Texas Rice Special Section
Highlighting Research in 2005

Agronomic Management

Evaluating Rice Varieties and Hybrids for Main and Ratoon Crop Production in Texas

When new varieties or hybrids are released, producers and consultants need to know their yield potential and any adjustments to management that might be required for growing conditions in Texas. Our objective is to identify the weak and strong points of potential and named varieties and hybrids from university, USDA, and private breeding programs in Arkansas, Louisiana, Mississippi, and Texas. The eighteen entries in this year's test will be evaluated for various agronomic traits at Eagle Lake and Beaumont. Some of the agronomic data collected will include (1) main and ratoon crop yield and milling response with and without fungicide when nitrogen is not limiting, (2) the contribution of certain management practices to ratoon crop yield using Cocodrie as the test variety, (3) best yielding and milling varieties or hybrids when planted after the optimum planting date, (4) an economic ranking from each entry's average main, ratoon and total crop net income and (5) variety characteristics and growth stage data for variety specific management.

The number of varieties and hybrids evaluated has increased from nine in 2004 to eighteen in 2005. First time conventional varieties include Trenasse (LA), Sabine (TX) and Spring (RU0101093 AR) while Cheniere, Cocodrie, Banks, Cybonnet and Presidio (TX9092), are included for a second, or more, year. The new herbicide resistant variety CL131 (Horizon Ag) is included in our test for the first time, as is the new herbicide resistant hybrid CLXP730 (RiceTec). Herbicide resistant CL161 and CLXL8 are also included for another year's evaluation. Additional hybrids appearing for the first time include XP721, XP728, XP729, XP731, and XP732 with XP723 and XP716 (med. grain) being evaluated for a second year. This research is funded by the Texas Rice Research Foundation.

Summary of 2004 Results

- Fungicide (Quadris + Tilt) applied to main crop did not consistently increase MC yield across all varieties and did not have significant effects on hybrids. MC fungicide did increase ratoon yield by 250 to 1000 lbs/A.
- For non-hybrids predrain N on MC and split N applications on RC did not increase ratoon yield. The 180 lbs/A total N rate increased MC yields for hybrids over the 150 lbs/A N when applied in 2 applications on clay soil but not on silt loam soil.
- At Beaumont the yield loss due to delaying planting from March 27 until May 10 was 177 lbs/A/week delay and for Eagle Lake delaying planting from April 1 to May 24 resulted in yield loss of 186 lbs/A/week delay.
- Varieties ranked in order of decreasing total crop net income per acre ($) at Beaumont in 2004 are: XP723 ($335), CLXL8 ($261), Cybonnet ($150), Cocodrie ($118), CL161 ($85), Banks ($64), Presidio ($42), Jefferson ($-1) and Cheniere ($-36). Varieties ranked in order of decreasing total crop net income per acre ($) at Eagle Lake in 2004 are: XP723 ($455), Cybonnet ($226), CLXL8 ($222), CL161 ($157), Banks ($124), Cheniere ($85), Cocodrie ($81), Presidio ($46) and Jefferson ($43)

Mike Jund, Research Associate and Darrell Hagler, Technician II, with recently retired Dr. Fred Turner (Center), Professor of Soil and Plant Nutrition.

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Cost of Fertilizer Plus Application for N Treatments

Fertilizer treatment	2003	2004
1) Fluid, all during planting	$60.06/A	$71.00/A
2) Dry, all just prior to planting	$65.08/A	$72.86/A
3) 2-way split (FF + dry)	$65.71/A	$68.50/A
4) 3-way split (all dry)	$73.95/A	$74.40/A

Banded Fluid Fertilizer and Early Flood

Recent increases in nitrogen fertilizer and application costs have Texas rice producers looking for ways to get the most out of their nitrogen dollar. Two years of research on clay soil and one year on silt loam soil indicates that banding fluid fertilizer at planting can increase N uptake, increase yield, and reduce application costs when compared to dry broadcast urea. Coupling banded fluid fertilizer with early flood (4 to 5 leaf rather than 5 to 6 leaf stage) in 2003 further improved N efficiency and yields on clay soils. In 2004 however, early flood did not have a significant effect, but subsurface banding of all fluid fertilizer at planting continued to improve N uptake and rice yield.

In conjunction with banded liquid fertilizer we are evaluating a new product that may improve phosphorus availability to rice plants. Avail is a water-soluble compound that can be applied directly to granular or liquid fertilizers and prevents the applied phosphorus from being fixed by certain ions in the soil. Field trials in other crops have shown yield increases where Avail was used. Data from the 2005 research will help refine fluid fertilizer recommendations for clay and sandy soils. The Fluid Fertilizer Foundation and Texas Liquid Fertilizer helped support this research.

Nitrogen Rates and Timings for Hybrid Rice in Texas

Hybrid rice has continued to improve in both yield and milling quality. In 2004 research plots, the hybrid XP723's total crop (main + ratoon) yield was 13,300 and 15,800 lbs/A at Beaumont and Eagle Lake respectively, with milling yields similar to those of Cocodrie. These high yields were achieved by applying 90 lbs N/A preflood to sandy soils and 120 lbs N/A preflood to clay soils. The preflood N was supplemented with 30 to 60 lbs/A late season N applied between booting and early heading.

RiceTec hybrid XP 723 being evaluated by the Soil and Plant Nutrition Project at the Beaumont Center.

In 2005, we are evaluating 7 hybrids (XP721, XP716, XP723, XP728, XP729, CLXP730, and XP732) to verify their optimum N requirements and application timing. Basic treatments are 90 and 120 lbs N/A preflood with an additional 30 or 60 lbs N being applied late season. In addition, we will evaluate mid season N applications for the hybrids. Previous year's data indicates that late season N applied to hybrids increases main crop yield as well as milling quality and provides for early ratoon tillering. RiceTec funding supports this research.

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Seeding Rates and Nitrogen Interactions

Reduced seeding rates are often used to compensate for the relatively higher cost of herbicide resistant rice seed. This sometimes results in plant densities below the recommended 15 to 20 seedlings per square foot for non-hybrid rice. In other cases, even though sufficient seeding rates were used, environmental conditions cause poor seedling emergence. Earlier research has shown that increasing N rates can help compensate for less than optimum plant densities through increased tillering.

This is the first year of research to help determine a plant density threshold at which various N rates can be used to compensate for low plant densities. Targeted seeding rates for the rice cultivars CL161 and Cheniere were 7.5, 15, 30, and 60 seeds per ft^2. Preflood nitrogen applications of 60, 120, or 180 lbs N/A were superimposed on each of the seeding rates. This research is also being conducted in Louisiana, Mississippi, Arkansas, and Missouri.

These studies were conducted by Fred Turner, Mike Jund, Darrell Hagler and the Eagle Lake staff.
For more information contact Mike Jund at 409-752-2741 ext. 2223 or email m-jund@tamu.edu.

Water and Fertilizer Management Impact on Ratoon Crop Rice


Dr. Garry McCauley

Production costs continue to increase and rough rice prices remain constant or have declined over time. For the Texas rice industry to survive and rebound from acreage decline in recent years, it must take advantage of its strengths. The long growing season is a major strength and should be exploited in ratoon crop (RC) production. RC rice has a lower per unit cost as the only inputs are water and fertilizer. Research is desperately needed to better define guidelines on when to pursue a RC and develop an integrated management system to increase and stabilize RC yields.

These studies look at the impact of RC water and N management on RC production. RC N is defined as all N applied after main crop (MC) heading. A split plot design with three replications was utilized. Drain and reflood times were main plots, and RC nitrogen rate and timing were subplots. Drain times were 15, 20, and 25 days after 5% MC heading. RC was flooded either 1 day after harvest, 10 days after harvest, or flushed and flooded 10 days after harvest. RC N applied pre-MC drain was applied 10 d after 5% heading in the MC, which was 5 days before the first scheduled drain. N rates for this application was one third of the total RC nitrogen, but never more than 35 lb/ A. RC N treatments were 75 or 100 lb/A applied just prior to the RC flood or split, with one application prior to MC drain and the remainder applied prior to RC flood, and 150 lb/A applied prior to MC drain and remaining N applied equally at preflood and PD. MC and RC yield and milling were monitored using standard techniques.

The MC and RC yield and RC milling were affected by RC water and N management. Based on the conditions of this study, the optimum water management would be to drain the MC 20 days after 5% heading. The RC should be flooded immediately after MC harvest. This would produce a dry period of 15 days. The optimum RC N management was 35 lb/A applied 10 days after MC heading and 65 lb/A applied prior to RC flood.

Preliminary Results:

- The 2003 yield and milling yield were below the average for the location.
- The highest RC yield was obtained with a single application of 100 lb/A.
- Splitting RC N increased RC whole and total milled by 3 to 5 %.
- Highest RC yield was obtained when the RC was flooded immediately after MC harvest.

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Agronomic Management continued...

- Flooding immediately after MC harvest resulted in the highest total and whole RC milled rice.
- Delaying the flood 10 days resulted in the greatest decrease in milled rice (about 6%).
- The duration of the dry period between MC drain and RC flood greatly influenced RC yield.
- Optimum dry period was 10 days in this study compared to 15 days in the previous study.
- Interrupting a dry period with a flush always reduced the RC yield. Flushing at 20 days into a 30 day dry period reduced the RC yield by about 700 lb/A.
- The difference in whole milled grain was generally less than 5%. Increasing the dry period tended to reduce the amount of whole milled grain.
- Stubble management is a critical component of RC management and optimizing yields. Optimum stubble height is 8 to 10 inches. The most economical way to reach this stubble height is with a flail mower.

Water Conservation In Rice

Water has long been a critical input for rice farming as it is essential for production and accounts for at least 20% of the input costs. The importance of water availability continues to increase with the growing metropolitan demand. A project was initiated this year to evaluate the impact of land forming and new management practices on rice irrigation water use. A study was initiated in 2005 to evaluate the impact of grading to slope and grading to zero slope on irrigation water use. The study is also looking at the impact of fall stale seedbed on rice irrigation water use. No results are available at this time. The study should be continued and possibly expanded for the 2006 season.

Research on these projects is being conducted by Garry McCauley and Jack Vawter with technical support from Clint Fowler and Kyle Cranek. For more information contact Dr. McCauley at 979-234-3578 or email gnmccaule@elc.net.

Entomology/Weed Management

Rice Water Weevil

Experimental seed treatments to replace Icon 6.2FS are being evaluated. Some of these seed treatments have broader activity than Icon 6.2FS. For instance, thiamethoxam has activity against aphids which Icon 6.2FS does not have. Postflood applied experimental insecticides - etofenprox and dinotefuron - are being evaluated. Etofenprox is less toxic to crayfish and fish than currently labeled pyrethroids. Dinotefuron may be effective when applied 10-14 days postflood. This application timing targets small larvae; thus, dinotefuron may be applied similar to Furadan 3G which was banned in the mid-1990s. Mustang Max and Prolex are being investigated to determine the best timing of application. Mustang Max impregnated on urea also is being investigated. A date of planting study is being repeated this year. In 2003 and 2004, we found that rice water weevil control - regardless of insecticide or date of planting - generated $40 and $30/acre, respectively, above the cost of control.

Dr. M.O. Way

Rice Stink Bug

Luis Espino, graduate student from Texas A&M University, has found that sampling rice with a "sweep stick" (pvc pipe used to disturb insects on panicles) is as effective as a sweep net. A survey will be conducted to determine the relationship between rice grade and number of insecticide applications. Oils tank-mixed with insecticides will be evaluated for residual activity. Experiments to revise economic thresholds will be performed.

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Stem Borers

Stem borer research is in cooperation with Dr. Gene Reagan at LSU, Brent Batchelor CEA Matagorda County and Chris Schneider CEA Jackson County. Last year, Mexican rice borer (MRB) was detected for the first time in Chambers and Liberty Counties. The insect is spreading eastward at about 15-20 miles per year. Host plant resistance tests are being conducted at Ganado where in the past, hybrid cultivars have demonstrated least susceptibility. Also, Prolex and Intrepid 2F are being evaluated at Ganado for activity. CEAs and farmers in Matagorda and Jackson Counties are cooperating to develop economic thresholds for stem borers. Results will allow farmers to apply insecticides when necessary instead of preventively. At Eagle Lake, a date of planting study is being conducted. Anecdotal observations suggest later planting dates encourage higher stem borer populations and damage.

Extension

Recent regulatory actions have resulted in Mustang Max receiving a stem borer label under a section 2 (ee). I am in the process of submitting a regional Section 18 for Orthene for rice stink bug control. This request involves Arkansas, Louisiana, Mississippi, Missouri and Texas.

Please be on the look-out for the South American rice leaf miner which I have observed this season in low numbers in Matagorda and Jackson Counties. If you suspect this insect is in your field, please contact me. I routinely make trips throughout the Texas Rice Belt. Do not hesitate to contact me if you have an insect problem. Every time I make an on-site visit, I learn something to help better serve you.

Mo Way would like to thank his crew for all their hard work and dedication: Mark Nunez, Research Associate; Becky Wolff, Technician II and MS Graduate Student; Luis Espino, PhD Graduate Student; Michael Weiss, Student Worker; Summer Workers Anthony Brown, Ryan McCormick, Ross Robinson, Mary Beth Destefano; and Cynthia Tribble for administrative support. Also, the Entomology Project thanks Texas rice farmers, Texas Rice Belt CEAs for assistance and Jack Vawter and his crew for managing my small plot tests at Eagle Lake and Ganado, Texas Agricultural Experiment Station, Texas Cooperative Extension, USDA/CSREES, Texas Department of Agriculture and agrichemical companies for their support. For more information contact Mo Way at 409-752-2741 ext. 2231, 409-658-7394, or email moway@aesrg.tamu.edu.

Discussion on Recent Herbicide Technology for Rice

Dr. Mike Chandler

Commercial companies have invested considerable time and money to develop unique and useful technologies for the control of weeds in rice. Command has been widely used in rice for several production seasons, but its use has been restricted to preemergence ground applications. This season, a Section 24C allowed aerial application of Command in rice production systems in Texas. Aerial applications of Command have improved the efficiency of planting and weed control procedures. Early postemergence application provides a wider window of time to make critical applications at or near the establishment of the rice crop. The early postemergence application requires the addition of a second herbicide to control any emerged grass. The smaller the grass is with postemergence applications, the better the control. Crop injury will be greatly reduced with postemergence applications. Based on research conducted in Texas, FMC Corporation has made application to register Command on coarse textured soils. This change will be on the federal label and will be extremely useful in Texas. The proposed rate for coarse soils will be 10 acres/gallon or 0.3 lb ai/A. Approval of this change is expected this fall prior to the 2006 production season.

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Entomology/Weed Management continued...

The recent introduction of imidazolinone tolerant rice has allowed for the release of the varieties CL121, CL131, CL 141 and CL161 plus the hybrid XL8. Additional varieties are currently being evaluated for release. The varieties have allowed the introduction by BASF Corporation and use of Newpath, Beyond, and Clearpath herbicides in rice production. Newpath control of red rice has been very important in many production regions of Texas. Optimum red rice control requires two postemergence applications of Newpath at 4 oz/A. Early applications to moist or wet soil is critical for excellent control. To maximize red rice control, Beyond was introduced in 2004 for late season red rice escapes. Beyond, at 5 oz/A of product, can be applied postemergence to Clearfield rice between tillering and panicle initiation. To further expand the weed spectrum of Newpath, a product called Clearpath was introduced in 2005. Clearpath is a mixture of Newpath and Facet that provides excellent broadleaf control which includes hemp sesbania, jointvetch, eclipta and morning glory. The Clearpath rate of application is 0.5 lb/A of product which contains the equivalent of 0.4 lb/A of Facet and 4 oz/A of Newpath.

Grasp, from Dow AgroSciences, was introduced for use in the 2005 production season. Grasp can be applied postemergence in all commercial rice varieties and has residual activity. It is a very useful tool for the control of alligatorweed and provides excellent control of barnyardgrass and junglerice. With Grasp, excellent ducksalad control in water-seeded rice has been observed. For best results, the 2.3 oz/A of product should be applied to wet soil when the weeds are small.

Research related to this discussion is being conducted by Sam Willingham, Weldon Nanson, Garry McCauley and Mike Chandler. For more information, contact Dr. Chandler at 979-845-8736 or e-mail jm-chandler@tamu.edu

Plant Physiology

Dr. Lee Tarpley

Physiological Bases for Texas Rice Ratoon Crop Management

Most Texas rice acreage is planted in varieties that ratoon well, thus inconsistent ratoon stand is due to an interaction of environment and physiology. Ratoon yield increases are being sought by (1) improving the environmental resources available for ratoon crop development, (2) improving vigor of the developing ratoon tillers, and (3) increasing the number of ratoon tillers through agrochemical treatments.

A low cutting height of the main crop along with pulverization of the straw can increase ratoon yield by: a) decreasing shading of the developing ratoon tillers, b) increasing photosynthetic capacity of the developing ratoon crop, c) removing inhibition due to the presence of upper growth, and d) optimizing the proportion of basal tillers that have good supporting resources and a longer developmental period.

In addition to unraveling the above effects, which lead to improved management schemes, we are evaluating the timing of gibberellin applied at several days post-flowering to late grain fill. This treatment stimulates early ratoon tiller growth and ratoon stand establishment starting about one week post-treatment. Gibberellin at 4 g a.i./A significantly increased ratoon yields of: 1) XL7 at Eagle Lake in 2003 from 4,671 to 4,995 lbs/A (and combined yield from 12,936 to 13,378 lbs/A); 2) XL7 at Beaumont in 2003 from 3,022 to 3,761 lbs/A (and combined yield from 10,239 to 11,044 lbs/A); and 3) XL8 at Beaumont from 2,671 to 3,121 lbs/A (and combined yield from 9,378 to 9,568 lbs/A). These ratoon yield gains of 300 to 700 lbs/A are typical of the average gains of about 500 lbs/A for Cocodrie seen during 2001 and 2002. These result in a net benefit of about $25-30/A or more when the treatment is combined with other treatments (e.g., insecticidal) commonly applied about that time. Neither yield nor quality has been adversely affected by this treatment.

Four different agrichemicals have been identified by the project that significantly increased the number of ratoon tillers from 25 to 100% in field studies. Generously funded by the Texas Rice Research Foundation.

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Effect of High Temperatures and Low UV Radiation on Rice Plant Development

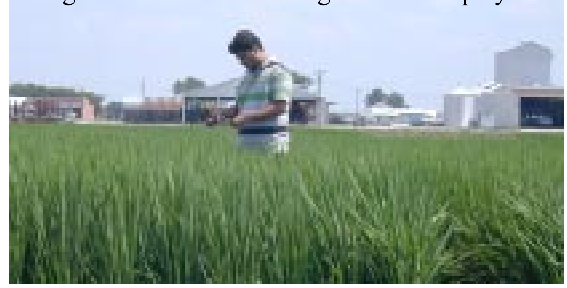
Environmental factors can diminish the yield of Texas rice crops by effecting specific developmental processes or through longer-term affects on the rate of crop production. For example, high temperatures, as experienced in Texas, can potentially lower rice yields by increasing respiration rates and shortening the period of crop development. In Texas, we can also have shorter periods of high nighttime temperatures, coinciding with and negatively impacting critical stages of rice development, such as pollen initiation.

A study utilizing rice plants grown in different night temperature regimes (ambient, ambient plus 2 and ambient plus 4℃) is determining the effects of high nighttime temperatures on plant respiration, enzymatic activities, and metabolite profiles, with an eye on developing chemical practices to prevent or remediate the heat damage. We have shown obvious developmental differences due to these modest increases in night temperatures. This study will also facilitate development of indirect techniques to evaluate heat tolerance in rice.

Another study is evaluating the effects of ultraviolet-B (UV-B) radiation on rice physiology with special emphasis on tiller development of both the main and ratoon crops. Previous studies indicate that low UV-B radiation decreased tillering in rice, suggesting that the low levels of UV-B found below the canopy in densely planted rice fields might affect ratoon tillering. Our results showed low tillering with sub-ambient levels of UV, but normal tillering with ambient and twice ambient levels of UV, suggesting that UV can play an important role in tiller initiation or early development. This research is generously funded by the Texas Rice Belt Warehouse through support of Mr. Mohammed's graduate studies.

Research on this project was conducted by Abdul Razack Mohammed and Dr. Lee Tarpley.

Abdul Razack Mohammed, Texas A&M graduate student working with Dr. Tarpley.



Invertase Manipulation and Its Impact on Texas Rice Yield

This study has the objective of understanding the role of sucrose hydrolysis, and the potential impact of its manipulation in commonly used rice varieties in Texas. We are looking at enzyme manipulation during early seed set in the bottom third of the panicles, heat stress at early grain filling, and ratoon tiller establishment. Photosynthesis by the rice plant produces sugars, in the form of sucrose, that are distributed throughout the plant where they are used for (1) energy, by being broken down during respiration, (2) construction of chemical building blocks, such as the units of the cellulose polymer that makes up a lot of the plant's structural material, and (3) storage compounds, such as starch, for later use. Partial breakdown (hydrolysis) of these sugars by a sucrose-specific enzyme called invertase is the typical route dedicating the sugars' use for energy via respiration. Because of the critical position of invertase in directing how sucrose will be used for various purposes by developing tissues, we are examining the possible role of invertase in several developmental events known to strongly impact Texas rice yield and quality. We are looking at over-the-top applications of chemical activators and inhibitors of invertase activity to determine how these affect yield factors and crop response to specific stresses. We anticipate that short-term manipulations of this enzyme's activity could increase the efficiency of the rice plant at certain developmental periods with resultant increases in yield of the main crop, ratoon crop, or their combined yield. Generous funding for this project has been provided by the Texas Rice Research Foundation.

Research on this project conducted by Elliott W. Rounds and Dr. Lee Tarpley. For more information contact Dr. Tarpley at 409-752-2741 or email ltarpley@tamu.edu. Additional information is also available at: http://beaumont.tamu.edu/eLibrary/TRRFReport_default.htm.

Elliott Rounds, Texas A&M graduate student working in the Plant Physiology Project.

Putting Sheath Blight Resistance Genes to Work in the Rice Field

Dr. Shannon Pinson

PROBLEM: Sheath blight disease has been the most economically significant rice disease throughout Texas, Louisiana, and Arkansas since the early 1970's. While several rice diseases can devastate yields, including blast and straighthead, sheath blight occurs the most consistently with several hundred thousand acres of rice requiring fungicide treatment each year to control this disease.

Rhizoctonia solani, the fungal organism that causes rice sheath blight disease, also attacks several plant species, including soybeans, and several of the weed species commonly found in and near rice fields, such as barnyardgrass, crabgrass and broadleaf signalgrass. Weed hosts and rotation crops may serve as sources of inoculum. Sheath blight is a soilborne disease, with fungal mycelia and sclerotia persisting in the straw and stubble of rice, soybeans, and other grasses. Sheath blight infects the rice plant at the water line then produces mycelia that grow up the leaf sheath. Sheath blight lesions are large with cream-colored centers and broad, dark reddish-brown borders. Alternating wavelike tan and brown bands extend up the sheath and leaves. When the fungus reaches the top of the canopy, a circular area often referred to as a "bird's nest" appears (Fig. 1). These spots often coalesce, forming large areas of the field that appear grayish (Fig. 2). The fungus spreads in the field by growing from tiller to tiller or from leaf to leaf on an infected plant, and across the water surface to adjacent plants. Yield is severely limited in plants exhibiting symptoms on all or part of the flag leaf, and grain milling quality is significantly reduced in plants exhibiting less severe leaf symptoms and yield losses.

Fig. 1. "Bird's nest" caused by sheath blight disease.

Chemical control is costly and incomplete. While several fungicides can slow the progression of *R. solani* infection, multiple applications repeated every 10 to 14 days are generally required, increasing the cost of chemical control. Scouting and chemical control must be accomplished during early plant development, starting with 1st internode elongation.

SOLUTION: Varietal resistance and genetic control. In the case of blast disease, the USDA-ARS Rice Research Unit in Beaumont, TX has demonstrated tremendous success in using molecular markers, or "gene-tags", to assist breeders in identifying and selecting breeding progeny containing desired blast resistance genes. Because single rice genes are known to confer clear and complete resistance to several races of blast pathogen, developing molecular gene-tags was relatively easy compared to the situation with sheath blight. Unlike blast, there is no complete resistance to sheath blight in rice, and the reduced levels of susceptibility demonstrated by Jasmine 85 and Saber are known to be due to a combination of several genes, each with small individual affect.

Fig. 2. The light circles in this mature rice field are areas affected by sheath blight.

In 1995, a team of researchers led by Dr. Shannon Pinson (USDA, Beaumont, TX) was first to identify specific chromosomal regions containing genes associated with increased resistance to sheath blight disease in rice. More recent findings by Dr. Pinson's team have clarified and confirmed the genetic location and effects of six of the resistance genes first reported in 1995, and uncovered the presence of nine additional disease resistance genes (Fig. 3).

The genes identified by Dr. Pinson's team are now providing a solid scientific base for a 4-year, $5 million, 8-State, Rice Coordinated Agricultural Project (RiceCAP) that was initiated January 2005 with funds from USDA-CSREES-NRI. RiceCAP goals are to 1) identify chromosomal regions containing genes for milling quality, and 2) develop molecular markers tagging the SBR genes identified by Dr. Pinson so that breeders can use markers to select SBR breeding progeny as they currently can for blast resistance.

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Genetics continued...

Other Texas scientists participating in the RiceCAP effort are Dr. Anna McClung (USDA-ARS Breeder), Dr. Bob Fjellstrom (USDA-ARS Molecular Geneticist), Dr. Rodante Tabien (TAES Breeder), and Dr. Arun Sharma (USDA/TAES Postdoctoral Scientist).

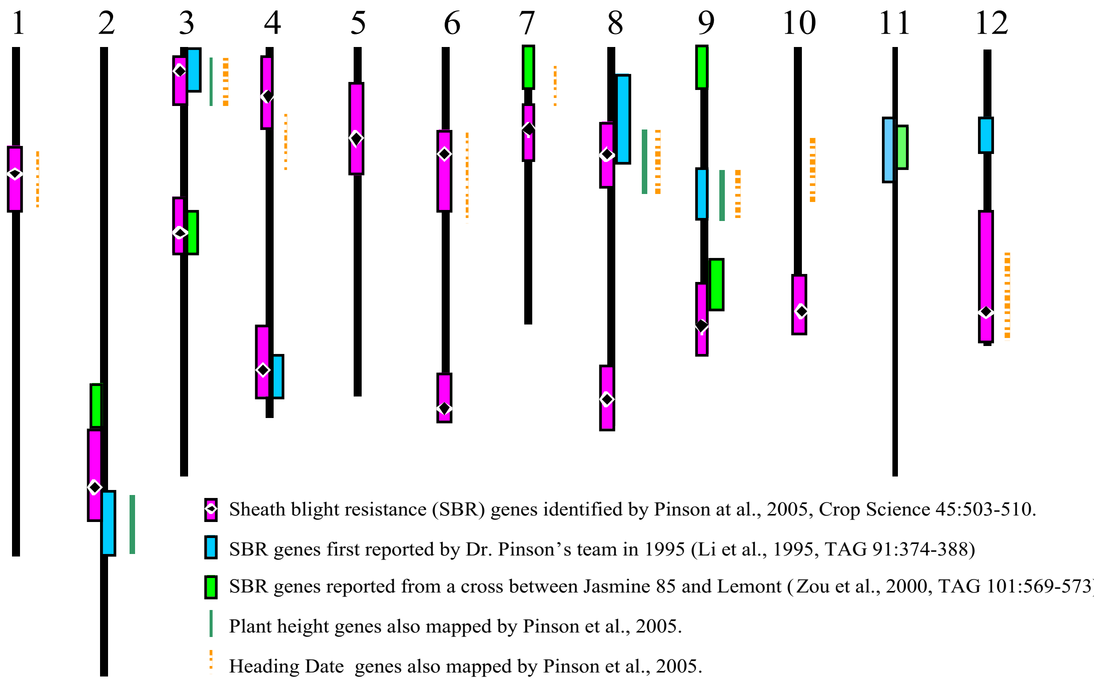

Fig. 3. Chromosomal location of rice genes affecting sheath blight resistance (SBR) identified by Pinson et al. using a gene-mapping population derived from Lemont x TeQing and comparatively mapped with SBR genes reported from two prior studies. Confidence in the predicted gene locations increases when they are identified in more than one study, such as those on chromosomes 2, 3, 4, 8 and 9. Because tall height and late heading can impact disease ratings but are not desirable in improved rice varieties, breeding emphasis will be on SBR genes not also associated with these traits.

For more information contact Dr. Pinson at 409-752-5221 ext 2266, email spinson@ag.tamu.edu.

Digging for Gold

Top: Carolina Gold
Bottom: Archeological Sample

About the time when the temperature started to turn in the Fall 2004, Dr. Merle Shepard of Clemson University sent the USDA-ARS Rice Research Unit (RRU) in Beaumont two rice seeds excavated from an archeological dig near the Old Exchange Building in Charleston, North Carolina. The seeds were discovered among artifacts in a soil layer associated with a hurricane that occurred in 1752. Dr. Shepard was aware of the fingerprinting technology that the RRU had developed for rice and wanted to determine whether the excavated seeds were evidence of Carolina Gold rice being grown in North Carolina during the time of the hurricane. The origin of Carolina Gold, the first known variety to be cultivated in the United States, is still unclear. The existence of this ancient seed could perhaps shed some light onto the origin and cultivation of Carolina Gold rice.

Fran Pontasch who works in the Molecular Genetics Lab of the RRU was given the task of handling the forensics under the supervision of Dr. Robert Fjellstrom. One of the seeds was used for analysis while the other was held under safe storage. As seen in the photo above, the excavated seed is similar to Carolina Gold in appearance and pubescence. Could enough DNA be extracted from one dirty seed over 250 years old verify its identity? Ms. Pontasch modified existing laboratory methods and was successful in producing enough DNA for a fingerprint analysis. The results were compared with several sources of Carolina Gold, cultivars of rice from other parts of the world where Carolina Gold may have originated, and with other species of rice. The results indicated that the archeological sample was not Carolina Gold, but more closely related to Southeast Asian *indica* varieties of rice (*Oryza sativa)*.

For more information contact Anna McClung, 409-752-5221 ext 2234, email amcclung@ag.tamu.edu

Molecular Markers in Rice Breeding

Dr. Bob Fjellstrom

Researchers in the USDA/TAES/TAMU Molecular Genetics Laboratory are continuing to develop and analyze markers for several economically important traits in rice. We are presently active in a multi-institute Coordinated Agricultural Project (RiceCAP) funded by the USDA National Research Initiative to develop DNA markers associated with milling yield and sheath blight disease (*Rhizoctonia solani*) resistance (see www.uark.edu/ua/ricecap for more details).

Genetic markers well-distributed throughout the rice genome will be analyzed for their association with increased milling yield or sheath blight resistance. To find these markers, rice mapping populations are being tested across several southern USA environments in multiple years. A total of 450 simple sequence repeat (SSR) DNA markers have been screened for genetic differences (polymorphisms) in the eleven parental lines used in the RiceCAP mapping populations. The following table shows that 77% or more of the markers screened in MY1 and SB4 populations are polymorphic (different between the two parents). These genetically diverse populations are derived from relatively wide crosses between the US cultivars Cypress and Lemont and indica germplasm (RT0034 and TeQing). The other more-narrow cross populations show less polymorphism and will require screening more markers to identify 150 well-dispersed polymorphic markers within each population. Even though 150 polymorphic SSRs have been identified between the MY2 parents, large gaps are present between markers that will need to be filled in with additional markers. Saturating the genetic map with well dispersed markers is necessary to find genes that are located anywhere on the 12 chromosomes and are associated with the two traits.

This research has been supported in part by USDA-CSREES-NRI and the Rice Foundation. Project participants include Eric Christensen, Fran Pontasch, Shannon Pinson, Anna McClung, and Bob Fjellstrom; Molecular Genetics, Variety Improvement, and Genetics Programs; USDA-ARS, Beaumont, TX. For more information call Dr. Fjellstrom at 409-752-5221 ext. 2225, or r-fjellstrom@tamu.edu.

RiceCAP Population	Cross	# Successfully Amplified SSRs	# Polymorphic SSRs	% Polymorphic SSRs
MY1	RT0034/Cypress	370	285	77.0
MY2	Cypress/LaGrue	389	150	38.6
MY3	L204/0Y110	365	129	35.3
SB1	Pecos/Rosemont	390	225	57.6
SB2	Cocodrie/10227	336	183	54.5
SB4	Lemont/TeQing	378	320	84.7

Genetic Markers Reveal Novel Genes Which Control Rice Cooking Quality

Rice molecular markers have been developed in the gene (*Waxy*) that control grain amylose content and the gene (*Alk*) that controls alkali spreading value. Both of these factors are considered major determinants of rice cooking quality and texture. This set of markers is now being routinely used by US breeding programs to expedite the development of improved rice cultivars that meet rice cooking quality standards as determined by the US rice industry.

For the first time, these markers have been used to characterize a subset of the rice germplasm collection that is maintained by the USDA-ARS National Small Grains Collection. There are over 20,000 accessions in the rice collection and about 1600 of these have been chosen as a representative core subset. These were grown in Stuttgart, AR during 2002 for plant trait evaluation and then sent to the USDA-ARS Rice Research Unit in Beaumont for genetic marker analysis. Several markers associated with the *Waxy* and *Alk* genes were evaluated. Fourteen different forms (alleles) of the *Waxy* gene were identified and 8.2% of the accessions were found to be

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mixtures. Of the *Waxy* alleles identified, eight were considered rare alleles, being found in less than 5% of the accessions. Five of these (CT 12, CT 13, CT 15, CT 21, and CT 22) were new alleles, not observed in our previous, smaller surveys. These new alleles were identified from a diversity of regions from around the world.

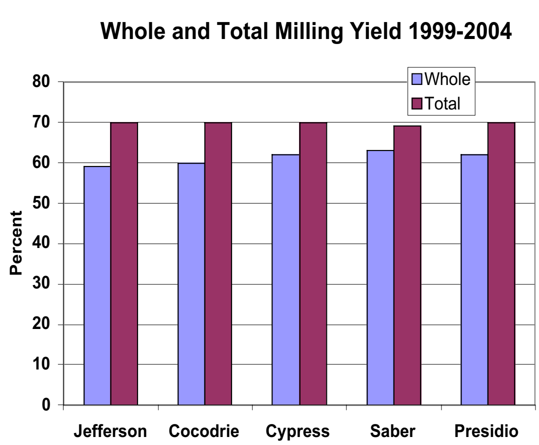
These results demonstrate that molecular marker evaluation provides an accurate method for characterizing world germplasm that is not influenced by the location where the seed was produced; markers reveal sample mixtures that may be obscured when traditional trait evaluation methods are used; and markers clearly distinguish unique alleles that may be useful for discovering novel cooking and processing qualities in rice.

For more information contact Anna McClung at 409-752-5221 ext. 2234, email amcclung@ag.tamu.edu.

Waxy Gene	Amylose Content (%)	Number of Accessions	Frequency (%)	Predominant Region Of Origin
99	26.3	95	5.8	Subcontinent
103	24.7	122	7.6	Subcontinent
105	24.8	322	19.9	China, South America, Subcontinent
107	19.8	5	0.31	Various
110	24.4	7	0.43	Various
112	23.3	14	0.87	Africa, Americas
114	20.1	6	0.37	Various
116	22.4	72	4.5	Africa, South America
118	19.4	246	15.3	North Pacific
120	17.9	396	24.6	Western Europe, Africa, South America
122	19.9	70	4.3	Australia, Africa, South America
124	21.6	121	7.5	Africa, Americas
126	20.6	3	0.18	South America, Western Europe
128	21.1	1	0.06	South Pacific
Mixture	-	132	8.2	Various
Total		1612		

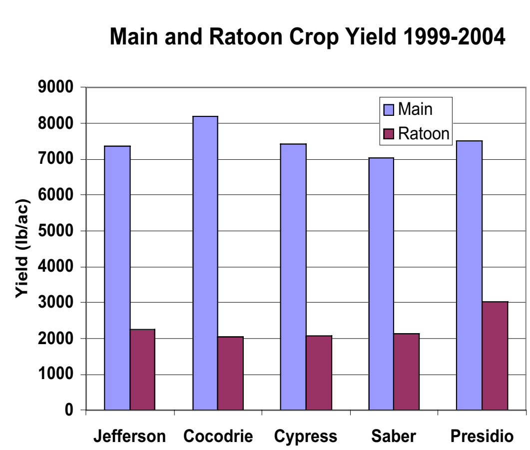
Variety Improvement

‘Presidio’ Rice - A New Long Grain Rice With Improved Ratoon Crop Potential and Milling Yield



USDA-ARS and TAES have announced the release of a new long grain cultivar for production in the South. Presidio rice was developed from a cross of a Jefferson sibling with Maybelle and Rosemont. Presidio is similar to Cocodrie in height and maturity. It has good sheath blight tolerance (rating of 5, with 1=tolerant, 8=susceptible) similar to that of Saber and better than that of Cocodrie (rating of 7).

Presidio possesses one of the two major blast resistance genes found in Jefferson which conveys resistance to five of the nine races of blast commonly found in the South. The chart shows the milling and yield performance of Presidio as compared to several check cultivars. The most important features of Presidio are that it has greater ratoon crop potential than Cocodrie and has high milling quality like Cypress.



For more information contact Anna McClung at 409-752-5221 ext. 2234, email amcclung@ag.tamu.edu.

Generation and Identification of Herbicide Tolerant Germplasms - an Update

Dr. Rodante Tabien

At the start of this project in 2003, two activities were initiated to generate and identify germplasm that can survive the application of either glyphosate (Roundup) or glufosinate (Liberty) herbicide. The first activity was the screening of germplasm from the gene bank collection and second was induced mutation using chemicals. Test entries were grown in flats having Cocodrie as susceptible check and 29 entries as test lines. At 4-5 leaf stage, these were sprayed at recommended dosage using knapsack sprayer. Three weeks after spraying, reaction of each entry was evaluated. Accessions or lines that survived the first screening were grown until maturity and were re-evaluated to remove potential escapes during the first screening.

In 2004 screening, there were 1444 germplasm from the gene bank evaluated. Among these entries, 291 and 63 plants survived Liberty and Roundup herbicide application, respectively. Of these survivors, 187 plants from 132 accessions produced seeds after treatment with Liberty, with 104 accessions producing sterile plants. With Roundup treatment, 32 plants produced seeds from 32 accessions, with an additional 31 accessions being sterile. High sterility was noted in several entries surviving the initial treatment, and this is likely the effect of the herbicide. Re-testing of the initial accessions producing sterile plants was started. Liberty treatment of 104 accessions resulted in 52 accessions with 80 plants producing seeds. Re-testing of 18 accessions previously sterile with Roundup has failed to produce survivors.

Mutation induction was done using ethyl methane sulfonate (EMS) and methyl nitrosourea (MNU). There were 411 seed-bearing plants from the mutagen treated Cocodrie, Presidio and TX8181 after herbicide application. The treated line Presidio showed higher herbicide tolerance than Cocodrie and TX-8181, especially for Liberty. In general, the progenies from EMS-treated seed exhibited good germination rates. Similar with the untreated gene bank germplasm, survivors show increased sterility, with surviving seed exhibiting poor germination rates, and offspring with even higher sterility. In contrast to the plants from EMS-treated seed, progenies from MNU treatment exhibited poor germination rates, generally with poor seedling vigor, and abnormal leaf morphology. Herbicide application exhibited especially lethal results, with very few survivors. In 2,348 entries evaluated, one plant from 1.5 mM MNU treatment of the variety Cocodrie has produced seed after surviving Roundup application. All other survivors of herbicide applications have perished. Currently, seeds generated from all surviving plants are planted for seed increase and further evaluation.

Development of High Yielding Rice Varieties for Texas

The Texas Vision 2020 planning process for rice identified high yield, grain quality, herbicide tolerance and seedling cold tolerance as important traits, thus the state breeding program focus on incorporating herbicide tolerance and seedling cold tolerance in high yielding breeding materials. Weeds are a perennial problem to farmers in all rice production areas in Texas and on average reduces yields and grain quality by 17%. Herbicide tolerant rice has tremendous value in rice weed management and the development of such varieties is an important component of this program. Seedling cold tolerance is important in early establishment of rice crops. With unpredictable cold spells during early spring, seedling cold tolerance will favor early season planting, uniformity of field emergence, and development of vigorous seedlings and tillers. Early planting increases main crop and ratoon yields by allowing the crop to develop prior to the hotter parts of the summer.

The second year of the breeding project continued the identification of available germplasm and evaluation of genetic resource developed in the first year to begin selection for herbicide tolerance. In the absence of a donor for herbicide resistance, 82 new germplasm with cold tolerance (15^{o} C), new plant-type traits and/or progenies of indica x japonica crosses from the Philippines and the U.S. collection that constitutes germplasm

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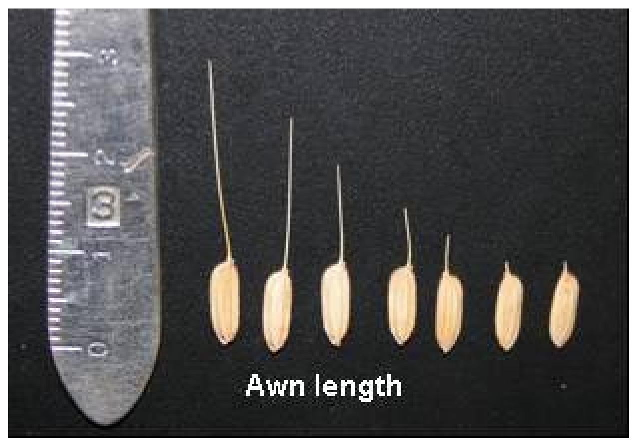
Variety Improvement continued...

from Italy, Korea, China and Russia reported to have cold tolerance, seedling vigor and high yields were planted and used for crosses. Over 100 crosses were made generating 65 single crosses, with a total of 322 new F_1 seeds produced. All F_1 plants were grown in the greenhouse and the F_2 population for selection is currently planted. There were 108 F_2 populations from 2003 crosses planted for selection and 50-100 panicles were harvested from each population. These selected panicles were sent to Puerto Rico and the rest are now planted at the 2005 pedigree nursery. The 2004 pedigree nursery was composed of lines selected from F_2 populations shared by Dr. S. Linscombe of LSU and subsequent segregating lines in each generation. The nursery was composed of 4,361 rows planted in 10 ft. rows and of these, 2,443 were selected for advancement. The observational nursery composed of lines from the pedigree that are uniform in appearance was not established since the lines planted at Puerto Rico for advancement had several different plant types within the row. Among the F_4 rows at the pedigree nursery, 12 rows had few visible differences, thus will compose the observational nursery in 2005. Grain yield taken from 1 linear meter length showed some lines had a potential yield of nearly 11,000 lb/acre.

These lines were sent to Puerto Rico for generation advance and were included in the 2005 observational nursery and DNA testing. The established Puerto Rico winter nursery was composed of selected panicles from Beaumont entries that need rapid advancement or seed increase. A total of 1,943 panicles were planted one panicle to a row at Lajas, Puerto Rico last October and December. Harvest from these entries is now planted in various 2005 nurseries.

Phenotypic Variations in 'Milagro Filipino' Rice Variety from Mexico

Rice variety IR8 developed by the International Rice Research Institute, popularly known also as 'Miracle rice' was released in 1966. This short stature, early maturing and fertilizer responsive variety launched the Green Revolution that averted hunger in major rice growing areas. The same variety was released in the following year in Mexico and was named 'Milagro Filipino'. After nearly 38 years from its initial release, this variety is still very popular in Mexico. Farmers in two big rice growing cooperatives in Cuenca del Papaloapan planted only Milagro Filipino.



Variations in awn length of the 1967 released 'Milagro Filipino' rice variety of Mexico.

After series of plantings and seed increases in farmers' fields, even in a self-pollinated crop like rice, change in the population is likely. Selection, both natural and artificial, coupled with limited seed purification can direct a change in the constitution of a population. This study was initially aimed for seed purification, but the large variations observed prompted the characterization of this population.

Forty-four panicles from a seed production plot of Milagro Filipino were kindly provided by Mr. Joe Crane of BU Growers. They were planted in 2003 and 2004, and a replicated test of 11 diversely derived lines was conducted in 2004. Agronomic and grain data were gathered in both years to describe the variations among the lines derived from the original population.

Two-year data showed variations in agronomic and grain traits among the lines derived from Milagro Filipino. Significant variations were noted in plant height, maturity, length of flag leaf, grain length and width, ratio of seed length and width, awn length and tillering ability. Variation on leaf senescence, panicle exsertion and awn length were also noted.

For more information, contact Dr. Rodante E. Tabien at 409-752-2741 ext 2210 or email retabien@ag.tamu.edu.

Development of an Ultra-High Yielding Cultivar

Rice production at Texas currently involves growing the main crop and ratoon crop. A new ultra-high yielding rice cultivar that has a sufficiently higher main crop yield than the current short season cultivars would be economically profitable even without the second crop. Furthermore, an ultra high-yielding rice cultivar, if broadly adapted, would reduce Texas rice water use by about 147,000 to 304,000 acre-feet of water per year, compared to the requirement for the main crop and ratoon crop of short-season cultivars.

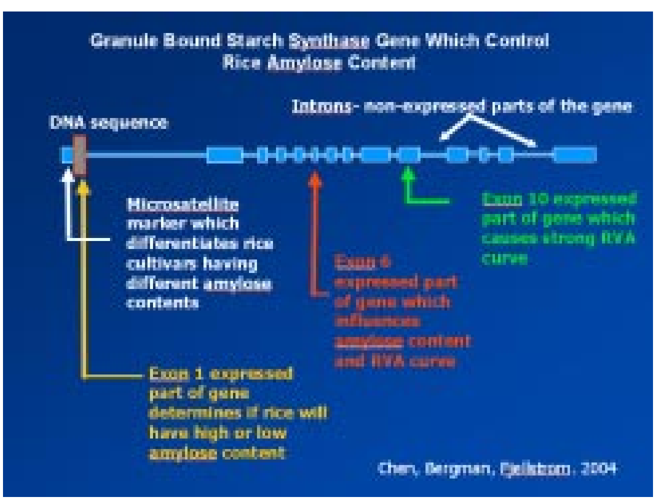
The best combination of traits for an ultra-high yielding cultivar for the Gulf Coast Environment was identified based on 187,500 different plant type simulations using the Rice Population Simulation Model and field studies of rice lines that exhibited the new plant-type traits. The breeding for a commercially acceptable, ultra-high yielding cultivar that would have a yield potential of at least 9,368 lb/A was initiated by the Beaumont Center in 2002, with financial support from the Lower Colorado River Authority. In comparison to existing short season cultivars, this new plant type will have 20% faster leaf production rate, 1 or 2 more leaves on its main plant, 20% heavier leaf weight, and it would take 4 to 7 days longer to mature.

For this 2005 cropping season, the pedigree and observation nurseries have been established and are being evaluated. The pedigree nursery consists of 5600 rows, while the observational nursery consists of 700 rows. There are also fields containing lines and cultivars which will serve as parents in this season's crossing work. Selected lines are also being evaluated by DNA analysis to determine whether they have the genes that confer the desired cooking quality, semi-dwarf stature, and blast resistance. The best 50 lines from last year were selected and entered into the project's first replicated yield trial.

Research on this project is conducted by Lloyd T. Wilson, Rodante E. Tabien, Stanley Omar PB. Samonte and James C. Medley. For more information, contact Ted Wilson at 409-752-3045 or email lt-wilson@aesrg.tamu.edu.

Rice Quality

A New Tool for Selection of Cooked Rice Texture



Progress has been made in identifying the specific region of the gene which controls rice amylose content that impacts cooked rice texture. Dr. Ming Hsuan Chen has worked as a USDA-ARS post-doc with Dr. Christine Bergman and Dr. Bob Fjellstrom over the last four years on a research project that was partially funded by the The Rice Foundation. The study involved characterizing 160 rice accessions from around the world for genetic variation associated with cooking quality traits. One of these traits, cooked rice texture, is measured by the Rapid Visco Analyzer (RVA) which determines the viscosity of rice flour paste as it goes through heating and cooling cycles. This mimics the performance of the rice as it is being cooked and then cooled. The RVA is a useful tool for determining the texture of cooked rice as would be perceived by in-home consumers and the processing quality of rice as determined by parboiling and canning industry end-users. Dr. Chen identified the expressed regions (exons) of the granule bound starch synthase (GBSS) gene which control the amount and structure of amylose that is produced in rice. DNA sequence variation in exons 6 and 10 of the GBSS gene cause dramatic changes in the RVA profile which results in some rice being suitable for parboiling and canning whereas others are not. As a result of this research, breeders now have a more accurate and efficient tool to develop new rice cultivars that have cooking quality traits that are desired by consumers and the processing industry.

For more information call Dr. Fjellstrom at 409-752-5221 ext. 2225, or bfjellst@ag.tamu.edu

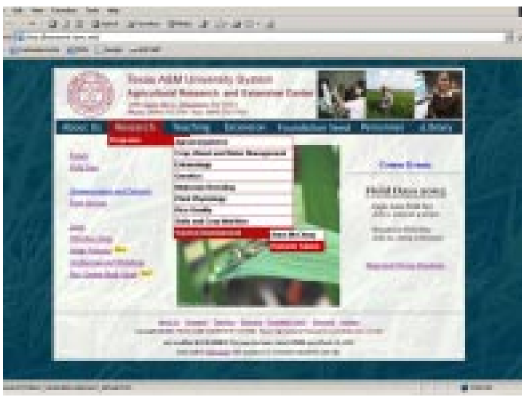
Beaumont Center Website

The Beaumont Center Website Project was started in March 2002, and involved participation by numerous Center faculty and staff. The website has been open to the public since March 2003, and it continues to improve, with new features added every month.

The website focuses on information and technology related to agricultural crops in Texas and the world, especially rice. The purpose of the website is to serve the rice industry, to promote the transfer of knowledge from research to technology to production, to facilitate communications and interactions between rice research, extension and educational communities, and to enhance the dissemination and access of information and knowledge related to rice research and production.

The website includes information on the history of the Beaumont Center, research programs, teaching, extension programs, personnel, foundation seed, an electronic library, a plant physiology forum, communication and outreach programs and farm services.

http://beaumont.tamu.edu



We are currently working on an online weather retrieval/delivery system, and are also developing a web-based rice knowledge/management system. As we strive to improve our website and continue to add new contents and features, we would appreciate your comments and suggestions so that future enhancements may best serve the rice industry and the research, extension and educational communities.

The web project team includes Dr. Ted Wilson, Dr. Yubin Yang, Peter Lu, Jenny Wang, Brandy Morace, James Medley and Jay Cockrell.

Rice Development Advisory Program

Dr. Yubin Yang and Peter Lu

In 1976, Dr. Jim Stansel developed the concept, methodology, and original data for forecasting rice development based on usable heat units. In 1986, Jack Vawter (TAMUS-Eagle Lake) wrote a DOS-based computer program 'DD50' based on Dr. Stansel's concept and methodology.

There are a number of limitations regarding the DOS-based DD50: (1) access to weather data for only two weather stations (Eagle Lake, and Beaumont), (2) need to manually input up-to-date weather data, (3) limited user interface, (4) accessible to only a small group of users, and (5) need to update and send out new copies of the program every year. In December of 2003, the Beaumont Center Director, Dr. Ted Wilson, started a project to develop a web-based program called Rice Development Advisory (RiceDevA) to replace DD50. RiceDevA is a complete rewrite of the DOS-based program. It provides an improved user interface and advanced options for creating, running, and displaying multiple field growth forecasts for different rice varieties, planting/emergence dates, and counties.

RiceDevA can provide growth forecasts and advisories for 21 rice counties in Texas. It can forecast rice growth stages for multiple varieties, different planting dates, and different rice counties. It allows users to create, view, and edit multiple field profiles. It also allows users to run multiple field profiles at the same time and display and print results for multiple field profiles. RiceDevA allows users to choose weather stations in Texas rice producing counties and choose weather data for a specific year or historic averages for the station. RiceDevA also provides interfaces for user to add, view, and edit their own weather data, and allows user to view and download county weather data.

We are currently in the process of developing a web version of our Rice Cultivar Selection program

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Education continued...

(RicePSM). The RicePSM is a physiologically based program that has been proven to accurately predicate rice crop growth stages and crop yields. It accounts for changes in crop development due to temperatures, rainfall, solar radiation, soil type, fertilizer application, water management, planting density, row spacing, and other factors. The program will give more options to users to manage and predict their rice crops.

As we continue to accumulate our knowledge and understanding of the rice cropping system through our research, we are also realizing the increasing importance of extracting and integrating diverse knowledge in agronomy, physiology, ecology, entomology, and economics, into a system that is user friendly and easily accessible. Such an integrated system would greatly help rice producers and consultants in managing their crop production, by maximizing the transfer of knowledge from research to extension, and production.

The Rice Development Advisory Program team includes Dr. Yubin Yang, Dr. Ted Wilson, Peter Lu, Jenny Wang, Jack Vawter, and Dr Jim Stansel.

For more information contact Dr. Yang at 409-752-2741 ext 2500 or email yyang@aesrg.tamu.edu.

Foundation Seed Program

Texas Rice Improvement Association (TRIA) has provided support in research since 1941. They have produced quality Foundation Seed for the rice industry for over 61 years. The improvement of Foundation Seed has always been the goal. Foundation Seed sales is still the major form of income, while still looking at ways to provide revenues for future projects. With new opportunities that have arisen, they now participate in organic seed production and custom grown seed. As small specialty markets and others become present as viable participants in the rice market, TRIA is adapting new attitudes to survive. They are currently working with Riviana, Doguet's Rice, RiceTec, Anson Mills, Arrowhead Mills, and Nature Safe.

Robert Weatherton

With organic research they are learning and developing new methods and practices to improve production and quality. With new USDA Federal Organic regulations in place producers of organic crops must plant organic seed when available. TRIA will offer the following varieties in organic seed rice in 2006: Carolina Gold, IAC600, and Neches. The Foundation Seed production varieties for 2006 sales are: Presidio, Sabine, IAC600, TX1104, Aborio, and TX1184. They're also producing commercial seed that helps supplement the foundation seed revenues. Please take a minute to go by the TRIA booth for more information.

As in the past TRIA will be doing a rice contest. The winner will be awarded 5 cwts. of foundation seed or 200 lbs. of milled rice, so have your calculators handy. The past year has been a busy one with many new challenges. TRIA has/will address these challenges head on for the advancement of research and the improvement of Foundation Seed. Texas Rice Improvement Association is a major component in the survival of the Texas Rice Industry and is always ready to help farmers and producers in any way possible.

If you have any questions TRIA's Foundation Seed manager, Robert Weatherton, will be ready to help, call 409-752-2741 ext. 2230, or email rweather@ag.tamu.edu