cannot supply sufficient N during rice growth to approach grain yield potential. Nitrogen is usually applied to rice as urea or ammonium sulfate. However, determining how much fertilizer and when to apply are not easy tasks. The reasons behind these simple questions are complex. The effective management practices must be based on the knowledge of N turnover and cycling in rice production. Numerous studies have been conducted to investigate N biogeochemistry in soils (Savant and Dedatta, 1982; Schlesinger, 1997). The main N biogeochemistry processes in paddy soil include ammonium evaporation, nitrification, denitrification, nitrate leaching, fixation, immobilization, and uptake. However, the effects of management practices on nitrogen use efficiency (NUE) in the southern US have not been well documented for new varieties. In this paper, we reanalyzed selected factors influencing NUE based on

Fig. 1 Nitrogen use efficiency of rice varieties at Eagle Lake, TX.

Fig. 2 Nitrogen use efficiency of selected rice varieties in 2008 and 2009 at Crowley, Louisiana, and Stuttgart, Arkansas.

Continued on the next page
Nitrogen Use Efficiency ...

previous studies from Arkansas (Norman et al., 2008; Norman et al., 2009), Louisiana (Harrell et al., 2008; Harrell et al., 2009) and Texas.

Nitrogen use efficiency has been defined in different ways. Traditionally, NUE is defined as the ratio of total nitrogen recovered by the crop or crop grain to the amount of fertilizer N applied. Since the purpose of nitrogen application is to increase rice grain yield, we define NUE herein as the ratio of increase in crop grain yield due to nitrogen fertilization: $\text{NUE} = \frac{(\text{Observed Maximum Yield} - \text{Yield without N Application})}{\text{Amount of N Applied}}$. The reason for using observed maximum crop yield in defining NUE instead of crop yield is due to the fact that crop yield responds to N supply is curvilinear, that is, yield increases at a slower rate the greater the amount of nitrogen applied.

An effective strategy for rice nutrient management has to take a number of factors into account when aiming to improve NUE.

Rice Varieties: Inbreds vs. Hybrids

Rice variety selection is one of the most important decisions that a rice grower has to make. Some varieties have higher yield potential than others. However, even for a variety with high yield potential, yield is highly influenced by environmental conditions, including N availability. Compared to inbreds, hybrids generally have higher NUE. In Fig.1, the average NUE of commercial hybrids ranged from 37 to 47 lb grain lb$^{-1}$ N, with an average of 42 lb grain lb$^{-1}$ N. The NUE of inbreds ranged from 23 lb grain lb$^{-1}$ N to 31 lb grain lb$^{-1}$ N, with an average of 27 lb grain lb$^{-1}$ N. The greater NUE often seen with hybrids is due to several reasons (Yang et al., 1999). One reason is that rice hybrids typically develop a more extensive root system, which may promote enhanced N absorption from the soil and top-dressed

Fig. 3. Average Temperatures during Rice Production Seasons in 2008 and 2009 in Crowley, Louisiana, and Stuttgart, Arkansas.

Continued on the next page
Nitrogen Use Efficiency ...

N-fertilizer. The other reason is that rice hybrids have greater capability to translocate N during the reproductive stage. In addition, compared to inbreds, hybrids usually have more resistance to diseases (Zhou et al., 2010).

**Site Difference**

Site differences may affect NUE in rice production even when soils are similar. In general, site differences include variation in soil properties, climate, management practices, and pest pressures. Differences in NUE may result from one or all of these factors. For example, the NUE of Catahoula, CL151 and Bowman at the Louisiana Rice Research Station was lower than at the Arkansas Rice Research and Extension Station in both 2008 and 2009 (Fig. 2). The soils at both sites are similar. The soil type in both years of the study in Louisiana was a Crowley silt loam (fine, smectitic, thermic Typic Albaqualfs). Both fields have been in a rice-fallow rotation for at least 25 years. The soil in Arkansas was a DeWitt silt loam soil (Typic Albaqualfs). In addition, the rice at both stations was drill-seeded. Urea was applied at the 4- to 5-leaf stage before flooding at both sites. Zhao et al. (2009) attributed yield differences among sites to differences in temperature. The higher yield in Louisiana may be due to higher daily temperatures compared to the Arkansas site, especially at the reproductive stage (Fig. 3). Although the occurrence of sterile spikelets caused by high temperature during flowering is often noted as a constraint to grain yield, it seems that the overall effects of the observed higher average daily temperature were positive for 2008 and 2009 at the Louisiana site. Similar effects of higher average daily temperature on rice yield were also observed in Texas with higher rice yield than found at the Arkansas site.

**Main and Ratoon Crop**

Although ratooning plays an important role in rice production in Texas, few studies have been conducted to assess NUE difference between the main crop (MC) and ratoon crop (RC). Our previous studies indicated that the ratoon crop responds well to N fertilizer, which is consistent with the findings of others (Mengel and Wilson, 1981). However, the NUE of RC was lower than that of MC (Fig. 4). The NUE for RC of the examined varieties ranged from 9 to 17 lb grain lb⁻¹ N. The corresponding NUE for MC was from 23 to 63 lb grain lb⁻¹ N, with the greater NUEs associated with Neptune at LA in 2008. The greater NUE for MC than RC may be partially due to a shorter duration of the ratoon crop, along with relatively low ratoon yields. In addition, the calculation of ratoon yield without N application is complicated by carry-over effects from stored nitrogen present in the MC stubble.

For more information, please consult the following references.


Fig. 4. Nitrogen use efficiency of main and ratoon crops of selected rice varieties at Beaumont, Texas, and Crowley, Louisiana in 2008.
Nitrogen Use Efficiency...


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Narrow Brown Leaf Spot...

tan to yellow (Fig. 1e). The fungus can also cause “neck blight” where the internodal area above or below the node at the panicle base becomes light brown to tan (Fig. 1c). The symptoms on leaves, leaf sheaths and panicles on the ratoon crop are similar to those on the main crop.

Several factors affect the development of symptoms. They include: 1) the susceptibility of rice varieties, 2) the physiological races of the fungus (Estrada et al., 1981; Sah and Rush, 1988), and 3) the growth stage of rice. Rice plants are susceptible to NBLS at all growth stages, but the plants tend to be more susceptible from panicle emergence to maturity (Table 1). Furthermore, nitrogen deficiency enhances the development of this disease (Saichuk, 2009). The disease usually is more severe on the ratoon crop than on the main crop due to significant levels of inoculums carried over from infected main crop (Table 1).

**Management of Narrow Brown Leaf Spot Disease**

Varietal resistance is the most effective method to manage NBLS. The currently available resistant cultivars include CLEARFIELD XL729, CLEARFIELD XL730, CLEARFIELD XL745, XL723, XL744, Jasmine 85, Della, Banks, Jupiter, Medark, Neptune, and Pirogue (Zhou et al., 2010). The rice varieties Presidio, Cocodrie, Cheniere, Catahoula, CL111, and CL151 are susceptible to NBLS. A multi-state disease evaluation team, which is composed of researchers from Texas, Louisiana, Arkansas and Mississippi, continues to evaluate the resistance of new rice varieties and elite lines. Research by Drs. Guangjie Liu and Xin-Gen Zhou on the identification and mapping of the genes responsible for NBLS resistance are being conducted at Texas A&M AgriLife Research and Extension Center at Beaumont, in collaboration with USDA-ARS. This research will accelerate the breeding program for NBLS resistance.

Application of fungicides is another effective option to manage NBLS. The recommended fungicides are Bumper®, PropiMax®, Tilt®, Stratego®, Quilt® and QuiltXcel®, which contain the

Continued on the next page
Narrow Brown Leaf Spot ...

active ingredient propiconazole (Zhou et al., 2010). When the disease is severe enough to justify chemical control, applications of fungicides should be made in the mid to late boot stage to maximize their efficacy. Preliminary studies conducted by Dr. Xin-Gen Zhou and Jack Vawter at the David R. Wintermann Rice Research Station at Eagle Lake, Texas, showed that rice ratoon crop yield was 13% higher and head rice milling quality was significantly improved when a propiconazole-containing fungicide was applied on the main crop at booting. Be aware though that some fungicides are not labeled for use in the ratoon crop. Please check the labels for legal use, rates and timing.

For more information, please consult the following references:


* Article by Drs. Guangjie Liu and Xin-Gen (Shane) Zhou, Texas A&M System AgriLife Research and Extension Center at Beaumont, TX 77713.

Table 1. Severity (0-9 scale) of narrow brown leaf spot disease in rice cultivars on main and ratoon (second) crops in Ganado, Jackson County, TX, in 2010.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Severity of Narrow Brown Leaf Spot Disease</th>
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<tr>
<td></td>
<td>Main Crop</td>
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<tr>
<td></td>
<td>Booting</td>
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<tr>
<td>Jazzman</td>
<td>0.5</td>
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<tr>
<td>Cocodrie</td>
<td>1.0</td>
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<tr>
<td>Presidio</td>
<td>1.3</td>
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<tr>
<td>Milagro Filipino</td>
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Rice Crop Update

As of April 15, 2011, about 86.0% of the rice crop acreage in Texas had been planted (Fig. 1). In comparison, about 83.9, 53.1, 83.7, 86.3, and 61.7% had been planted as of April 15 in 2006, 2007, 2008, 2009, and 2010, respectively. About 68.0% of the Texas rice acreage had emerged seedlings as of April 15, 2011 (Fig. 2). In comparison, about 73.1, 37.7, 63.0, 67.4, and 31.7% had emerged seedlings as of April 15 in 2006, 2007, 2008, 2009, and 2010, respectively. Weekly updates on the acreage and percentage of rice grown in Texas that are in the various growth stages are available at our website at http://beaumont.tamu.edu/CropSurvey/CropSurveyReport.aspx. Our website also shows that varieties planted as of April 15, 2011, included Presidio, CLXL 745, Cheniere, Neptune, Catahoula, Cocodrie, and others (Fig. 3).