Texas Rice Special Section
Highlighting Research in 2007

Agronomic Management

Evaluating Rice Varieties and Hybrids for Texas

The rice producer has to choose from many different varieties and hybrids each year. Many of these varieties are developed in other rice producing states having soil, climatic conditions, and cultural practices different from those in Texas. This Texas Rice Research Foundation funded research helps the Texas rice producer identify varieties and hybrids that perform well under Texas growing conditions. Each of the 12 entries in this year's test is being evaluated for various agronomic traits on sandy soil at Eagle Lake and on clay soil at Beaumont. Some of the agronomic data collected will include (1) main and ratoon crop yield and milling response with and without fungicide when nitrogen is not limiting, (2) the contribution of certain management practices to ratoon crop yield using Cocodrie as the test variety, (3) an economic ranking of each entry's average main, ratoon, and total crop net income, and (4) variety characteristics, tillering potential, and growth stage data for variety specific management.

For the second year, we have included an early planting date (first week of March) that will provide information on main and ratoon crop yield potential when planted under cooler early season conditions compared to late March or early April plantings.

Mike Jund and Darrell Hagler

This year, we are evaluating ten conventional varieties and two hybrids.

First-time conventional entries include 4484-1693 which is a potential variety having high yield and milling quality equal to or better than Dixiebelle, and Tesanai which is a specialty rice. XP744 is the new hybrid entry from RiceTec. Included in our test for the second or more year are the conventional varieties: Cocodrie (La), Trenasse (La), Presidio (Tx), Sabine (Tx), Spring (Ar), Cybonnet (Ar), CL161 (Horizon Ag), and CL171 (Horizon Ag). The hybrid from RiceTec included for the second or more year is XL723.

Hybrid Rice Management

Currently RiceTec is supporting research to (1) validate nitrogen rates and timings for hybrids, (2) identify management practices which contribute to improving hybrid ratoon yields and milling, and (3) evaluate the use of banded fluid fertilizer at planting on hybrids.

Nitrogen Rates and Timings: As new hybrids are released, each is evaluated to verify their optimum N requirements and application timing under Texas growing conditions. The hybrids in this year's test are XP744, Clearfield XL729, Clearfield XP745 and Clearfield XL730. Basic treatments are 90 or 120 lbs/A N applied pre-flood with an additional 30 or 60 lbs N being applied late season. In addition, mid-season N applications are being evaluated.

Hybrid Ratoon Best Management Practices: This research is designed to identify main and ratoon crop management practices that will allow producers to maximize the high ratoon yield potential associated with

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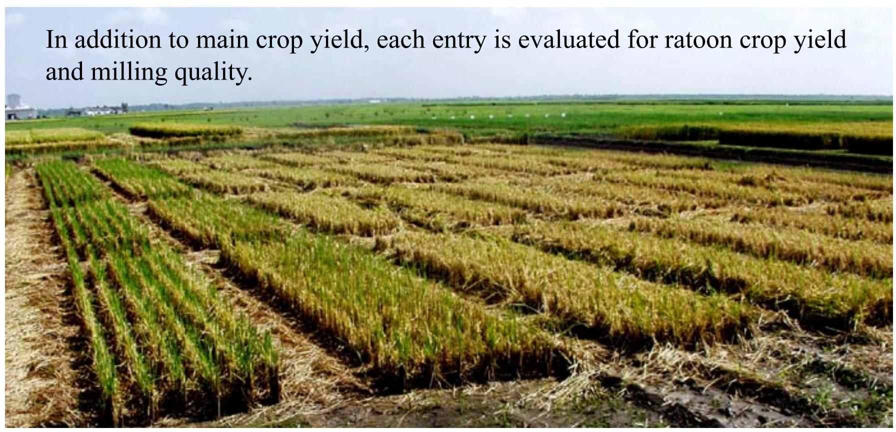
hybrid rice and is being conducted at Eagle Lake and Beaumont. Some of the treatments being evaluated in the first year of this test include main crop stubble height, fungicide on main and ratoon crop, gibberellin applied to main crop, ratoon N rates and timing, splitting ratoon N, and insecticide applied to ratoon.

Evaluating Banded Fluid Fertilizer For Hybrid Rice Production: Recent research with conventional rice varieties has shown that subsurface banding of fluid fertilizer can improve N uptake efficiency and significantly reduce fertilizer application cost. Current N fertilizer recommendations for hybrids are to delay initial N application until pre-flood in order to reduce excessive vegetation early in the growing season. This research will determine if applying fluid fertilizer while planting can be used in hybrid rice production. Several fluid fertilizer N rates are being evaluated and compared with current recommended practices for hybrids using dry urea on clay soil at Beaumont. Texas Liquid Fertilizer has helped support this research by providing fertilizer, equipment, and help in calibration.

Management Practices for Texas Rice Production


In addition to main crop yield, each entry is evaluated for ratoon crop yield and milling quality.

- The total crop (main plus ratoon) yield advantage for early planting (March 6) compared to the recommended planting date (April 6) averaged 1000 lbs/A across all cultivars at Beaumont. The total crop yield advantage to early planting (March 7) across all cultivars averaged -930 lbs/A compared to the March 27 planting at Eagle Lake. The yield advantage for early planting was most evident in the ratoon crop at both locations.
- At Beaumont, a significant main crop yield increase (1000 lbs/A) was achieved for Spring and Cheniere when Quadris plus Tilt was applied to the main crop. At Eagle Lake, main crop fungicide increased main crop yield 300 to 450 lbs/A for some varieties. Main crop plus ratoon crop fungicide did not consistently improve ratoon yields at both locations. In 2006, fungicide was not applied to hybrids since they are moderately resistant to disease.
- Using a flail mower to reduce main crop stubble height to 8 to 10 inches has consistently improved ratoon yield at both Beaumont and Eagle Lake.
- At Eagle Lake, applying Karate to the ratoon to control stem borer has significantly increased ratoon yield (1000 lbs/A) while no yield response has been observed at Beaumont.
- On clay soil at Beaumont the three entries having the highest total net income/A when planted April 6 were the hybrids Clearfield XL729, XL723, and Clearfield XL730. The three conventional varieties having the highest total net income/A were Sabine, Cybonnet, and Cocodrie. On sandy soil at Eagle Lake when planted March 27, Clearfield XL730, Clearfield XL729, and Cybonnet were the top entries for total net income/A followed by Banks, XL723, and Presidio.
- Hybrids on clay soil at Beaumont showed a main crop yield increase from 180 lbs/A total N compared to 150 lbs/A total N. On sandy soil at Eagle Lake, 120 lbs/A total N yielded as well as 150 lbs/A total N.

Generous funding for the Soils and Nutrition projects was provided by the Texas Rice Research Foundation and RiceTec. For more information contact Dr. Tarpley at 409-752-2741 or email ltarpley@tamu.edu. Additional information is available at http://beaumont.tamu.edu/eLibrary/TRRFReport_default.htm.

Rice Irrigation Efficiencies

The first rice in Texas was grown south of Beaumont about 1890. The water loving crop flourished in the Texas coastal prairie region because of the impervious soils and abundance of water. The significant rainfall of the area supplemented the irrigation requirements. Abundant water was available from the seven rivers flowing through the upper coastal prairie to the Gulf of Mexico. There was minimal competition for the water during the first 80 years of production. The rice fields provided tremendous habitat for the wildlife. The rice field tailwater fed the fresh and saline marshes of the coastal area during the dryer summer months. The population explosion of the costal region and hill country areas in recent years has placed tremendous demand on the regions water supply. The rice industry is being forced to conserve and fight for the remaining water supplies.

Research was conducted from 1982 and 1986 to develop management techniques to conserve water. This research was initiated and funded by the Texas Agricultural Experiment Station and USDA Natural Resource Conservation Service (Soil Conservation Service) with supplemental funding from LCRA. Main and ratoon crop water balances were measured on 33 fields during this 4 year period. The impact of water source, soil type and improvements (land forming, multiple inlets, levee spacing, etc.) were evaluated. Land forming is defined as changing the surface topography of a complete field.

A second study was conducted in 1992 and 1993. The main emphasis of this project was to evaluate the area water quality impact of rice production using best management practices. The study was conducted by the Texas Agricultural Experiment Station with supplemental funding from the Texas Soil and Water Conservation Board. Water balances were developed for the three fields studied over the two years. The data was limited and interactions could not be evaluated.

A third research effort was initiated in 2005 and continued in 2006 to reevaluate the impact of land forming and conservation tillage on rice irrigation water use. The new project was conducted by the Texas Agricultural Experiment Station with funds provided by the LCRA-SAWS project. The looked at 8 main crop fields and 6 ratoon crop fields in 2005 and 12 main crop fields and 9 ratoon crop fields in 2006. The main focus was the impact of land forming and conservation tillage on irrigation water requirements. The data was limited and interactions could not be evaluated.

Observations:

- All degrees of land forming reduced rice irrigation water requirements.
  - No major difference between zero grade, continuous grade and bench grading were observed.
  - Maximum irrigation inflow reductions were observed when tall, permanent inside and outside levees were installed.
- Early studies showed a significant savings from multiple inlets and levee spacing. Levee spacing controls flood depth which has also been shown to increase yields of the semidwarf varieties.
- Lowest irrigation inflow always occurs with ground water fields.
- Early studies indicated reduced irrigation inflow for lighter soil textures. This may relate to the number of flushes required.
- The only influence of varieties is the days from emergence which translates to the days under flood. Each day of flood adds about 0.35 inches of irrigation requirements.
- Reduced tillage can reduce irrigation inflow. The greatest impact occurs in dry years that require more flushes.
- The reduction from any management practice is related to the intensity and experience of management.

Research conducted by Dr. Garry N. McCauley, for more information call 979-234-5077,
or email gnmccaule@sbcglobal.net

The Use of Sub-surface Drip Irrigation for Rice

Research Associate, Jim Medley, inspecting the irrigation tape used in the drip study.

An experiment is being conducted to determine the feasibility of using sub-surface drip irrigation for rice crops. Plots were established at the Texas A&M University Agricultural Research and Extension Center at Beaumont, Texas.

In 2001, plots were arranged in two randomized blocks, each consisting of a conventionally flood-irrigated treatment, and two drip-irrigated treatments of 32 and 16-inch tape spacing. Drip irrigation tape was installed at a 6-inch depth. In 2002, two additional blocks were established and in 2003 another block was added for a total of five randomized blocks. Each plot consisted of 18 rows spaced at 8 inches and 75 ft in length.

In 2006, a large-scale drip study was begun that consisted of four randomized blocks, each with a single sub-surface drip irrigation plot and a conventionally flood-irrigated plot. Plots are approximately 1.15 acres each. Drip tubing was installed at a 6-inch soil depth and 30-inch row spacing. Analysis of the yield data from 2001 to 2003 showed no significant difference between the drip-irrigated treatments and the flood-irrigated control. An interaction exist for year x treatment because both drip-irrigated treatments (16 and 32-inch spacing) had higher yields in 2001 than the flood-irrigated control, but in 2002 and 2003 that trend was reversed.

Yield difference between years was highly significant. Average water use of the drip-irrigated treatments for the three year period was approximately 42% that of the flood-irrigated controls. Water usage for the 16 and 32-inch drip-irrigated treatments differed by less than 0.12 ac ft during the three-year period. Since no significant difference exists for yields or water usage between the 16 and 32-inch treatment, the 2006 large-scale blocks were setup with only one drip-irrigated treatment at 30-inch spacing. For the purpose of analyses, the 2001 to 2003, 16 and 32-inch drip-irrigated treatments were considered simply as drip-irrigation.

Yield analysis for the four-year period shows a significant interaction of year x treatment. This interaction is due to the drip-irrigated treatment having higher yields in 2001 and 2006 but lower in 2002 and 2003 compared to the flood-irrigated control. Difference between drip and flood-irrigated for yields were not significant. Yields were significantly different between years.

Water use of the drip-irrigated treatment in 2006 was approximately 48% of the amount used for the flood-irrigated control, which was very similar to the 2002 and 2003 water usage (55 and 47%, respectively). Water usage in 2001 was only 17% of the amount used for the flood-irrigated control, due to the very short season and the amount of rainfall that year. Water usage for the drip-irrigated plots in 2006 was higher than required due to the fertilization scheme used. Approximately 30 days after planting, fertilizer was applied to the drip-irrigated plots in small amounts through the drip irrigation system three times a week.

In 2007, an early planting, March 22, of Persidio resulted in a very low stand count due to the unusual cold and wet weather. A second planting of Trenasse was planted April 30. And went to permanent flood on June 6.

The drip irrigation tape was buried, 4 rows at a time, using a specialized implement attached to a tractor.

Research conducted by J.C. Medley and L. T. Wilson.
For more information call 409-752-2741 ext. 2252
or email jmedley@aesrg.tamu.edu

Rice Stink Bug Research

Sequential sampling plans for rice stink bug (RSB) recently have been developed by Luis Espino, graduate student under Mo Way. The plans minimize sampling effort to help you more easily make an accurate decision regarding RSB control. Table 1 shows the number of sweep net samples needed to reach a spray decision for heading and milk rice given an economic threshold of 5 adult RSB per 10 sweeps. A 10 and 20% risk of making an incorrect decision also are included in the analysis. Table 2 is similar to Table 1 but pertains to dough rice given an economic threshold of 10 adult RSB per 10 sweeps.

Table 1. Sequential sampling table for sampling rice stink bugs using the sweep net method (Economic threshold = 5 adult rice stink bugs/10 sweeps, heading and milk stages).

Sample unit number	Cumulative number of adult rice stink bugs					
	10 % risk			20 % risk		
	Stop sampling, control action not needed	Continue sampling	Stop sampling, control action needed	Stop sampling, control action not needed	Continue sampling	Stop sampling, control action needed
4	14 or fewer	15-33	34 or more	16 or fewer	17-26	27 or more
5	18 or fewer	19-38	39 or more	20 or fewer	21-32	33 or more
6	22 or fewer	23-43	44 or more	25 or fewer	26-37	38 or more
7	27 or fewer	28-48	49 or more	30 or fewer	31-42	43 or more
8	31 or fewer	32-54	55 or more	34 or fewer	35-48	49 or more
9	36 or fewer	37-59	60 or more	39 or fewer	40-53	54 or more
10	40 or fewer	-	65 or more	43 or fewer	-	59 or more

Table 2. Sequential sampling table for sampling rice stink bugs using the sweep net method (Economic threshold = 10 adult rice stink bugs/10 sweeps, soft dough stage).

Sample unit number	Cumulative number of adult rice stink bugs					
	10 % risk			20 % risk		
	Stop sampling, control action not needed	Continue sampling	Stop sampling, control action needed	Stop sampling, control action not needed	Continue sampling	Stop sampling, control action needed
4	29 or fewer	30-60	61 or more	33 or fewer	34-50	51 or more
5	38 or fewer	39-70	71 or more	42 or fewer	43-61	62 or more
6	47 or fewer	48-80	81 or more	51 or fewer	52-71	72 or more
7	56 or fewer	57-91	92 or more	61 or fewer	62-82	83 or more
8	65 or fewer	66-101	102 or more	70 or fewer	71-93	94 or more
9	74 or fewer	75-112	113 or more	79 or fewer	80-103	104 or more

As you know, we lost Icon 6.2FS seed treatment, but we have been evaluating several replacement seed treatments. This year we are evaluating seed treatments from three agrichemical companies. All seed treatments have proven effective against rice water weevil (RWW).

Table 3 shows results of a single test in 2006 involving two experimental seed treatments. Based on data we collect this year, we will submit a Section 18 for one or more of these seed treatments for use in 2008.

Also, a Crisis Exemption for Trebon 3G was approved in May 2007. This product is not as toxic to crayfish and fish as other labeled pyrethroids; thus, Trebon 3G can be used to control RWW in normal situations as well as in rice fields adjacent to crayfish and fish ponds.

Table 3. Experimental seed treatments for rice water weevil (RWW) control. Beaumont, TX 2006.

Trt. no.	Treatment	Rate	Timing$^{\alpha}$	Immature RWW/5 cores Jul 7	Immature RWW/5 cores Jul 17	Yield (lb/acre)
1	Untreated	---	---	104 a	30 a	6932 de
2	Fipronil	One rate	ST	9 de	4 c	7554 ab
3	A	low	ST	2 ef	1 de	7381 abc
4	A	mid	ST	0 f	0 e	7507 ab
5	A	high	ST	0 f	0 e	7670 a
6	B	low	ST	4 ef	1 de	7405 abc
7	B	mid	ST	2 ef	1 de	7169 bcd
8	B	high	ST	0 f	1 de	7304 abcd
9	C	low	PF	20 cd	2 cd	7001 cde
10	C	high	PF	7 de	1 de	7395 abc
11	D	low	PF	50 b	16 b	6688 e
12	D	high	PF	53 b	10 b	6705 e
13	E	low	PF	65 b	13 b	6666 e
14	E	high	PF	28 c	13 b	6929 de
15	Karate Z	One rate	PF	8 de	3 cd	6924 de

$^{\alpha}$Timing: ST = seed treatment, PF = post-flood
Means in a column followed by the same letter are not significantly different at the 5% level (ANOVA, LSD).

Entomology Crew, L to R.
Top: Becky Pearson - Technician II, Mark Nunez - Research Associate, Luis Espino - Graduate Student.

And then the 'Corps Dawgs', who do the lion's share of the core sampling for the rice water weevil research. On average, they collect, wash, and count 7000 cores a growing season. Middle: Tony Brown and Ryan McCormick. Bottom: Ross Rogers and Emily Nunez.

Stem Borer Research

Preliminary research data from 2006 indicate the economic injury levels (EIL's) for stem borers are:

Rice Stage	**% Culms With At Least 1 Lesion Below (Early) or above (Late) Flag Leaf**
Early (1-2 inch panicle)	8
Late (late boot/early heading)	0.6 (With Fungicide) 1.4 (Without Fungicide)

Inspect at least 3, 1 ft. row samples in each of 4 areas in a field, avoid field margins. Stem borer lesions on culms are easily recognized. The lesions are orange-tan and when the sheath is pulled away from the culm, feeding activity, frass and borer head capsules can be observed.

For more information contact M.O. Way at 409-472-2741 ext. 2231 or email moway@aesrg.tamu.edu. I wish to thank my dedicated, hard-working crew for their commitment to helping Southeast Texas farmers. I thank Mark Nunez, Research Associate; Becky Pearson, Technician II; Luis Espino, Graduate Student; and the 'Corps Dawgs', Tony Brown; Ryan McCormick; Emily Nunez; and Ross Rogers. Keep up the good work! I also thank Texas rice farmers for funding a good part of my research in 2007. Finally, I thank Jack Vawter and his dedicated Eagle Lake staff for agronomic help at Eagle Lake and Ganado.

Clearfield and Command Technology Continues to Expand for Rice Production

Sam Willingham, graduate student of Drs. Mike Chandler and Garry McCauley.

Clearfield rice represents the first available herbicide technology that selectively removes red rice from commercial rice without harming the crop. Previously research has indicated that first generation Clearfield cultivars displayed minimal tolerance to Newpath therefore a second generation was developed and displayed increased tolerance. As new cultivars are developed, research testing tolerance continues to be important. This year we are looking at four new or existing cultivars, CL-XL745, CL-XL730, CL-XL729, CL171-R, and CL161 testing tolerance to increasing rates of Newpath.

Beyond herbicide is an effective tool for removal of late-emerging or previously missed red rice in Clearfield rice varieties and hybrids following two applications of Newpath. Research has shown that reduction in rice yield can occur when Beyond is applied after the panicle initiation growth stage. Currently we are testing new and existing varieties and cultivars for tolerance to Beyond when applied at the various growth stages.

The 2007 growing season was the first time in Texas rice that we could apply Command by ground or air to all rice acreage except for Harris and Fort Bend (north and east of highway 36) counties. Producers and commercial applicators continue to be excellent stewards of the technology. The 24C label for aerial applications of Command is renewed annually. This annual renewal is supported by our ongoing research trials at the Beaumont and Eagle Lake research centers.

Studies conducted in 2006 and 2007 show that Command can be applied early postemergence in combination with Stam, Aim, Clincher, Duet, Facet, Newpath, Regiment, Ricestar, Bolero, Grasp, or SuperWham. These combinations provided adequate weed control without injury to the rice crop. Split applications of Command preemergence followed by early postemergence applications were evaluated. In general on both fine and course soils, the split applications of Command within the labeled rate ranges provided excellent weed control with little crop injury. On course soils, crop injury occurred when the combined application rate exceeded the labeled rate range.

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

Dr. Lee Tarpley

Increasing Yield of Hybrid Rice

The combined use of increased nitrogen fertility at mid-season and Palisade, a growth retardant, was evaluated to increase main and ratoon crop yields of semi-dwarf hybrid rice, while maintaining milling quality and not increasing lodging susceptibility. The early-maturing hybrid rice can be nitrogen-limited, at least on heavy clay soils; Palisade (Syngenta) is a growth retardant that can decrease the risk of lodging.

In 2005 at Beaumont, we obtained high yields for XL723 (RiceTec) using a nitrogen-management scheme more typical for conventional semi-dwarf varieties (11,627 lbs/A main crop [MC], 4,367 lbs/A ratoon crop [RC], 16,372 Total). In 2006, we evaluated an application of Palisade at a couple of weeks post-PD along with the high mid-season N. The combination should allow high yields without lodging. In 2006 at Beaumont, the use of 201 lbs N on MC as a 3-way split increased yield of XL723 by 1400 lbs/A (10,530 lbs/A MC, 4,356 lbs/A RC, 14,493 lbs/A total) vs. 143 lbs N on MC as a 2-way split (9,324 MC, 3,421 RC, 13,060 total). The combination of higher N at mid-season and Palisade treatment also increased yield (10065 lbs/A MC, 3852 lbs/A RC, 13924 total) compared to 143 lbs N treatment. Although these yields were less than those without Palisade, the risk of lodging would not usually be worth the additional 500 lbs/A.

In 2005, a gibberellic acid (Valent BioSciences) treatment applied during early grain filling on top of the high mid-season N treatment increased XL723 ratoon crop yield another 700 lbs/A and total crop yield by 900. The next step is combine the main crop yield advantages of high N fertilization, the lodging-prevention advantages of Palisade, and the ratoon crop yield advantages of gibberellic acid (as a tank mix with MC grain-filling treatments for stink bug – see next article).

Tank-Mixing of Rice Stink Bug Insecticides and Gibberellic Acid

Insecticides are often applied at the rice soft dough stage for control of adult rice stink bug (RSB). Recently we developed the use of gibberellic acid treatment (Gibb) applied at main crop soft dough to enhance early growth of the ratoon tillers and thus increase rice ratoon yield. The very-early maturing hybrid rice cultivars are especially responsive to the Gibb treatments with average ratoon crop yield increases greater than 600 pounds/acre. We are examining the potential for tank-mixing the RSB insecticides and gibberellic acid.

Studies were conducted at Beaumont in 2005 and 2006 using replicated field plots. In 2005, the Gibb treatment, at the recommended 0.009 lb. a.i./acre, had no effect on insecticidal activity of Karate Z, and had no insecticidal activity of its own. The Karate Z had no effect on activity of Gibb, which resulted in 500 lb/A ratoon crop yield increases with or without the Karate Z. The Karate Z had no gibberellin-like activity. In 2006, Gibb had no effect on insecticidal activity of Mustang Max or Orthene 90S (we were evaluating Orthene in the chance that it received EPA approval for limited use). Gibb had no insecticidal activity. The ratoon crop was not harvested in this study, so no data were available concerning the effects on Gibb efficacy. Additional RSB insecticides are being evaluated in 2007 for potential as tank-mix partners with gibberellic acid.

Tank mixes of gibberellic acid and the pyrethroid insecticides used for stink bug control can be applied aerially or by ground rig. Weldon Turner, working with the Plant Physiology project, is shown adding ingredients for a combination (tank mix) application.

Gibberellic acid at these rates is exempt from EPA tolerances. Our results to date indicate that gibberellic acid is a compatible tank-mix partner with pyrethroid insecticides used for RSB control when applied at soft dough. This study is being conducted jointly with Dr. M.O. Way.

High Nighttime Temperatures and High UV-B Radiation Can Decrease Rice Yields

Graduate student with Dr. Lee Tarpley, Abdul Razack Mohammed

Rice crops in Texas currently experience high nighttime temperature and UV-B radiation levels above the optimal ranges for critical stages of rice development. High nighttime temperature can potentially lower rice yields by increasing respiration rates and spikelet sterility; high UV-B radiation can decrease yield by reducing photosynthesis.

Two studies were carried out in the greenhouse, studying the effects of high nighttime temperature and high UV-B radiation on rice plants. In one study, rice plants (Cocodrie) were grown in two nighttime regimes (ambient and ambient plus 5 ^{o}C). Plants were sprayed with 3 different chemicals (Salicylic acid, Glycine betaine and Vitamin E) to prevent damage by high nighttime temperature. In addition, indirect methods to evaluate heat tolerance in rice will be developed. In another study, eight southern US rice cultivars (Cocodrie, CL161, Cypress, Cheniere, Sierra, Presidio, XL8 and XL723) were grown under 3 different UV-B regimes (no UV-B, ambient UV-B, 2X UV-B) to evaluate their sensitivity to enhanced UV-B radiation.

Rice yield (panicle dry weight) was decreased due to high nighttime temperature affecting increases in respiration rates and spikelet sterility. All three chemicals (Salicylic acid, Glycine betaine and Vitamin E) limited the damage due to high nighttime temperatures by decreasing respiration rates compared to untreated plants. Enhanced UV-B radiation decreased yield and photosynthesis in all cultivars. However, the magnitudes of reduction in yield and photosynthesis varied among cultivars. The hybrids were less sensitive to enhanced UV-B radiation, compared to conventional cultivars. This research was conducted by Abdul Razack Mohammed and Dr. Lee Tarpley.

Generous funding for the plant physiology projects was provided by the Texas Rice Research Foundation and the Texas Rice Belt Warehouse (through support of Abdul Razack Mohammed's graduate studies). For more information contact Dr. Tarpley at 409-752-2741 or email ltarpley@tamu.edu. Additional information is available at http://beaumont.tamu.edu/eLibrary/TRRFReport_default.htm.

Genetics

Dr. Shannon Pinson

A New Micro-Chamber Method for Selecting Sheath Blight Tolerant Rice

Dr. Pinson's role as an applied Plant Geneticist is to develop new knowledge and techniques that allow breeders to be more efficient and successful at developing improved rice varieties. While visiting with various rice researchers in Bangladesh in 2002, Dr. Pinson gained some knowledge and ideas that have since led to the development of a new method for evaluating rice lines for sheath blight susceptibility. This new method, known formally as the micro-chamber method, but informally referred to as the "Coke bottle method", offers several advantages over the previously used field-plot evaluations – including requiring less seed, less labor, and less plant-growth time. Furthermore, the new method is conducted under controlled lab conditions, freeing breeders from the previous restriction of a single growing season per year under difficult field conditions .The most widely accepted method for evaluating rice for sheath blight susceptibility is to inoculate densely-planted field plots with *Rhizoctonia solani*, the fungus that causes sheath blight disease; allow the pathogen to grow over time; then rate the plots for severity

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of disease symptoms.

Sheath blight inoculum normally floats on flood water and infects rice plants at the water line. All rice, regardless of its later disease tolerance, is susceptible to *R. solani* infection. Infection sites can be seen about 3 days after inoculation, but then the disease generally stops growing, leaving all rice looking similar for the next several months with differences in susceptibility not being evident until near maturity.

Humidity trapped by plastic bottles can encourage growth of *R. solani* on rice seedlings

After heading, the rice plant transports its carbohydrate reserves as sucrose up the stem to feed the developing grain. In *R. solani* infected plants, the moving sucrose also feeds the pathogen which now grows rapidly up the stem. In the most susceptible rice lines, disease lesions quickly extend all the way up to the flag leaf and even affect the panicle, causing severe yield losses. In tolerant rice varieties such as Jasmine 85 or TeQing, *R. solani* is still seen to infect the sheaths, but disease symptoms may now extend only a few inches up the outer sheath, infecting only a few of the lower leaves, and causing little or no yield loss.

Unfortunately, *R. solani* is so sensitive to even small environmental differences such as changes air humidity, air flow, and temperature that non-genetic factors such as low plant stands, nearness to the edge of the field, or canopy coverage from a neighboring plot of taller plants, can impact disease development in a plot as much as, or even more strongly than, the genes within the plants. Sometimes disease simply does not grow in a particular plot, even though the plants are genetically susceptible, and even though disease is growing in neighboring plots. This is known as ‘false resistance’. Conversely, a plant that is genetically tolerant may look susceptible if inoculum catches on and infects a plant’s upper leaf node, or if an upper leaf becomes diseased after touching a leaf from a neighboring plot.

Planting multiple rows per plot, but rating only the inside rows, can minimize variability coming from outside the plot. Planting and rating multiple plots per variety (called replication) allows scientists to statistically work with the data errors caused by false resistance and false susceptibility. The Beaumont sheath blight nursery is equipped with overhead sprinklers to minimize false resistance by ensuring humid conditions which encourage pathogen growth. However, sometimes the weather is such that disease pressure is too strong, allowing significant disease development even on tolerant lines, and making moderately tolerant lines appear susceptible. Scientists prefer replicating sheath blight evaluations over multiple years as well. All these repeat replications require much seed, which is not available until later breeding generations.

The problems, then, with the most commonly used method for evaluating sheath blight susceptibility include a need for numerous replications to contend with high sensitivity to small environmental differences, large volumes of seed, inability to evaluate early breeding generations, and the requirement to grow plants in the field to near maturity before their differences in susceptibility can be reliably seen.

Overhead sprinklers in the sheath blight field nursery ensure the wet conditions that encourage growth of *Rhizoctonia solani*, the fungus that causes rice sheath blight disease.

While visiting watery, foggy, Bangladesh, where rice is hand transplanted to fields out of densely planted nursery plots, Dr. Pinson saw seedling nurseries dying from infection by *R. solani*. This suggested the exciting possibility of developing a time-saving seedling screening method. Dr. Pinson also saw researchers using soda bottles as inexpensive “dew chambers”

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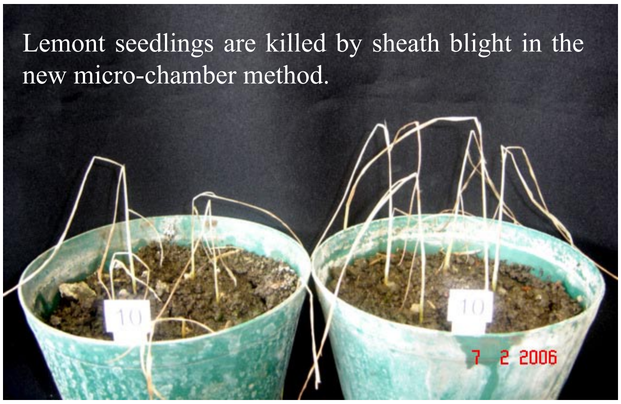

Lemont seedlings are killed by sheath blight in the new micro-chamber method.

for studying rice seedlings under highly humid conditions.

In 2003, USDA-CSREES approached U.S. rice researchers as a community, asking them what collaborative research they would like to accomplish if funding were provided for 4 years (the RiceCAP grant program). It was jointly decided that a portion of funds would be used to collaboratively develop and validate a micro-chamber sheath blight screening method. RiceCAP funding and collaboration allowed the rapid collection of numerous field and micro-chamber replications, and all participants were excited to see just how well micro-chamber data matched field-plot data for sheath blight tolerance ratings. Not only were differences clear and fairly consistent between highly tolerant lines such as Jasmine 85 and TeQing, and susceptible lines like Lemont, but also the moderate levels of tolerance exhibited by Saber and Maybelle were detectable with the new seedling evaluation method. Plant-to-plant variability in the micro-chambers is still high enough that replications are still recommended, but now each replication requires only 5 to 10 seed, 5 weeks to accomplish, and can be conducted year-round. The micro-chamber or "Coke Bottle" method for evaluating sheath blight response will speed the progress of the ongoing RiceCAP efforts to molecularly tag genes conferring tolerance to rice sheath blight disease.

This work is being jointly supervised in Beaumont by Drs. Shannon Pinson, Bob Fjellstrom, Rodante Tabien and Anna McClung, with daily focus from Dr. Yueguang Wang, a postdoctoral scientist.
For more information contact Shannon Pinson at 409-752-5221, or email Shannon.Pinson@ars.usda.gov

TeQing, known to be tolerant of sheath blight in the field, also survived fungal infection in micro-chambers.

Variety Improvement

Rice Tolerance to Roundup and Liberty Herbicides: Initial Mass Field Screening


Dr. Rodante Tabien

The project to identify tolerant rice genotypes to either Roundup or Liberty started in 2003. Two activities were initiated; first, the screening of germplasms from the gene bank collection and elite lines shared by the breeders, and the second, inducing mutation on Texas elite lines and Cocodrie using chemicals. The test entries were grown in the greenhouse and sprayed at the 4-5 leaf stage using recommended dosages. Surviving plants were grown to maturity and replanted in the greenhouse or the field for seed increase and further testing.

Sixteen accessions and 23 breeders' elite lines from Roundup greenhouse testings, and 19 accessions and 18 breeders' elite lines from Liberty greenhouse testings were selected for 2006 field screening at recommended rates. Eight accessions and 13 lines consistently showed high number of survivors and were able to produced grains. These surviving lines will be re-tested during the 2007 season, along with new selected lines. The most promising lines will be advanced for comparison to the best current elite lines.

Mutation induction used ethyl methane sulphonate (EMS) and methyl nitrosourea (MNU). Only the EMS-

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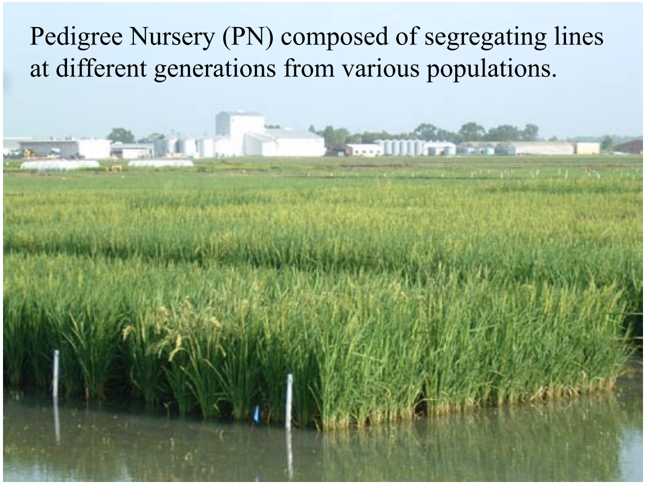


Pedigree Nursery (PN) composed of segregating lines at different generations from various populations.

treated seed had viable herbicide survivors in the greenhouse, with 519 seed-bearing Roundup survivors from 231 lines, and 488 Liberty survivors from 263 lines. In addition, 39 crosses were made in 2006 using surviving lines. These crosses will be advanced and evaluated for tolerance. Similar crosses are planned for the 2007 season. The 2006 field screening with Roundup identified 15 lines from TX9092 and four lines from TX8181. Liberty testing identified 12 tolerant lines from TX9092 and one line from Cocodrie. All survivors and new selections will be evaluated in 2007.

Field entries of the state rice breeding projects were sprayed near alleys with Roundup and survivors were tagged and grown to maturity. Many of these plants were among the best and most fertile survivors. The field screening was repeated during the 2005 and 2006 seasons. In nine tagged plants from 8 lines/varieties, 70 plants survived additional Roundup application, 26 plants survived Liberty, and four survived in both Liberty and Roundup. Field testing with Roundup identified six lines with tolerant plants, including three lines from Cypress, two from Saber, and one from a Cocodrie/LQ243a cross. Liberty testing identified tolerant plants from three Cypress/L201 lines, and an LQ39a/L202 line. Selected lines will be included in the 2007 field screening using both Liberty and Roundup.

Studies on genotypes with herbicide tolerance are conducted by Rodante E. Tabien, Patrick Frank, and Chersty Harper.

High Tillering Rice Mutant

Rice is considered as a good model crop for the study of branching in monocotyledonous plants. Tillering in rice is a very important agronomic trait which determines the yield potential of a particular variety. A number of high tillering rice mutants have been identified, but most of them are not fully characterized because of their poor appearance or several weaknesses. Very high tillering mutants will be very useful in understanding the genetic factors that control tiller number in rice.

In our studies, a very high tillering and dwarf phenotype was selected from an early generation of L202 x Saber cross. The identified mutants were 50 to 55 cm tall in field condition and produced 80 to 90 tillers per plant at maturity. The rate of tiller production was much faster than conventional variety and this resulted in a final tiller number that is approximately four times that of Cocodrie and Zhe733. It was observed that 80-85 % of the tillers of the mutant were productive tiller bearing a very short panicle (10-12 cm) and few grains (25-30 grains/panicle). It never stops producing new tillers even at late reproductive stage, thus these mutants might be useful for higher biomass production and ratooning studies. On average, the mutants headed after 95 days from emergence and it took 121 days to harvest. The pattern of flowering was normal with good grain filling but the long grain was smaller than Cocodrie. Currently, we are evaluating the effect of different dose of nitrogen and plant density on the tillering ability of these mutants. Future studies will focus on the effect of gibberellic acid and other growth regulators on the germination, tillering ability and the grain formation.

The very high tillering mutants (second and fifth pot from the left) relative to conventional rice cultivars.

Studies on mutants are conducted by Dhananjay Mani, Rodante E. Tabien, Chersty Harper and Patrick Frank.

Development of High Yielding Rice Varieties with Important traits for Texas

The state rice varietal program funded by the Texas Rice Research Foundation continues to focus on developing new rice varieties to benefit farmers and increase production in Texas. Several germplasms with high yield, good milling quality, herbicide tolerance, disease resistance and seedling cold tolerance are included as donors of important traits in the development of better varieties. New crosses are being developed to produce populations needed in the generation of elite lines with these desirable traits.

In 2006, the breeding project conducted several yield trials of elite lines. The yield trials consisted of Observational Nursery (ON), Preliminary Yield Trial (PYT), and a Statewide Preliminary Yield Trial (SPYT) in two locations. The ON contained 2,300 rows of breeding material with one of the best lines yielding around 9,000 lb/acre compared to Cocodrie's 7,491 lb/acre. The PYT contained 80 entries producing higher yields than many of the current conventional varieties included as checks. The highest yielding line had 9.5% yield advantage over Cocodrie. The 11 lines present in SPYT yielded 7,075 lb/acre to 8,535 lb/acre, with the highest out yielding the checks. All entries included in the yield trials were evaluated for total and whole grain percentages, and grain appearance. After analysis of all data, lines were advanced to compose the 2007 breeding materials. Currently, the ON contains 4,747 rows; the PYT has 75 lines, while SPYT includes 17 lines. After four years, the state breeding project has elite lines included in the Uniform Rice Regional Nursery (URRN). Five of the project's most elite lines are planted among the other 200 URRN entries from various breeding programs. As in the past, the breeding project has a pedigree nursery (PN) containing earlier generation materials planted in 4,604 rows, and a hybridization block (HB) having breeding materials for new crosses.

Statewide yield trial plots at Eagle Lake.

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

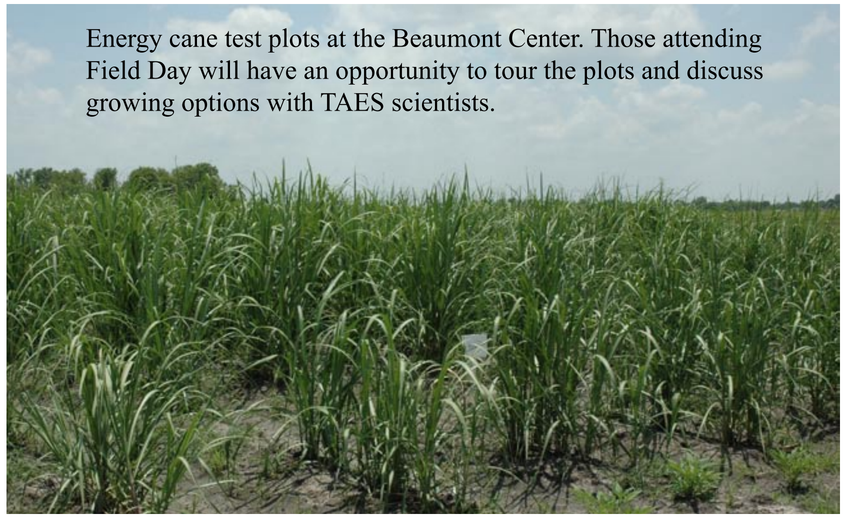
Development of a High-Yielding Water-Efficient Cultivar

As competition for water between agriculture and urban centers increases, greater pressure is placed on more efficient water use. In 2002, the Texas Agricultural Research and Extension Center began an ultra high-yielding single crop rice cultivar selection program, with financial support from the Lower Colorado River Authority (LCRA) and San Antonio Water System (SAWS). In comparison to existing short season cultivars, our new breeding program focuses on developing a new plant type that is slightly larger, slightly later in maturity (4 to 7 days) and has a yield potential that is greater than that of conventional short-season rice varieties.

For the 2007 cropping season, 4852 pedigree nursery rows and 900 observational nursery rows are being evaluated as part of the LCRA/SAWS varietal development program. In addition 74 lines are being evaluated in replicated yield trials, 52 in the preliminary yield trials at Beaumont, 17 in the statewide preliminary yield trials at Beaumont and Eagle Lake, and 5 in the Uniform Regional Rice Nursery. Hybridization blocks have also been established with lines and cultivars serving as parents. Marker-assisted selection is being used to identify lines that have genes for desired cooking quality, semi-dwarf stature, and blast resistance.

Research on this project is conducted by Lloyd T. Wilson, Rodante E. Tabien, Stanley Omar PB. Samonte, and James C. Medley. For more information, contact Ted Wilson at 409-752-3045 ext. 2210 or e-mail lt-wilson@aesrg.tamu.edu.

Energy Cane Research for the Biofuel Industry



Energy cane test plots at the Beaumont Center. Those attending Field Day will have an opportunity to tour the plots and discuss growing options with TAES scientists.

The Entomology Project is conducting research on energy cane by cooperating with USDA/Houma, LA to evaluate promising germplasm for adaptability to Southeast Texas. Energy cane is a type of sugarcane that produces high biomass and high sugar concentration. Germplasm was obtained from Robert Cobill and Dr. Tom Tew at USDA/Houma, LA. The following entries are in the test at the Beaumont Center: 02-113, 99-51, 99-58, 03-19 and 03-48. A standard sugarcane cultivar, 85-384, also is in the test serving as a standard for comparison. We are providing necessary agronomic data to help build a biofuels industry in Southeast Texas.

Flax Trial at the Beaumont Center

Randy Eason harvesting flax at the Beaumont Center in the spring of 2007.

Common Flax is one of the earliest crops domesticated by man. Flax was used by early man for its seed as well as its fiber. Egyptian mummies have been found wrapped in linen cloth made from flax fiber. The early colonists in the United States grew small fields of flax and commercial production began in 1753. The invention of the cotton gin in 1793 caused a rapid decline of flax production in the U.S. and in the 1940's it had dropped to almost zero. Today only a few individuals grow flax for its fiber or linen in the U.S., most of the linen today comes from Russia, Poland and France.

North Dakota, South Dakota, and Minnesota produce the majority of the flax seed in the United States. Seed is used for oil and its nutritional value for human and animal consumption. Linseed oil that is produced from flax has many industrial uses. It can be used as a drying agent for paints, varnish and lacquer. The oil also has nutritional value and is very high in Omega 3 fatty acids, which has been found to improve cardiovascular health in humans. Linseed oil mill is an excellent livestock feed as it has 35% crude protein availability.

Seed flax is an annual plant that grows to a height of 12 to 36 inches. It has a distinct main stem with numerous branches at the top, which produce flowers. Branches from the base of the plant may also occur depending on variety, stand, and environment. The plant has a branched taproot system, which may extend to a depth of 3 to 4 feet in coarse textured soil. Spring-sown varieties of the North Central region are less cold tolerant, exhibit less basal branching, and grow more upright in the seedling stage than fall-sown varieties of Texas and southern California.

The experiment at Beaumont was planted on December 6, 2006. The seeding rate was 42 pounds/acre. A John Deere drill was used to plant the seed on 7.5 inch centers at a depth of ½ to 1 inch. The area that was

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planted was 1.0 acres and the seed bed was well prepared and free of weeds and the soil texture was fine. No herbicides were applied. The soil type was a Labelle silt loam. Fifty units of nitrogen was applied pre-plant (aprox. 108 pounds of urea) to the area and also a top dress of urea was applied at the same rate on March 6, 2007. Harvest occurred on a June 7, 8 2007. The harvest was done mechanically with an Almaco plot harvester. Harvest should be done when 90% or more of the pods of the plant are dry for maximum threshing ability. Sharp knives are essential on the cutter bar because of the high fiber content of the flax stalk. A desiccant of sodium chlorate such as *Defol* can be used in order to speed the harvest time. At Beaumont desiccants were not used. Yield for the Beaumont test was approximately 1,700 pounds/acre of seed. The harvested seed was dried in a sack drier to a moisture level of 10% which is the recommended moisture level to safely store flax seed.

Average yields of flax in Minnesota are 35 bushels/acre. A flax bushel weighs 60 pounds. The yield at Beaumont was comparable 28 bushel/acre (1680 lbs/ac).

Research conducted by Randy Eason, Ted Wilson, Bill Dishman Jr. For mor information contact randy Eason at 409752-2741 ext. 2291 or email r-eason@aesrg.tamu.edu

Rice Quality

Rice Waxy Gene: Associations with Apparent Amylose Content and Pasting Properties

Rice end-use quality is strongly impacted by apparent amylose content (AAC). For example, the conventional long-grain rice in the US has intermediate AAC, and after cooking the rice is firm and fluffy in texture; while the conventional medium-grain rice has low AAC, and the texture of the cooked rice is soft, moist and sticky. The Waxy gene on chromosome 6 encodes the granule-bound starch synthase enzyme and controls much of the variation in rice AAC. The AAC, however, does not explain all the variation in rice processing characteristics. Some varieties with similar AAC have very different pasting viscosities and processing properties. For example, Dixiebelle, a high AAC-type, has a stronger pasting curve than some other high AAC-types and has a superior processing property. The Waxy gene reportedly has major effects on starch-pasting properties. We investigated the sequence variations in the Waxy gene and their associations with AAC and pasting properties using 171 rice accessions originating from 43 countries in an effort to develop molecular markers for grain-quality traits. Three sequence variation sites in Waxy gene, intron 1, exon 6 and exon 10, were genotyped and the combination of these sequence variations generated four alleles. The allele 1 associated with low AAC-, allele 2 associated with intermediate AAC-, and allele 3 and 4 correlated with high AAC-type rice accessions. A mean comparison of each parameter of the RVA pasting curve demonstrated that rice accessions containing the Waxy allele 4 type had significantly higher hotpaste, coolpaste and setback viscosities (alpha = 0.05) than all the other allele-types regardless of their AAC. The difference between allele 4 from all other alleles is the sequence variation in exon 10 of the Waxy gene. Molecular markers developed for this sequence variation site would be able to assist breeding programs selecting for specialty rice with superior processing properties.

Research conducted at the USDA ARS SPA, Cereal Chemistry Laboratory in Beaumont by Ming-Hsuan Chen, Janis Delgado and Naomi Gipson, with collaboration by Christine Bergman and Bob Fjellstrom.

Rice Bran Phytonutrients

The bran layer of the whole grain rice contains potential health-beneficial compounds. These include vitamin E homologs (tocopherols, tocotrienols), oryzanol fractions, simple phenolics and poly-phenolics. These are antioxidants that are believed to provide protection against diseases such as cancer and cardiovascular disease. Human feeding studies demonstrated that the tocotrienol-rich fraction and oryzanol fractions of rice bran reduce serum cholesterol level, primarily by decreases in the LDL level. Studies also demonstrated that tocotrienols, rice bran phenolics and rice bran extracts were able to suppress proliferation of cancer in cell lines and in experimental animals. We studied the accumulation of tocopherols, tocotrienols, and oryzanol fractions

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during grain development. The developing grains of Cypress (tropical japanica) and Teqing (indica) were harvested every three days starting from 10 days-after flowering (DAF) to post-maturity. The contents of total tocopherols, tocotrienols, and oryzanols were accumulated at different rates in the two cultivars. However, the accumulation patterns for each family of antioxidants were similar between the two cultivars. Total tocopherols accumulated to the maximum level during early grain development, and then dropped down to very low levels at grain maturity and post-maturity; while the total tocotrienols and oryzanol accumulation patterns were parallel with grain weight or dry mass accumulation and remained high post-maturity. This suggested that the possible function of tocopherol was for the protection of oxidative damage during rapid seed growth, and that the tocotrienols and oryzanol might have different metabolic pathways and functions for the developing and mature grain. The increasing knowledge showing the health benefits of tocotrienols and γ-oryzanol, and their accumulation patterns in the developing grain indicate these two families of antioxidants are good targets for enhancing their levels through breeding.

Research conducted at the USDA ARS SPA, Cereal Chemistry Laboratory in Beaumont by Ming-Hsuan Chen, Janis Delgado and Naomi Gipson, with collaboration by Christine Bergman and Shannon Pinson. For more information contact Dr. Ming-hsuan Chen at 409-752-5221 or email: ming.chen@ars.usda.gov

Integrated Cropping Systems

Integrated Agricultural Information and Management System (*i*AIMS)

Agriculture in Texas and U.S. is facing increasing challenges. Continued urban expansion is competing with agriculture for land, water, and other resources. Global competition, combined with trade inequities, continues to shrink U.S. agriculture profit margins. To maintain economic competitiveness and viability, U.S. agriculture must continue to strive for increased efficiency with limited resources. Achieving increased efficiency depends on our understanding of cropping systems.

The multidisciplinary nature and inherent complexity of cropping systems pose challenges to both producers and scientists and requires integration of data, knowledge and skills from different disciplines and the effective delivery of technologies. In cooperation with several state and federal institutions, Our team has developed an Integrated Agricultural Information and Management System (*i*AIMS). The focus of the system is the consolidation and integration of data and the effective delivery of research results as decision tools. The system is built around foundation class climatic and soil databases that are independent of the overlaying crop systems.

The foundation class climatic database is the largest and most easily accessed web-based climatic database of any U.S. Agricultural university. A unique feature is its capability to automatically and continuously fetch near real-time weather data from available sources, filter the fetched data and update the data continuously via an automated data retrieval program. The edaphic component of the databases fetches SSURGO soil data and updates the data into a customized geo-referenced soil database that is accessible by any application program. These databases provide a common structure for developing diversified applications that require dynamic access to near real-time data. A number of applications have been developed that seamlessly access the foundation class databases. These applications also provide several interfaces targeted at different user levels to hide unnecessary complexity.

Collectively these applications address water conservation, rice production and management problems in the Upper Gulf Coast. The increasing use of these applications by producers and researchers demonstrates that this framework is a viable approach that can be expanded to address problems involving a wide range of cropping systems across Texas and different regions of the US. An added advantage of this framework is its systems focus, which facilitates cooperation and integration by researchers across a wide range of disciplines.

Research conducted by Ted Wilson and Yubin Yang. For more information contact Yubin Yang at 409-752-2741 or email yyang@aesrg.tamu.edu