Texas Rice Special Section
Highlighting Research in 2002

Agronomic Management

Dr. Fred Turner

Screening Public and Private Rice Varieties for Main and Ratoon Crop Yield and Quality in Texas

Dr. Turner's Soil and Plant Nutrition Project evaluates main and ratoon crop yield and quality of potential Ark, La, Miss and Texas rice varieties as well as herbicide resistant and hybrid rice varieties. The trials are planted on two different dates and at two locations having different soil types. They also test multiple plant populations and nitrogen rates. The data helps producers and consultants make variety-specific management decisions for Texas growing conditions. For each of the 15 rice varieties evaluated data are collected on seed/lb, targeted seeding rates and achieved seedling/ft^2, maximum tillering capacity, optimum nitrogen rates, plant population effect on yield, plant development for predicting growth stages, sheath blight resistance, plant height, lodging potential, variety strengths and weaknesses and an economic ranking for main, ratoon and total crop yield based on the combination of yield and milling data.

Last year the highest economic ranking varieties for total yield (i.e., main plus ratoon crop) at Eagle Lake were Wells, Cypress, CL121 and Cocodrie. At Beaumont the highest economic ranking varieties for main and ratoon crop were Saber, Wells, Cocodrie and Bolivar. This year two experimental hybrids, three Clearfield varieties, Francis, TX9092 and TX8181 were added to the trails.

Nitrogen Fertilizer Management for Hybrid Rice

In cooperation with Dr. Jim Stroike, Technical Director for RiceTec, Inc. Dr. Turner's Soil and Plant Nutrition Project is in their fourth year of contributing to the identification of optimum nitrogen rates and timing for two released hybrids (XL7 and XL8) and two experimental hybrids (XP710 and XP711) on sandy and clay soils. Because hybrid rice seed is relatively expensive, hybrid rice varieties are planted at 30 to 35 lbs seed/acre. The lower seeding rates are possible because hybrids tiller about 50% more than the best conventional rice varieties under proper nitrogen fertilizer management.

Research data show that hybrids differ from conventional varieties in response to nitrogen fertilizer. Current hybrids (XL7 and XL8) produce excellent main crop rice yield with only two nitrogen applications - one application just prior to flooding and a second application just prior to or at heading. Turner's data show that nitrogen applied at heading in conventional varieties has not consistently improved yield, but typically increase hybrid main crop yield and milling as well as ratoon yields especially on clay soils. Last year, two applications of nitrogen on main crop (one at preflood and one near heading), plus one application just prior to ratoon flooding at Eagle Lake produced up to 13,000 lbs rice/A (i.e., 8000 lbs/A for main crop + 5000 lbs/A for ratoon crop). Similar nitogen applications at Beaumont produced total rice yields of about 10,000 lbs/A because ratoon yields were only about 1/2 of those at Eagle Lake.

For more details, or to request a copy of our annual research report, contact Dr. Fred Turner at 409-752-2741 ext. 2223 or email f-turner@tamu.edu.

Agronomic Management continued...

Reducing Production Cost Through Innovations in Fertilizer and Water Management

The Soil and Plant Nutrition Projects conducts cooperative research with Dr. Garry McCauley at Eagle Lake with the objective of reducing Texas' rice production costs so Texas rice farmers will be more competitive in the rice market. We all recognize that significant reduction in Texas' rice production cost will likely require major changes in current rice management practices. This year we coupled all innovations in fertilizer management (improved fertilizer efficiency) with innovations in water management (early flood and its benefits) to reduce rice production costs. The proposed package of practices to be evaluated should contribute to less fertilizer costs, less application costs, less flushing, less herbicide, 20% less irrigation water creating an earlier and more uniform main crop followed by a higher yielding ratoon crop. The accumulated cost saving estimate is $75/A which is a 12% reduction in the $600/A total production cost or 16% reduction in $473/A variable production cost.

Fields being flooded at the 4-leaf stage, rather than 6, saving water and herbicide.

Yield data from the Project's test plots is not available yet for this year, but establishing a 4 inch flood at initial tillering (4-leaf stage rice) eliminated one herbicide application and one flush relative to flooding at the 6 leaf stage. The early flood also produced more plant biomass and 3 to 7 days earlier plant development on the clay soil at Beaumont. On the sandy soil at Eagle Lake the early flood effect on biomass was less evident but still plants reached the reproductive stage earlier.

Technical support for the Soils and Plant Nutrition project consist of Mike Jund (Research Associate), Darrell Hagler (Technician) and Jack Vawter (Farm Services Manager at Eagle Lake).

Integrated Rice Management for Ratoon Production

Dr. Garry McCauley

Dr. Garry McCauley, with the help of technician Kyle Cranek, has evaluated the impact of main crop (MC) management on ratoon crop (RC) production for the past 4 years in Cypress, Cocodrie, and Jefferson at the Eagle Lake Station. Input variables included nitrogen, fungicide, late season phosphorus, shading, and MC cutting height. Cutting heights evaluated were high (just below the head), mid (mid straw), and low (4 inches above the ground.) A fungicide treatment consisted of Tilt when the developing panicle was 2 inches long, followed by Quadris 14 days later. Late season phosphorus was 40 pounds per acre of 0-60-0 applied at the soft dough stage of the rice.

Shade at post flowering in the MC drastically reduces the RC yield and reduces the impact of the other management inputs even with fungicide. Cutting height was the only MC management variable that consistently impacted RC yield. The lower the MC was cut the higher the RC yield. Late season phosphorus tended to reduce RC yield. Two MC fungicide applications did not consistently nor significantly increase RC yield. In 2001, MC fungicide increased MC yield 700 to 1000 pounds per acre and RC yield by about 600 pounds per acre. A single RC fungicide application added another 500 pounds per acre to the RC yield. Reducing the MC nitrogen from 180 to 120 pounds per acre only reduced the RC yield by about 200 pounds per acre. The only producer-controlled variable that consistently increased RC yield was cutting height.

Large field Evaluation of Row Spacing and Seeding Rate in Cypress and Cocodrie

Dr. McCauley's project has evaluated row spacing and seeding rates in Cypress and Cocodrie in large field tests on Garrett Farms in Brazoria County for the past 5 years. Row spacing was 7.5 and 10 inch and seeding rates were 20, 40, 60, 80, 100, and 120 pounds per acre. MC and RC yields with 7.5-inch row spacing were always equal to or better than the 10-inch row spacing. Optimum seeding rate was 40 to 60 pounds per acre at 15 to 20 seedlings per square foot. Yield declined severely from 40 to 20 pounds per acre. The yield penalty was not as great as seeding rate increased from 60 to 100 pounds per acre. Thus producers should select a seeding rate that allows some error to the higher rate. Seed stacking does appear to be a problem as seeding rate increases.

The most important yield component appeared to be panicles per seedling, as panicles per seedling declined from 5 to 2 as seeding rate increased from 20 to 120 pounds per acre. Panicles per seedling were nearly constant from 80 to 120 pounds per acre. In the ratoon crop, panicles per seedling declined from 6.5 at 20 pounds per acre to near 2 at 120 pounds per acre. Sterility was a constant 28% and would appear to be a limiting factor in the RC yield.

Seeding rate studies have been conducted with Cocodrie rice on a silty clay loam soil on the Gertson farm in Wharton County for the past two years. Optimum seeding rate appears to be 60 to 80 pounds per acre and 15 to 20 plants per square foot. Maximum yields were obtained at the same plant populations at both locations and with both varieties, but in Wharton County it took 20 more pounds per acre of seed to reach the same plant population as in Brazoria County.

For more information contact Dr. Garry McCauley at 979-234-3578 or email gmccaule@elc.net.

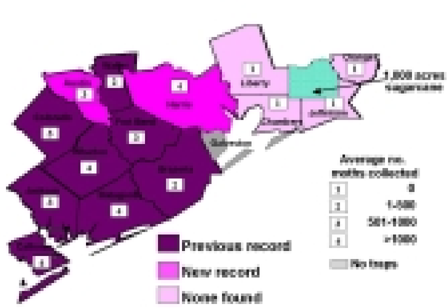
Entomology/Plant Pathology/Weed Management

Stem Borer Research


Dr. M.O. Way

A collaborative research study is being conducted with LSU sugarcane entomologist, Dr. Gene Reagan to monitor the movement of the Mexican rice borer (MRB). The insect pest has gradually moved from Mexico into the Texas Rice Belt. Through pheromone trapping we have discovered that the MRB has extended its range to include all rice-producing counties west and south of Chambers where approximately 1000 acres of sugarcane are grown (Table 2). The MRB does not occur in Louisiana, so Louisiana sugarcane and rice growers are concerned about the movement of this insect. We received a USDA grant to develop an IPM program for MRB in rice and sugarcane.

Table 2. Mexican Rice Borer Pheromone Trapping, 2001



We are also conducting biological, insecticidal and host plant resistance tests for these stem borers on rice plots at a site in Ganado, Texas. We are collecting information such as timing of stem borer infestations, correlating yield loss with stem borer numbers and damage and developing effective sampling plans for stem borers. We are also screening an array and timings of insecticides, and evaluating 10 commonly grown rice varieties for resistance. This research is being funded from check-off funds, the USDA grant and private agrichemical support.

Icon 6.2FS vs Sharpshooters

A seedling response greenhouse study was conducted in 2001 at the Beaumont Center to evaluate Icon 6.2FS seed treatment on sharpshooters, *Draeculacephala portola*. Cocodrie was treated with Icon 6.2FS at 0.05 lb (AI)/cwt and placed in pots partially flooded in a basin to assure adequate soil moisture. Rice was fertilized with urea as needed. Seedlings were thinned to 4 per pot. Selected pots were infested at 6 days old, with 0, 1, 2 or 4 adult sharpshooters by placing in cages over the seedlings. Sharpshooter mortality was recorded 72 hours after infestation. Results of the test showed no evidence of chlorosis and plant height decreased slightly with increased insect density regardless of treatment (Table 1). The Icon 6.2FS seed treatment gave 100% control of sharpshooters.

Table 1. Icon 6.2FS vs Sharpshooters (SS). Beaumont, TX 2001

Treatment	No SS/pot	Avg. % SS mortality	Avg. plant ht. (cm) Aug 9	Aug 15
Icon 6.2FS[a]	0	-	40.4	49.0
	1	100	37.3	48.4
	2	100	36.2	49.2
	4	100	35.0	44.4
Untreated	0	-	38.6	49.1
	1	0	37.5	45.5
	2	0	36.0	46.0
	4	12.5	35.7	41.7

[a] Seed treatment at 0.05 lb (AI)/cwt

Evaluating New Chemistry for Rice Water Weevil, Rice Stink Bug and Stem Borers

The entomology project continually evaluates new insecticides for control of insects attacking rice. This year is no different. At Beaumont, we are evaluating Cruiser 5FS (neo-nicotinoid) as a seed treatment, F0570 (resolved isomer of Fury) as a foliar pre or post-flood application, and GF-317 (resolved isomer of Karate) as a foliar pre or post-flood application for rice water weevil (RWW) control. We are also evaluating both resolved isomers for rice stink bug (RSB) control. At Eagle Lake, we are evaluating GF-317 applied pre or post-flood for RWW control. At Ganado, we are evaluating Novaluron (insect growth regulator) and GF-317 for stem borer control. In addition, we are attempting to improve stem borer control by applying Karate Z at various times after flood in plots planted with Icon 6.2FS-treated seed. Preliminary results of our Eagle Lake experiment are shown in Table 3.

Table 3. Control of Rice Water Weevil at Eagle Lake, TX. 2002

Treatment	Rate [lb(AI)/acre]	Timing	% Control
Untreated	-	-	-
GF-317	0.003	BF[1]	83
GF-317	0.01	BF	99
GF-317	0.03	BF	100
GF-317	0.003	AF[2]	30
GF-317	0.01	AF	54
GF-317	0.03	AF	79
Fury 1.5EC	0.04	BF	94
Fury 1.5EC	0.04	AF	74
Karate Z	0.03	BF	94
Karate Z	0.03	AF	72
Dimilin 2L	0.1875	AF	32

[1] BF = immediately before flood
[2] AF = 4 days after flood

For more information contact M.O. Way at 409-752-2741 ext. 2231 or email moway@aesrg.tamu.edu.

Newpath on Coarse Soils

For the last two years studies have been conducted near Eagle Lake, Garwood, Lissie, and Katy, TX to evaluate Newpath herbicide (imazethapyr) for weed control and crop tolerance in CLEARFIELD* rice (CL 121) grown on coarse soils. Soils at these locations range from 55-65% sand. Clay content appears to be as or more important than sand content in explaining injury. Application timings evaluated were sequential applications made preemergence (PRE) and postemergence (POST) at the 4 to 6 leaf, 1 to 2 tiller rice stage.

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PRE rates included 3, 4, and 5 oz/A. POST rates evaluated include 2, 3, and 4 oz/A. Weeds evaluated were broadleaf signalgrass at Eagle Lake, and red rice at Lissie and Garwood. Broadleaf signalgrass control at Eagle Lake 26 days after POST treatments for all rates of Newpath was greater than 98%. Red rice control at Lissie and Garwood 26 days after POST treatments was greater than 95%. Injury in the form of height reduction of 0 to 25% was observed 14 days after the POST applications of Newpath. Injury gradually diminished when permanent flood was established and there were no significant differences in yield among Newpath treatments. Adequate weed control with minimal crop injury was consistently achieved using 4 or 5 oz/A Newpath PRE followed by 3 oz/A POST on coarse soils. Research on these projects was conducted by John O'Barr, Garry McCauley and Mike Chandler.


Dr. Mike Chandler

Factors Influencing Command Injury

Studies are currently in progress at Eagle Lake, Ganado and Beaumont to better understand the factors that contribute to rice injury from Command (clomazone). Planting dates, roughly thirty days apart, were established in early March, April and May at each location to include a wide variety of environmental conditions with varying soil types. Rates included 0.2, 0.3, 0.4, and 0.5 lbs active ingredient (ai)/A applied PRE (15, 10, 7.5 and 6 acres/gallon respectively). Injury (bleaching) ratings were highest at all three locations in May followed by March and April. There was significant seedling death at the higher rates in the May planting. Early season injury may be due to the cooler temperatures, which stress the rice and reduce its ability to metabolize the Command. Late season injury might be due to faster growth rates and increased Command uptake, resulting in toxicity to the rice. Command solubility and rice growth rate in addition to temperature, soil type, and herbicide rate, may all contribute to injury. Further research will be conducted in the laboratory this fall and in field studies over the next few years. Research on these projects was conducted by John O'Barr, Garry McCauley and Mike Chandler.

For more information contact Dr. Mike Chandler at 979-845-8736 or email jm-chandler@tamu.edu.

Fungicide Research in Rice


Dr. Joe Krausz

New fungicides, improved application timing, and rate efficacy are constantly evaluated at the Texas A&M Center at Eagle Lake. New fungicides available for 2002 include Gem 25WG, Stratego 250EC, and Propimax 3.6EC. Gem, along with Quadris, is a member of the new family of fungicide chemistry called strobilurins. Gem and Quadris have excellent control of sheath blight and blast. Gem differs from Quadris in not being a true systemic, but has excellent adhesion to the waxy layers of the rice plant foliage and has translaminar movement from one surface of the leaf to the adjacent surface. Tests have shown Gem to be very competitive with Quadris for control of sheath blight and blast.

Stratego is a combination product containing Gem and propiconazole, the active ingredient in Tilt. Stratego is designed to give broader disease control activity than Gem by enhancing control of narrow brown leaf spot and kernel smut. The active ingredient in Propimax is propiconazole, and therefore, is very similar to Tilt. With the excellent sheath blight control products Quadris and Gem, research has indicated that the most effective application timing is mid-boot (about a 2- to 4-inch panicle) as opposed to an earlier PD (panicle differentiation) or later very late boot application.

For more information or a copy of the 2002 rice fungicide test results from the Eagle Lake Center, contact Joe Krausz at 979-845-8001 or by e-mail at krausz@ppserver.tamu.edu.

Weed Management Systems in Rice


Dr. Arlen Klosterboer

In addition to traditional Extension Activities, an extensive weed control research program is conducted annually in rice and soybeans. The objectives of the program include 1) to screen and develop herbicides for utilization in rice and soybeans, 2) to develop new and improved technology for commercial herbicides to achieve more effective and economical weed management and 3) to provide necessary research information to the agricultural chemical industry for the development and registration of experimental herbicides in weed control systems, and for expansion of uses of presently labeled herbicides. The research has played a major role in the development and introduction of Arrosolo, Basagran, Command, Facet, Grandstand R, Londax, Permit, Regiment, Ricestar, Storm, Whip 360 and conservation tillage. Herbicides presently being researched include Clincher and the Liberty Linked weed control system.

The results are used extensively in rice and soybean weed control educational programs to provide farmers current information regarding weed management. This research program is presently being supported by the agricultural chemical industry and also through the cooperation of numerous farmers who have provided research sites in their rice and soybean fields.

For more information contact Dr. Arlen Klosterboer at 979-845-1461 or email a-klosterboer@tamu.edu.

Genetics


Dr. Bill Park

Genetics in Rice Research

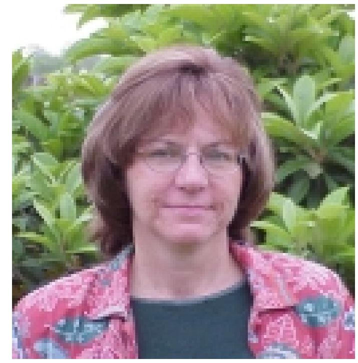
Dr. Park's lab in the Department of Biochemistry & Biophysics is currently working on several projects directly relevant to the Texas rice industry. Connie Bormans recently completed development of a set of flanking DNA markers for the blast resistance gene Pi-z. This was done in collaboration with Anna McClung at Beaumont and with Carl Johnson, a public rice breeder in California. These markers were specifically developed to be useful in US long grains and that will facilitate development of rice varieties with wide spectrum durable blast resistance. These markers have been transferred to Beaumont for routine use in the breeding program.

Kelly Vaughan has been involved in two projects. In one project, she is examining control of red rice using a combination of herbicide treatment and water management. She is also working on a novel strategy to enhance ratoon yield by manipulation of nitrogen metabolism using GMO technology. It should be noted that for this work, Kelly is using elite Southern US long grains such as Cypress and Cocodrie rather than Taipei 309, which is typically used in transformation work.

Grace Walker has continued to work with the USDA breeding program at Beaumont looking for molecular markers associated with cooking and processing quality. Also, she is now screening all of the crosses from the TAES breeding program to identify selfs (self pollinated) so that they can be discarded without wasting time and effort on them in the field.

For more information contact Dr. Bill Park at 979-845-8868 or email wdpark@tamu.edu.

Development of DNA Markers to Distinguish Commercial U.S. Rice Cultivars



Dr. Anna McClung

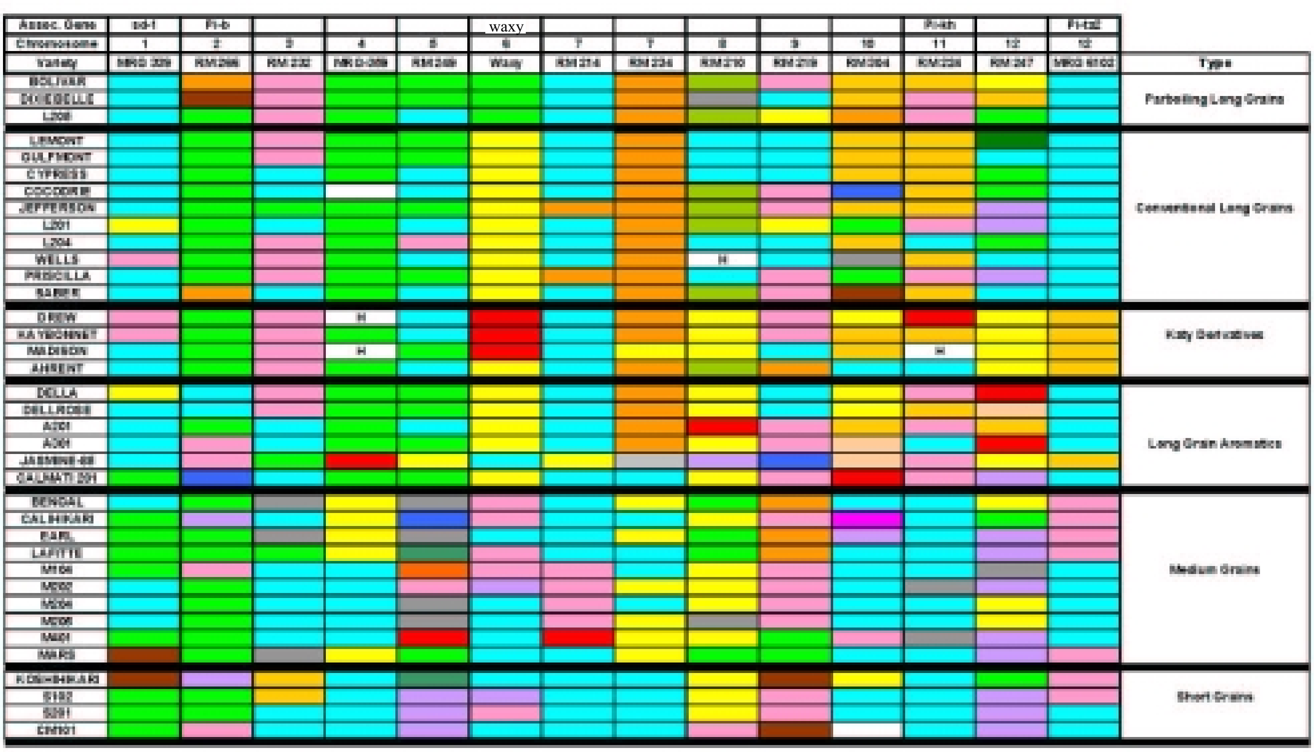
Biotechnology offers new tools that will help in rice cultivar identity preservation and verification. This is becoming a significant issue as the number of commercial cultivars that are being made available to the U.S. rice industry increases. Some of these cultivars may have special properties that are important to niche markets whereas others may possess proprietary technology. Moreover, many U.S. breeding programs utilize a relatively narrow germplasm base making it difficult to phenotypically distinguish some cultivars. Having a set of molecular markers which differentiate among U.S. cultivars will benefit rice researchers, producers, seedsmen, mills and end-users that desire seed purity and identity preservation.

Over 30 commercial rice varieties representing conventional long, medium, and short grains from across the U.S. as well as several specialty rices were obtained for analysis. Most were cultivars that had been released from public breeding programs located in Arkansas, California, Louisiana, Mississippi and Texas. DNA markers that mapped to each of the twelve chromosomes in the rice genome were evaluated for their ability to distinguish cultivars. Several of these markers are located near genes that are important to many U.S. rice breeding programs and include Sd1 on chromosome 1, Pi-b on chromosome 2, Waxy on chromosome 6, and Pi-kh on chromosome 11. DNA was extracted from leaf tissue from each of the cultivars using standard methods. PCR analysis was performed using a capillary electrophoresis genetic analyzer.

Although we did not use enough markers to clearly fingerprint all cultivars, our results indicate that a relatively small set of molecular markers can be used to distinguish most common U.S. rice cultivars that are commercially grown. These markers can be used to verify the identity of seedlots, production fields, and rice samples and can be performed using leaf tissue or rough, brown, or milled forms of rice grain.

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

DNA fingerprint of 37 commercial U.S. cultivars using 14 molecular markers that span the 12 chromosomes in rice.



H = heterogenous for this marker

Physical and Chemical Factors Underlying Fissure Resistance

Dr. Shannon Pinson

Kernel fissuring is one of the leading causes of reduced milling yield. Any reduction in fissuring will result in direct increases in whole-kernel yield and profit for the producer. Many producers experienced this increased profitability first hand when they began growing the variety 'Cypress' after its release in 1993. Cypress was used as a parent in the development of two subsequently released varieties, 'Cocodrie' and 'Jodon'. Unfortunately, no one has yet developed a cost-effective technique for identifying fissure resistant lines within segregating breeding populations. Without such selection techniques, breeders were not able to maintain Cypress' high level of fissure resistance in these subsequent varieties. Drs. Shannon Pinson (USDA, Beaumont, TX) and Scott Osborn (U. of AR) are combining their Genetics and Ag. Engineering expertise together to develop the required selection methodology. This research is supported by USDA, TAES, TRRF, and The Rice Foundation.

It is well known that exposure of dry rice to high humidity, dew or rain induces cracks or fissures within the kernels. The fissures result from stress caused by moisture gradients and differential swelling within the rewetted rice kernels. A multitude of components in rice seed, such as hull chemistry and tightness, bran chemistry and thickness, and endosperm chemistry and shape could contribute to the overall mechanism of fissure resistance (Fig. 1). It is likely that separate genes are responsible for each of these attributes. Therefore it becomes important to identify what physical mechanisms, and thus specific grain components, affect kernel fissuring for a specific variety. By determining the key mechanisms or components responsible for fissure response, there is a greater probability of developing a reliable, small sample method for identifying fissure resistance among segregating breeding lines - possibly even by identifying fissure resistance genes through molecular tags.

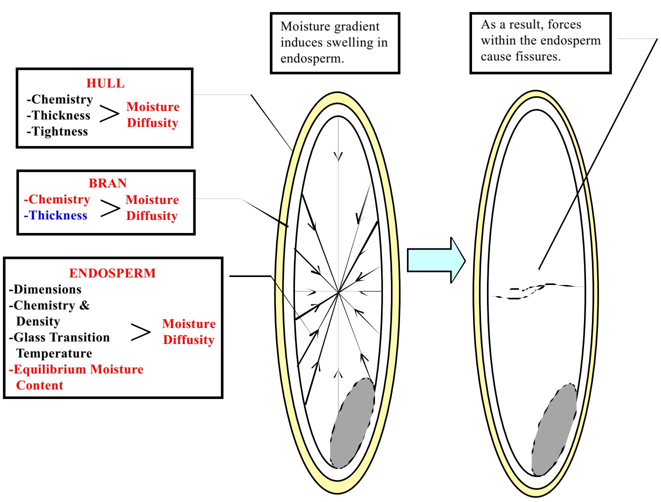


Figure 1 describes the properties studied by Pinson and Osborn to determine their relative importance to fissure resistance. Properties determined in 2001 to be significantly associated with fissure resistance/susceptibility are shown in red, factors determined to not be associated with fissuring are in blue, factors not yet evaluated are in black.

Drs. Pinson and Osborn have learned that low diffusivity (ability to transmit water) of hull and bran and high diffusivity of the endosperm are all associated with fissure resistance. Interestingly, Lemont's bran is twice as thick as Cypress', but allows significantly more water to pass through to the endosperm. This suggests that chemical aspects of Cypress' bran are contributing to its low bran diffusivity. Drs. Pinson and Osborn will be evaluating the bran chemistry of Cypress, as well as adding detailed analysis of Saber to their study in 2002.

Another short-term goal of this project was to modify a laboratory evaluation method known as the Kunze/Jodari method to make it capable of detecting small differences in fissure response, such as those seen between Lemont and Lagrue, from as few as 150 kernels. This improved method was then used to evaluate fissure resistance in a Lemont/Teqing gene-mapping population. Five genes associated with fissure response have been putatively identified. This gene finding effort will soon be expanded to include data on bran chemistry and hull, bran and endosperm diffusivity.

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

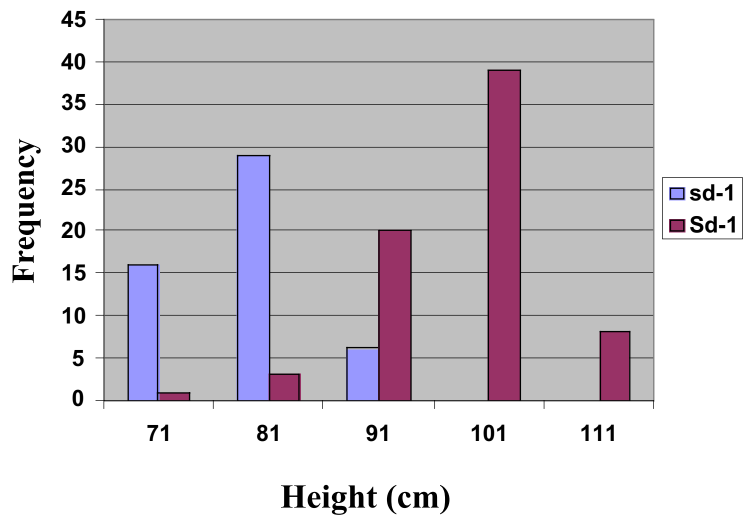
Genetics continued...

Developing and Utilizing DNA Markers for Rice

Dr. Bob Fjellstrom

The molecular genetics and breeding program has evolved over a short period from studying a handful of markers in a few hundred rice lines to the point where we made about 30,000 marker analyses from 8,000 plants in 2001. The laboratory staff members that have aided such remarkable improvements are Eric Christensen (USDA) and P. Mickey Frank (TAES), with the assistance of Angel Menard (USDA/TAES). They have greatly increased marker output through the use of a capillary electrophoresis instrument, which substantially reduces time and labor requirements for scoring the presence or absence of genetic markers. They have also made several improvements in DNA isolation techniques, resulting in the ability to economically extract DNA from up to 400 plants per week. We typically isolate DNA from leaf tissue, but have been able to run several genetic markers from as little as one-half of a kernel of rice.

Our lab has developed and/or analyzed DNA markers associated with grain aroma, amylose content, Basmati-type grain elongation, and four blast resistance genes. Recently, we have finished developing new markers for semi-dwarf growth habit. This trait is important because semi-dwarf cultivars are less likely to fall over (lodge) in fields. This attribute is particularly meaningful in Texas, because frequent high winds here can knock down taller varieties like Drew much more easily than semi-dwarf varieties like Cypress or Cocodrie. The graph below shows the correspondence between the presence of our new marker (sd-1, in blue) and absence of the marker (Sd-1, in pink) with plant height (in cm) in a genetic analysis experiment.



We intend to use this new marker to help us select for desirable plant height in early generation selections and in environments (like winter nurseries) where the difference between lines with and without the semi-dwarf gene is not easily distinguished.

For more information contact Bob Fjellstrom at 409-752-2741 ext 2225, email r-fjellstrom@tamu.edu

Plant Physiology

Plant Growth Regulators (PGRs) For Improving Yield

Dr. Lee Tarpley

Lee Tarpley, in cooperation with Fred Turner and Mike Jund, is examining the agronomic and physiological effects of selected PGRs applied late in main-crop development. The hormonal-like activities of these PGRs can potentially be used to stimulate ratoon tiller development when main-crop yield and quality are not affected. In the first year of the study, gibberellin (a research formulation) applied three days after main-crop flowering increased: 1) ratoon tiller earliness (more of the ratoon tillers tend to be in elongation rather than in bud-swelling, when measured two weeks before main crop harvest), 2) ratoon tiller number about 50%, and 3) yield (400 pounds per acre). Cytokinin (or benzyl adenine, which is used in some commercial PGR mixes for rice) increased ratoon tiller number about 50%. We are also studying how the various parts of the

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rice plant temporarily store and use carbohydrates (sugars and starch) and nitrogen-containing compounds (such as protein). The plant naturally uses these reserves to help fill the grain, to help ratoon tiller establishment, and to help ratoon grain filling. The PGR applications and other management practices can potentially be used to direct the timing and extent of the plant's use of these reserves. The 2002 field sites are in Beaumont and Eagle Lake. The emphasis of this second year of the study is on establishing the rates, timing and combinations for three PGRs. Tesfamichael (Tesfa) Kebrom, a TAMU graduate student, is working on this and other aspects of the project. Ronnie Porter is providing technical research assistance. Alicia Delgado, Casey Hall and Landon Reneau are helping for the summer. This research is sponsored by the TRRF Board.

Physiology of Lodging Resistance and Vegetative Reserve Storage in Hybrids

Lee Tarpley, with sponsorship by RiceTec, is identifying physiology-based characteristics of lodging resistance. These characteristics will be used by RiceTec to further the incorporation of lodging resistance in their hybrid development program. In addition, Lee Tarpley is studying how the various parts of the hybrid plants are temporarily storing and using carbohydrates (sugars and starch) and nitrogen-containing compounds (such as protein). The timing and extent of use of these reserves differ between the hybrids and the Texas cultivars. These differences present some unique opportunities for hybrid improvement and management. The 2002 field sites are in Beaumont, Eagle Lake, and Bay City.

Environmental Factors Affecting Rice Ratoon Stand Establishment

Tesfamichael (Tesfa) Kebrom, a TAMU graduate student working with Lee Tarpley, is using several approaches to understand the physiological bases of inconsistent rice ratoon stand establishment and growth. Among these is consideration of specific environmental factors. Large amounts of organic matter in the field water can result from algae accumulation, shedding of lower leaves, and straw left in the field after main-crop harvest. When this organic matter is degraded under low-oxygen conditions, such as are often present in flooded rice fields, plant growth-inhibiting compounds can be released. The effects of various combinations of straw, activated charcoal (to adsorb specific kinds of compounds released from the straw) and water aeration upon rice plant growth and development are being examined. The results from this study, other "environmental factor" studies, and characterizations of the physiology of rice ratoon tiller induction and elongation and ratoon plant growth will be used to propose specific improvements to management, and possibly varietal improvement.

For more information contact Dr. Lee Tarpley at 409-752-2741 ext. 2235 or email ltarpley@tamu.edu.


Dr. Ted Wilson

The Physiological Basis for Superior Yield Performance in Texas Rice

The focus of this research is to estimate primary plant traits, for major rice varieties produced in Texas. This information is being used to test the ability of a computer model to predict the yield performance of different rice varieties grown in Texas. During each of the previous two seasons and the current season, an experiment partially funded by the Texas Rice Research Foundation has provided detailed information on the growth and development of six major rice varieties. Samples were taken for each rice variety once a week, with up to 48 rice growth parameters recorded for each. Before planting,

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five soil samples were taken from each field. Clay, silt, and sand contents, pH, organic matter, bulk density, nitrate (NO_3), ammonium (NH_4), and total N were measured. Soil samples were taken from the center of the sampling area to a depth of 45 cm representing soil from 0-5, 6-15, 16-25, 26-35, and 36-45 cm. In addition to the main study, a companion experiment was conducted to determine how fast nitrogen moves in the soil at both a heavy clay soil location (Beaumont), and a relatively low clay soil location (Eagle Lake), and to determine the effect that different levels of nitrogen has on the rate of development of different plant processes.

Our previous research shows that each variety differs in terms of its key growth parameters. These parameters included those that control earliness of tillering, the number of tillers produced, the rate of leaf production, and the number of leaves produced before the plant produces a panicle. Of the 28 plant traits that have been discovered which determine a specific varieties response to climatic variables, such as temperature and sunlight, and agronomic inputs, such as fertilizer inputs, 8 are responsible for explaining about 80% of the variation in yield across different varieties and across different environments.

Field experiments have shown that the model explains 85-95% of the yield variability across years and across varieties. Field experiments have demonstrated that the model has the ability to predict which combination of plant traits will result in a high yielding plant type and which combination will not. The model is now being used as part of a project with the Lower Colorado River Authority to determine which of several plant varieties to cross to develop new varieties that have the greatest potential for increasing rice yield potential, while reducing the amount of water necessary to grow the crop. To date, over 1,000 crosses have been completed, with the progeny of these crosses now being grown in the field.

Researchers on the current project include Lloyd T. Wilson, Jim Medley, Chersty Harper and Jay Cockrell. For more information contact Dr. Ted Wilson at 409-752-2741 ext. 2227 or email lt-wilson@aesrg.tamu.edu.

Rice Quality

A Rapid Method for Determining Carbohydrates and Nitrogen at Different Stages of Rice Development (Part II)


Dr. Christine Bergman

Geneticists and physiologists are studying relationships between rice plant nonstructural carbohydrate (TNC) and nitrogen (N) contents, and grain production. This type of research requires that a large number of samples be analyzed. The rate at which these studies progress is constrained because the traditional procedures for determining TNC and N are time consuming. Last year we reported on our efforts to develop a rapid method for determining the TNC contents of rice stems and leaves during plant development. The near infrared spectroscopy (NIR) method we developed was suitable for rating plant tissues as being low, medium or high in TNC, but was not sufficiently accurate for use in research. Our main concern was that the age of the samples we used for this study confounded the results. Therefore, during phase II of the project we used only freshly harvested tissue. Nitrogen analysis was also added to the study. NIR spectral scans were collected from 1,604 rice plant tissue samples. These samples were from several of Ted Wilson's recent projects: Nitrogen studies in Beaumont, El Campo and Eagle Leak; spikelet density study; and leaf tagging study. Each study consisted of tissue harvested from primary (main and tiller) and secondary (leaf and stem) structures; at the vegetative, panicle differentiation, reproductive, and maturation growth stages. Approximately 1/3 of the samples were from several different varieties (Jefferson, Cocodrie, TX6178, Lemont and Wells) and the remainder were from Cypress. A software program was used to identify the smallest number of samples that could represent the entire set (Figure). The 305 samples selected were used to develop NIR calibration equations for TNC and N. The coefficient of

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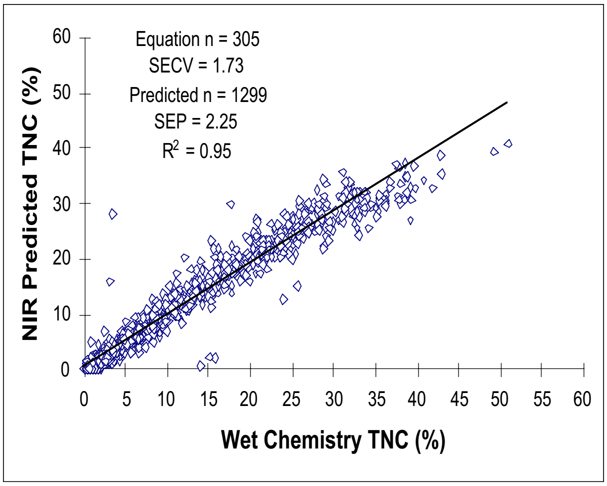
determination (R^2) for TNC and N values determined using traditional laboratory methods versus NIR were 0.95 and 0.97, respectively. That means that the NIR equations were able to accurately predict rice tissue TNC and N contents. Using these equations for research purposes would require approximately 75% less technician time for TNC and N analyses compared to using traditional laboratory methods. Researchers on this project include Christine Bergman, Naomi Gipson, Shannon Pinson and Ted Wilson.



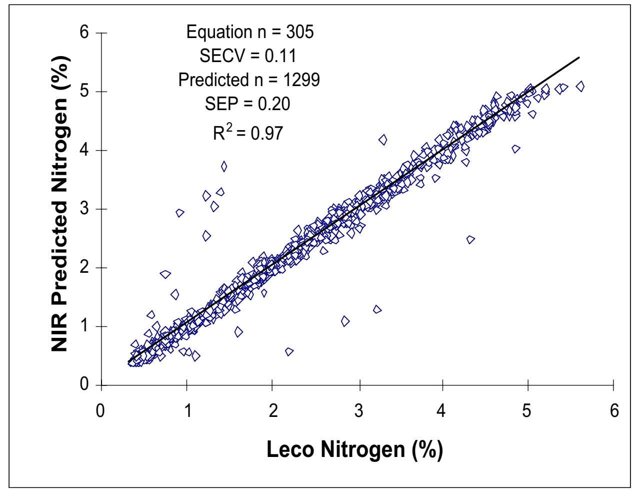


Figure. Linear relationships between TNC and N values obtained using wet chemistry methods and NIR predicted values. Samples were from six genotypes, main leaf and stem, tiller leaf and stem, three production areas and several stages of growth. Select program used to determine samples to be in equation and those not selected were used as the validation set. SECV = standard error of equation cross validation. SEP = standard error of prediction.

Have You Had Your Rice Bran Today?

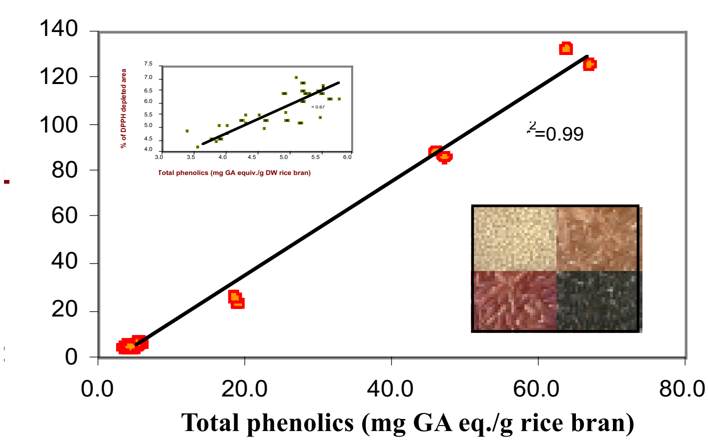


Figure. Correlation between total phenolic content and antiradical efficiency across U.S. and exotic accessions. Upper insert displays the correlation between total phenolics and antiradical efficiency across accessions with low phenolic content. Lower insert shows cultivars with different bran colors.

Across the world little value is captured from rice bran because soon after milling the bran develops off flavors and aroma. Extrusion processing has opened up the possibilities for using rice bran in food applications because it is able to denature the enzymes that cause hydrolytic rancidity. Rice bran is composed of many different potentially valuable phytochemical fractions such as tocols, gamma-oryzanol and phenolics. These compounds have free radical scavenging potential. Phytochemicals with such activity may be protective against oxidative damage, which has been implicated in a range of human diseases such as cancer and cardiovascular disease. The free radical scavenging ability of some phytochemicals can also prevent oxidative deterioration of lipids and thus improve

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the shelf life of some foods. We have studied the phenolic content and antiradical activity of U.S. and international rice germplasm. The cultivars with white or light brown bran had similar low phenolic content, whereas those with darker bran (dark brown, red and black) showed a greater range in phenolic concentration. These dark bran lines had a wide range in total phenolic (23-fold) content, antiradical efficiency, and types of simple and polymeric phenolics. For example, A Brazilian cultivar with black bran that was released recently by the Instituto AgronÔmico Rice Program, Campinas, São Paulo, has a very high level of total phenolics. Across the germplasm collection we studied, antiradical efficiency was highly correlated (R^2 = 0.99) with total phenolic content (see figure). Our future focus will be to separate and identify the specific phenolic compounds in rice bran. Applications for the use of rice bran and its phenolic fractions in food and industrial products will also be investigated. Researchers on this project include Fernando Goffman and Christine Bergman.

Dr. Fernando Goffman

The Analysis of Rice Amylopectin by Mass Spectrometry

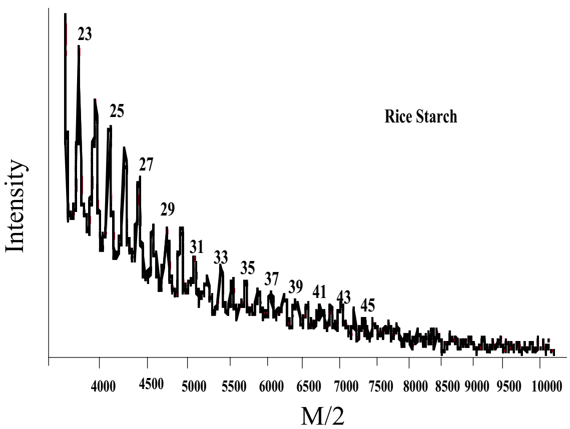

Figure. MALDI-TOF mass spectrum of debranched rice amylopectin. Display is a blow-up of the high mass region. Numbers correspond to the glucose units in the amylopectin chain (i.e., length).

Starch is composed of two fractions: amylose and amylopectin. The amylose content of rice plays a major role in determining its cooked texture and processing functionality. Over the past few years it has become clear that structural aspects of the more highly branched starch fraction, amylopectin, also impact rice grain properties. Analytical tools that can quickly and accurately determine the distributions of amylopectin chains are needed. Such methods would enhance our ability to study the relationships between amylopectin structure and many aspects of rice cooking and processing quality. Amylopectin is one of the largest molecules found in nature and as a consequence is a challenging molecule to study. Solubilizing starch which is required prior to analysis is problematic. Short chains readily go into water while longer chains require the use of organic solvents. Over the last decade, improvements have been made in the use of mass spectrometry to analyze large molecules. The objective of our ongoing research is to test the possibility of using matrix assisted laser desorption/ionization - time of flight mass spectrometry (MALDI-TOF-MS) to characterize rice amylopectin. Starch was separated from a milled sample of 'Cypress' using an alkaline extraction. We studied various matrix and solvents. The optimized method for MALDI-TOF-MS of debranched amylopectin was determined to be dimethylsulfoxide for starch solubilization and 2,5-dihydroxy benzoic acid as the sample matrix. A series of peaks was differentiated by a mass of 162 Daltons, the equivalent of a single glucose unit (see figure). Relative intensities increased to a maximum of 9 or 10 glucose molecules depending upon the sample. Thereafter, a gradual decrease in peak intensity was observed with the addition of each successive glucose unit. MALDI-TOF-MS provided an accurate snapshot of rice debranched amylopectin, except for the very longest chains. More work is needed to optimize the method along with the sample preparation procedure. But, MALDI-TOF-MS appears to offer promise as a rapid method since each run requires only about one minute. Researchers on this project include Casey Grimm, USDA-ARS-SRRC; Deborah Grimm, Coordinated Instrumentation Facility, Tulane University; Ming-Hsuan Chen, Janis Delgado and Christine Bergman at the USDA-ARS-Rice Research Unit in Beaumont.

For more information contact Dr. Christine Bergman at 409-752-5221 ext. 2260 or email c-bergman@tamu.edu.

Foundation Seed Program

TRIA Changing Direction and Focus While Striving For Improved Foundation Seed

Robert Weatherton

Texas Rice Improvement Association (TRIA) has provided support to research since 1941. They have also provided quality foundation seed to the rice industry for over 61years. Today our major income is still from producing Foundation Seed. TRIA is continually striving for improvements in Foundation Seed. New farm bills and economy has provided TRIA with new opportunities to diversify. This year as in others we are conducting more field experiments in conjunction with industry. We have worked with Uncle Ben's, Rivianna Foods, Doguets Rice, Clearfield Rice, Nature Safe, Stoller Chemical and many more.

This year we are producing Foundation Seed but also working with Nature Safe on organic rice research. Doguet Rice, Carolina Plantation Rice and Stansel Rice Co. on contract seed production. We are working with Doguet Rice on an innovative crawfish project. And Stoller Chem. on zinc project. With the new opportunities that have arisen, we now will participate in custom grown seed. As small specialty markets and others become present as viable participants in this rice market we must adapt to new attitudes to survive.

Organic Rice

Organic field of Saber.

This experiment has been conducted to allow producer's knowledge of new organic fertilizers in conjunction with manure's or litters. We first applied one ton of chicken manure to soil and incorporated with do-all. There was one acre that has zero applied and some with only Nature Safe. The manure gave us approximately 4% nitrogen per acre. or 80 units preplant. We then used presprotted seed to drill into moisture. This gave us three-day head start on our weeds. Flood was applied and then drained to apply first application of Nature Safe. This is because for Nature Safe to release its nitrogen it must be wet then dry and wet again. The flood was resumed after a couple of days.

We expect to show that timings and amounts of nitrogen are very important in organically grown rice. Yield components as well as quality and milling will be compared to cost of imputes and revenues. The Nature Safe preformed well but should see better results in the pellet form. This will allow for the product to stick in the mud and not drift or be lost. We will have data this year and will replicate for at least two more years.

Crawfish Project With Doguet Farms

Harvesting crawfish in a rice field.

This project is a cooperative between Texas Rice Improvement and Doguet Farms to evaluate late season crawfish and a new method of cultivating crawfish called "Racetrack Farming". These two are being done in the same season as to evaluate the best method for late season crawfish and rice production.

Saber rice had been planted on March 11^{th} into moisture. Permanent flood was established and rice has had only fertilizer applied. Management allowed the use of no herbicides this season. Water is being kept at 12" to 20" level in ponds. Crawfish peelers were added

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Foundation Seed Program continued...

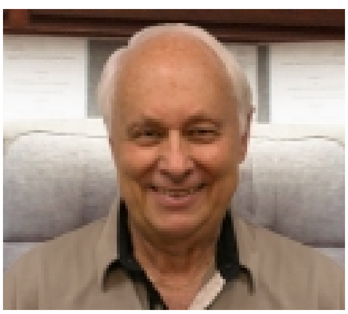
to ponds at 850 lbs. per acre on May 17th. These will be seeded this year and the crawfish will dig in and reproduce. They will be harvested again next spring. Harvesting will begin this year on June 6th. Main rice crop will be harvested on July 12. There will be fertilizer added to promote ratoon crop but not harvested. This will give existing crawfish food and protection until spring. There will be a second harvest early spring. There will be further examination of revenues after spring harvest. These will be addressed in order to evaluate this project long term.

There should be approximately 1,600 lbs/ac - 1,900 lbs/ac of crawfish harvested this season. These numbers are based on the average growth of the crawfish that has been documented to date. We are currently catching mediums to large crawfish with only three weeks of growth in ideal conditions. With the high input cost currently occurred, revenues will be only on the harvested rice and what the current farm program pays. Expectations are high for the rest of this current season and the spring crop.

For more information contact Robert Weatherton at 409-752-2741 ext. 2230 rweather@taexgw.tamu.edu.

Education

The Rice Plant – Its Growth, Development and Yield



Dr. Jim Stansel

To manage crop stress effectively, farmers need to understand how the crop grows and develops and how stresses can impact the crop. The key to high yields and good quality are to minimize the impact of plant stresses by good timely crop management. To improve sound crop management, a farmer education program about the basics of plant growth was developed and released as a CD.

The CD is a narrated Microsoft PowerPoint presentation divided into three parts. Part 1 discusses and illustrates the vegetative stage of development and how the first yield component (panicles per acre) influences yield very early in the development of the crop. Part 2 covers the reproductive stage and how the grain per panicle (the second yield component) is impacted by management and weather. PD, PI, and Green Ring are discussed and illustrated. The third part looks at grain filling and maturation stage of development during which the third and final yield component, weight of each grain is determined. Factors impacting grain quality are also discussed.

All three parts of the narrated CD takes 1 hour and 37 minutes of playing time and uses 522 Mbytes of space. However, each part can be viewed separately, requiring from 25 to 42 minutes. To play the CD requires Microsoft PowerPoint software and is only PC compatible. CD's are available at no cost at the Beaumont Research and Extension Center and from your County Agricultural Extension Agent.

The program is designed to provide the farmer with a better understanding of how yield and quality are impacted by management, weather, and biotic stresses at each stage of crop development. It is the intent to help the farmer make even better and more timely production management decisions thereby making production even more competitive. This program was funded by the Texas Rice Research Foundation.

Panicle Initiation, Green Ring and Panicle Differentiation

RICE GROWER MAIN CROP YIELD AND QUALITY RESULTS
OF PREDOMINANT VARIETIES PRODUCED IN TEXAS

2001						
Variety	Number of Fields Reported	Reported Acres	Yield lbs./ Acre	Milling Yield %H	Milling Yield %T	Grade
Cocodrie	234	25,321	6,548	61	70	2
Cypress	60	6,520	5,706	63	70	2
Gulfmont	8	1,088	5,367	52	67	3
Jefferson	9	859	5,228	56	68	2
Lemont	15	1,418	4,847	56	68	2
CL121/141	7	622	6,442	65	71	2
CFX 18	22	971	7,035	66	71	2
Saber	5	227	6,856	64	70	2
Wells	4	239	6,446	57	72	2
Total:	364	37,265				
Weighted Av:			6,283	61.0	69.8	2.0

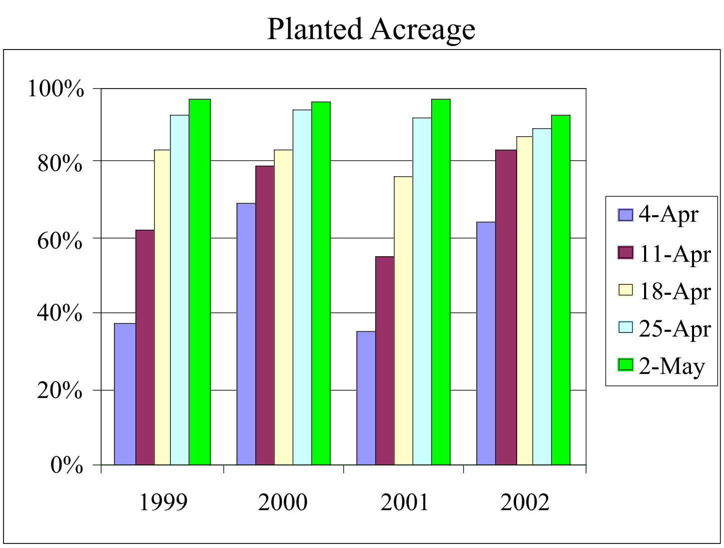
Compiled by Cynthia Tribble, Robin Clements, and Jim Stansel, TAES-Beaumont.
Data are compiled from Texas rice belt grower reports, rice dryers and marketing offices.
All yields are adjusted to 12 percent moisture.

Variety Performance

Farmers need accurate variety yield and quality field performance data from producers in their region and across the state. Detailed yield and quality information is gathered on up to nine varieties, grown on about 40,000 acres in all regions of the state. This information is published each year in the Rice Production Guidelines.

Acreage, Production and Carryover Stocks

Accurate and timely estimates of planted rice acres, production and carryover stocks have been difficult for farmers to find. Inaccurate estimates can and have had negative impacts on rice markets. With funding by the Texas Rice Research Foundation we conduct extensive surveys to determine rice acres by variety for each rice county in Texas. We also accumulate and publish weekly reports by county on crop development and identify crop problems when they occur. Such data is useful in determining crop sensitivity to unfavorable weather, disease, and insect conditions so appropriate alerts and management recommendations can be made.



Crop Development Projections

To help farmers and crop advisors plan for management inputs, crop development projections on participating farmer fields are made using a computerized program. The program called DD50 uses accumulative heat units to predict important stages of development and their associated management inputs. The program uses daily maximum and minimum temperatures above 50˚F starting at seedling emergence until the date projections are made. The program then uses average temperature data for future days to predict crop development. DD50 stands for Degree Days above 50˚F.

These crop development projections on a field by field basis, help to improve planning and execution of field scouting for timely crop inputs. This program does not take the place of field scouting but it can help users to be more efficient in crop management.

For more information contact Dr. Jim Stansel at 409-752-2741 ext. 2258 j-stansel@tamu.edu.