Texas Rice

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

October 2007 Volume VII Number 8

Sorghum Research Sheds Light on Sugar Movement

Picture this – Intravenous lines in a sorghum field. It's not as far-fetched as it sounds. It's one way that scientists at the Texas Agricultural Experiment Station are researching crops that may contribute to the biofuel revolution. In Beaumont, Dr. Lee Tarpley, plant physiologist, and College Station colleague, Dr. Don Vietor, professor of crop physiology, have focused their research on sweet sorghum.

Sucrose is the form of sugar transported from the leaves and throughout the plant for most plant species, and is also the form of sugar accumulated in the stalks of sugarcane and sorghum. The study relied on getting labeled sugar into the plant's normal internal distribution routes, so that the team could sort out the path by which it moves into its accumulation site under natural conditions.

While sweet sorghum and sugarcane are close relatives, the researchers have shown that the two species have different ways of moving and storing sugar. Radioactively labeled sucrose is injected into growing plants, using a system similar to an IV. Once the sucrose is inside the plants, the researchers can track the movement and distribution.

Nonstructural carbohydrates, such as sugar, that are accumulated in vegetative parts of plants can be remobilized to support new growth during periods of low photosynthesis, or during periods of high demand. This allows continued growth and biomass accumulation under stressed conditions. "The remobilization of carbohydrates occurs in many kinds of plants," said Tarpley, "but is especially prominent in the grasses, a group which includes the cereal crops, such as rice and wheat.

Arrows point to the IV line used to insert the labeled sugar.

However, the accumulation of high amounts of sugar can possibly be detrimental to biomass yield because stored sugar is energetically more costly than cellulose deposition. As the stalk of a large tropical grass or cane plant grows, there is a transition from growth (cellulose accumulation) to ripening (sugar accumulation) of the parts (internodes) of the stalk. In the stalks,

Sorghum trials at the Beaumont Center, grain sorghum in the foreground, and sweet sorghum in the background.

continued on page 7

From the Editor...

A Changing Paradigm for University Research

Welcome to the October issue of *Texas Rice*. This is the time of year that our researchers wrap up the 2007 field season, begin to analyze results from their research, and begin to write research proposals to industry, state, and national funding agencies.

As mentioned in a recent editorial, generating grant support is a big part of what we now do at the Texas A&M University System. Historically, state funding was used to pay cooling, heating, and fuel bills, pay for repairs to our building and roads, purchase equipment to conduct field and lab research, and employ our faculty, staff, post-docs, and students. Now nearly 50% of our total research activities are supported by external grants. Producing nationally competitive grants is not an easy process, and it is something that many of the university's most senior professors are not totally comfortable doing. I remember only two and a half years ago being asked by one of my scientists why TAES Beaumont and College Station administration was not providing him sufficient funding to run his entire program. Unfortunately, those days are behind us.

I think an article from the Virginia Polytechnic Institute was the first time I read about a university referring to its research program as being "state-assisted" instead of "state-supported". This is the reality of agricultural research universities today. Without the often time consuming effort by our scientists working to generate funding, the magnitude of modern-day agricultural research would be a small shadow of its former self. Regardless of the source of funding our scientists are here to help our agricultural clientele by developing scientifically-based solutions to management problems.

September and October turned out to be extremely busy months. September found a number of our scientists working to generate new partnerships. Dr. Yubin Yang met with Dr. Osborne at Lamar University to discuss possibly partnering through joint training of student interns. As a result of this meeting, I am hopeful we will have our first joint graduate student intern starting in January. The intern will work with Dr. Yang to receive on-the-job training in the development of web interfaces for agricultural decision support tools, including tools to aid rice farmers in improving post-harvest management of grain feeding insects, improve water and fertilizer management of cotton in the Texas High Plains, and evaluate the suitability of candidate bioenergy crops for different parts of Texas.

A few weeks ago, the Center received a three-day visit from Dr. Lewis Wilson, who works for the Australian Commonwealth Scientific and Industry Research Organization. Lewis is one of Australia's very best cotton entomologists, with extensive experience in developing biologically-based integrated pest management and insecticide resistance management programs. Part of Lewis' recent research focuses on the use of predatory insects and mites to suppress the build-up of plant feeding pests, and the development of soft chemical control approaches to maintain beneficial natural enemies in the cotton fields. One of the most interesting aspects of Lewis's visit was a discussion on how cotton is able to tolerate and compensate for low levels of injury to leaf and fruiting structures.

Immediately following the meeting with Dr. Lewis Wilson, Drs. Lee Tarpley, Yubin Yang, and I hopped on a plane and spent three days in Weslaco discussing potential collaborative research to determine which candidate bioenergy crops have the greatest potential for production in each climate zone for different soils across the Gulf Coast, from the Rio Grande Valley to the Florida coast. I remain optimistic that this visit played an important role in bringing the Beaumont and Weslaco Centers together in developing a unified bioenergy research program.

In late-September, I had the pleasure of being invited by USDA-ARS to give a presentation on quan-

continued on page 9

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.

Growers Meet to Discuss Organic Rice Production

Mike Doguet, President of Texas Rice Improvement Association, and TRIA Foundation Seed Manager Julio Castillo, discuss weed control in a field of organic Sierra rice.

In early October, farmers, scientists and industry representatives met at the Texas A&M Research and Extension Center in Beaumont to discuss the latest news in organic rice production. The meeting was organized by Doguet's Rice Milling Company, a major buyer of organic rice in Texas. According to Mike Doguet, roughly half of the organic rice consumed in the United States is imported from other countries.

Currently, organic rice is fetching double the price of conventional rice, which puts it at around $24.00 cwt. Table 1 on the following page was provided by Doguet, and provides Doguet's estimate of the potential profit margin producing organic rice both East and West of Houston.

For 2007, the Texas Department of Agriculture certified 10,894 acres of organic rice in the state, Doguet would like to see that number increase by at least half. That was the purpose of the meeting, to get more farmers interested in joining this growing market.

To start the day, Beaumont Center Director, Dr. Ted Wilson, gave an overview of the work being conducted in organic rice production by TAES and USDA scientists in Texas. He noted that TAES initiated a large-scale organic study in 2007, and the USDA-ARS breeder, Dr. Anna McClung, was hiring a post-doc to conduct organic research at the Center.

Julio Castillo, Texas Rice Improvement Association Foundation Seed Manager, went on to discuss the challenges faced in a 2007 organic rice study. There were six 1-acre blocks, drill planted with Sierra at 100 lbs/ac. Each block was fertilized at planting with two organic fertilizers. The overwhelming problem was with weed control. In the end, they were not able to harvest the crop due to a massive population of hemp sesbania.

What was learned? Castillo said zero grade is critical to establishing an even and early flood. Also, the seeding rate in organic systems should be higher to ensure a thick stand, which would in turn help with weed suppression. And he believes the fertilizer should be applied at the 2 – 3 leaf stage, and not incorporated pre-plant, which may give the weeds an advantage. Castillo also pointed out that a deep flood in the fall and winter could decrease weed pressure for the next rice crop.

In two other production fields, TRIA grew organic Carolina Gold and Sierra under contract. In the Carolina Gold field, Castillo planted in muddy conditions, using a seed spreader rather than a drill. The seed rate was 120 lbs/ac, but the emergence and stand was thinner than expected (6-8 plants per foot). The good thing was that the variety competed well against the weeds using that technique. They yielded 1000 lbs/ac dry at a cost of $225/ac, with a profit of $125/ac.

In the Sierra field, he planted in dry ground with a drill. The rate was 120 lbs/ac, with two perpendicular passes at 60 lb/ac each, making a checkerboard pattern.

continued on next page

At the 3-leaf stage, there was a good stand and the field was put in permanent flood. That field yielded 1,502 lbs/ac dry at a cost of $250/ac. The Sierra crop was planted on a 50 ac field. We were only able to harvest 41 acres, due to hemp sesbania, and the portion that was harvested had high numbers of the weed seeds in the final product. This, and a significant amount of brokens, drastically reduced the price received for the crop, resulting in a net loss of $2.14 per acre.

Doguet suggested that another option might be to 'mud-in' the field, and then fly on seed. Pre-sprouting the rice was also mentioned as another technique, then drill seeded, or water seeded by air.

Dr. David Bade with Excell Garden Products talked about the benefit of legume cover crops, such as clover and vetch. He emphasized the use of legumes in an organic production system, for their ability to fix nitrogen from the air and make it into a form available to the plants. In SE Texas, legume cover crops are best grown in the cooler months, and may fit well into a rice rotation. He pointed out that the nitrogen is used by, and stored, in the legume plants, and is only available to other crops after the cover crop is tilled into the soil and decomposes. Bade also reminded farmers that the legume crops required a bacterial inoculant to produce to their full potential, and that the inoculants were specific for different legumes. He said that the amount of nitrogen put back in the soil would vary, but was directly related to the biomass produced. Therefore, the more the cover was allowed to mature, and the better the growing conditions, the more benefit would be gained. Related to that, he said that additional phosphorus may be needed for healthy plant growth. Another good reminder was that the inoculant is a living organism, so seed that has been treated should be kept cool and out of direct sunlight.

Thomas Harr, the owner of Earthwise Organics, has been practicing organic production for over 20 years. He spoke to the group about general organic practices that apply to any crop. Harr emphasized that organic production requires a totally different mindset, and that growers can't simply substitute organic amendments for chemical ones. It requires intensive management and observation, and a good understanding of ecologi-

continued on next page

Table 1. Sample budget for growing organic rice provided by Mike Doguet.

Organic Rice Budget Per Ac East Side 2007 – 2008		Organic Rice Budget Per Ac West Side 2007 - 2008	
Income			
35 dry cwts @ $24.00/cwt $840.00 per Ac		35 dry cwts @ $24.00/cwt $840.00 per Ac	
Expenses - Direct			
Seed	$37.50	Seed	$57.00
Organic Fertilizer	$115.00	Organic Fertilizer	$100.00
Insecticide	$0.00	Insecticide	$25.00
Care of Crop Labor	$62.00	Watering Labor	$25.00
Land Preparation & Clean Up	$112.49	Land Preparation & Clean Up	$75.00
Airplane App fert & Insecticide	$35.14	Airplane app fert & insecticide	$25.00
Levee Surveying	$0.00	Levee Surveying	$5.00
Harvest Expense	$45.00	Harvest Expense	$50.00
Freight to Bmt	$14.00	Freight to Bmt	$51.00
Total Direct	$421.13	Total Direct	$413.00
Settlement Sheet Expenses			
Drying	$44.00	Drying	$53.00
LNVA – Water	$23.51	LCAR – Water	$85.00
Land Rent	$50.00	Land Rent	$75.00
Sales Com & T.R.P.B.	$2.80	Sales Com & T.R.P.B.	$4.00
Total Settlement	$120.31	Total Settlement	$217.00
Outcome			
Total Payment	$840.00	Total Payment	$840.00
Total Expenses	$541.44	Total Expenses	$630.00
Net Cash	$298.56	Net Cash	$210.00

cal systems.

Good record keeping is also very important, not just to be successful in producing crops, but to be certified as organic. Leslie McKinnon, Organic Coordinator for the Texas Department of Agriculture, talked to the group about the requirements of certification. Since adoption by the USDA of the National Organic Program (NOP) in 2002, agencies like the TDA are accredited to issue organic certification, as are many third party 'independent' certifiers. The USDA-NOP is an umbrella under which the different certifiers operate, with set standards that everyone follows.

For a crop to be certified organic, it must be harvested not less than 36 months since the last application was made of an unapproved material, such as a synthetic fertilizer or pesticide. For the transitional label, the amount of time is 12 months. The certification program does not allow the use of bio-solids or sewage sludge, genetically modified crops, or irradiation of food. The following is an overview of the general requirements growers must meet:

Provide a Farm Plan. Fields must have distinct borders with buffer zones adequate to prevent contamination from neighboring fields. All practices must be well documented, including tractor work, inputs, sources of off-farm inputs, and timing of treatments. Growers must attempt to locate certified organic seed, and document if there is a lack of availability. In addition management practices must be documented, and clearly define how co-mingling with non-organic produce is prevented.

Practice Preventative Management. Successful organic production hinges on identifying problems early, and avoiding them if at all possible. This would include regular soil tests to help with nutrient management, good sanitation, selecting well-adapted varieties, as well as mechanical and physical controls.

Utilize Crop Rotation. Crop rotation is the cornerstone of organic production, and includes the use of grass and legume cover crops, in addition to the rotation of the cash crops. This practice can provide additional fertility, add organic matter back into the soil, and decrease weed, disease and insect pressure.

McKinnon stressed that good record keeping is paramount in an organic production system. Not only does it help in the certification process, but it helps growers better understand cause and effect factors so they can make adjustments in the farm plan to achieve better results. *

The following is a partial listing of available resources for organic producers. TDA provides this list for reference only, based on current information made available to our agency. TDA does not endorse any private organization or business listed.

Organic Resource List

Texas Department of Agriculture Contacts:

Coordinator for Organic Certification
Leslie McKinnon
512.475.1641

Organic Program Specialists
Betsy Levy
512.463.7615
organic@tda.state.tx.us

Gery Henderson
512.463.7551
organic@tda.state.tx.us

Rural and Agribusiness Development
Judy Fort
512.475.1608
Lisa Anhaiser
512.936.6339
finance@tda.state.tx.us

Director for International Marketing
Terry Ovalle
512.463.7469
International_Marketing@tda.state.tx.us

Director for Food Marketing
Sarah Riggins
512.475.1663
GoTexan@tda.state.tx.us

Director for Horticultural Marketing
Richard De Los Santos
512.463.7472
GrowTexan@tda.state.tx.us

For information regarding certification standards and procedures:

Texas Department of Agriculture
Organic Certification Program
512.463.7615 or 512.475.1641
www.tda.state.tx.us

U.S. Department of Agriculture
National Organic Program
202.720.3252
www.ams.usda.gov/nop/

Grower, Trade, Commodity, Marketing Associations:

Texas Organic Farmers and Gardeners Association
Provides a forum for Texas growers to discuss organic industry issues. Provides links to industry websites and promotes educational programs.
877.326.5175 toll free or (512) 929-3700 (Austin area)
www.tofga.org

Organic Farming Research Foundation
Sponsors research related to organic farming, disseminates results to farmers and provides educational resources about organic farming issues.
831.426.6606
www.ofrf.org

Organic Trade Association
Industry trade association for U.S. and Canadian organic growers and processors.
413.774.7511
www.ota.com

Texas Organic Cotton Marketing Cooperative
Texas organic cotton growers can independently market their product through this cooperative.
806.748.8336
www.texasorganic.com

U.S. Department of Agriculture:

Alternative Farming Systems Information Center (AFSIC)
Provides information related to alternative cropping systems.
301.504.6559
www.nal.usda.gov/afsic

Natural Resources Conservation Service
Understand the issues related to the state of our natural resources.
www.nrcs.usda.gov

Organics
A monthly newsletter with reports on organics from around the world.
www.fas.usda.gov/htp/organics/organics.html

Sustainable Agriculture and Research and Education Programs (SARE)
SARE sponsors competitive grants for sustainable agriculture research and education.
301.504.5199
www.sare.org

National Agricultural Statistics Service
Understand the trends driving U.S. agriculture.
800.727.9540 or 202.720.3878
www.usda.gov/nass

Online resources for organic and sustainable agriculture:

Appropriate Technology Transfer for Rural Areas
ATTRA provides assistance to farmers in sustainable farming practices, alternative crop and livestock enterprises and innovative marketing.
800.346.9140
www.attra.org

Henry A. Wallace Institute for Alternative Agriculture
Part of Winrock International, a global research and education organization promoting responsible resource management.
301.441.8777
www.winrock.org/what/wallace_center.cfm

University of California Sustainable Agriculture Research and Education Program
SAREP supports scientific research and education to balance economic viability with resource conservation.
530.752.7556
www.sarep.ucdavis.edu/about.htm

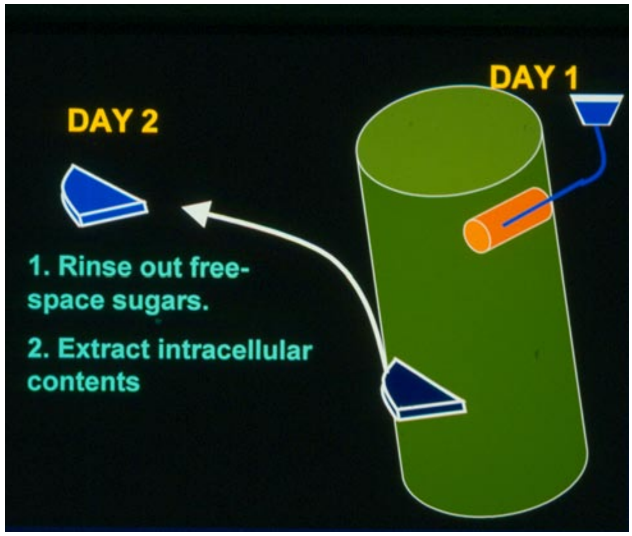
Kerr Center for Sustainable Agriculture
Provides analysis of markets to help develop rural economies.
918.647.9123
www.kerrcenter.com

Organic Materials Review Institute
Publishes lists of materials allowed and prohibited for use in the production, processing, and handling of organic food and fiber.
541.343.7600
www.omri.org

Sustainable Farming Connection
An information resource of sustainable production and marketing techniques.
607.753.8925
www.ibiblio.org/farming-connection

Eco-Farm Association
Non-profit educational organization that promotes ecologically sound agriculture.
831.763.2111
http://www.eco-farm.org

grasses such as sorghum, sugarcane and corn, and probably other grasses (such as the millets and switchgrass, which are closely related to each other), the allocation between cellulose and sugar can have a major influence on the yield of the respective compounds because together they account for a major part of the carbon in the stalks. The researchers believe that an increased allocation to cellulose will contribute to an increased biomass yield of the lignocellulosic crops, such as energy cane and biomass sorghum.



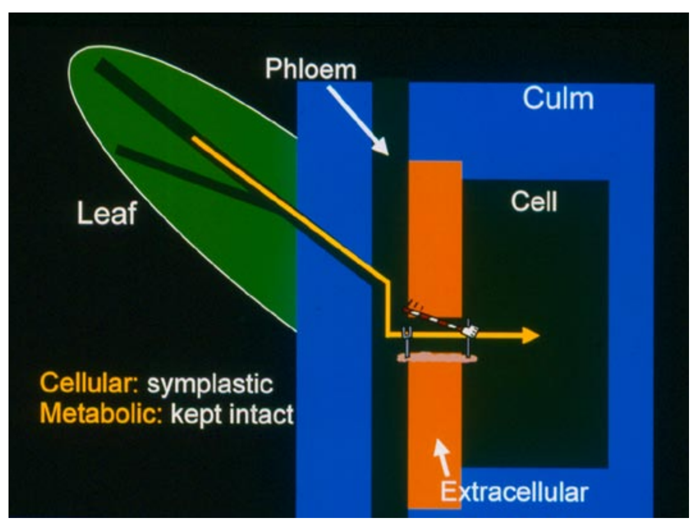
Tracer sugar is infused into the stem. A day later, after the sugar has had time to be distributed throughout by the plant's natural processes, the tracer sugar is extracted from a tissue sample taken from a distant portion of the stem. The sugar is analyzed to determine the metabolic and physical paths by which it had traveled. Graphic courtesy of Lee Tarpley.

Said Tarpley, "We need to understand the details of this transition period in order to manipulate it to our advantage for either lignocellulose yield or sugar yield. The details of how the plant moves and stores its sugar help explain part of this transition period. We need this information to identify the mechanisms by which the sugar accumulation occurs." This helps identify likely targets, molecular or biochemical, to manipulate the transition between cellulose deposition and sugar accumulation.

The information can be used to help breed better varieties of sweet sorghum as a feedstock for bioethanol production from sugar, but it can also contribute to the breeding of better varieties of high biomass (low sugar) sorghum. These biomass sorghums would have increased biomass yield, less storage losses, and might also be less susceptible to lodging. The labeled sucrose research helps narrow the search for the best target for developing molecular markers that are used to speed up the breeding for sugar accumulation in sorghum.

During rapid internode elongation (growth) in sorghum, and probably in sugarcane and maize, after the sucrose leaves the transport vessel called the phloem, it moves from cell-to-cell always staying within the cells, and without being broken down and resynthesized. A transition occurs in the cellular path, so that by ripening in sorghum, most of the sucrose passes outside of cells along its path but is still not broken down and resynthesized. In contrast, most scientists believe that the developmental overlap between cellulose deposition and sucrose accumulation is greater in sugarcane than in sorghum because there is a biochemical "pull" that is present in the sugarcane cells as early as mid- to late internode elongation. Furthermore, as the transition proceeds into ripening, the cellular path appears to deviate from that of sorghum by continuing to be from cell-to-cell. This latter is based on anatomical evidence, and needs to be studied directly by following the fate of labeled sucrose in intact plants, similar to the sorghum study by Tarpley and Vietor.

Two kinds of labeled sucrose were used simultaneously in the sorghum study. One was a radioactively



In sorghum and sugarcane, the sucrose produced by photosynthesis is transported from the leaf to the rest of the plant. In the elongating stems, after the sucrose leaves the transport vessel (phloem), it moves from cell-to-cell (without entering an extracellular space) until it reaches the tissue where it is used for various purposes. Graphic courtesy of Lee Tarpley.

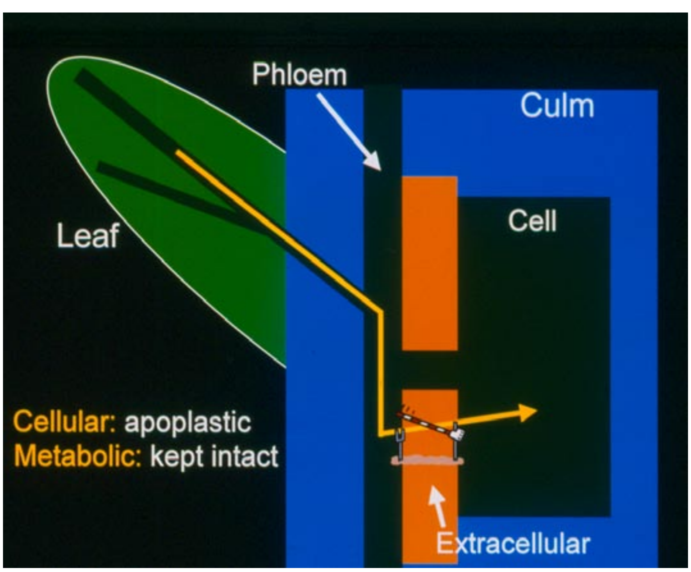
continued on next page

labeled form of sucrose in which the carbons in the sucrose molecule were uniformly labeled. The other kind was also radioactively labeled, but with only one half of the sucrose molecule labeled. This latter kind of labeling was used to detect if the sucrose molecule was metabolized then later re-synthesized before being recovered from the tissue. If labeled atoms appeared in the unlabeled part of the recovered sucrose molecules, then the sucrose must have been re-synthesized.

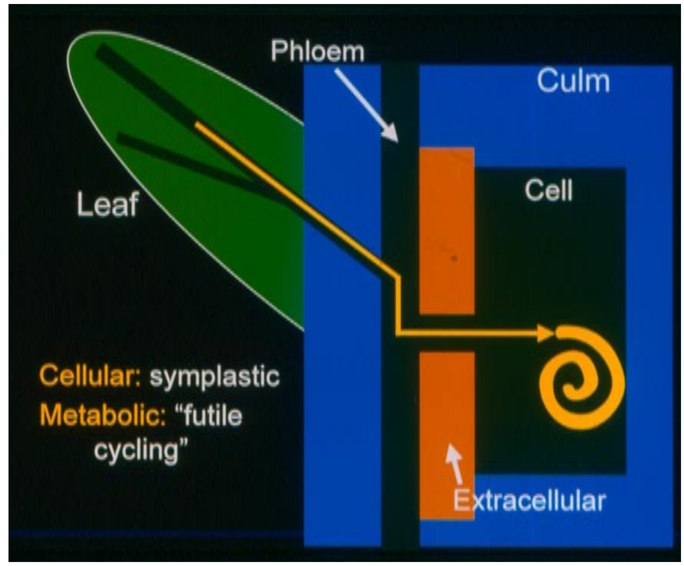
It is important to note that sucrose is present naturally both inside cells and in the space between the cells. From the moment of being introduced into the plant, the labeled sucrose is diluted with naturally occurring unlabeled sucrose.

The researchers did not follow the sucrose while in the plant per se, but instead relied upon extracting the sucrose from various compartments, followed by exhaustive analysis of the recovered sucrose to interpret what metabolic and cellular paths the sucrose must have followed.

"We recovered the sucrose from various compartments to determine which had the higher ratio of tracer sucrose to total sucrose, and thus was earlier in the path of sucrose movement to the accumulation site," said Tarpley. They found that sweet sorghum appears to be more efficient in reusing the stored sugar to support growth of other parts of the plant. However, the



During ripening (sugar accumulation phase) of sorghum stem, most of the sucrose moves through an extracellular space before reaching the tissue where it accumulates. A special sucrose transporter protein helps the sucrose move into the cells where it accumulates. Graphic courtesy of Lee Tarpley.



During ripening (sugar accumulation phase) of sugarcane stem, the sucrose continues to move from cell-to-cell. Metabolism acts to biochemically hold onto the sucrose in the cells where it accumulates. This metabolism is illustrated by the spiral path inside the cell. Graphic courtesy of Lee Tarpley.

mechanisms in sugarcane allow it to accumulate very high levels of sucrose.

"The differences are critical, and need to be understood for breeders to develop new varieties specifically for the biofuel industry," Tarpley said, "sweet sorghum and sugarcane are both well suited for this purpose. While sorghum is an annual and can fit well into a crop rotation, sugarcane is a suitable perennial for many areas."

To maximize the potential of sweet sorghum as a biofuel crop, breeders need to understand the physiology of the plant and not use sugarcane as a model. "There is a large body of research on sugarcane that was previously thought to apply equally well to sorghum. Instead, we need to fully understand how sorghum moves and stores sugar in order to elevate to the next level in our breeding efforts," Tarpley said.

The research conducted contributes one piece of the puzzle to understanding the processes of allocation between cellulose and sucrose in sorghum stalk. The results were interesting because of the unexpected contrast with what is known about these processes in sugarcane. *

The study results were published in the June 2007 issue of BMC Plant Biology. To read the entire article, go to http://www.biomedcentral.com/1471-2229/7/33

From the Editor continued...

titative approaches to determining how and why rice responds to abiotic and biotic stresses the way that it does. Dr. Ziska, who works for USDA-ARS in Beltsville, Maryland, gave a fascinating presentation showing that cultivars of rice (and other commercial crops) respond very differently to elevated CO_2 levels and the higher temperatures that are expected to occur due to global warming. An outcome of this meeting was an informal agreement by Dr. Anna McClung (USDA-ARS, Stuttgart, AK), Dr. Lewis Ziska (USDA-ARS, Beltsville MD), and me to work together to develop a joint project to study the impact of global climate change on rice performance. The Stuttgart meeting ended up generating a second meeting to discuss the USDA-AHPIS-PPQ emergency action notifications for the rice panicle mite.

In early-October, I spent three days in Baton Rouge working with Dr. Gene Reagan to develop a national proposal to further research on stem borer pests of rice and sugarcane. At the end of my last night in Baton Rouge, I had the pleasure of having dinner with the Director of the LSU AgCenter, members of the LSU entomology department, and members of USDA-APHIS-PPQ. I am hopeful that this meeting played a role in the recent decision to begin the process of removing the emergency action notifications for the rice panicle mite, and instead classify this mite as a non-actionable pest. Once this change in classification becomes effective, it will allow our scientists to develop integrated pest management programs that will allow us to identify if and/or when this pest is sufficiently abundant to warrant control.

On my way back from Baton Rouge, I stopped off at Jennings, Louisiana, to participate in a field tour of the Verenium cellulosic-based bioethanol facility. Verenium is a leader in the development of cellulosic-based bioethanol. There is tremendous opportunity for our Center to work with Verenium in developing production and management programs for bioenergy crops.

Two weeks ago, Dr. Yang and I spent 5 days in Austin, Texas, the first three days of which were occupied participating in a Scientific Review Panel meeting addressing all aspects of the Lower Colorado River Authority (LCRA)-San Antonio Water System (SAWS) Project. Our role in the meeting was to provide an update on the potential for water savings using precision grading, multiple inlets, conservation tillage, and tail-water recovery systems. The last two days were spent providing LCRA program leaders an overview of results from both our water conservation analyses and from economic analyses produced by the LCRA-SAWS socio-economic team.

Recently, three of our research scientists, along with our communications specialist, had the pleasure of visiting a rice farm owned by Mr. Bill Wilson. He showed us something that we had not seen previously. The rice field that we visited was being harvested the very next day. Harvesting rice is certainly not new, but given that this harvest represents the 3rd ratoon crop harvest of a field that had originally been planted in the spring of 2006, this particular case was certainly new to us. During the 2006 season, where both a main and ratoon crop were produced, the field had been rolled and flooded in the winter to serve as a habitat for migratory water fowl. In the early spring, the field was drained and tiller buds from the original plants began to grow in tremendous numbers. Apparently the flooding had protected the rice from freezing conditions; but we are not really sure as to why this was the case. We do know that a very large number of the regrowth plants originated from tillers produced by the plants that developed from the 2006 planted seed. Suffice it to say, we were all eyes and ears trying to determine how Mr. Wilson was able to grow four crops from a single rice planting. A detailed article about Mr. Wilson's unusual production practice is planned for our winter issue.

One of the greatest things about my job is the opportunity that it provides to meet with almost all aspects of agricultural production and management. Long ago, I quit being amazed by the ingenuity of many of our growers and scientists. But I will never loose my appreciation or excitement for what they bring to the table in our grower-researcher partnership.

Please keep on sending us your suggestions.

Sincerely,

L. T. Wilson

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

HARDY Rice: Less Water, More Food

An international team of scientists has produced a new type of rice that grows better and uses water more efficiently than other rice crops. Professor Andy Pereira at the Virginia Bioinformatics Institute (VBI) has been working with colleagues in India, Indonesia, Israel, Italy, Mexico and The Netherlands to identify, characterize and make use of a gene known as HARDY that improves key features of this important grain crop. The research, which was recently published in the Proceedings of the National Academy of Sciences, shows that HARDY contributes to more efficient water use in rice, a primary source of food for more than half of the world's population.

Rice (*Oryza sativa*) uses more water per acre when compared to other crops. It typically uses up to three times more water than other food crops, such as maize or wheat, and consumes around 30 percent of the fresh water used for crops worldwide. In conditions where water is scarce, it is important to have crops that can efficiently generate biomass (plant tissue) using limited amounts of water.

Under laboratory greenhouse conditions, HARDY rice shows a significant increase in biomass under both drought and non-drought conditions. The researchers found that the biomass of HARDY rice increased by around 50 percent under conditions of water deprivation (drought) compared to the unmodified version of the same type of rice.

Dr. Andy Pereira stated, "This transdisciplinary research project involved the study of two plants. First we used a powerful gain-of-function screening technique to look at a large number of *Arabidopsis* plants that might have features favorable to water and drought resistance. We were able to identify the HARDY mutant due to its considerable reluctance to be pulled from the soil and its smaller, darker green leaves. Molecular and physiological characterization showed that the improved water usage efficiency was linked to the HARDY gene."

Dr. Aarati Karaba, who worked on the project as a graduate student jointly at the University of Agricultural Sciences in Bangalore, India, and at Plant Research International, Wageningen, The Netherlands, commented: "The next step was to introduce the HARDY gene into rice and examine the features arising from this transformation.

In rice, HARDY seems to work in a slightly different way than *Arabidopsis,* but it still leads to improved water-use efficiency and higher biomass. Further studies showed that HARDY significantly enhances the capacity of rice to photosynthesize, while at the same time reducing water loss from the crop."

Dr. Andy Pereira, added: "DNA microarray analysis allowed us to look at gene expression patterns regulated by HARDY. We specifically focused on genes that have gene ontology terms, namely genes that have been assigned by the scientific community to specific biological processes or functions. Using this approach we were able to identify clusters of known genes regulated by HARDY, whose levels changed under conditions of plant water deprivation. We also saw distinct changes of gene clusters linked to the metabolism of key proteins and carbohydrates, which probably explains some of the feature differences we have detected in *Arabidopsis* and rice."

The scientists have been able to track down these improvements in water-use efficiency to a specific type of molecule known as AP2/ERF-like transcription factor. Transcription factors are proteins that bind to DNA and control gene expression and the HARDY gene encodes a protein that belongs to a specific class of AP2/ERF-like transcription factors.

Shital Dixit, graduate student at Plant Research International, Wageningen, The Netherlands, commented: "At this point in time, we do not know the exact function of this transcription factor, although we suspect that it impacts maturation processes linked to tissue desiccation. More work remains to be done to elucidate the precise function of this protein as well as the processes on which it has a major impact.

What is clear is that HARDY rice offers the exciting prospect of improved water-use efficiency and drought resistance in rice and perhaps other grain or seed crops. This should contribute in a sustainable way to maintaining high crop yields under conditions of limited water availability." *

Article by Barry Whyte, whyte@vbi.vt.edu,
540-231-1767, Virginia Tech

Proposed Farm Bill

The Senate Committee on Agriculture, Nutrition and Forestry voted unanimously to report a farm bill that includes a new average crop revenue or ACR option for row crop producers and greatly expanded conservation, energy and nutrition programs.

But anyone who expects the committee bill to be the last word on those, and issues such as payment limits, only had to look at the outpouring of criticism of the bill from farm and environmental groups, and the words of committee members themselves to see how far the process has to go. Even Committee Chairman Tom Harkin, D-Iowa, indicated he would support some attempts to modify the bill once it reaches the Senate floor, which could occur the first week in November, Senate sources said.

"I may be involved in offering some amendments on the floor myself," Harkin told reporters. He was answering a question about legislation creating a permanent disaster program, but he said he's also likely to support an amendment putting a "hard cap" of $250,000 on farm program payments.

Although the committee bill would reduce the adjusted gross income a farmer could have and remain eligible for farm payments to $750,000 in 2010, Sen. Charles Grassley, R-Iowa, told the committee he would introduce much more stringent payment limit rules on the Senate floor.

Harkin said he believes the overall bill, the Food and Energy Security Act of 2007, will have support on the Senate floor and chances are good that he will still meet his goal of getting a farm bill out of the Senate and to a conference committee before Congress adjourns for the year. "We're going to have amendments, don't get me wrong," he said. "We will have a payment limit amendment — the Grassley-Dorgan legislation, and I have every reason to believe that it will pass. There may be other amendments to reduce direct payments and put the savings into the Food Stamp program."

Harkin said he also expects Sen. Richard Lugar, R-Ind., to try to pass an amendment that would replace the current crop subsidies with legislation known as the Farm Ranch Equity Stewardship and Health Act. Instead of subsidies, the reform bill would provide a federally backed insurance program that would be free for all growers.

"Quite frankly, it might get a lot of votes," said Harkin. "But, one way or the other, we are going to hold this bill together, and we're going to proceed. It may be a little bit different coming out the Senate, but that's nothing new, they always are."

One of the "highlights" of the bill, Harkin said, is a new Producer Income Protection Program called the Average Crop Revenue Program.

"It will give farmers an option of sticking with the old ways of doing things or trying something new," he said. "It's about time that we start getting some reforms in and start moving our farm programs in a different direction." But USDA officials and farm and environmental groups said the reforms in the bill don't go far enough. Acting Agriculture Secretary, Chuck Conner, was among those criticizing the bill's lack of significant reforms in such areas as payment limits.

"At this point we don't believe the adjusted gross income limit that has been passed by the Senate committee with its so-called 'soft cap' represents real reform, and really equates to no reform at all," said Conner. "In fact, our economists believe that it will have less of an impact on payments than the House version of the bill." Conner said the Senate committee's inclusion of a revenue-based counter-cyclical program "is a recognition that the current safety net has some flaws in it, a safety net that pays farmers the most when they need it the least and doesn't pay them very much at all when they do need a lot of help."

The National Corn Growers Association, one of the first and strongest supporters of the revenue-based counter-cyclical program, said it was disappointed by the Senate committee's decision to strip a "key component" of the program, its integration with federal crop insurance.

At the last minute, the committee adopted an amendment offered by Sen. Pat Roberts, R-Kan. The amendment changed the percentage of base acres eligible from 100 percent to 85 percent and removed a reduction in federal crop insurance premiums for farmers who participated in the average crop revenue program. "While we are pleased a revenue package is in the final bill reported out of the committee, NCGA is deeply disappointed with this setback," said NCGA President Ron Litterer. "The amendment makes the revenue proposal a much less attractive option to growers."

Article by Forrest Laws, Farm Press Daily

Research Position Opening at the Beaumont Center

The Texas A&M University System is pleased to announce the opening of the search for an Assistant Professor of Integrated Cropping System Nutrient Management to be located at the Agricultural Research and Extension Center at Beaumont.

Significant aspects of the research are expected to focus on nutrient transport, as affected by edaphic, climatic, biotic and physiological variables that impact the plant/soil continuum, and the response of rice and other crops to nutrient availability.

For a complete position announcement: http://beaumont.tamu.edu. To apply on-line by November 30: https://greatjobs.tamu.edu. Refer to NOV# 02973. For additional information contact Dr. Lee Tarpley at ltarpley@tamu.edu or (409) 752-2741 ext. 2235. *

32nd Rice Technical Working Group Meeting

February 18 to 21, 2008

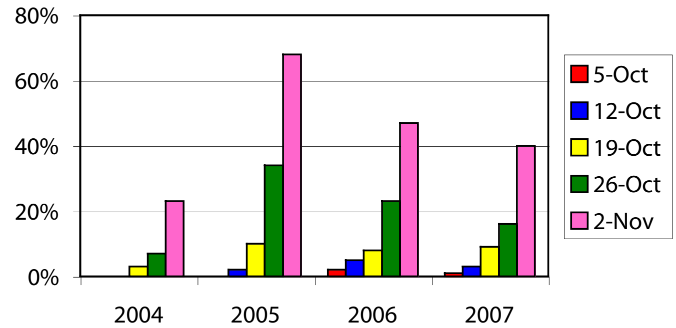
Westin San Diego Hotel
San Diego, California

The complete schedule for the 32nd RTWG is posted on the web at

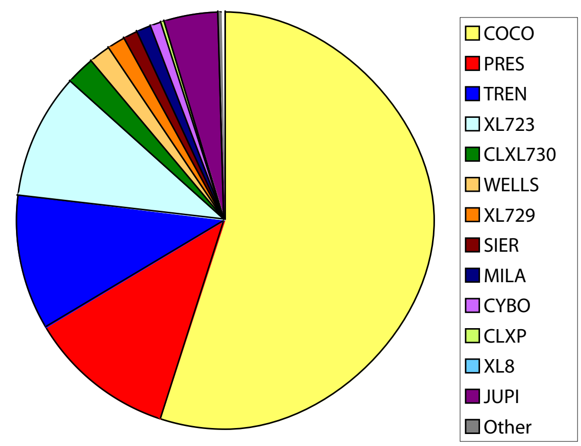
http://www.plantsciences.ucdavis.edu/rtwg

Rice Crop Update

% Ratoon Harvest



MC % of Each Variety Grown in 2007



****

Reminder:
Look for the article on
Sustainable Weed Management
in the next issue of *Texas Rice*

****

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

ADDRESS SERVICE REQUESTED

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