Texas Rice

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Red Rice: Classification, Containment and Control

What exactly is the noxious weed known as "red rice"? Scientists used to think that all red rice found in the United States could be classified as *Oryza sativa* subspecies *indica.* That was before Dr. William Park and his team of graduate students, along with Dr. Mike Chandler, determined that there is more to this weed than meets the eye.

Phenotypic differences led the team of researchers to test for genotypic differences as well, in other words, studying which genes are responsible for which plant traits. Says Park, "Simple observation revealed that the plant types collected from commercial fields throughout the rice growing states were vastly different. Some plants are short rather than tall, others are awnless, and some red rice even has the straw colored hull typical of commercial varieties. With these phenotypic differences, it seemed likely we were dealing with more than one ecotype." Using a DNA test referred to as 'simple sequence length polymorphisim'(SSLP), the Texas A&M scientists learned that besides the subspecies *indica*, there is also *Oryza sativa* subspecies *japonica*, and two completely different species classified as *Oryza rufipogon* and *Oryza nivara* (Vaughn et al. 2001).

Red rice infested plots of CL141. The plot on the right was treated with Newpath and the plot on the left was not. Notice the taller, later maturing red rice plants in the untreated plot.

According to Park, "These findings are especially important, since previous agronomic and physiological studies may not reflect the traits of all the red rice that is out there."

A bane to rice farmers across the Texas rice belt, the problem is especially prevalent on the east side of Houston. This is possibly due to the fact that rice has been produced in the Jefferson/Chambers/Liberty counties longer than anywhere else in the state. Once brought in to Texas, red rice has spread by way of combines, tractors, birds and seed rice.

Those outside of farming circles may be wondering why red rice is such a problem. As mentioned before, this noxious weed is in the same genus as cultivated rice varieties. This means that chemicals capable of killing red rice will also kill the planted crop. Aggravating the situation further, red rice is particularly aggressive and can rob the crop of valuable nutrients and space, greatly reducing yields. And in the marketplace farmers are paid for their grain based on how it is graded. Lots that are contaminated with a high percentage of red rice kernels bring a much lower price for the producers.

So what is the solution? Unfortunately for growers there is no 'silver bullet' that will completely eliminate red rice, but we do have a growing arsenal of weapons. Until recently, cultural controls were the only tools growers had to manage this noxious weed. In infested fields some of these controls included crop rotations, fallow pastures or grazing, and overwintering the rice stubble rather than tilling the red rice seeds below the soil surface. This last is very important as we now know that some red rice, if buried with sufficient moisture, can remain dormant in the ground for 15 years or longer. Leaving it on the surface over winter increases the chances that it will be eaten by water fowl, the seeds will rot in the damp cool weather, or the stragglers will germinate and be tilled down by spring cultiva-

continued on page10

From the Editor...

For many rice producers, red rice ranks up there with the Farm Bill and foreign import restrictions as their greatest challenge. What is so unique about red rice, that makes its management in commercial rice so very different from management of other weeds in rice or the management of other weeds in other crops, is its genetics. In a nutshell, red rice and commercial rice are, practically speaking, the same species.

All of us have seen the classical "bull-red" ecotype, with hairy spikelets and hulls, red bran, easily shattering panicles, dormant seed, late maturity, and tall stature. But, fewer are aware that red rice ecotypes can vary from the easily distinguishable "bull-red" ecotypes to ecotypes whose grain and growth characteristics blend in with many of our commercial varieties. Why are there so many types of red rice and why are some of the red rice ecotypes so similar to commercial rice varieties?

Because red rice and commercial rice are so closely related, they can cross and produce hybrids that have characteristics of both plants. The extreme variation in red rice ecotypes is a result of natural crosses that have occurred in thousands of rice fields across the U.S. throughout the years. A small percent of pollen from red rice plants fertilize a few of the flowers on adjacent commercial rice plants, and a small percent of pollen from commercial varieties fertilize a few of the flowers on adjacent red rice plants. Over time, some of the naturally produced crosses have crossed with nearby red rice plants, some in turn have crossed with nearby commercial rice plants. After a hundred or so years of rice production, this has resulted in a wide range of red rice ecotypes. Texas A&M University scientists have identified over 200 distinct red rice ecotypes. Were the researchers able to sample each and every rice field in Texas, the actual number of red rice ecotypes would likely be several times higher.

The major difference between commercial rice and any single red rice ecotype can be explained by a handfull or two of genes that regulate the previously mentioned plant characteristics. In other words, the difference between red rice and a commercial rice variety is not that much greater than the difference between two commercial US rice varieties. This genetics similarity is the crux of the problem with using herbicides to manage red rice in commercial rice. If an herbicide were applied to control red rice, it would also kill the commercial rice.

Through the years, rice producers have suppressed red rice using a range of management approaches. These include rice-fallow-fallow rotation, rotations with other crops, "mudding" fields in the fall or spring to kill dormant seeds, and by not planting on land that historically has had a severe red rice problem. The pervasive nature of red rice has had a tremendous influence on the evolution of rice production practices in the US. If it were not for red rice, it is quite conceivable that a much greater percentage of rice would be grown in a tighter rotation. This change alone would tremendously change the economics of rice land use and rice production in Texas.

The management of red rice is on the verge of entering a new era. This revolutionary change can be traced to the discovery of a few herbicide tolerant rice plants. Researchers at the Louisiana State University were able to successfully cross these abnormal rice plants with commercial varieties, creating new varieties that can be treated with 'imi' or Newpath herbicide without killing the rice. In the past, a rice producer risked killing his commercial rice if he attempted to treat the red rice. The herbicide tolerant rice will now allow red rice control without harming the commercial rice.

This new tool in our weed management arsenal has tremendous potential benefit to the rice industry. But as with any new technology, herbicide tolerant rice poses some unique challenges. Because red rice and

continued on back page

Inside This Issue

Cover Story

Red Rice: Classification, Containment and Control

Extension in the News: Arlen Klosterboer 3
Grower Profile: Bill Kondo 5
Researcher in theNews: Garry McCauley 7
Industry Update 9
Highlighting Research and Funding 14
State, National and International News 15
Rice Crop Update 16

Texas Cooperative Extension in the News...

Arlen Klosterboer - Professor and Extension Agronomist

When Arlen was a kid he wanted to be a farmer like his dad, but Henry had other plans for his oldest son...

Arlen grew up on a 320-acre traditional family farm in Rock Rapids, Iowa. Everyone in the family contributed to the farming enterprise, which included cattle, hogs and laying hens in addition to cash crops such as soybeans, corn, oats and flax. They had some permanent pasture for the cow/calf operation, but otherwise all the crops were rotated.

When he finished high school Arlen went off to college at South Dakota State University (SDSU) in Brookings. Only 90 miles from the farm, he returned home every weekend and during the summer to work on the farm. His long time sweetheart, Arlene, who also grew up in Rock Rapids, was in Brookings at the same time working as a secretary in the Animal Science department at SDSU. They knew it was meant to be, so Arlen and Arlene were married just after his junior year in college.

After receiving his BS in Agronomy, Arlen went on to Clemson University in South Carolina for his MS in Agronomy, but with emphasis on soil fertility and experimental statistics. Knowing he would go on at some point to get his doctorate, Arlen pushed hard and completed many of those credits while still working on his Masters degree.

From Clemson he went to Weslaco in South Texas to work for The Ansul Company at their research farm. There he worked with carbon-based arsenical herbicides such as MSMA, DSMA and cacodylic acid. He worked three years at the Weslaco farm and then had the opportunity to finish his PhD through sponsorship by The Ansul Company.

Arlen chose the University of Minnesota for his PhD, as they had an excellent program in Agronomy with emphasis on weed science. Since he had completed some of the work previously at Clemson, Arlen was able to finish his doctorate in less than two years. He continued to work for Ansul for a couple of months and then took a position with Texas A&I University at Kingsville as a field researcher. This job actually brought him back to Weslaco, as his work was at the A&I Citrus Center in the valley. There he worked on weed control in citrus orchards for the next 3 years, when fate played a hand.

Arlen's wife Arlene was the office manager for Jim Selmen, District Extension Director in Weslaco. She heard about a position open in Beaumont and told Arlen. He went to talk with Selmen, and was convinced that his future was with Extension. In 1974 the couple moved to Beaumont and Arlen began his career in rice and soybeans.

After 23 years in Beaumont, Arlen was transferred to College Station, although his program remained unchanged. When asked if this was a hardship for Arlene to move after so many years Arlen said, "We both missed all the friends we made, but are now very happy in College Station. And Arlene had already retired from her career in office management, so we made the transition smoothly."

Arlen has replicated trials at the Beaumont Center, and conducts on-farm trials throughout the rice belt. Up until this year, Arlen's right-hand in Beaumont was K.D. Austin. The two had a great working relationship and spoke highly of one another whenever the opportunity arose. Starting in April, Cullen Minter began working part-time in weed science, and will endeavor to fill the void left with K.D.'s retirement. Another great source of support for Arlen over the years was Ann Pfleider, who retired after 18 years as his secretary and office support staff. She prepared reports, kept up with scheduling and appointments, and helped Arlen juggle the many responsibilities of an Extension Specialist. Looking back Arlen said, "Ann was more than just dedicated, her objective was to make my program the best it could be. I could not have been near as successful without her support."

One of the projects Arlen is involved in this year is the CLEARFIELD/Newpath verification trials. Bill

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Extension continued...

Kondo is one of the growers participating in this program. The idea is to verify the recommendations made by Texas A&M researchers for this newly emerging technology. Bill will provide feedback to Arlen about the performance of the rice and the effectiveness of the weed control program.

More at home in the field than the office, this is Arlen at the Beaumont Center 2001 Field Day.

Around 90% of the funding for Arlen's weed science program comes from agri-chemical companies. According to Arlen, his main purpose for conducting herbicide trials is to make scientifically-based recommendations to the growers, and provide data to the chemical companies for product registration. Said Arlen, " The chemical companies need the university to generate data and review products for efficacy on specific crops, while in turn the university looks to the chemical companies for financial support."

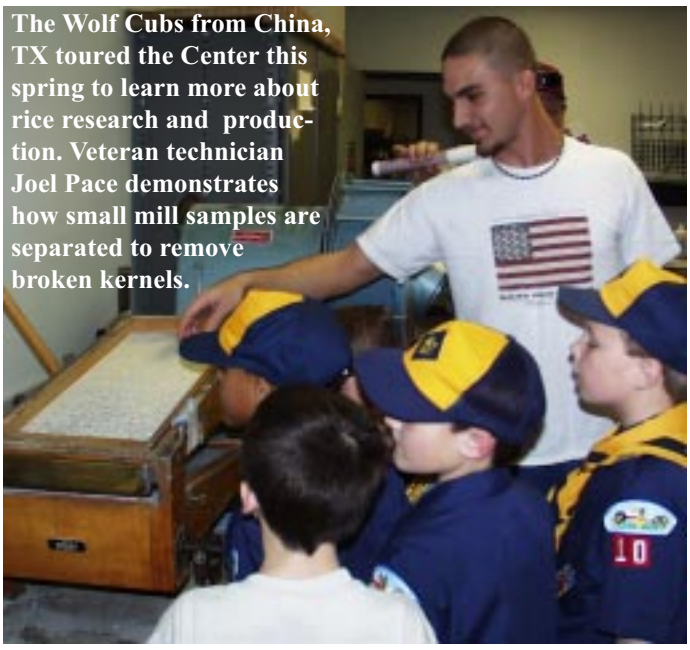
In addition to rice trials, Arlen also has on-farm soybean trials in many of the Westside counties including Wharton, Calhoun, Victoria, Jackson, Matagorda and Ft. Bend. According to Arlen, the farm trials are the backbone of his program. Although there is no immediate monetary incentive for the farmers, they consistently sign up to participate in his weed control tests. Said Arlen, "I really appreciate all the farmer cooperation over the years. I could not have done it without them!" He told me he would like to sit down and write everyone a thank you, but hasn't for fear of leaving somebody out. He is truly dedicated to the growers, and wants them to be successful. Maybe this attitude comes from his farming roots in Iowa, when he only wanted to be a farmer like his dad.

A long-standing member of the Southern Weed Science Society and the Weed Science Society of America, Arlen was honored as Rice Researcher of the Year in 2001 at the National Conservation Tillage Cotton and Rice Conference held in Houston. Said John LaRose, Chairman of the Conservation Conference, "We appreciate the work Dr. Klosterboer has done to promote the conservation cause through his research efforts, and his dedication to preserving the environment."

Arlen and Arlene have two sons, both of whom graduated from Texas A&M. David is an attorney for State Farm and lives in Bloomington, Ill. with his wife Susan and their two children, Michael and Katie. The younger son Travis is a sales rep for Aventis and lives in Humble with his wife Janell and their three children, Ethan, Bryce and Heidi. Heidi is the newest grandchild, just born in February!

Arlen says he enjoys hunting, mostly pheasants, but also doves, ducks and geese,which works out well since he spends a fair amount of time in rice fields. He also likes to fish and play golf. When I asked what his handicap was Arlen said, "Well….I've been playing golf once a year for nearly 30 years, but I just got serious about the game in the past two years." I guess we can interpret that as *If you ask me no questions, I'll tell you no lies!* *

Outreach & Education from the Beaumont Center



The Wolf Cubs from China, TX toured the Center this spring to learn more about rice research and production. Veteran technician Joel Pace demonstrates how small mill samples are separated to remove broken kernels.

Grower Profile...

Bill Kondo: Continuing the Tradition from Japan to America

Sakichi Kondo came to America with his parents in 1912 when he was 4 years old. The family settled in Orange County, along with many other Japanese immigrants, and began farming rice. Adjusting to life in the U.S. was difficult at first, but the family managed well, and soon became established in the farming industry.

Years later, Sakichi married and had four children of his own, the youngest being Bill. Bill is the only one of his siblings that continued the farming tradition started by his grandfather, although he has relatives in Japan that still grow rice today. After high school Bill wanted to go straight into farming, but his father thought he should attend college, get a degree, and then decide if he wanted to farm.

So Bill enrolled at Lamar University and got his degree in Chemical Engineering. During this time he met Donna Fontenot, who was also attending Lamar. They dated through college and were married after Bill graduated in 1978. After graduation, Bill took a job in Bay City working for a chemical company, but in 1979 his dad had a heart attack so Bill and Donna moved back home to help out.

In 1980 the couple began farming on their own, and the next year Donna went back to Lamar and finished her degree in Elementary Education. In 1982 their first child was born, but sadly, that was the same year Bill lost his father. For over 20 years now Bill has farmed the land his father did, and in 1994 he was finally able to purchase the 450 acres on LaBelle Road that has provided for his family for three generations. Bill continues to lease another 450 acres off I-10 south of Beaumont, and 350 acres on Hwy 365 near Fannett.

As for his rotation, Bill has found that one year in rice and two years fallow works best, although this year he will work 130 acres of milo into the rotation. He has tried other alternative crops in the past such as soybeans, but the climate in Southeast Texas does not produce dependable yields for beans. Says Bill, "With soybeans you can count on bringing in a crop only 1 year out of 5, not very good odds." And while farmers are gamblers by nature, they certainly know when to hold and when to fold.

Bill is a third generation U.S. rice farmer, but his family farmed rice in Japan for many generations before coming to America. Bill has relatives in Japan who still farm rice today.

This year Bill planted 178 acres of CL121, 80 acres of Cypress and 60 acres of Bengal. He likes Bengal because it grows and mills well. It's also a little cheaper to produce as it requires less fertilizer and is quite vigorous. For fertilizer, Bill uses urea most years because it is more economical. He also applies phosphate and potash pre-plant. Planting is staggered from the last week of March through the second week of April so that all of his fields do not come in at once. He does this to avoid the extra expense of bringing in help to harvest. This allows bill to economize on labor, while at the same time making sure he doesn't overload his drying facilities and storage bins. He does have one year-round employee, Ronnie Walker, who Bill says is good reliable help. The two have a history together, as Ronnie's dad worked for Bill's dad for over 20 years.

With Ronnie there to help with the daily routine, Bill does his own scouting, but has participated in the Extension IPM program in the past. He believes it is well worth the money for those who don't have the time or experience to do their own scouting. Bill emphasized, "If I get to the point where I have too much acreage to handle on my own, I will definitely sign up for the IPM scouting program again. But with production costs up, and the price of rice down, we have to squeeze out every dollar we can."

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Grower continued...

Saving money and increasing profits becomes even more difficult with a red rice problem. Bill has not ratooned in the past because the red rice problem is so bad on his farm, even following the strict 'one year in, two years out' rotation. Other cultural practices have helped some, like keeping the soil moist so it doesn't form large cracks where the air and light can get down to dormant seeds. But more drastic measures were called for, and when the CLEARFIELD technology became available, Bill decided it was worth the extra investment to try and clean up his farm. He attended the training meeting in Winnie last year, where growers learned about the stewardship program required to maintain this technology. In signing the 'grower agreement' with Horizon and BASF, he consented to following the guidelines they provided designed to prevent outcrossing of the red rice with conventional varieties. Says Bill, "The CLEARFIELD /Newpath system costs around $25 per acre more than conventional, mostly due to the higher cost of the seed. It will be worth it, though, if we can get the red rice under control." For the broadleaf weeds that Newpath doesn't control, Bill uses the herbicide Grandstand, and finds this combination keeps the fields relatively clean.

In addition to farming, Bill also does contract laser leveling for growers in his area. He purchased the equipment in the late '80s for use on his own land, and found that the extra income through contract work really helped out. He charges by the hour, and says it costs the farmers about $65 an acre to get the land leveled. But once done, you only have to go back about every 5 years to touch it up. Bill believes it is well worth the money, as it saves water and labor in maintaining consistent flood levels. His water comes from LNVA and runs $50 - $60 per acre, compared to the Devers canal system, which can go as high as $80. Again, any way that a farmer can reduce production costs over the long term is worth the investment.

Speaking of reducing production costs, this is an area where Bill believes researchers can do *even* more to help the farmers. Bill's opinion is that "breeding programs have achieved enough in the way of yields," and that, "what we need now is lower production costs." Granted, the most recent releases such as Saber have achieved higher levels of disease resistance, and their use may reduce the need for at least some of the costly fungicide applications. But Bill believes fertilizer costs are still the biggest obstacle in increasing grower profits. Bill asked, "Can't we get a variety like Jasmine that competes vigorously with weeds, requires half the nitrogen of conventional varieties, but without the aroma and pubescence?" He suggested that maybe breeding programs should be making selections in fields where 100 units/acre of nitrogen is the standard, rather than 200. This might result in varieties with good disease resistance, adequate yield, and much lower fertilizer requirements. Bill added, "We won't find it if we're not looking for it."

With all the challenges facing farmers, Bill will advise his children as his father did, "Get your degree first, then decide what you want to do with your life". Bill and Donna have 3 children, Allison who is 19, Kyle is 17 and the youngest, Alan is 13. When I asked Donna how it has been for her as the wife of a farmer she replied, "It can be a risky business, but I've always had faith in Bill to make the right decisions. Everything he does is very carefully thought out. When he decided to leave his career in chemical engineering to come back home and farm with his dad, I knew that he had considered all the pros and cons." Donna emphasized that, in spite of the hard times the industry has seen lately, she is very proud of her husband and happy with the life they have chosen. *

Farmer Resources

The Rice Growth and Development CD produced by Dr. Jim Stansel and funded by the Texas Rice Research Foundation is available free to all producers. It provides valuable information on rice physiology, fertility management, disease and insect control. Call Tammy Tindel at 409-752-2741 ext. 2227 to get your copy.

If you have not received the *2002 Rice Production Guidelines* call your county Extension agent for a free copy.

Extension agents also have information about the DD50 Program for rice producers. You can either provide your agent with the required information to get your advisory read-out, or you can request a copy of the program and run the report on your home computer.

Researcher in the News...

Dr. Garry McCauley in Eagle Lake

Stationed in the heart of the rice belt, strategically positioned to best serve Texas growers.

Garry with his technician Kyle Cranek. Kyle has a BS in Agronomy/Kinesiology and comes from a rice growing family.

Garry McCauley grew up in the small town of Healdton, OK, the youngest of three children. With two older sisters, Garry admits to being a bit henpecked as a youngster, but remembers fondly the typical little brother/older sister relationship he shared with his siblings. Garry's dad worked in the oil fields and had a mid-sized cattle operation.

In addition to the market herd of cows, mostly Hereford crosses, Garry was responsible for milking the family's Jersey cow. When I asked him if that was a pleasant memory Garry replied, "It can be pretty cold at 4:00 am in Southern Oklahoma!" Enough said.

The school in Healdton was very small, and Garry remembers having one-on-one interactions with his teachers. He was very interested in math and science, and excelled in both areas. His goal was to attend college and become a veterinarian, so he worked hard in his studies. Just after graduating Garry married his high school sweetheart, Ruth Putnam, before starting college at Murry State Junior College in Tishomingo, OK.

After Junior College, Garry transferred to Oklahoma State University and applied for vet school. Unfortunately, only 40 students were brought in each year and Garry made the first alternate. As the realization soaked in that he would not be able to pursue his career of choice, Garry was devastated. He recalls, "I wasn't sure where to go from there. I changed majors three times over the next year." During that time Garry was working for Dr. John F. Stone in the Agronomy Department at OSU. Dr. Stone was an excellent mentor and encouraged Garry to pursue studies in the field of Agronomy. Garry received his BS in 1968, his MS in 1972, and his doctorate in Soil Science in 1975 with Dr. Stone as his major advisor.

After college, Garry received two offers of employment, one from South Dakota (too cold!) and the other from the Texas A&M Research Center in Beaumont. In March of '75, Garry McCauley came to work at the Beaumont Center as an Assistant Professor and Project Leader in Water Management. At that time water was cheap and abundant, and McCauley was the only scientist in the U.S. working on water management and water quality in rice. When asked what was the greatest challenge on coming to Beaumont, McCauley replied, "Well, the first order of business was learning what a rice plant looked like, as all my experience was in corn, sorghum and peanuts." In the early days he relied heavily on senior faculty for help and guidance, namely Dr. Fred Turner. "Turner was great," McCauley recalls, "he really took the time to help me get oriented in my new position and get the project off to a good start."

Also helpful were rice producers, and members of the TRIA board who provided early financial support. Says McCauley, "I spent a lot of time talking with the growers and learning about rice production, figuring out exactly what their needs were." The Extension agents came through as well, and really helped the young scientist connect with the rice industry.

One of the most notable studies McCauley conducted early in his career at Beaumont was the rice water quality project. Station and on-farm trials were set up that carefully monitored the chemicals and fertilizer applied to the fields, and then evaluated the compounds present in the run-off water. After extensive testing the results indicated that if growers used best management practices, such as holding water long

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enough to get the full benefit of the chemical used, and followed herbicide and pesticide label directions carefully, then the water running out of the field was often cleaner than the water that went in. Emphasizing the importance of good water management, McCauley was able to help producers preserve the fragile wetland habitat that commonly surrounds rice fields in Texas.

When TAES weed scientist Dr. Ford Eastin left the Beaumont Center in 1989, McCauley began supervising that project in addition to water management. This was when his first research in red rice control got started. In 1995, 20 years after coming to Beaumont, Garry was asked to relocate his project to the Eagle Lake Station, as there had been no scientist in residence at the Westside location since Dr. Jim Stansel had returned to Beaumont to take the job as Resident Director.

Coleen Meitzen has been with the Eagle Lake Experiment Station since 1999. As the only office support, she stays busy with various tasks including bookkeeping, data entry, and compiling reports.

After McCauley moved to Eagle Lake, his research focused on weed management and agronomic production. Without the technical support necessary to run the sophisticated equipment used in evaluating water samples, the water quality work had to be put on hold. He hopes to work with scientists in College Station on water quality studies again in the future.

Some of the work conducted since moving to Eagle Lake includes row spacing, seeding rates, weed management and ratoon potential (looking at factors like fertility management, cutting height, and fungicide use). McCauley has research plots at the Westside locations, in Beaumont, and most notably in producer fields across the Texas rice belt.

Over the past few years the seeding rate studies have revealed some potentially money-saving information for producers. There was a time when production costs were relatively low, and the price of rice was fairly good. When this was the case, too high of a seeding rate was not a big issue. Things are different now, and farmers must take advantage of every opportunity to reduce production costs, including what they spend on seed rice. This is especially true with the hybrids, which may go for as much as $150 per cwt, and the new CLEARFIELD lines which can top $70 per cwt. According to McCauley, what growers should be looking at is plants per square foot, not pounds per acre. If a farmer gets 15 – 20 plants per square foot, potential yield will be near optimum. The reason for this is simply the growth habit of the rice plant. When plants are crowded together, each one may produce only 2 to 4 tillers. When the plants are spaced out more, they tiller more and produce larger panicles, thus maintaining the yield potential. Another interesting finding from this work is that sandier soils require a higher seeding rate to get the same number of plants per square foot. McCauley will continue his seeding rate studies on different soils to develop better recommendations for producers, on both the east and the west side.

About 70% of Dr. McCauley's total research budget comes from producer check-off funds, via the Texas Rice Research Foundation. His weed management studies are funded entirely by TRRF, and done in cooperation with Dr. Mike Chandler in College Station. Together they look at weed management 'systems' to determine how growers can pick from all the chemicals available to get the best combination for optimum control in their specific situation. In addition, rates for chemicals such as Command vary when you move

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from the heavy soils of Jefferson County to the sandier soils west of Houston. Currently the scientists have two graduate students funded by Rice Belt Warehouse who conduct research on replicated plot studies in Eagle Lake and Beaumont, in addition to the on-farm sites located on producer fields.

McCauley and Chandler are also looking closely at the CLEARFIELD system in order to make the best recommendations to growers for this newly emerging technology. Since Newpath does not control broadleaf weeds such as jointvetch and hemp sesbania, initial studies are evaluating the combination of Newpath, Command and Facet – looking at rates, timings and tank mix application of the herbicides.

Another important area of research for McCauley has been evaluating ratoon potential with regard to fertilizer management and cutting height of the main crop. Their research suggests that, contrary to popular belief, the late season application of phosphorus does nothing to increase ratoon yield. As for cutting height, a lower setting on the combine appears to increase ratoon yield, assuming all other factors are equal. Says McCauley, "When you cut the first crop lower down, the ratoon tillers get off to a better start. And reducing the mass of stubble also decreases the chance of disease in the ratoon plants." When I suggested that this might slow down first crop harvest by cutting lower, McCauley pointed to the Combine Tests conducted in 2000-2001 saying, "The farmers should be reducing their combine speed anyway to minimize grain loss out of the back." And what about the stripper headers? These are obviously not for those intending to ratoon, but definitely speed up harvest. According to McCauley they are also easier on the grain, causing less broken and shattered kernels.

Garry and his wife Ruth have a home in El Campo and both enjoy reading, music, bird watching and gourmet cooking. Ruth is an 8th grade science teacher and a member of the district site base planning committee. She is an elder in the First Presbyterian Church and very active in the church women's group. Garry is a trustee for the First Presbyterian Church, the adult Sunday school teacher, member and director of the El Campo Rotary Club, and enjoys volunteer reading for the El Campo first graders. They have two grown daughters, the youngest JoAnn, lives in Houston and is the district manager for a retail clothing chain. The oldest, Paula, is married to a marine and currently lives in New York. They have two boys, ages 12 and 9, and a girl who just turned 4.

I asked Garry if it is difficult having the grandchildren so far away. He said of course it is, but the boys fly down each summer to stay a week with their grandparents and they always look forward to the visit. Says Garry, "It was really hard when they lived in Japan for 5 years, and we saw them only a couple of times during that whole period." I guess that makes New York seem a whole lot closer to home. *

Industry Update:

a forum for rice industry organizations to share information with producers.

TRIA has finished all seed treatments, field preparation and, due to the favorable weather conditions, all foundation seed has been planted. Varieties planted this year include Cypress, Cocodrie and Sierra, which is a new aromatic variety released by Dr. Anna McClung in 2001.

This year TRIA has a total of 150 acres in production. On March 13th TRIA planted a 43-acre joint study with Dr. Fred Turner on the effects of crawfish production on soil structure and fertility. March 14th, 69 acres of Saber were planted for a zinc research study.

Contracted acreage include 23 acres of Delmati (a Basmati type), 9 acres of the specialty rice Della and 12.5 acres of organically grown Saber. Fertilizer for the organic acreage was donated by Nature Safe, a subsidiary of Griffin Industries. Saber was chosen for this study because of its favorable disease resistance and milling quality.

On April 4th there was a meeting between rice industry representatives and the Texas Agricultural Experiment Station to address the issue of future licensing of new rice cultivars. Representing TRIA was Robert Bauer, Andy Anderson, Dick Ottis and Jim Stansel. TRRF was represented by Cliff Mock, Layton Raun and Bill Dishman. TAES representatives included Dr. Charles Scifres, Dr. Frank Gilstrap and Dr. Ted Wilson. Also attending was Dr. Chuck Onstad with USDA/ARS. *

Red Rice continued...

tion. Research by Noldin, Chandler and McCauley has shown that leaving stubble and grain to overwinter on the soil surface will break dormancy and the seed will germinate (Noldin et al. 1995). And of course, producers are encouraged to buy certified or registered rice seed to reduce the chances of bringing in red rice by way of seed stock.

Scientists have been working to provide producers with additional forms of control. A study conducted by Dr. Richard Dunand at the Louisiana State University (LSU) Rice Research Station in Crowley showed that using the plant growth regulator maleic hydrazide in combination with early maturing conventional rice varieties had the potential to provide good control of red rice. In the experiments, early maturing rice varieties were allowed to reach the milk stage of development before the application of maleic hydrazide. At this stage, most red rice was just beginning to flower. That made it susceptible to the action of the plant growth regulator, which inhibits cell division, thereby arresting seed development. The drawback to this type of control is twofold. First, timing the application is critical. If applied too early, the rice crop will be injured. If applied too late, the red rice will not be effectively controlled. An additional drawback is that relying on this form of control assumes there are no early maturing red rice biotypes in the area, which we now know may not necessarily be true.

In 1993, an important discovery was made by Dr. Tim Croughan of the LSU Rice Station, which may prove to be the best hope yet for controlling red rice. After 12 years of research and thousands of dead ends, Dr. Croughan produced a mutant strain derived from an old variety called AS3510 that was tolerant to

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A Historical Perspective

When Tim Croughan started his work in 1981, he had no idea the winding road that would lead to his discovery of an 'imi' tolerant rice. And actually, he started out screening with other contact herbicides, as the imi chemistry had not yet been developed.

At first Croughan tried cellular level selection in petri dishes, whereby meristem cells were collected from rice plants, placed in a growing medium where they began to divide, then exposed to a contact herbicide. This was a practiced technique, and had already led to the development of many cultivars. In this case, though, no resistance was found. Then he tried mutating rice seeds, using radiation and chemicals. The seeds were germinated and grown to maturity, and then screened for resistance using the contact herbicides. After thousands of attempts, nothing was found.

It was around this time that a new family of chemical herbicides came to the market, the imidazolinones, which are 'single site of action' herbicides. Croughan decided to use the imi herbicides for his screening process, as it increased the likelihood of finding a plant with a *small* genetic change that would still confer herbicide resistance. Croughan went back to the lab and began growing tissue cultures, both somaculture (using meristem tissue) and antherculture. From this tissue, callus cultures were produced and yielded over 25,000 plants per year. These were grown out in the greenhouse, and the progeny seed was planted in the field before the imi herbicide was applied. No resistance was found.

Nearly 10 years had passed since Croughan began looking for an herbicide tolerant rice, and it was beginning to look like the project would not succeed. Going back to a methodology he had tried early on, Croughan began soaking seeds in a chemical called ethyl-methane sulfonate (EMS) to induce the mutations. EMS has been used for decades by plant breeders to cause point mutations, also known as base-pair mutations, in an effort to develop improved varieties. In fact, over 1000 varieties of grain and vegetable crops are available today as a direct result of this methodology.

Croughan began with 10 varieties of rice, including the old release Alexandria Seed 3510 (known as AS3510). This line was included because it was a very early maturing variety, and if the mutation was successful, had the potential to produce a variety resistant to the imi herbicide *and* flower well ahead of any red rice that may be present in the field. In 1993, Croughan found a single plant from the mutated AS3510 seed that could survive elevated levels of the imi herbicide Newpath. The plant was grown out, its progeny planted in the field and then sprayed with Newpath. All the plants survived. Dr. Croughan had finally succeeded and the rest, as they say, is history. *

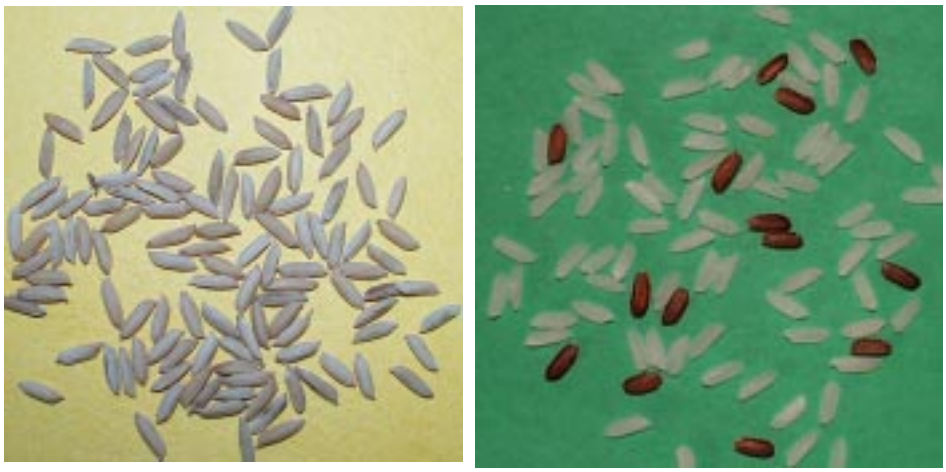
imazethapyr, the active ingredient in the herbicide Newpath™. BASF (at that time American Cyanamid) was manufacturing the 'imi' herbicide and began working with Dr. Croughan on the development of the CLEARFIELD system through a licensing agreement with LSU. The first step was to incorporate tolerance into varieties having acceptable agronomic quality. Croughan took the tolerant mutant strain (designated as 93AS3510) and began crossing and backcrossing it with conventional varieties.

After the crosses and backcrosses were made, Croughan planted the resulting seed in the field and rice breeders had an opportunity to pick out material they felt showed promise for development into new rice varieties. LSU rice breeder Dr. Steve Linscombe made selections from crosses to Cocodrie and Maybelle, which eventually led to the release of CL121 and CL141, respectively. CL161, which should be commercially available next year, was developed using the same technique that was used to cause the mutation in the AS3510, but instead he used the variety Cypress as a starting point. This time he found improved imazethapyr tolerance in a line that already had desirable agronomic traits, so no crossing was necessary. Unlike CL121 and CL141, which are imi tolerant varieties and can suffer injury from imi herbicides if applied at too high a rate, at the wrong stage of crop development or under cool weather conditions, CL161 appears to be imi resistant showing no damage under any of these circumstances.

In a phone interview with Dr. Croughan, he shared his optimism for the potential of the upcoming release. He said, "Growers will find that CL161 has 5 to 10 times the resistance of the earlier lines. That means the plants will not be set back at all, regardless of the weather conditions after the herbicide is applied." Currently, Croughan's lab is making over 1000 crosses a year, to incorporate the CL161 imi herbicide resistant trait into even better varieties.

To avoid the expense of starting a seed company from scratch and to concentrate on the role of technology development, BASF signed an agreement with Horizon Ag, LLC of Memphis, TN to produce, market and track the patented CLEARFIELD lines. Due to the proprietary nature of the CLEARFIELD seed, Horizon developed the Orygen Seed Marketing System ™ to insure that the CLEARFIELD technology would be preserved.

According to Michael Prudhomme, Regional Manager for Horizon Ag, "Protecting the CLEARFIELD technology requires two things, bringing quality red rice free seed to the marketplace in a way that insures compliance with specific production and sales guidelines, and educating the producers about the critical role of stewardship and its long-term impact." Horizon owns and manages foundation and registered seed production. The registered seed is then sold to 22 contracted seed companies who produce certified seed that is sold either to licensed seed retailers or directly to the farmers. Horizon tracks all sales of CLEARFIELD seed, and BASF tracks all sales of Newpath. When seed and herbicide sales data is combined, there is strict accountability and assurance that producers are following the stewardship guidelines.



On the left is a red rice ecotype with straw colored hulls, making it very hard to distinguish in the field. On the right is the grain with the hull removed, showing the red bran.

What are these stewardship guidelines and how are they enforced? First, the grower must attend a training program hosted by BASF where they learn about the agronomic recommendations and the stewardship requirements necessary to preserve the CLEARFIELD technology. To grow CLEARFIELD rice farmers must sign a 'grower agreement' that outlines the following

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requirements and recommendations:

BASF requires the following:

1. Farmers must purchase certified seed for planting a single commercial crop (ie. no brown bagging or seed saving).
2. If the grower uses an imidazolinone herbicide, it must be Newpath.

BASF recommends the following:

3. Avoid continuous rotation of CLEARFIELD varieties, and if possible plant another crop in between, such as soybeans.
4. Use herbicides with alternative modes of action in subsequent crops (herbicides in a different chemical class than imidazolinone) to prevent build-up of resistant weed populations.
5. Plant CLEARFIELD rice early enough to avoid synchronous pollination and avoid outcrossing potential (red rice *usually* matures later than commercial varieties).
6. Rogue red rice escapes.
7. Roll and flood CLEARFIELD fields after harvest to promote germination of red rice seed.
8. If red rice is present at harvest, do not ratoon as this will increase the chances of synchronous pollination and therefore outcrossing.

According to Matt Plitt, Rice Market Manager for BASF, the stewardship recommendations are in place to protect the grower. Says Plitt, "We need the producers to realize that it's in their best interest, and that of their neighbors, to follow the guidelines carefully in order to protect this valuable technology."

Researchers emphasize that failure to adhere to these rules will certainty reduce the field life of the imi tolerant and imi resistant varieties. If used properly, there is a good chance that Texas growers will be able to successfully manage red rice for years to come, and in the process bring land back into production that historically has been unusable due to major red rice infestation. Conversely, producers who grow imi tolerant or resistant varieties back-to-back too many times will soon find that some of the red rice plants will obtain imi tolerant and imi resistant genes and will no longer be controlled with the imi herbicide.

How long can we expect the imi tolerant and imi resistant varieties to work? Previous research on the rate of developing pesticide resistance in insects suggests that with proper management we could possibly see effective red rice suppression for 10 to 20 cropping seasons. But, if producers plant CLEARFIELD rice back-to-back, or if too many red rice plants escape, this new technology will be short-lived.

Besides the BASF recommendations, there are key production practices outlined on the Newpath label that will enhance red rice control using this system. Water is one critical issue. It is very important for the farmers to flush the herbicide into the active root zone for it to work most effectively. If a good rain doesn't fall within 48 hours of application, the farmer should be ready to bring in water. Dr. Garry McCauley at the Texas A&M Research Station in Eagle Lake, specializes in water management and had the following suggestions. If it's going to take more than 3 days to get water down to the last cut, farmers may want to consider spraying the top half of the field first, then coming back with the remainder of the herbicide just ahead of the water. Another alternative would be to use side inlet irrigation, to get the water across the whole field much faster. Another important issue is timing of the post emergence herbicide application. The label specifies that the application should be made at the 3 to 5 leaf stage, giving growers some flexibility. Dr. Mike Chandler, Weed Scientist at College Station, has conducted preliminary studies that indicate rice grown in heavy clay soils doesn't show as much injury as when the system is used on course textured sandy soils. Considering

Above, black hulled *Oryza nivara* growing in the greenhouse. Below, a close-up photo of the rough grain.

continued on next page

Red Rice continued...

these results, farmers on clay soils may want to make the Newpath application at the 3-leaf stage, while farmers working in course sandy soils would wait until the 5–leaf stage, when the rice is older and better able to rebound. Overall, though, farmer reports of injury to the CLEARFIELD rice after Newpath applications have not been consistent. There have been some reports of injury on clay soils, and none on sandy soils, indicating there are other factors at work besides soil type. We do know that cool nights after the herbicide application will cause yellowing no matter what the soil type. But as indicated before, when Newpath is applied at the recommended rate the rice recovers with no apparent yield loss.

An example of the classic looking easily identifiable red rice, distinguished by the black hull and long awns.

The question is, will CLEARFIELD be the 'silver bullet' that ends all red rice problems? Probably not, as 100% control is realistically not attainable. Still, Newpath herbicide can offer 95% control of red rice and other tough weeds, and CLEARFIELD rice has the potential to be a great asset to rice producers - if the technology is used properly. Texas producers and researchers have been seeking red rice control for over 100 years. While this system holds great potential, nothing is perfect. The future of this system is in the hands of the rice producers. *

For more information on the CLEARFIELD Production System for rice contact your ORYGEN™ Seed Retailer, your local herbicide retailer, or your BASF representative.

Cited References:
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2. Noldin, J.A., Chandler, J.M., and McCauley, G.N. 1995. Seed longevity of red rice (Oryza sativa L.) ecotypes in soil (Abstr.) 48th Annual Meetings of Southern Weed Science Society. 16-19 Jan 1995, Memphis, TN.

How Does the Technology Work?

The imidazolinone family of herbicides are known as 'single site of action' chemicals, and specifically effect the AHAS enzyme in plants. This enzyme is responsible for the production of three amino acids that are necessary for the plant to build new proteins. In susceptible plants, the imi herbicide prevents the AHAS enzyme from releasing these essential amino acids, so that the plant can no longer build new proteins, and slowly dies.

Scientists know that the AHAS enzyme is coded by approximately 2000 base pairs, and only one pair needs to change for the enzyme to show tolerance to the action of the imi herbicide. This is a very small change. That is why Croughan used ethyl-methane sulfonate (EMS) to cause the mutation in the Alexandria line. EMS makes minute changes, known as base-pair or point mutations, rather than large scale mutations as you find with radiation.

So what happened to the AHAS enzyme in the 93AS3510 line that made it resistant to the action of the herbicide? While they are not really certain, scientists believe that the mutation changed the shape of the enzyme, either physically or chemically, to the point where it could still produce and release the essential amino acids, even in the presence of the imi herbicide.

To use Dr. Croughan's analogy, it may be that the imi herbicides do not shut down the factory, but simply block the door. So if the shape or size of the door is altered, then the amino acids can still be released for use by the plant in building proteins. It is speculated that in CL121 and CL141, the door was altered enough to let some amino acids out, in spite of the blocking action of the herbicide. As a result of this partial blockage, CL121 and CL141 are imi tolerant and not imi resistant. In other words, too much imi herbicide applied to these cultivars can stunt or even kill them.

While in CL161, the door was changed sufficiently that the herbicide cannot block the passage of the amino acids at all, resulting in the superior resistance this line shows to the imidazolinone herbicides. *

Highlighting Research and Funding

Beginning with this April 2002 issue of Texas Rice, we will profile rice research projects and the agencies that fund them.

The table on the right lists the projects funded this year by the Texas Rice Research Foundation. In this issue and future issues we will describe each project, beginning with the following three on red rice and insect control.

Integrated Weed Management System for Rice
$43,124 - Chandler, Park, and McCauley

No herbicide gives total control. A herbicide package is usually required for acceptable control. This proposal evaluates weed management systems for the many new rice herbicides. There are three primary objectives 1) define the effect of soil type on weed control and plant injury for Newpath; 2) define the effect of soil type on weed control and plant injury for Command; and 3) evaluate the advantages of Newpath-Command-Facet tank mixes and sequential applications. This research will be conducted at Eagle Lake, Beaumont, Ganado and on producer fields. To accomplish the above objectives McCauley and Chandler have John O'Barr, a doctoral student on the Rice Belt Warehouse assistantship. Bill Park will coordinate management of the Liberty tolerant TX4 red rice.

Water Management in CLEARFIELD/Newpath System
$6,900 - McCauley and Senseman

The new CLEARFIELD/Newpath management system calls for the last application at the 3-5 leaf stage, and then flood immediately. The 3-5 leaf stage is generally much earlier than Texas producers flood their rice. This research will evaluate the impact of application and flood timing on rice yield and weed control. Luis Antonio de Avila, a doctoral student funded by Brazil, will be working on this project. The TRRF funds will supplement the cost of his research.

Rice Research Extension Entomology Program
$57,490 - Way

The program is divided into three broad areas - biological studies, insecticidal studies and outreach activities. Experiments dealing with biological studies will look at rice water weevil (RWW), Mexican rice borer (MRB), stem borers and chinch bugs. Insecticidal experiments will evaluate Fury and tank mixes of Karate Z and Quadris. Outreach activities will consist of site visits with farmers about problem fields, and publication of articles for the rice industry.

TRRF Funded Projects for 2002

Amount	Recipient	Project
$11,327	Cockrell	Communications, Press and Public Outreach for the Texas Rice Industry
$20,000	Emerson	Research on Sewage Sludge
$43,124	McCauley	Integrated Weed Management System for Rice
$6,900	McCauley	Water Management Systems and Their Effect on Weed Control in Clearfield Rice
$31,752	McCauley	Integrated Rice Management System for Ratoon Production
$101,768	McClung	Development of Improved Rice Cultivars
$44,000	Park	Direct Manipulation of Yield Determinants in Rice
$15,000	Pinson	Determining the Physical, Chemical and Genetic Mechanisms of Fissure Resistance
$24,445	Stansel	Texas Rice Crop Survey 2002
$45,345	Tarpley	Rice Physiology Research
$46,000	Turner	Evaluating Potential Rice Varieties from University and Industry Breeding Programs
$22,425	Turner	Reducing Production Cost Through Innovations in Fertilizer and Water Management
$57,490	Way	Rice Research and Extension Entomology Program for 2002
$39,710	Wilson	The Physiological Basis for Superior Yield Performance
$75,000	Womack Richardson	Farm Level Analysis for the Evaluation of Farm Policy
Equipment		
$1,510	Tarpley	Gas Analyzer
$31,000	Vawter	Backhoe

State, National and International News...

Joint Statement on Farm Bill Progress for immediate release: March 19, 2002

Washington, D.C. - Lead negotiators of the House/Senate Farm Bill Conference issued the following statement: "Farm Bill negotiators today struck agreement on the needed framework to speed negotiations for early April completion of the House-Senate Conference Report. This framework allows for incorporating the many policy initiatives within the overall $73.5 billion agreed-upon ten-year farm bill budget. Members of Congress on the Conference Committee expect to be positioned to make the final farm bill decisions in public meetings of the Conference the week of April 9."

Excerpted from an article in the New York Times March 23, 2002 by Elizabeth Becker

WASHINGTON – For big rice and cotton farmers, the issue is a provision that would limit each farmer's annual subsidy to $275,000. For advocates of the poor, the goal is to add legal immigrants to the food stamp program without undercutting hungry school children or their mothers.

After three weeks of closed-door negotiations over the farm bill, lobbyists for agribusiness and the poor are claiming victory, while environmentalists are complaining. "This represents a very important investment for the needy," said Ellen Vollinger of the Food Research and Action Center, which lobbies for nutrition programs for the poor. Mary Kay Thatcher, director of public policy at the American Farm Bureau Federation, said the 70 percent increase in subsidies was good enough for farmers to get on with their spring planting. "It's never easy for a farm bill," Ms. Thatcher said. "But now Congress won't have to deal every year with giving economic disaster assistance for farmers."

Environmentalists, who have argued for more money to protect the land and water, are admitting defeat, saying they feel betrayed. "Once again, Congress was extremely generous to the very largest, most heavily subsidized farming operations in the country," said Ken Cook, president of the Environmental Working Group, which operates a Web site detailing how much farmers receive from the government.

But this was only the first round, although a critical one. All special interests are getting a second and third chance to influence the farm bill as negotiators try to work out a common policy from the differing House and Senate measures. After more than a year of hearings and weeks of arguments and votes in Congress, the critical decisions are being made by 21 lawmakers who will carve up the money and decide which programs to adopt and which to abandon.

In the best of years, the farm bill incites passions not associated with wheat, corn and soybeans. When a $6 billion mistake is made, as was done this year by the Congressional Budget Office, those passions become crucial matters. The Senate approved a farm bill last month that included big increases for food stamps and environmental programs, only to discover that $6 billion of that money did not exist. The budget office had miscalculated the cost of the crop subsidy program.

With farmers complaining that they need to know how much money they will receive from the government to complete their spring planting, the negotiators have decided to put about $15 billion each year into subsidies for grains and cotton, largely at the expense of environmental programs. The environmental and conservation money, originally $22 billion in the Senate bill, has been cut to $17.1 billion over 10 years, $1 billion more than in the House version. "This isn't a farm policy, it's a check-writing machine for the big commodity growers," said Ferd Hoefner of the Sustainable Agriculture Coalition, which represents small farmers and rural communities generally ineligible for most of the big programs.

Large commercial farmers have fared better. Crop subsidies will be increased by 70 percent and a new one, for peanuts, added. "This is certainly a program we could be comfortable with," said Patricia Buschette of the National Association of Wheat Growers.

While neither party wants to appear unfriendly to farmers, the Democrats say they would spread the money further through environmental programs if the House Republicans would agree to the $275,000 payment limits. That would free more of the money initially cut from conservation and rural development programs. Senate Majority Leader Tom Daschle, of South Dakota, said this week that "we can do even better if our colleagues in the House agree to cost-saving payment limitations." *

Editor's Page continued...

commercial rice are kissing cousins, care must be taken in how the herbicide tolerant rice varieties are used. If herbicide tolerant rice is grown too frequently in the same field and if the herbicide is not applied in a manner providing near 100% red rice suppression, some of the red rice plants will survive to cross with herbicide tolerant commercial rice plants. If this happens too frequently and in too many fields, this valuable technology will be lost to the rice industry. The better our producers are able to adhere to the stewardship program, the longer this technology will be available to Texas rice producers.

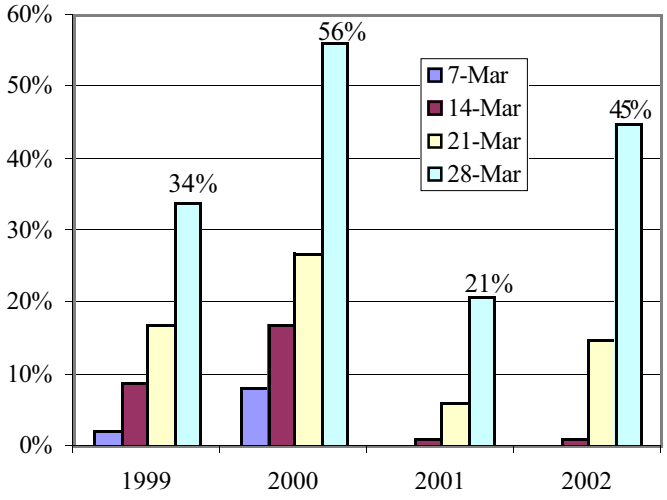
I hope you enjoy this issue of *Texas Rice*. Please let us hear your ideas on what you would like to see in future issues.

Sincerely,

Ted Wilson
Professor and Center Director

Rice Crop Update

Planted Acreage as of March 28th



EU Targets U.S. Rice In Response To U.S. Action On Steel Imports

USA Rice Federation - Earlier this week media and trade sources reported that European Union officials were circulating internally a list of U.S. agricultural and non-agricultural exports to be subject to increased import duties in retaliation for the president's announcement on March 5 of increased import duties, on a temporary basis, on certain steel imports.

What's the relationship between steel and rice? The president acted under U.S. law and the WTO's Agreement on Safeguards to provide temporary import relief to the U.S. steel industry by raising certain steel duties for three years to provide a period of adjustment in response to a rise in steel imports. Steel imports from several countries, including the EU, are affected by the president's decision.

The EU, which bitterly and vocally opposes the U.S. action on steel, said that U.S. long grain brown and milled rice as well as broken rice would be subject to an additional 8 percent duty.

The EU, Brazil, and Japan have started the dispute settlement process by asking for consultations with the United States. The dispute settlement process frequently takes over one year from start to finish. The U.S. has lost three previous safeguards cases taken by other WTO members.

What actions is USA Rice taking? We are continuing to seek information on the EU's official intentions, and their options for action in light of conflicting interpretations of WTO rules by the United States and the EU. We will also work with USTR and USDA offices at the U.S. mission to the EU in Brussels as well as the EU industry to minimize any potential increase of duties on U.S. rice. *

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

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

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