Texas Rice

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Past, Present, and Future Disease Management in Rice

The Texas Rice Belt provides a warm, humid climate favorable for the development of many rice diseases. Rice diseases cause significant reductions in yield, grain quality, and income to rice growers. The development of diseases is greatly affected by many factors including varietal resistance, environmental conditions, and agronomic practices. As a result, the prevalence and severity of diseases significantly vary with year and location. However, losses from certain diseases can be reduced by the use of resistant varieties, improved practices and management, and effective fungicides and their combinations. The purpose of this article is to briefly review past and current rice diseases and their management and to outline future disease management of rice in Texas.

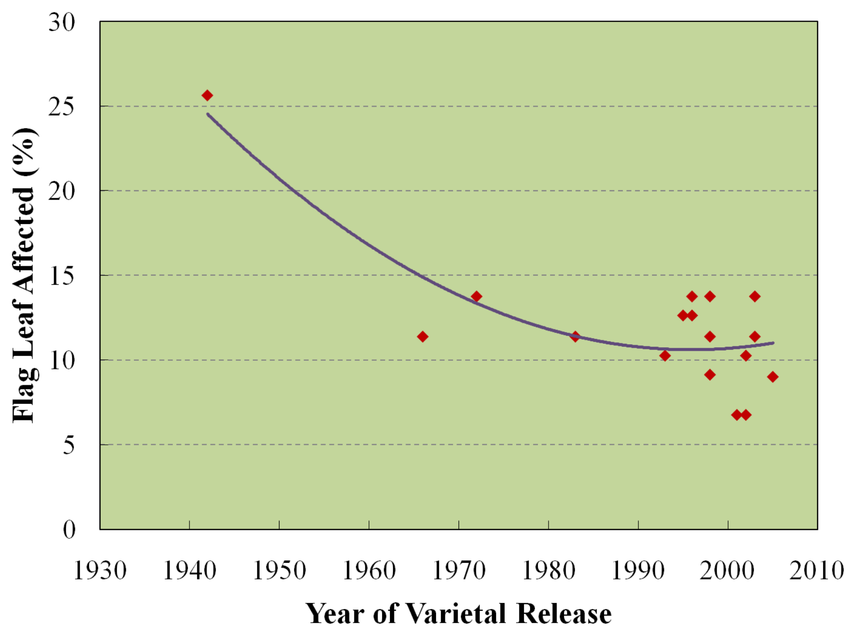

Fig. 1. Severity of brown leaf spot in rice varieties affected by year of varietal release.

Rice diseases have changed profoundly in severity and importance affecting grain yield over the past 100 years of Texas rice production. Since the first Texas rice production in the 1800's, rice diseases have continued to be one of the factors limiting rice production. It was believed that some of the earliest rice diseases were originally introduced along with rice seeds imported from foreign countries such as Madagascar and Japan where the diseases already occurred at that time. The earliest reports of rice diseases in Texas were brown leaf spot caused by *Bipolaris oryzae* in 1934, leaf smut caused by *Entyloma oryzae* in 1934, narrow brown leaf spot caused by *Cercospora janseana* in 1935, and kernel smut caused by *Tilletia barclayana* in 1936 (Atkins, 1975). These diseases were commonly seen in rice fields. However, leaf smut, narrow brown leaf spot, and kernel smut were minor in damage to rice. Brown leaf spot could cause severe damage to rice under favorable environmental conditions. The Bengal famine of 1943, which caused an estimated 3 million deaths (Lee, 1992), is an example that demonstrates

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From the Editor ...

The Eagle Lake and Beaumont Field Days

Welcome to the June issue of *Texas Rice*.

On June 29, our Center will be holding the 36th Annual Eagle Lake Field Day. The theme of this year's Field Day is *Maximizing Profits – Minimizing Risk*. A field tour at the David R. Wintermann Rice Research Station starts at 4:00 PM with three field stops. Each field stop will focus on approaches producers can use to increase the economic competitiveness of their operation while minimizing unacceptable risks. The first stop will highlight the varietal improvement program, with Dante Tabien providing an overview. The second stop will include a presentation by Mo Way on his entomological research. Mo will also introduce Fugen Dou who is the Center's new nutrient management scientist. The third field stop will involve a presentation by Garry McCauley on his weed management research. Garry will also introduce Xin-Gen (Shane) Zhou, who is the Center's new plant pathologist. Shane is conducting a large number of experiments this year at the Eagle Lake station and at the Beaumont Center. The evening program will be held at the Eagle Lake Community Center with the dinner catered by Austin's BBQ. L. G. Raun will provide an overview of Farm Policy Development, while Ron Gertson will discuss water issues as they relate to the Lower Colorado River Authority.

On July 8, our Center will hold the 63rd Annual Beaumont Field Day. The theme is also *Maximizing Profits – Minimizing Risk*. The Field Day starts at 8:00 AM and has four field stops, with each stop having two speakers. The first stop features Omar Samonte, who will highlight the Center's research on hybrid heterosis, also known as hybrid vigor. Omar will be teamed with a presentation by Ted Wilson, who will describe photosynthesis research that focuses on unraveling and better understanding why the yield of hybrids often out-performs conventional inbred varieties. The second stop has a presentation by Shannon Pinson on research involving the genetics of grain quality and disease resistance, and a presentation by Dante Tabien highlighting the Center's inbred rice breeding program. The third stop features Fugen Dou, who will discuss his nutrient management research, and Lee Tarpley who will describe his plant physiology research. The last stop will involve presentations by Mo Way on his entomological research, and Shane Zhou on his plant pathology research.

The Beaumont Center field tour will be followed by a general overview by Ted Wilson of state/regional issues involving rice production, followed by three keynote presentations. Dennis DeLaughter who is the President of Progressive Farm Management, will provide an overview of economics issues affecting rice production. Eric Webster, who is a Professor of weed management at LSU University, will provide an overview of issue involving weed resistance management. Dr. Richard Norman, who is a professor of Crop, Soil, and Environmental Sciences at the University of Arkansas, will end the morning program with a presentation on maximizing profits and minimizing risks through fertilizer management. The morning program will be following by a luncheon. If you are able to stick around during the afternoon, please plan on attending our afternoon field day. Garry McCauley and Scott Senseman will highlight research on weed management, Anna McClung and Shane Zhou will provide presentations on organic rice research, and a team of scientists will describe the Center's bioenergy crops research.

I would be remiss were I not to thank our growers,

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Farming Rice

A monthly guide for Texas growers

Providing useful and timely information to Texas rice growers, so they may increase productivity and profitability on their farms.

Beaumont Center Website Access Revisited

In our July 2004 and 2008 issues of *Texas Rice*, we provided overviews of the amount and type of information being accessed by users of the Beaumont Center website. The current article provides an update and describes trends in website use over time.

History of the Center's Web Access

The Beaumont Center website has been online since March 10, 2003. Prior to that time, our web presence was limited to a single page that showed a worker with a hard hat and a shovel with a sign that said "Under Construction". Although clever, it was not particularly useful. In early 2002, the Center begin the development of a true web presence. The initial driving force was the need for an alternative approach to delivering research information, such as the Texas Rice Newsletter. The new website was launched in early 2003. Since then access to the site has increase at a high rate. The web statistics summarized in Table 1 have increased from 27% to 45% per year from 2003 to 2010. The total hits, which are a measure of the number of pages visited; the total visits, which are a measure of the number of separate occasions that individuals entered our website; and the number of unique visitors, have increased at a 27 to 44% annual rate. While the number of downloaded files has increased at a 31% annual rate, the volume of information downloaded has increased at a 45% annual rate. The cumulative hours of web access, although showing a 43% annual rate of increase,

Table 1. Annual rate of use statistics for the Beaumont Center Web Site for 2003 to 2010.

Category	2003 (Pro-rated)	2004	2005	2006	2007	2008**	2009	2010 (Pro-rated)	Estimated Annual Rate of Growth	Estimated Growth since Initiation
Hits	613,736	1,417,879	1,968,160	2,379,013	2,432,349	3,608,010	4,582,828	6,088,881	38.79%	992%
Total Visits***	71,995	149,731	218,545	299,232	361,910	381,135	710,866	903,979	43.54%	1,256%
Unique Visitors	12,473	25,244	33,629	41,046	43,519	55,320	59,900	67,915	27.39%	544%
Files Downloaded	61,847	94,336	128,771	156,886	164,631	164,174	285,146	411,094	31.07%	665%
Bytes of Downloaded Files (billion)	11.6	22	37	48.5	68.7	109	132.2	153.6	44.64%	1,324%
Cumulative Hours of Website Access*	3,748	45,521	113,289	98,144	18,285	44,732	74,650	45,549	42.87%	1,215%

* Web server updated in the latter part of 2006, providing more memory and a faster CPU, and again in 2009, thereby increasing server efficiency.

** Extrapolated due to the Webtrends going off-line for at least 1 month in 2009.

*** From the "Top Directories" panel of Webtrends.

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is misleading, and access in fact is increasing at a higher rate than this number suggests. Every time the server is updated, the speed of access increases and the annual cumulative hours of CPU used decreases. For example, in late-2006 and again in late-2009, the website was moved to a faster server and the amount of memory was increased. As a result, the cumulative hours of access decreased each of the following years, even when website access continued to increase.

Pattern of Web Access

In the two previous Internet use reviews (2004 and 2008), distinct patterns of daily user access were apparent. In contrast, while Friday's have the largest number of web visits across days of the week, access during Friday's was only marginally greater than observed for Mondays and Tuesday. Overall, average daily access was within ca. 10% across days of the week (Fig. 1). The greatest access occurs from 8:00 to 9:00 AM Central Time. However, a considerable amount of access occurred 24 hours a day, with hourly access within about 20% of the overall mean for any single hour period. While part of the high level of access during off-hours is undoubtedly by people in other time zones a very large amount is undoubtedly due to web-crawlers and web-robots that are constantly and increasingly searching the Internet.

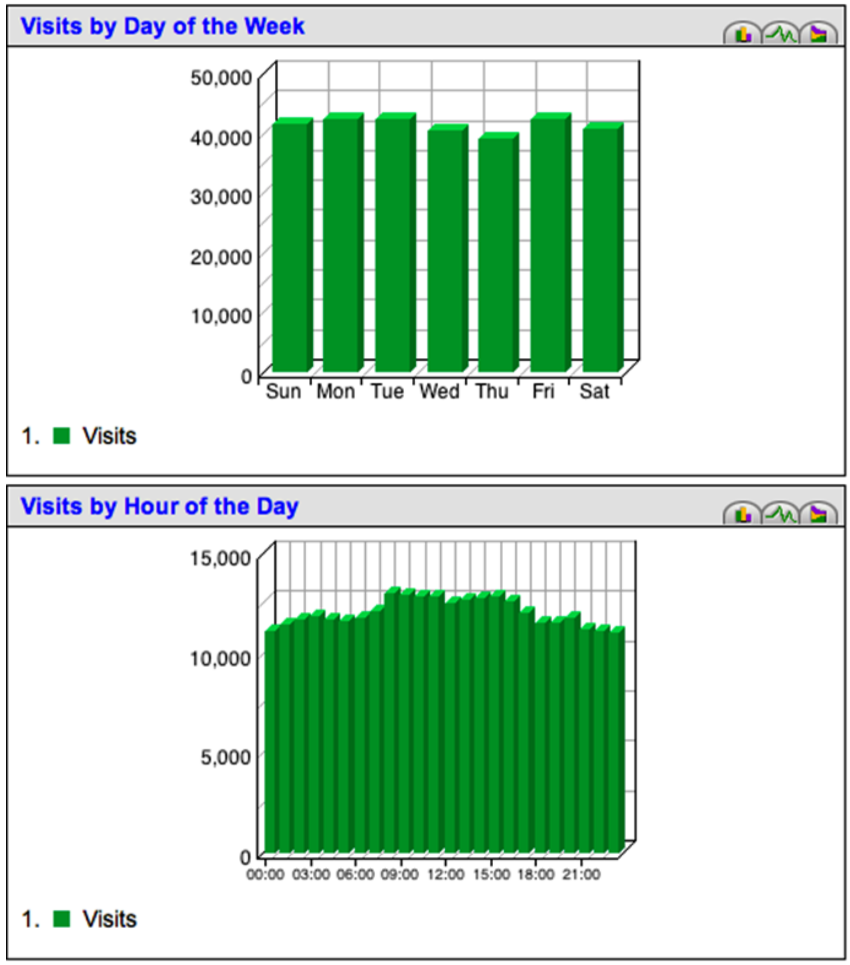

Fig. 1. Pattern of user access of the Beaumont Center's Website at different days of the week (top), and different hours of the day (bottom).

Access by Country of Origin

In 2003, over 85% of Beaumont Center web server access was by individuals who live in the U.S., with the remaining 14.7% from 133 other countries. In 2008, nearly 87% of the web traffic originated in the U.S., with the remaining 13.3% originating from 137 countries. In 2009, these numbers were 91.9% and 8.1%, respectively, with visitors from 146 countries accessing the website. For the first half of 2010, 95.7% of all visits originated in the U.S. Table 2 summarizes the top 20 countries who accessed the website during 2003, 2008, 2009, and the first half of 2010. Twelve of the top 20 countries commercially produce rice. The remaining 6 countries are either net importers of rice or has a significant presence in the international commodity trading area.

The number of countries from which users accessed the Center website has stayed relatively constant for the past 3 years, reaching 146 in 2009, as indicated earlier. With the exception of parts of Central/West Africa, Madagascar, a few mid-east countries, parts of the old Soviet Union, and North Korea, accesses occurred from nearly every country of the world in 2009. Outside of the U.S., regions of the world from which the top 10 access accesses occurred during the first half of 2010 include North America (Canada),

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China, Australia, and Western Europe (Netherland, Switzerland, United Kingdom, France), Japan, and South Africa.

Most Accessed Directories

Table 3 summarizes the ranking of access for the top 25 most visited web directories in 2003, 2007 through 2009, and for the first half of 2010. The electronic library (*eLibrary*), which houses the *Texas Rice Newsletter*, the *Texas Rice Production Guidelines*, and the Center's other publications, topped the list in 2003 (20.6%),

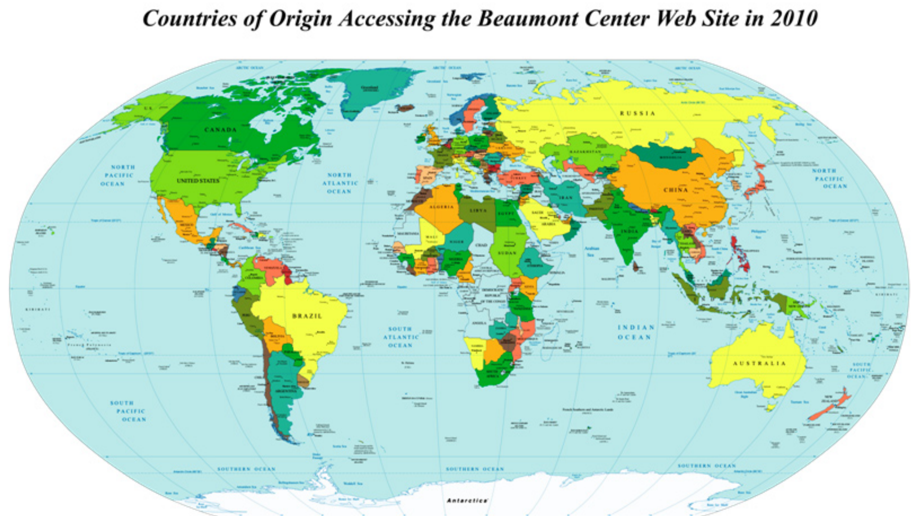

Fig. 2. Users worlwide have accessed the Beaumont Center Web Site.

Table 2. Country of origin, rank, and percent of total access to the AgriLife Research and Extension Center Website by individuals.

Country	Rank in 2003	% of Visits in 2003	Rank in 2008	% of Visits in 2008	Rank in 2009	% of Visits in 2009	Rank in 2010*	% of Visits in 2010*
United States	1	85.61	1	86.70	1	91.89	1	95.66
China	6	0.74	4	0.62	3	1.73	2	1.56
Australia	3	0.91	3	1.44	4	0.65	3	0.41
Netherlands	10	0.51	9	0.39	8	0.21	4	0.22
Switzerland	34	0.01	5	0.59	5	0.38	5	0.19
United Kingdom	8	0.71	7	0.46	6	0.24	6	0.17
Canada	4	0.88	6	0.51	9	0.21	7	0.16
France	17	0.27	10	0.33	10	0.15	8	0.13
Japan	12	0.42	16	0.13	12	0.08	9	0.09
South Africa	40	0.08	19	0.12	11	0.08	10	0.07
South Korea	15	0.35	15	0.14	13	0.08	11	0.06
Germany	9	0.61	11	0.29	7	0.22	12	0.06
Sweden	13	0.37	8	0.39	16	0.07	13	0.06
India	7	0.73	13	0.20	14	0.08	14	0.05
Brazil	-	-	20	0.10	23	0.03	15	0.05
Mexico	-	-	26	-	28	0.02	16	0.05
Italy	-	-	-	-	24	0.03	17	0.04
Israel	-	-	34	-	15	0.07	18	00.04
Singapore	29	0.12	12	0.25	20	0.04	19	0.04
Iran	19	0.25	17	0.13	19	0.05	20	0.03
Total Countries	**133**		**137**		**146**			

* Ranking and percents for 2010 as of 6/11/2010.

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Table 3. Beaumont.tamu.edu directories accessed by users. Each asterisk indicates a one position increase or decrease in access ranking from 2008.

Directory	Rank in 2003	% of Visits in 2003	Rank in 2007	% of Visits in 2007	Rank in 2008	% of Visits in 2008	Rank in 2009	% of Visits in 2009	Rank in 2010	Projected Visits in 2010	Change in Rank from 2008
ClimaticData	17	0.12%	7	8.11%	2	17.09%	1	55.94%	1	62.15%	*
eLibrary	1	20.60%	1	17.40%	1	17.38%	2	8.20%	2	7.73%	*
Research	4	10.16%	4	9.89%	3	9.74%	3	6.21%	3	5.70%	
Main Webpage	5	8.95%	9	3.39%	7	3.13%	6	2.46%	4	3.76%	***
Personnel	2	14.37%	5	8.05%	5	7.76%	4	3.84%	5	3.52%	
Images	3	11.21%	8	4.06%	6	5.18%	5	3.13%	6	2.99%	
PhotoGallery	7	2.85%	2	10.51%	13	1.11%	7	2.21%	7	1.92%	******
Conference	5	8.68%	3	10.47%	4	8.73%	8	2.18%	8	1.20%	****
WebTrends	-	-	-	-	14	1.65%	10	0.84%	9	0.78%	*****
RiceDevA	NA	0.00%	15	1.57%	12	1.43%	12	0.74%	10	0.71%	**
AboutUs	9	1.93%	18	1.04%	16	0.88%	15	0.68%	11	0.68%	*****
Events	18	0.12%	14	1.67%	10	1.85%	11	0.83%	12	0.68%	**
Teaching	8	1.95%	19	1.00%	17	0.80%	14	0.72%	13	0.67%	****
RiceSSWeb	NA	0.00%	11	2.38%	8	2.59%	9	0.87%	15	0.58%	*******
CropSurvey	NA	0.00%	13	1.96%	11	1.47%	20	0.58%	16	0.49%	*****
MetricsManager	NA	0.00%	NA	0.00%	24	0.27%	38	0.11%	17	0.48%	*******
FoundationSeed	10	1.35%	20	0.68%	18	0.65%	23	0.47%	18	0.46%	
Forum	16	0.44%	27	0.23%	22	0.33%	26	0.32%	19	0.45%	***
RTWG2006	NA	0.00%	10	2.77%	9	1.91%	13	0.72%	20	0.44%	***********
SoilData	NA	0.00%	33	0.12%	15	0.95%	21	0.53%	21	0.44%	******
eTools	NA	0.00%	26	0.25%	23	0.31%	25	0.33%	24	0.33%	*
Outreach	15	0.46%	27	0.45%	19	0.52%	28	0.28%	25	0.32%	******

2004 (20.0%), 2005 (16.8%), 2006 (17.2%), 2007 (17.4), and 2008 (17.4%), and second in 2009 (8.2%) and during the first 6 months of 2010 (7.7%). The *Rice Contest Study Guide for Weeds* was the single most downloaded item in 2003, with the *Texas Rice Production Guidelines* the most downloaded item from 2004 to 2009. *Texas Rice Newsletter* issues have accounted for 9 or more of the top 20 downloads since 2003, the year the website was launched.

Seven of the top 10 web directories accessed during the first half of 2010 were also top directories in 2003, these being *eLibrary*, *Research*, the websites main website directory *(Beaumont.tamu.edu), Personnel, Images, PhotoGallery, and Conference*. The *ClimaticData* directory continues to show the greatest increase in visits, increasing from 0.12% of total visits in 2003 to 8.11 % in 2007, 17.09% in 2008, 55.94% in 2009, and 62.15% for the first 6 months of 2010. While % of total visits for this directory increasingly dwarf that of the other directories, 15 of the most visited directories in 2010 showed increased downloads, with only 5 showing a decrease compared to the average for 2007 through 2009. Two of these directories contain records of conferences held in 2003 and 2006, respectively, and as a result are not updated each year. As a result, downloads are not expected to increase each year for these directories.

The increasing popularity of the *ClimaticData* database results from its usefulness by providing hourly and/or daily temperature, precipitation, windspeed, and solar radiation data for over 20,000 geographical locations covering a large majority of countries worldwide, with records for some locations going back over 100 years. The original source of most of our climatic data is the National Oceanographic

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Website Access ...

and Atmospheric Administration. The climatic data have been checked for errors and repackaged so that each weather station and the associated climatic records is easily accessed and directly tied to specific geographic locations. When combined with our soils, road network, and cropland database layers, this information comprises the *integrated Agricultural Information Management System (iAIMS)*, which serves as foundation data used to drive a number of site-specific management tools developed by Center scientists (see below). Our web robots automatically search the Internet every 2 to 3 days looking for new climatic data to keep the data as up-to-date as possible. If you are interested in the technical details of our climatic database, you might want to review Yang et al. (2010).

Data from the climatic database is used by the *Rice Development Advisor (RiceDevA)* to forecast rice crop development, the *Rice Post-Harvest Storage System* Model (*RiceSSWeb*) to predict the impact of bin temperatures on post-harvest pest populations, by the *Rice Water Conservation Analyzer (RiceWCA)* as a planning tool to identify the potential for water savings using different on-farm water conservation measures, and by the *Rice Cultivar Selection Program (RiceCSP)* to analyze the potential growth pattern and yield of different rice phenotypes as an aid in developing new rice varieties. *RiceDevA* is beginning to get a bit long in the tooth. A major update is scheduled for latter this year to incorporate a complete slate of new rice varieties.

Visits to the *ClimaticData* directory increased from 86 in 2003 to a projected 562,000 for all of 2010. The increase is largely a result of scientists and organizations from across the world, but mostly from the U.S., using the climatic data to compare degree-day or heat unit accumulation for different years and parts of the world. The relatively high rate of access of the Center's climatic database highlights its value as possibly the single largest repository of climatic data at a Land Grant University.

Government assisted agencies, such as those that comprise the Texas A&M University System, and more specifically AgriLife Research, have an obligation to serve the needs of our different clientele groups to improve their economic competitiveness. The Beaumont Center website was developed specifically for this purpose. A safe bet is that the Beaumont website will continue to grow as new and expanded information is provided.

References Cited

Yang, Y., L. T. Wilson, and J. Wang. 2010. Development of an Automated Climatic Data Scraping, Filtering and Display System. Computers and Electronics in Agriculture 71: 77–87. *

* Contributors to this article are L. T. (Ted) Wilson, Yubin Yang, Jenny Wang, and Brandy Morace. For more information on the Beaumont Center website, please email Ted Wilson at lt-wilson@aesrg.tamu.edu.

Disease Management ...

the potential damage caused by a rice disease under conducive weather conditions. A severe epidemic of brown leaf spot during the flowering and grain-filling stages in Bengal led to yield losses of 40 to 90% and was largely responsible for the Bengal famine (Lee, 1992). In Texas, a seedling disease complex caused by several pathogenic fungi was severe since no fungicides were available at that time for seedling disease control (Atkins, 1975).

From the 1950's through the 1970's, major diseases affecting Texas rice production changed to those including blast (Fig. 2) caused by *Magnaporthe oryzae*, a seedling disease complex, brown leaf spot, and straighthead caused by a physiological disorder with unknown causes. Sheath blight (Fig. 3) caused by *Rhizoctonia solani* was a minor disease

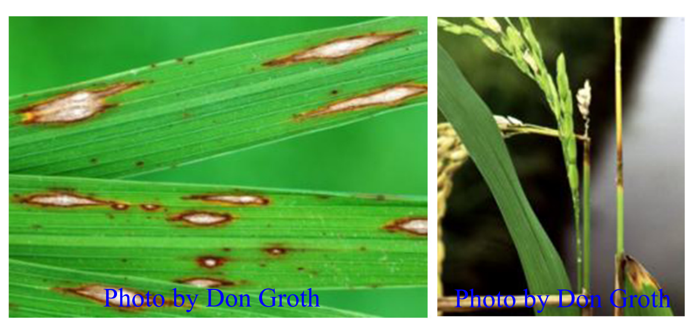

Fig. 2. Symptoms of blast on leaves and panicle necks of rice.

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although it first occurred in rice fields in Texas as early as 1934 (Atkins, 1975). Other minor diseases were narrow brown leaf spot, leaf smut, black kernel caused by *Curvularia lunata*, and stem rot caused by *Magnaporthe salvinii*. No occurrence of false smut caused by *Ustilaginoidea virens* was recorded.

During the 1980's through 2000's, blast and seedling diseases were among the most important diseases in Texas. Sheath blight continued to increase in importance and has become the most damaging disease in recent years. Since the late 2000's, narrow brown leaf spot also has become a major disease (Fig. 4), especially in the ratoon crop. Bacterial panicle blight (Fig. 5), primarily caused by *Burkholderia glumae*, was first recognized to occur in the southern United States including Texas in the late 1990's and early 2000's (Nandakumar et al., 2009). The authors of that paper concluded that bacterial panicle blight has become one of the most important diseases in Louisiana and Arkansas; however, data have not been provided documenting this to be the case for commercial rice. This bacterial disease, which can result in yield losses of up to 50% under experimental conditions (Nandakumar et al., 2009), may have the potential to damage rice production in Texas.

Current major diseases of rice include sheath blight, blast, narrow brown leaf spot, brown leaf spot and seedling diseases (Zhou et al., 2010b; 2010c). The diseases that are of potential importance to Texas rice production include bacterial panicle blight, sheath rot, stem rot, false smut, kernel smut, and straighthead. In 2010, a new disease called rice white leaf streak, caused by the fungus *Mycovellosiela oryzae* (syn. *Ramularia oryzae*), was reported in Texas (Zhou et al., 2010a). The occurrence of the disease is of concern because most Southern rice varieties are susceptible or moderately susceptible, and no information is available for effective management of this disease.

The shift of rice diseases in prevalence and severity over the history of Texas rice production is closely associated with changes in crop rotation, varietal resistance, nitrogen fertilization, and other agronomic factors. A shift from long-term to short-term rotations of rice production tends to increase inoculum of pathogens, resulting in more severe rice diseases and more yield losses. Shortened rotations

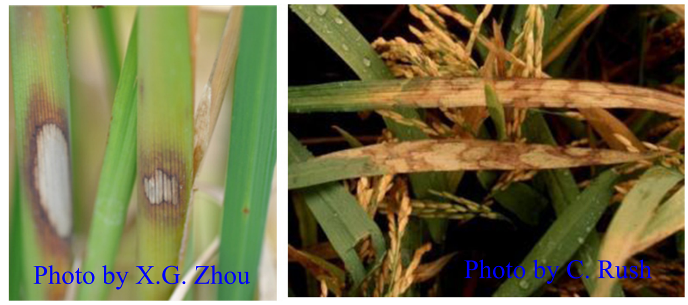

Fig. 3. Symptoms of sheath blight on sheaths and leaves of rice.

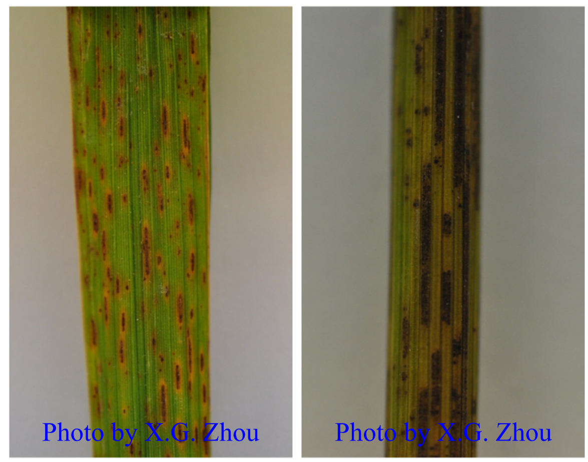

Fig. 4. Symptoms of narrow brown leaf spot on leaf (left) and sheath (right) of rice.

Fig. 5. Symptoms of bacterial panicle blight on the rice panicle.

partially contributed to the increased annual yield loss caused by diseases from 5% in the 1950's (Atkins, 1975) to approximately 12% in recent years (Zhou et al., 2010b) across the Texas Rice Belt. Rice was normally planted on land for 1 to 2 years followed

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by pasture for 2 to 5 years in the 1950's (Evers and Craigmiles, 1975). However, in recent years, the cycle of each rotation has decreased such that there is one year of rice planted followed by two or fewer years of fallow (no rice).

Wide use of resistant varieties is the major factor shifting certain diseases in prevalence and severity over the years. White tip, caused by the nematode *Aphelenchoides besseyi*, was an important disease in Texas in the 1950's and 1960's, when the nematode susceptible varieties Blue Rose, Early Prolific, and Zenith were commonly planted (Atkins, 1975). However, after wide planting of resistant long-grain varieties, white tip has become a minor disease since the early 1970's. Rice blast was one of the most serious diseases in Texas, but its severe occurrence has not been observed in recent years due largely to improved varietal resistance resulting from many decades of successful blast resistance breeding programs conducted in Texas and other states. With the introduction and wide use of susceptible semi-dwarf varieties in the past three decades, sheath blight has become the most severe disease in Texas as well as other southern rice-producing states, causing 25 to 50% yield losses under severe conditions (Way and Groth, 2009).

The use of fertilizers, especially nitrogen, plays a role in affecting levels of rice diseases. While the proper use of nitrogen can reduce severity of some foliar diseases such as brown leaf spot and narrow brown leaf spot, the excessive use of nitrogen promotes the development of other diseases including rice blast and sheath blight. The end of World War II made the supply of nitrogen fertilizer more affordable for rice production. An increase in severity of rice blast with an increase in the rate of nitrogen was observed in a 1956 test in Texas (Atkins, 1975). With increased usage of nitrogen fertilizer, rice blast and sheath blight become major diseases. High nitrogen fertility also favors the development of false smut.

Several management options have been developed to help Texas rice growers reduce yield losses caused by diseases. Varietal resistance is the most effective and economical means of managing diseases. Therefore, for many decades, the development of disease resistant varieties has been a major focus of plant pathology programs in collaboration with rice breeders. As a result, many varieties or germplasm that is resistant to major diseases or multiple diseases have been released by USDA-ARS scientists located at the Beaumont Center (Tabien et al., 2008). Texas Patna released in 1942 was one of the earliest varieties that showed resistance to the prevalent race of the rice blast pathogen (Atkins, 1975). Other varieties resistant to rice blast include Labelle released in 1972 and Saber in 2004. Jasmine 85 is one of the varieties showing resistance to multiple rice diseases including rice blast, sheath blight, and narrow brown leaf spot (Zhou et al., 2010b). In general, over the history of Texas rice production, there is a trend of increasing the magnitude of resistance to certain diseases in varieties through disease resistance breeding programs. Brown leaf spot is one example. In 2009, a field plot study conducted by Drs. Xin-Gen Zhou (research plant pathologist) and Rodante Tabien (rice breeder), comparing levels of resistance to brown leaf spot in 17 varieties released from 1942 to 2005, demonstrated the trend of increasing resistance in varieties over time (Fig. 1). Texas Patna (released in 1942) had 26% of the flag leaf area covered with lesions of brown leaf spot, while Presidio (released in 2005) had only 9%. Jefferson (released in 1996) was in the middle level with 14%. With significant advances in the understanding of molecular mechanisms of disease resistance, rice breeding programs at the Beaumont Center currently are developing and employing DNA maker-assisted selection to identify breeding lines possessing genes for major and partial resistance to blast, sheath blight, and narrow brown leaf spot.

Fungicides are an effective and powerful tool to combat rice diseases. Therefore, continued efforts have been placed on developing effective fungicides, especially foliar fungicides, and effective fungicide application techniques. Fungicides were first developed to treat seeds for control of seedling diseases in the 1960's (Atkins, 1975). Earliest fungicides used in Texas were the organic mercury materials and thiram formulations. Other seed-treated fungicides that were later developed for use on rice included benomyl, captan, and Dithane M-

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45. Because of its toxicity, mercury fungicides were withdrawn for use by federal registration since the middle 1970's, and benomyl fungicides have been discontinued for use on rice and other crops for many years. Foliar fungicides were not labeled on rice until the late 1970's (Atkins, 1975). At present, there are more choices of fungicides, which are much less toxic to vertebrates, more effective, and are applied at much lower rates compared to older fungicides. Some currently labeled fungicides are Quadris, Gem, Propimax, Stratego, Quilt, Tilt, Bumper, and Moncut. All of these fungicides have multiple activities against a variety of rice diseases. In 2010, there are two new formulations of existing fungicides that are coming to the market. One is the foliar fungicide QuiltXcel (Zhou et al., 2010b), while the other is the seed treatment CruiserMaxx containing three fungicides and one insecticide for control of a broad spectrum of early seedling diseases (Zhou et al., 2010c). Future trends in fungicide development will emphasize new formulations of current fungicides that are more effective against multiple diseases, more compatible with other pesticide (insecticide and herbicide) management programs, and possess new risk-reduced chemistries (Way and Groth, 2009). More investigations are needed to understand and develop the best rates and timings of fungicides, scouting methods, and economic thresholds for use on the ratoon (second) crop to maximize the benefits from applying fungicides (Fig. 6).

Employing a single disease management option is frequently not very effective or sustainable. Currently, rice producers are recommended to manage disease through an integrated use of resistant varieties, chemical control, and sound cultural practices to maximize monetary return.

The success of future rice disease management is highly dependent on developing more economical and environmentally sound integrated disease management programs. Emphasis will be placed on identifying major and partial resistance genes and breeding for rice varieties resistant to sheath blight, blast, and narrow brown leaf spot. Also, developing more effective and compatible fungicides and cultural practices will improve disease management. Investigations are needed to develop other sustainable management tactics (e.g., biological control methods) and incorporate these tactics into current integrated pest management programs to make disease management more affordable to rice growers. More research is needed to better understand the biology and epidemiology of key diseases and the impacts of changing climate and modern rice production techniques on disease severity. More work is needed to investigate the epidemiology of diseases in organic rice and develop effective disease management programs for organic rice production. Continued financial support of rice research and extension and improved collaboration among universities, USDA, rice industries, chemical companies, other private institutions and regulatory agencies are the key to the success of future rice disease management.

For more information, please read the following references:

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Fig. 6. A seed fungicide treatment trial showing the difference in severity of rice seedling diseases (left plot, treated; right plot, untreated control) at Eagle Lake in 2010.

Continued on the next page

Disease Management ...

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* Article by Dr. Xin-Gen Zhou, Texas A&M System, AgriLife Research and Extension Center at Beaumont, Texas.

From the Editor ...

seeds producers and dealers, equipment dealers, the pesticide and fertilizer industry, and the growing bioenergy industry, whose financial support allows us to conduct much of the research that is underway at Eagle Lake and Beaumont, and for providing funds to cover much of the expenses that are incurred in putting together the field days. A special thanks goes to BU Growers who have long supported the dinner at Eagle Lake and the lunch at Beaumont, which are highlights of each field day.

This issue of *Texas Rice* provides what we hope are two interesting articles. The cover article is by Shane Zhou and provides a history of plant pathogen management in rice in the U.S. His insightful article provides information that is hard to come by and generally not readily available. Shane is proving to be a thorough researcher who is aggressive pursuing funding to expand his growing research program. Shane arrived at the Center less than 1 year ago, but he is already working on his second nationally competitive research grant proposal. He fills a very important need for the Texas rice industry that has been missing from the Center for nearly 10 years. Shane's presence has an added benefit of helping to develop greater integration of different research program at our Center, by including a number of our scientists in his competitive grant proposals.

The second article in this issue provides an update on the type, volume, and countries of origin of users who access the Beaumont Center website. Since the Center website came online in 2003, its use has increased at an annual rate ranging from 27.4% (unique visitor) to 44.6% (bytes of downloaded files). If the current rates continue, by 2011 downloaded files will reach 500,000, by 2012 hits will reach 10 million and downloads will reach 200 billion bytes, and by 2013 unique visitors will reach 100,000.

One of the most striking of the web statistics is the rate with which users access our Center's climatic data, with visits to the *ClimaticData* directory increasing from 86 in 2003, the first year of release of the database, to a projected 562,000 for all of 2010. This represents a 6,533-fold increase in 7 years, or a 251% projected annual rate of increase. Although not as impressive, downloads increased at a respectable 44.6% annual rate as mentioned earlier. The Center development of what appears to be the largest climatic database maintained by a Land Grant University at least in part contributes to the rapid acceptance of there value by our Internet users.

Part of the utility of the website is determined by the quality of articles that are produced in *Texas Rice*. Electronic downloads of the *Texas Rice Production Guidelines* is expected to approach 23,000 copies in 2010, In contrast, 790 copies were downloaded in 2003. Similarly, electronic downloads of *Texas*

From the Editor ...

Rice is expected to exceed 127,000 copies in 2010, In contrast, ca 13,498 copies were downloaded in 2003.

A continuing goal of the Center is to provide useful information to growers and peer scientists. Please don't forget to send us suggestions for future research articles.

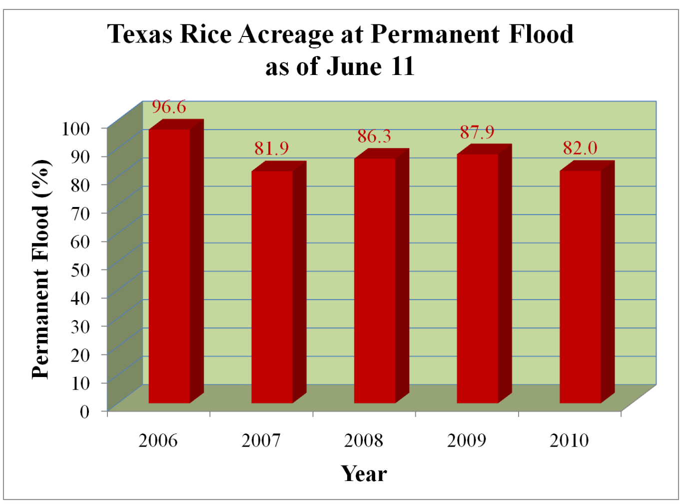
Sincerely,

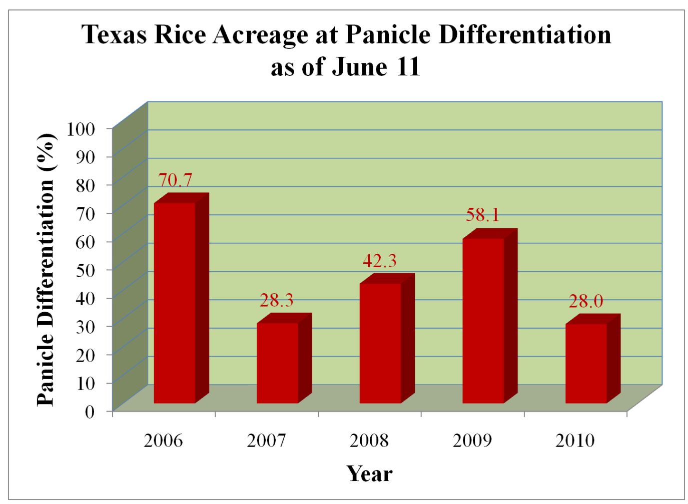
L.T. Wilson
Professor & Center Director
Jack B. Wendt Endowed

Rice Crop Update

As of June 11, 2010, the main crop rice acreage in Texas that are at permanent flood was 82.0%. In comparison, 96.6, 81.9, 86.3, and 87.9% were at permanent flood by June 11 in 2006, 2007, 2008, and 2009, respectively. About 28.0% of the main crop rice acreage in Texas was at permanent flood by June 11, 2010. In comparison, 70.7, 28.3, 42.3, and 58.1% had emerged seedlings by June 11 in 2006, 2007, 2008, and 2009, respectively. The figures below show the comparison in rice acreage percentage that were at permanent flood and that were a panicle differentiation by June 11 in 2006 to 2010.

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.





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