Texas Rice

Texas A&M University System
Agricultural Research and Extension Center
Beaumont, Texas

August/September 2005 Volume V Number 6

Development of a Web-Based Rice Water Conservation Analyzer


Flowmeters, like the one pictured below, allow accurate measurement of the amount of water entering fields.

The San Antonio Water System (SAWS) is funding a project to study the feasibility of piping water to San Antonio from the Lower Colorado River. The water would be made available through conservation efforts in the Lower Colorado River Authority (LCRA) irrigation districts in Matagorda, Wharton, and Colorado Counties. The goal is to provide a win-win situation for growers and municipalities in these counties and the water-hungry city of San Antonio.

The agricultural conservation study is one of several studies involved in the LCRA/SAWS project. Parties involved in this study include TAES, Parsons Engineering, CH2MHill, and LCRA. TAES is involved with three aspects of the overall project, one focusing on the development of a high-yielding, water-use efficient rice variety; the second studying the potential for saving water via in-field water conservation; and the third developing a decision tool to estimate potential water savings and costs that could accrue from adoption of different on-farm water conservation measures.

This article provides a description of on-farm rice water conservation practices and discusses how their impact will be incorporated into an on-farm water conservation management decision tool, the Rice Water Conservation Analyzer (RiceWCA).

Water Conservation Practices

Field improvements can be broadly categorized as including five conservation practices: 1) precision grading, 2) multiple inlets, 3) conservation tillage, 4) tail water recovery systems, and 5) lateral improvement.

Precision Grading. Precision grading is the process of configuring the field shape and surface slope to optimize water management, crop production, water conservation, and operation efficiency. Field leveling reduces the amount of water required for flushing and flooding and greatly facilitates subsequent management practices for stand establishment, weed control, and field drainage for harvest (California Rice Production Workshop 2004). The more level a rice field, the greater the uniformity of crop growth, which translates to greater evenness of crop maturity across the field. Increased uniformity of water depth aids in weed control and in some cases increased crop yields. Areas of rice fields that have excessive water depth, which is present at a greater percent for fields with steeper slope between levees, can result in retarded plant growth and a decrease in rice crop yield.

Multiple Inlet. The basic approach to multiple inlet rice irriga-

continued on page 9

From the Editor...

Early reports from rice producers west of Houston are showing highly variable main crop yields. On the high-end, yields in a few fields have exceeded 11,000 lbs/ac (at 12% moisture). On the low side, a few fields have yielded less than 5,500 lbs/ac. On a positive note, it looks like the 2005 main crop yields will be higher than what was experienced in 2004.

Milling yields appear on average slightly lower than last year. This trend may hold. While higher than average temperatures have promoted rapid crop growth and strong grain development, high temperatures are a double-edged sword and can result in increased grain fissuring and chalk-belly. Over the next few weeks, as crop survey results continue to come in, we should be able to provide a better assessment of 2005 main crop yield and grain quality.

There is some question whether ratoon crop production will be higher or lower than last year. On the negative side, high temperatures cost the plants more energy when assimilating and converting carbon dioxide to sugars and starches. On the positive side, higher temperatures can result in greater culm (stem) and leaf mass, and a greater capacity for the plant to produce and store carbohydrates. Carbohydrates are the fuel used by regrowth tillers to jump-start the ratoon crop. The question is whether the net effect resulting from the higher temperatures was an increase or decrease in stored carbohydrates.

With the typical variability that has historically been experienced with the ratoon crop, and the increasing production costs that are being experienced this year, I am hearing that some of our rice producers are opting not to use as much fertilizer. As a good rule of thumb, if main crop insect and disease pressures were well controlled and if the ratoon crop is greening up and retillering well, the greater the chances for a good ratoon crop yield, and the greater the benefit that will occur from fertilizing at a higher rate. If the main crop experienced serious insect or disease problems, and if the ratoon crop is not greening up or retillering well, then the yield potential probably will not justify the cost of nitrogen applications to the ratoon crop.

On a very negative note, the costs of agricultural production have skyrocketed the past two years, largely due to increases in fuel and fertilizer costs. While the latest federal monthly report on inflation appears positive in showing consumer costs increasing 0.1%, household income increasing by 0.4%, and an unemployment rate of less than 5%, these numbers do not accurately reflect what our agricultural producers are experiencing. The major problem is that production costs are increasing at a very fast rate, while market prices have either remained stable or dropped.

The major cause for the increase in production costs rests squarely on increasing costs of fuel. The following are summarized from a recent presentation by Larry Falconer, who is a Texas A&M University System, Cooperative Extension Specialist. In 2003, the average cost of fuel for rice producers in Texas was ca. $0.95/gallon. For the 2004 season, this cost increased to $1.35/gallon. For the 2005 season, the average cost rose to $2.20/gallon. On a per annum basis, this represents a 52.5% average annual rate of increase.

Although the average consumer is also experiencing these fuel cost increases, the impact on the average consumer is far less than what it is for our agricultural producers. The bottom-line, is that petroleum based input costs represent a much greater percent of grower costs than what the non-agriculture sector of our economy experiences. From cultivating and planting fields, to pumping water from wells or buying water that was pumped through canals, to applying petroleum based insecticides, herbicides, and fungicides, to harvesting the crop, to drying the crop for storage or sale, to aeration of on-farm stored grain, to laser leveling the fields in the late summer/early fall, each of these steps use fuels or petrochemicals and require cost outlays.

continued on page 16

Inside This Issue

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.

Environmental Quality Incentives Program

Annual rice field days hosted by the Texas A&M Research and Extension Center are an excellent way for farmers to learn about issues that are important to their industry. This year, Wharton County rice farmer Ronald Gertson presented information on the Environmental Quality Incentives Program (EQIP) at both the Eagle Lake and Beaumont field days. Gertson is a member of the Natural Resource Conservation Service Texas State Technical Committee, and is very knowledgeable about the program, and how farmers can obtain assistance in improving their land. The following is an overview of the information Gertson presented.

Program Overview

EQIP was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers to promote agricultural production and environmental quality as compatible national goals. EQIP offers financial and technical help to assist participants install or implement structural and management practices on eligible agricultural land. The program is administered through the Natural Resource Conservation Service (NRCS).

EQIP offers contracts which provide incentive payments and cost-shares to implement conservation practices. Individuals engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

EQIP may cost-share up to 75 percent of the costs of conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered by them during the term of the Farm Bill.

EQIP in Texas

In 2004, EQIP money allocated to Texas totaled $63,266,502. The funds are split between statewide concerns and local concerns. Local concerns are determined by a local workgroup in each county in conjunction with the District Conservationist. Last year, each county in Texas received about $106,000 to spend on local concerns for a total of about $31 million. Unspent funds were redistributed to counties that had the most un-funded applications.

The State Conservationist sets statewide concerns, with input from the Texas State Technical Committee. In 2004, $25.4 million was spent on statewide concerns. As one of the statewide concerns, water conservation received $10.6 million

Equipment for laser leveling can be very expensive, and many growers choose to have the work contracted out.

continued on next page

with about $2.5 million going to the Gulf Coast Irrigation Unit that serves 17 rice-producing counties.

When deciding on your farm improvement projects, consult with your local conservationist to assess your chances of being approved under both state and local concerns.

Payment Guidelines for Precision Leveling

Precision leveling is one of the leading water conservation tools that is funded through the EQIP. Payments are 50% of the county average cost per yard, as determined by the District Conservationist, and either 250 yards/acre or the design yardage (whichever is less.) The following is a specific example for Wharton County under the State Concerns.

Field size = 100 acres.
Design yardage = 276 yds/acre.
Wharton County NRCS avg. cost = $1.25/yd
NRCS avg. yardage not to exceed 250 yards

EQIP Payment Per Acre:
250 yards x $1.25 x 50% = $156.25/acre

EQIP Total Payment for 100 acre Field
$156.25/acre x 100 acres = **$15,625**

Other cost sharing rates through EQIP include:

- Underground Pipe: 50% of $0.52 x pipe diameter in inches x feet of length.
- Multiple Inlets: 50% of $2,000 per field inlet with one inlet per 25 acres.
- Irrigation Water Management: first rice crop planted after leveling and multiple inlets is eligible for $10.00 per acre.

After the application is completed, NRCS fills out a ranking sheet for each application. Once per year (in April, May or June), the NRCS will choose applications for contracts starting with the highest-ranking applications, and will provide funding until either all applications are funded or until funding is exhausted.

After the contract is signed, contact your local NRCS office to arrange for a GPS survey when the field is relatively smooth. The engineer will use the survey to develop a design for the field - a "best fit" and perhaps one or two alternate designs. He will then meet with you to look over the design possibilities and help you choose a design to implement.

Once an agreeable design is achieved it will be sent to the local conservationist as an approved design and you can begin construction. Upon signing the contract, the applicant is liable to the NRCS for 20% of its value should the contract stipulations not be upheld. There are exceptions for emergency or unforeseeable circumstances.

After construction the NRCS should be called to check and certify the portion of work that is complete. If it passes and is certified, the NRCS will make payment for that portion that is completed and certified, usually in 30 to 60 days. If it does not pass, you will be asked to correct deficiencies before certification can take place.

Problems and Concerns

Like all federal programs, EQIP is subject to the annual whims of Congress, therefore this program cannot be counted on to be available each year. Also, if funds allocated within an area of the state are not fully utilized they are redistributed to other areas. Continued availability of funds depends greatly on the numbers of applicants seeking the funds.

Other concerns are that the applicants relying on the NRCS for surveying and design do not know how much the project will cost them before signing the EQIP contract. Also, will the NRCS require an applicant to implement a design that he is not agreeable to? Will the NRCS design minimize your out-of-pocket expense, minimize cut depth and meet the applicants' stated desires? These are questions the farmers need to consider carefully, and discuss with their local NRCS office or District Conservationist.

In Conclusion

EQIP offers great promise for helping farmers implement water saving improvements, whether it be precision leveling or the installation of side-inlet irrigation. As with any government program, a thorough and complete understanding of all requirements and stipulations is crucial to achieve the maximum benefit. EQIP sign-up information is available through your local NRCS office or online at http://www.nrcs.usda.gov/programs/eqip/ *

America's Golden Treasure

In late August, noted culinary experts, historians, scientists, scholars, chefs, and food enthusiasts gathered in Charleston, South Carolina to consider the history and future of Carolina Gold Rice. Framing these events, 35 of America 's finest chefs and culinary historians collaborated to offer fine foods and beverages inspired by Carolina cuisine, past and present.

The symposium was sponsored by the Carolina Gold Rice Foundation, whose mission is to advance the sustainable restoration and preservation of Carolina Gold Rice and other heirloom grains. The Foundation also seeks to raise public awareness of the importance of historic rice lands and heirloom agriculture. The Foundation encourages, supports and promotes educational and research activities focused on heirloom grains and serves as an information resource center to provide authentic documentation on heirloom grain culture and heritage.

The following is from a paper presented at the symposium by Drs. Anna M. McClung and Robert Fjellstrom, from the USDA-ARS Rice Research Unit at the Texas A&M Research and Extension Center in Beaumont.

Using Molecular Genetics As A Tool To Identify And Refine "Carolina Gold "

The production of Carolina Gold rice along the southeast coast of the North American colonies was fundamental to establishment and growth of their economy. Although there is documentation of the introduction of Carolina Gold rice into North America, its origin is still undetermined. Molecular marker technology has been used to better understand the history of Carolina Gold rice as well as purify it for use in contemporary markets.

As a result of the International Rice Genome Sequencing project, the rice genome has recently been sequenced. This has provided researchers with a very detailed roadmap for identifying some 40,000 functional genes in rice. In addition, this sequence information can be used to evaluate the evolution and domestication of rice. McClung and Fjellstrom used molecular marker technology to fingerprint historical and contemporary sources of Carolina Gold rice as well as its possible ancestors and descendants. They have used several fingerprinting markers dispersed among the 12 chromosomes of rice as well as a genetic marker (RM 190) that is found in the *Waxy* gene which controls the amount of amylose produced in the rice grain. Amylose is a component of rice starch and is considered to be a major determinant of rice cooking and sensory quality.

Previous research conducted in collaboration with Dr. W.D. Park, with the Texas Agricultural Experiment Station, demonstrated that Carolina Gold possesses a unique form of the RM190 marker that can be traced through the US rice pedigree and is found in current commercial cultivars. This specific strand of DNA controls rice grain quality, and was introduced into North America several hundred years ago in Carolina Gold rice, and still has a major impact on the US rice industry today.

McClung and Fjellstrom evaluated a representative subset of the 17,000 world rice accessions that are maintained by the USDA ARS National Plant Germplasm System to determine how common this form of the RM190 marker was in the collection. Among the 1600 cultivars that were evaluated, the RM190 marker was identified in less than 1%.

Essentially all of these were derived from Carolina Gold or were collected in Africa, the Caribbean, or South America. There has been speculation that Carolina Gold may have originated in Indonesia or Madagascar. McClung and Fjellstrom evaluated a small number of accessions from these regions as well as several other species of rice that are indigenous to other parts of the world and none possessed the same form of the RM190 marker as Carolina Gold. It is possible that the RM190 marker that is found in Carolina Gold originated in Africa through natural mutation, and then was introduced into the New World

continued on next page

through trade and commerce. The length of a genetic marker is inversely related to its evolutionalry age. The size of the RM190 marker that is found in Carolina Gold is larger and considered less ancient than the forms commonly found in indica cultivars from Asia, but it is smaller and more ancient than cultivars found in the US today.

Figure 1. Example of gold and white hulled panicles commonly found in Carolina Gold.

Dr. Merle Shepard with Clemson University provided McClung and Fjellstrom with two rice kernels from Martha Zierden, Curator of Archaeology for the Charleston Museum, that were excavated at an archeological site associated with a hurricane that occurred in 1752 and which was conducted at the Old Exchange Building in Charleston, South Carolina. Shepard and Zierden wanted to know if the fingerprint genetic markers could be used to determine if the excavated rice kernel was Carolina Gold rice. A visual comparison of the sample with Carolina Gold rice showed interesting similarities. A genetic analysis was conducted on the archeological sample using eight markers, including RM190. Following the DNA extraction and marker analysis of the excavated kernel McClung and Fjellstrom determined that it was not Carolina Gold but instead had genetic markers typical of many Asian varieties.

Over the last few years, there has been increasing interest in reviving Carolina Gold production for use in specialty markets. The researchers obtained several sources of Carolina Gold that were being grown on limited commercial scale and compared them with samples that had been maintained in a few historical collections. Although only a small amount of seed was analyzed from each source, most samples appeared to have a mixture of gold and white-hulled kernels (i.e. Carolina Gold and Carolina White) (Figure 1). Seed samples were sorted by color and then analyzed with 14 molecular markers. Gold seed of the various sources appeared quite uniform in the marker analysis suggesting that there had been no major genetic change due to conscious or inadvertent selection.

An analysis of the white kernels indicated a relatively high number of markers that were heterogeneous indicating segregation, outcrossing, or mixtures. In 2002, a further analysis of seed from each of 20 gold panicles and 12 white panicles, demonstrated that the white panicles had different alleles and mixtures of alleles that were not found in the gold panicles. Seed from each of the panicles were sown in 2003 to compare the plants for height and maturity. Although the average height and maturity were the same for the two sets of lines, the plants derived from white seed were more variable. Leaves from 50 white hulled plants identified in a commercial field of Carolina Gold were analyzed using four DNA markers. Results showed that 56% of the plants had more than one allele for at least one marker indicating that they were derived from seeds that were hybrids, likely due to natural outcrossing in the field. Of the remaining white-hulled plants, almost all possessed alleles that were not found in the gold-hulled plants. Thus, the white-hulled plants that are commonly found in Carolina Gold fields appear to be genetically different than the gold-hulled plants and these may be perpetuated through outcrossing.

In an effort to provide high quality pure seed to growers interested in commercially producing Carolina Gold, the researchers used trait data and molecular markers to help remove off-types and outcrosses to produce a uniform, pure gold version. After three generations of selection, "Carolina Gold Select" (PI 636345) was released to the public as certified foundation seed through the Texas Rice Improvement Association at Beaumont.

To contact the Texas Rice Improvement Association call (409)752-2741 ext. 2230. To learn more about the Carolina Gold Rice Foundation visit www.carolinagoldricefoundation.org/ *

Article and photos by Drs. Anna McClung and Bob Fjellstrom

The University of Arkansas Division of Agriculture is leading a major multi-state rice biotechnology research effort funded by a USDA grant of $5 million for 4 years, announced Dr. Milo Shult, UA vice president for agriculture.

The grant, awarded through the USDA Cooperative State Research, Education and Extension Service (CSREES) National Research Initiative Competitive Grants Program, will fund the Rice Coordinated Agricultural Project (RiceCAP).

"Rice was chosen for this major plant biotechnology award because it is an immensely important crop in the U.S. and internationally," Shult said.

In addition to University of Arkansas researchers, leading rice scientists at the USDA Agricultural Research Service, and 10 other institutions in nine states, have joined forces to use the most modern tools of molecular biology to improve rice production in the U.S. Included in this group are Beaumont researchers Drs. Anna McClung, Bob Fjellstrom and Shannon Pinson from the USDA-ARS, and Rodante Tabien from the Texas A&M University System.

The purpose of the project is to create a bridge between the basic research of rice genomics and the applied research of rice breeding. The goal of the group is to identify important genes and generate genetic markers that can help breeders work with greater precision.

The project's goal is *not* to develop genetically modified rice crops, but to employ the powerful potential of molecular marker analysis to expand conventional breeding techniques.

Rice breeders can follow the genes while using traditional pedigree breeding to develop improved varieties with desirable agronomic traits that have been difficult to acquire in the past.

"The RiceCAP goal is to identify and verify the genes that control two important traits in rice that have been difficult to improve through conventional breeding techniques", said Dr. Jim Correll, UA plant pathologist and project leader. These traits are improved milling yield and resistance to sheath blight, one of the most pervasive and destructive diseases of rice worldwide.

"RiceCAP aims to develop a set of biotechnology-based tools to improve these two attributes in U. S.

Top row L to R: Don McCaskill, Eric Larrabee, Neil Rutger, Gurdev Khush, Ron Phillips, William Crosby and Dwight Roberts. Bottom row L to R: Chuck Wilson, Ernest Girouard, Jose Re and Dave Mackill.

rice varieties," Correll said. "This biotechnology toolbox will allow traditional rice breeders to solve problems that they have been unable to adequately address in the past."

The rice genome, or DNA genetic code, is composed of approximately 35,000 to 50,000 genes that control all plant traits. With the publication of the 2005 August 11th issue of *Nature,* containing the paper entitled "The map-based sequence of the rice genome", the gene sequence information is now publicly available to rice researchers worldwide.

"To effectively utilize this valuable resource, rice researchers need to begin to understand the function of these genes and how they impart economically valuable attributes to commercial rice," he said. "A better understanding of these genes will enable researchers to develop a hardier and more productive rice crop."

Milling yield and resistance to sheath blight are likely controlled by multiple genes, instead of one important gene, that determine whether a plant has one of these traits. Such traits are hard to track using conventional breeding practices

According to Dr. Anna McClung, scientists based at the Beaumont Center will be working to identify candidate genes and other molecular markers linked to quantitative trait loci which control milling quality and resistance to sheath blight disease.

Some 500 F11 random lines from the MY1 RT0034/Cypress mapping population were provided to the RiceCAP project by RiceTec, Inc., Alvin, TX. The lines were grown in Beaumont in 2004 to pro-

continued on next page

Rice CAP continued...

duce enough seed for replicated field trials at multiple locations in 2005. Based upon the molecular marker analysis, 156 F12 lines were selected for planting during the 2005 season. Seed was distributed to Crowley, LA, Stuttgart, AR, and Beaumont, TX for planting. Five other mapping populations are being developed for the RiceCAP project using similar means.

Regarding molecular efforts, the scientists are evaluating parental lines for genetic polymorphism. A total of 222 simple sequence repeat markers (SSR, also known as microsatellite) have been screened for genetic differences (polymorphisms) in nine parental lines used in the RiceCAP milling yield and sheath blight resistance mapping populations. Most of this work is being conducted in Dr. Bob Fjellstrom's lab at the Beaumont Center.

In addition to the breeding and molecular work, Dr. McClung is also responsible for developing technical training programs and resources to insure implementation of molecular marker and gene validation technologies to solve rice problems.

To this end, she organized a Marker Assisted Selection Workshop, which took place in mid-June, following the annual RiceCAP meeting in Stuttgart, AR. Forty-seven participants were from university programs, 32 from federal programs, and 16 were from the private sector. The workshop was presented in a lecture format with 24 invited talks being presented over the 2 1/2 day meeting.

Regarding the purpose of the workshop, McClung said, "The first and most important hurdle to be overcome will be increasing breeders' confidence and familiarity with this technology. New know-how will come from conducting the proposed research along with participating in workshop training opportunities that will build the skill level of the breeding community."

In addition to a strong scientific component, the project will include extension efforts to fully inform rice producers, processors and consumers about the potential benefits of the overall RiceCAP effort, and the merits of such an approach to improve rice cultivars.

More information can be found at the RiceCAP Web site: http://www.uark.edu/ua/ricecap/ or contact Dr. Anna McClung at 409-752-5221 ext. 2234.*

Texas Aggies Respond to Hurricane Katrina

Texas A&M University System employees and students have contributed a significant amount to relief efforts in the wake of hurricane Katrina. Besides the countless hours volunteered through churches and civic organizations, System-wide efforts have been made to help those affected by this devastating storm.

Dr. Elsa A. Murano, Vice Chancellor and Dean of Agriculture and Life Sciences and Director of the Texas Agricultural Experiment Station; and Dr. Ed Smith, Director of Texas Cooperative Extension, authorized all TAES and TCE employees to take 4 hours of emergency leave to assist in the relief efforts for those affected by hurricane Katrina. Given that the two agency's combined budgeted employees exceed 3200, this is a significant amount of man-hours committed to helping those affected by the disaster.

On campus, President Robert Gates authorized the use of the Reed Arena to temporarily house those displaced by the storm. According to Gates, the Commandant of the Corps of Cadets, Lt. General John Van Alstyne, was placed in charge of this endeavor. "This is in no small part because one of his last responsibilities at the Pentagon was taking care of displaced military families after 9/11," said Gates in a statement issued in early September. " I also wanted a no-nonsense person in charge. He has told me that he is quite comfortable with the security arrangements. Either he or his chief-of-staff are at Reed 24/7."

The Corps of Cadets set up several hundred beds on the floor of Reed Arena, helped establish a structure for processing the evacuees, made arrangements for them to shower and get new clothes, and helped develop a process for medical checks. The Corps Commander, Matt Ockwood, asked for 300 volunteers to accomplish these tasks - 900 cadets volunteered, and Reed Arena was made ready in less than 24 hours, as many of the cadets worked all through night.

In addition to the Corps, the women of the Aggie Dance Team organized a distribution center for pillows, towels, bedding, personal hygiene kits, baby

continued on page 16

tion is to place irrigation tubing across the field and punch holes or install gates for water inlets to irrigate each paddy that the tubing crosses (Delta Farm Press 2003). The potential benefits of multiple inlet rice irrigation include reduced water loss, quicker flood establishment, improved fertilizer and herbicide efficiency, reduced irrigation pumping time and costs, reduced labor, reduced runoff, and shallower flood.

Conservation Tillage. The term conservation tillage applies to any tillage and planting system that leaves 30 percent or more of the soil surface with crop residue after planting (Texas Rice, 2005). Conservation tillage has proven to be an extremely efficient and effective tool for reducing erosion, protecting the quality of surface and ground water, and providing habitat for a variety of wildlife species (Texas Rice, 2005). The potential benefits of conservation tillage include reduced labor, time and fuel use, reduced machinery wear, higher soil moisture, and reduced runoff (Texas Rice, 2005). Conservation tillage often reduces the number of flushes early in the season by retaining a greater amount of moisture in the soil prior to planting.

Tail Water Recovery. Tail water recovery systems facilitate the reuse of water by capturing water leaving fields from drainage and by capturing rainfall. With the ever-escalating costs of production inputs, including water, tail water recovery systems have the potential to provide rice producers with major monetary savings.

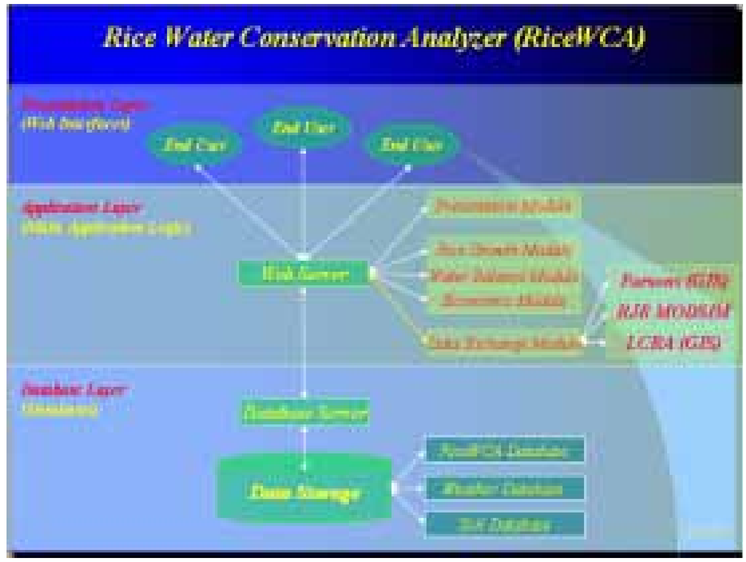


Figure 1: RiceWCA System Architecture

Lateral Improvement. Lateral improvement involves the control of vegetation inside the lateral and on the lateral banks, and installation of underground pipe in place of lateral ditches. Vegetation control along the lateral ditches and on the surface of the water reduces water use that is normally lost through plant transpiration. In the course of a season, a heavy growth of weeds along a lateral will transpire as much as 40 inches of water. In extreme cases, where fast growing invasive plant species such as the Chinese tallow become established along the canals or laterals, a single tree can use as much as 500 gallons of water per day (LNVA, personal communication). Aquatic weeds that grow on the water surface not only account for a major amount of additional water use, they also impede water flow, requiring a greater flow rate to get the water to fields in a timely manner. Effective weed control can eliminate much of this water loss at a very low cost.

Burying rigid pipe laterals is another option to conserve water and improve the efficiency with which water can be delivered to individual rice fields. A properly sealed lateral pipe can almost totally eliminate lateral water loss.


The poly pipe pictured above is often used for multiple inlet irrigation, which can conserve water and increase productivity.

Rice Water Conservation Analyzer

Researchers at the Beaumont Center

continued on next page

Water Conservation continued...

Figure 2: RiceWCA Web Interface

began to develop the Rice Water Conservation Analyzer (RiceWCA) in January of this year. When completed, RiceWCA, will be able to rapidly estimate the costs and water savings associated with implementing a wide range of rice on-farm conservation measures. The web-based program will provide estimates of water use as a function of currently used on-farm water management practices, and will estimate the potential water savings and costs associated with varying degrees of implementation of on-farm water conserving measures throughout the LCRA districts. Users will be able to analyze the benefits (water savings and in some cases yield increases) and costs (land improvements, labor, and in a few cases, yield decreases or increased fertilizer use), for a range of laser leveling options, lateral improvements (weed control and buried pipe), multiple inlet systems, tail-water recovery systems, and conservation tillage practices. RiceWCA will allow users to conduct individual analysis at the levels of irrigation districts, sub-districts, canals, and turnouts. The ultimate beneficiaries of this study will be the rice producers who implement the most cost-effective conservation measures.

System Architecture. The overall architecture of RiceWCA is described in Figure 1. It contains three major layers (presentation, application and database). The presentation layer is a web-based interface through which users interact with the program. The application layer contains the main application logic. The database layer provides data that are needed to run the simulation and store simulation results for later analysis.

RiceWCA will provide water use and cost analysis 1) at the levels of districts, sub-districts, canals and turnouts, 2) for baseline conditions of laterals and fields, 3) for multiple agronomic practices, and 4) for different weather scenarios. It will allow users to create, edit, and run multiple water conservation profiles and present graphic displays of results. It also provides dynamic access to field-specific weather and soil data.

Menus. Users will be able to access the RiceWCA using any web browser. Figure 2 is a preliminary version of the interface and illustrates many of the RiceWCA features. The left side of the interface window displays links to the major features of the Rice Water Conservation Analyzer (*About RiceWCA*, *Login*, *New Account*, *Conservation Profiles*, *Water Use Analysis*, *Cost/Benefit Analysis*, and *Data Viewer/ Downloader*). The remaining part of the window will allow users to input, edit, and view data or display results. A user can access features of the RiceWCA by

continued on next page

These pictures taken at L.G. Raun's farm in El Campo illustrate a cement 'water box' used to control water flow across levees. According to L.G., these improve water management by saving time and resources.

clicking the menu and making appropriate selections.

New Account. To create a new account, a user will click the *New Account* menu, fill in the appropriate information, and click the *Submit* button. Once an account is created, a user is automatically logged in, and will be able to access any menu item on the left side.

Establishing a uniform shallow flood is possible when fields have been laser leveled before planting.

Conservation Profiles. A conservation profile is a collection of field and lateral improvement options, as well as production and weather data needed to simulate water balance and carry out water use and economics analysis. To create a new profile, a user will click the *Create Profile* menu, fill in the appropriate information, and click the *Save* button (see Figure 2). Data needed to create a conservation profile include 1) general data, 2) district/canal, 3) in-field conservation, 4) lateral conservation, and 5) agronomy.

The *General Data* page will allow users to choose the type of analysis, year of the field data set, and a particular year or weather scenario. The *District/Canal* page will allow users to choose the scope of the analysis, from fields in a single turnout, to all fields at the canal, sub-district, or district level, and to all the fields in the entire LCRA irrigation system. The *In-Field Conservation* page will allow users to choose a specific degree of precision grading, installation of multiple inlet or tail water recovery systems, conservation tillage, and establishment of temporary and permanent levees. The *Lateral Conservation* page will allow users to configure the degree of vegetation control along the lateral and an option to replace the lateral with underground pipe. The *Agronomy* page will allow users to select a specific rice variety, cropping patterns (from continuous rice to a range of rotation schemes), planting dates, and flood depth.

Users can create three types of analysis: *Baseline*, *Advanced*, and *Extended*. The *Baseline* option will allow users to create profiles without selecting any conservation options. The *Advanced* option will allow users to create conservation profiles with multiple levels of parameter values, but with a limitation on the maximum number of parameters that can have multiple levels. The *Extended* option will allow users to create conservation profiles without limitation. All profiles can be saved to the underlying database and users can choose any profile to view, edit, run, or export for analysis and display in a wide range of statistics and graphics programs.

Figure 3: Water Use Analysis

Water Use Analysis. The *Water Use Analysis* menu will allow users to view and analyze water use estimates for a conservation profile. The water use analysis page will allow users to choose a specific profile and select options for conservation practices, results display, and parameter settings (Figure 3). The available options depend on the configuration of the profile when it is created.

The *Conservation Options* will allows users to examine water use with *No Improvement, Improve Filed Only, Improve*

continued on next page

Water Conservation continued...

Figure 4: Cost/Benefit Analyzer

Lateral Only, or Improve both Field and Lateral.

The *Display Options* will allow users to view the water use and cumulative water use (ET, Flood, Flush, Percolation, Rainfall, Tail Water, Water Demand, Supply & Demand) at the intervals of daily, weekly, monthly, and yearly in either tabular or graphic format.

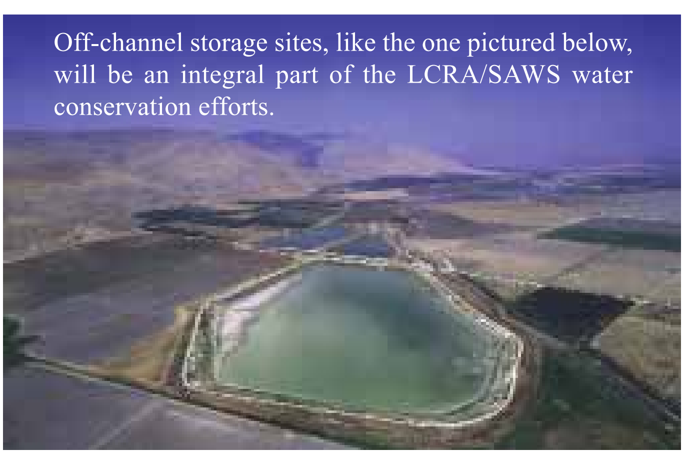
The *Parameter Settings* option will allow users to look at water use for any combinations of parameter values as set by the user when the profile is created.

Cost/Benefit Analysis. The *Cost/Benefit Analysis* menu will allow users to view and analyze the costs and benefits for each conservation profile. The available options are also dependent on the configuration of the profile when it is created. The layout of the cost benefit analysis page is similar to the water user analysis page. It has an additional option for users to customize the values for the cost/benefit parameters (Figure 4). The *Display Options* will allow users to view costs and benefits in three different formats: *Itemized Cost/Benefit*, *Summarized Cost/Benefit*, and *Cost/Benefit Comparison*. The *Itemized Cost/Benefit* will allow users to look at the costs/benefits for each measure of the conservation practices. The *Summarized Cost/Benefit* will allow users to look at the cost/benefit for field and lateral improvement as a whole. The *Cost/Benefit Comparison* will allow users to look at the cost/benefit of water conservation practices with regards to baseline conditions (i.e. existing conservation practices). Users can also check the cost and benefit of conservation practices with or without the Environmental Quality Incentives Program .

Viewer and Downloader. The data viewer and downloader menus will allow users to view, plot, and download data associated with the RiceWCA, including *Field Maps*, *LCRA Irrigation Data*, *Simulation Results*, *Weather Data,* and *Soil Data*.

The future of agriculture is tightly tied to water. As urban center continues to expand, society will be increasingly faced with the challenge of optimizing water allocation between agriculture, urban, and industry needs. An ever pressing challenge will be to meet the dual demands of maintaining or possibly enhancing agricultural production to feed our growing population and providing safe and abundant water for human consumption.

RiceWCA will be one of the strategic planning tools used by LCRA to determine how to best conserve water to meet demands for water in the Lower Colorado River basin and surrounding cities. *



Off-channel storage sites, like the one pictured below, will be an integral part of the LCRA/SAWS water conservation efforts.

References: Delta Farm Press, 2003, http://deltafarmpress.com/mag/farming_multiple_inlet_rice_2/. Texas Rice, 2005, Conservation Tillage (http://beaumont.tamu.edu/eLibrary/Newsletter 2005_June_Newsletter.pdf). California Rice Production Workshop, 2004, Land Formation.

Article by Yubin Yang, Ted Wilson, Jim Stansel, Jenny Wang, Manuel Gallegos and Peter Lu.

Research News From Plant Physiology

Studying How UV Radiation Affects Rice Plant Development

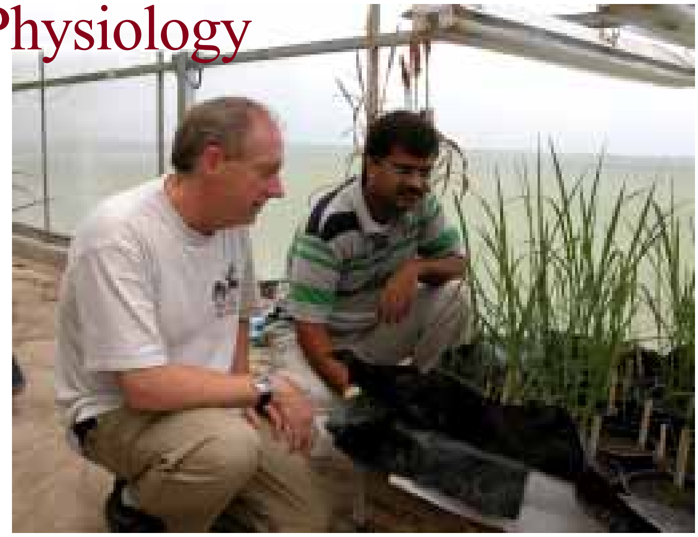
Low levels of ultraviolet-B radiation below the canopy in densely planted rice fields have a negative impact on tiller initiation and development. Moreover, there is a varietal difference in the response to UV-B radiation in rice. The objective of this study was to examine the effects of UV-B radiation on rice physiology with special emphasis on tiller development of the main crop for three different rice cultivars: Cocodrie, Sierra and CL-161.

Plants were grown in the greenhouse where the roof material was opaque to incoming natural UV-B radiation, hence artificial UV-B was provided using bulbs. The UV-B radiation intensity was checked daily with a digital radiometer. Rice plants were exposed to UV-B radiation of 0 (control), 8 (ambient), or 16 (twice ambient) kJ $m^{-2} d^{-1}$ in Experiment I. In the field, below the canopy, vegetation is experiencing a UV-B of 1 to 4 kJ. Therefore, in the second experiment, UV-B treatments of 0, 4, and 8 kJ were selected. Exposure started 20 days after emergence and lasted until the early grain-filling stage. All fertilizer treatments were the same. Plant height, tiller number, leaf chlorophyll content and leaf temperature were all measured. In addition, leaf sugar levels were determined in the second experiment.

In the first experiment, there was no significant difference between 8 and 16 kJ for plant height, tiller number, leaf temperature and chlorophyll content. However, there was a significant difference between 0 and 8 kJ in tiller number for variety CL-161. The same results with respect to tiller numbers were seen in the second experiment. In the second experiment, there was no significant interaction among the treatments and the varieties. Moreover, there was no significant difference between 0 and 4 kJ for all the parameters measured. Plants were taller and had more tillers when grown in the ambient UV-B environment, when compared to UV-B free environment (Table 1).

Table 1.
* Indicates Significant Difference Using LSD (*P*<0.05)

UV-B Treatments	Plant Height, cm	Tiller Number	Chlorophyll Content, SPAD Meter Index
0 kJ $m^{-2} d^{-1}$	94.25	7.42	43.69
4 kJ $m^{-2} d^{-1}$	94.10	7.42	43.43
8 kJ $m^{-2} d^{-1}$	103.13*	9.00*	45.28



Mr. Abdul Razack Mohammed (R) is pursuing a Ph.D. in Molecular and Environmental Plant Science at Texas A&M University since 2003 under the guidance of Dr. Lee Tarpley (L). His primary research concerns the effect of high nighttime temperature and role of antioxidants on growth, respiration and carbohydrate metabolism of rice plants.

There was no significant difference for chlorophyll content among the treatments.

Indole acetic acid or IAA is the most commonly known naturally occurring auxin. It is synthesized by plants from the amino acid tryptophan. IAA is produced in the apical meristems of shoots and diffuses downward, suppressing the growth of lateral buds. It plays a major role in stem elongation of many herbs and young grass seedlings. Plants sense light using photoreceptors and, in nature, use different photoreceptors to collect information about light intensity, gradient, duration, quality etc. Hence any difference in light quality or intensity or duration can affect plant growth and development.

Increase in tiller numbers might be due to three reasons:

1. more carbohydrates are produced to support tillers,
2. an increase in the content of photo-oxidation products of IAA under increased UV-B,
3. or changes in the photoreceptor for UV-B.

Leaf sugar levels were determined to see if more carbohydrates were produced as a result of UV-B to support the tillers. Our results indicate no significant difference in glucose, fructose or sucrose content among the UV-B treatments (Table 2). This indicates that the increase in tiller number was not due to an increase in carbohydrate content as a result of increase in UV-B levels. Therefore, the difference might be due to an

continued on next page

Table 2

Treatments	Glucose µg/g	Fructose µg/g	Sucrose µg/g
0 kJ $m^{-2} d^{-1}$	4314	59311	112700.0
4 kJ $m^{-2} d^{-1}$	3264	67794	129113.5
8 kJ $m^{-2} d^{-1}$	3168	66504	118455.5

increase in the content of photo-oxidation products of IAA under increased UV-B or due to the changes in the photoreceptor for UV-B.

In our next project, Tri-Iodo Benzoic Acid (TIBA), an auxin transport inhibitor, will be applied to evaluate the effects of IAA on rice tillering.

Article by A.R. Mohammed and Dr. Lee Tarpley

Looking Inside A Rice Plant To Monitor Development

Rice plants respond to the environment in many ways. These include change in the number of tillers, grains per panicle, rate of growth. Invisible chemical changes also occur as the requirements for energy or production of structural material, defense chemicals or food reserve compounds, such as starch, change in various parts of the plant. Because the plant changes in an orderly way during development and responds to environmental changes in a predictable fashion, the chemical changes that are a fundamental, but invisible, part of these changes are also orderly, and can possibly be monitored as a way of quantifying the rice plant's responses to differences in environment.

Rice plants constantly respond to the environment at several levels, ranging from altered growth and development of the whole plant, to biochemical changes occurring in individual parts of the plant (as exemplified in this infrared-enriched photo of leaves variously shaded in the canopy). In the accompanying article, Dr. Tarpley describes a new technology that will help scientists tie together knowledge at these different levels of plant response, all of which influence rice crop productivity.

Recent technological improvements in the ability to measure many metabolites in the plant simultaneously, and to measure many plant samples in a fairly short period, have enabled new research in this area. Dr. Lee Tarpley's Plant Physiology Project at the Texas A&M Agricultural Research and Extension Center in Beaumont and Dr. Lloyd Sumner at the Samuel Roberts Noble Foundation in Ardmore, Oklahoma, have begun to chemically monitor rice plant development and response to environment.

From an initial count of over 350, they identified a set of 21 metabolites that could consistently represent the changes taking place within the rice plant. These metabolites were chosen because they would be present in virtually any plant sample, and could be measured using high-throughput screening methods.

This set of 21 biomarker metabolites; which contains fairly common metabolites such as amino acids, sugars and organic acids; was tested for its ability to predict the chemical differences occurring among the different parts of the plant at different periods of tiller development, and performed very well. The biomarker set also did very well at predicting the change of other metabolites in rice leaves during the change from day to night as measured by other researchers, which indicates that the biomarker set will be useful for comparative studies.

The next steps will be to finish the development and optimization of the procedures for each of the biomarkers, so that they can be reliably measured using the high-throughput screening methods, and to modify procedures that Dr. Tarpley developed as part of remote sensing research for use in examining the changes among the biomarkers so that they can compare rice plant samples taken from many different situations. The information will be useful in diverse ways, such as improving our ability to model rice plant response to environment, to chemically define tiller development, and to gain new understanding of how a rice plant responds to nitrogen fertilization.*

Article by Dr. Lee Tarpley.

These research projects were partially supported by the Texas Rice Research Foundation and/or Rice Belt Warehouse. For references or more information contact Dr. Tarpley 409-752-2741 ext. 2235 or email ltarpley@ag.tamu.edu.

State, National and International News...

Scientists Map Rice Genome

Scientists have deciphered the genetic code of rice, an advance that should speed improvements in a crop that feeds more than half the world's population.

It's the first crop plant to have its genome sequenced, which means scientists identified virtually all of the 389 million chemical building blocks of its DNA. Certain sequences of these building blocks form genes, like letters spelling words.

"The advance will help breeders produce new rice varieties with traits such as higher yield, improved nutritional content and better resistance to disease and pests," said one of the project's leaders, W. Richard McCombie, of Cold Spring Harbour Laboratory in New York. "I would think this is going to help people find genes and probably enhance the crop in well under 10 years," McCombie said.

The work is reported in the August 11th issue of the journal *Nature* by the International Rice Genome Sequencing Project, which was established in 1998 and includes scientists from 10 nations. Japanese researchers led the effort.

In the *Nature* report, scientists estimated rice contains around 38,000 genes, but said that figure would no doubt be revised with further research. Humans, by contrast, have only 20,000 to 25,000 genes.

They also said that having the genome sequence in hand will be crucial for breeding and biotechnology advances to increase rice yield, noting that by one estimate the world's rice production must increase by 30% over the next 20 years to keep up with demand.

$5 Million To Restore And Protect Wetlands

Agriculture Deputy Secretary Chuck Conner has announced the availability of $5 million in the Wetlands Reserve Program (WRP) for restoration activities in 20 states. These funds will restore and protect nearly 40,000 acres of wetlands.

"This is another step towards meeting the president's wetlands initiative goal set last year to restore, improve and protect at least 3 million acres of wetlands. Through cooperative conservation efforts with federal and state agencies, private landowners and nongovernmental organizations, saving wetlands is resulting in cleaner air and water, healthier soil and improved fish and wildlife habitat," said Conner.

WRP, administered by the Natural Resources Conservation Service, is a voluntary conservation program that offers landowners the opportunity to protect, restore and enhance wetlands on their property.

The goal of the program is to achieve the greatest wetland functions and values and create optimum wildlife habitat on every acre enrolled in the program.

Mid-South and neighboring states receiving the WRP funds announced are Louisiana, $800,000; Mississippi, $100,000; Missouri, $550,000; Oklahoma, $50,000; South Carolina, $385,000; Tennessee, $75,000; and Texas, $521,125.

Food To Iraq

The USDA today announced that it will donate 21,250 metric tons of corn and 8,750 tons of soybean meal to the U.S. Grains Council, a private organization, for use in Iraq. "Agriculture is vital to the Iraqi economy and this donation will help to revitalize their agriculture sector as an engine of economic growth," says Agriculture Secretary Mike Johanns. "We are very pleased that USDA's food for progress program will help to improve the quality of life available to the Iraqi people." The U.S. Grains Council will sell the corn and soybean meal and use the proceeds to help revitalize the Iraqi poultry industry.

from The Corn & Soybean Digest

White House to Focus on Cooperative Conservation

The U.S. Department of Agriculture (USDA) and other federal agencies participated in the White House Conference on Cooperative Conservation in St. Louis, MO, August 29-31. The conference, convened by the White House Council on Environmental Quality, sought to identify innovative and effective approaches to promoting cooperative conservation.

USDA Secretary Mike Johanns, Under Secretary Mark Rey, and senior officials from Farm Service Agency, Forest Service and Natural Resources Conservation Service was among the participants.

Organizers intended the three-day conference to launch a new conservation dialogue and philosophy for the 21st century.

See: http://www.usda.gov/2005/08/0309.xml for more detail.

From the Editor continued...

Increased fuel cost, while benefiting the energy sector of our society are obviously out of control and threatens the fabric of our agricultural sector, the transportation sector, many seniors who are on fixed incomes, and many of the poorer members of our society. Maybe it's time for our government to rethink our energy pricing policy?

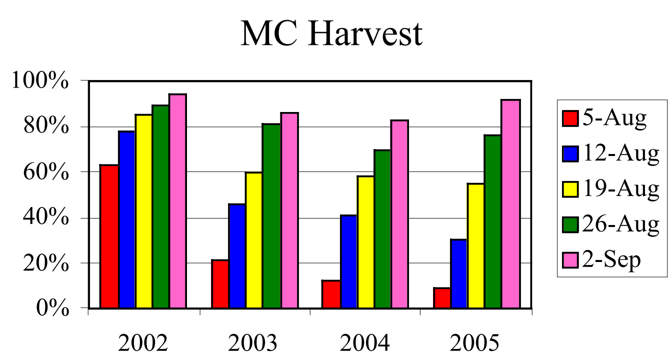
I hope you continue to enjoy *Texas Rice*. Please keep on sending us your suggestions.

Sincerely,

L.T. Wilson
Professor and Center Director
Jack B. Wendt Endowed Chair
in Rice Research

Rice Crop Update

As of September 2nd, 92% of the main rice crop was harvested. This is about 9% ahead of 2004, but 2% behind 2002.



Hurricane Relief continued...

food and diapers. Many of the sororities organized a childcare facility for the children, well supplied with toys, juice and coloring books. Many students came forward to replace the cadets, some of whom had been at Reed for more than 50 hours.

The university staff, faculty and administrators also stepped up to help in the efforts. Over 1,000 students were displaced by the hurricane, and these people put in long hours to ensure that these displaced students were processed into Texas A&M to continue their education.

"Aggies need to know that this was a high point in the history of Texas A&M, as we have responded to this terrible disaster named Katrina." said President Gates. "Seeing the desire to serve, the organizational skill, the willingness to work and the caring and compassion has been a profoundly moving experience."

President Gates concluded his statement with comments about the pride and spirit of Texas A&M students, saying, "Aggies often speak of 'the other education' here. My original intent had been to keep the evacuees entirely isolated from our students. Once assured of the safety of the students, that would have been the wrong decision.

" I have no doubt that the Aggie students who are participating in this extraordinary humanitarian endeavor will never forget it - or what they are learning from it about crisis management, and, far more importantly, about their own humanity and character. Nor do I doubt that the evacuees, all of whom are now wearing Texas A&M t-shirts, will always remember how these young people treated them and cared for them." *

Professor and Center Director: L.T. (Ted) Wilson
lt-wilson@aesrg.tamu.edu
Ag Communications Specialist: Jay Cockrell
j-cockrell@aesrg.tamu.edu
Texas A&M University System Agricultural Research and Extension Center
1509 Aggie Drive, Beaumont, TX 77713
(409)752-2741
Access back issues of *Texas Rice* at
http://beaumont.tamu.edu

Texas Rice is published 9 times a year by The Texas A&M University System Research and Extension Center at Beaumont. Interviews, writing and layout by Jay Cockrell. Editing by Ted Wilson, Jay Cockrell and Brandy Morace, with additional support by Jim Medley. Information is taken from sources believed to be reliable, but we cannot guarantee accuracy or completeness. Suggestions, story ideas and comments are encouraged.

Texas A&M University System
Agricultural Research and Extension Center
1509 Aggie Dr.
Beaumont, TX 77713

NONPROFIT
ORG.
U.S. POSTAGE
PAID
BEAUMONT, TX
PERMIT NO. 367