



Texas Rice

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Nobel Peace Prize Recipient Dr. Norman Borlaug

Four years ago this month, the Texas A&M Research and Extension Center at Beaumont was honored to welcome one of the most influential people in agriculture. Nobel Peace Prize recipient, Dr. Norman Borlaug, has a long history of making a positive impact on people all around the world, many times averting mass starvation.

That wasn't exactly the road he saw himself following - as a kid Borlaug thought he was going to play second base for the Chicago Cubs. And in college, his wrestling skills got him into the University of Minnesota Hall of Fame.

Still, his roots were in agriculture. Borlaug was born in Iowa, where he grew up on a family farm. It was a small community, and Borlaug spent his first eight years in school in a one-room schoolhouse.

Entering the University of Minnesota as the Depression began, Borlaug was horrified to see the conditions people were suffering through in the larger city. Whole families on the streets and children begging for food made a deep and lasting impression on him.

He worked for a time in the Northeastern Forestry Service, often with men from the Civilian Conservation Corps, occasion-

ally dropping out of school to earn money to finish his degree in forest management. He passed the civil-service exam and was accepted into the Forest Service, but the job fell through. He then began to pursue a graduate degree in plant pathology.

During his studies he did a research project on the movement of rust spores. The project, undertaken when the existence of the jet stream was not yet known, established that rust-spore clouds move internationally in sync with harvest cycles, a surprising finding at the time. The process opened Borlaug's eyes to plant disease and food production. He eventually received his M.S. and Ph.D. degrees in Plant Pathology.

During this time, the Midwest was becoming the Dust Bowl. Though some mythology now attributes the Dust Bowl to a conversion to technological farming methods, in Borlaug's mind, the problem was the lack of such methods. Since then, American farming has become far more technological, and no Dust Bowl conditions have recurred. Borlaug was horrified by



September of 2003 was a time etched in history for the faculty and staff at the Texas A&M Research and Extension Center in Beaumont. Dr. Borlaug spent the day talking about his lifetime of work, and his vision for the future.

L to R: Dr. Fred Turner (retired), Dr. Borlaug, Dr. Rodante Tabien, and Dr. Lee Tarpley.

the Dust Bowl and simultaneously impressed that its effects seemed least where high-yield approaches to farming were being tried. He decided that his life's work would be to spread the benefits of high-yield farming to the many nations where crop failures were as awful as those in the Dust Bowl.

As a young scientist in the 1940s, he was sent by the Rockefeller Foundation to run a project in Mexico. The country's wheat harvests were being devastated by stem rust. The program's initial goal was to teach Mexican farmers new farming ideas, but Borlaug soon had the growers seeking agricultural innovations. One was "shuttle breeding," a technique for speeding up the movement of disease resistance between strains of

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From the Editor...

Rice Production and Management: An Ever Changing Biological System



Welcome to the September issue of Texas Rice. Have you ever stopped to think about how much change has occurred to society during just the last few decades? A little over 20 years ago, desktop computers were quite rare. I remember a colleague purchasing an IBM computer in 1985. This machine was decked out with an 80286 processor and an 8088 coprocessor. At that time, the IBM computer was revolutionary and represented a big step in bringing mathematical computational power to the desktops of scientists. Contrast that with nearly all computers purchased today having a central processor with a clock speed that is ca. 400 times faster, performance several thousand times greater, and availability to almost everyone, not just scientists at major universities. If each of us were to stop and think for a few minutes, we could easily point out major changes to society that have occurred during the past 2 decades.

While managed biological systems do not evolve at quite the same rate as have man-made devices, biological changes can nevertheless be impressive. As an example, in the rice pest management area alone, the number of insect, disease, and weed species found in rice in the U.S. has changed considerably over the last 20 years. The following are but a few examples from Texas.

Drs. Garry McCauley, Mike Chandler, and others have documented that changes in chemical use patterns have had a great effect on which weeds are the most severe in a rice field. Some weeds that historically were easy to control have increased in severity, often due to the gradual, then rapid, increase in the number of weeds in a population that are resistant to commonly used herbicides, but also as a result of changes in the chemistries used to control the weeds. Changes in cultural operations, such as how fall and early spring vegetation is managed and how the soil surface is prepared for planting, have also greatly impacted the

complexity of weeds that survive and compete with the rice crop. Historically, annual weeds have been the predominant weed pests in rice. As the rice industry has begun to shift toward the use of limited till and no-till production systems, perennial weed species have increased in importance.

Only a few years ago, false smut appeared in Texas rice, causing alarm and, in at least a few instances, significant crop injury. In contrast, although *Cercospora*, also known as narrow brown leaf spot, has historically been of only minor importance, it caused major yield loss to many rice fields in Texas and Louisiana during the 2006 season.

In the early 1980's, the Mexican rice borer "decided" to copy its cousin the cotton boll weevil and migrate north from the Mexico border near Weslaco, to begin to "look" for a new home. By the early 1990's, it reached the western edge of the Texas rice belt. By 2006, it occupied the entire Texas rice belt, with the exception of a small area of land in distant northeast Texas near Texarkana. Prior to that time, the sugarcane borer was the dominant stem-boring rice pest, with sporadic borer injury occasionally caused by a second species. Although the sugarcane borer was, and still is broadly distributed across the Texas rice belt, populations can be controlled and damage minimized by properly timed insecticide applications.

While the sugarcane borer is difficult to sample, the Mexican rice borer requires even more training and know-how to accurately sample. The Mexican rice borer, can be a pest of major economic proportions, when the populations are large, and are allowed to feed and injure the rice plants, and multiply uncontrolled. A few years ago, Dr. Mo Way conducted an experiment near Ganado, Texas, where he showed that mixed populations of Mexican rice borer and sugarcane borer

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Dr. Norman Borlaug

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Farming Rice

a monthly guide for Texas growers

Providing useful and timely information to Texas rice growers, so they may increase productivity and profitability on their farms.

Biology and Ecology of Rice Water Weevil in Southeastern Texas

The rice water weevil, *Lissorhoptrus oryzophilus* (Coleoptera: Curculionidae), is one of most important pests of rice in the USA and has emerged as a pest of rice in several eastern Asian countries, including China. To investigate invasive and population dynamic mechanisms of this pest, we conducted several laboratory and field experiments



Fig. 1. Dark (left) and light (right) morph of *L. oryzophilus elytra*.

on its biology and ecology at the Texas A&M University Agricultural Research and Extension Center, Beaumont, in 2005-06.

We found that both females and males of RWW have two color morphs in southeast Texas: the central pattern of their elytra (the hard covering over the abdomen) is black (dark morph) or gray (light morph) (Fig. 1). The occurrence of each morph in spring populations and possible relationships to female reproductive development was studied. Adults were collected from three sources: 1) over-wintering sites near rice, *Oryza sativa* L., 2) a light trap placed in grassy vegetation and fallow fields, and 3) flooded rice plots from mid-April to late May 2005. Interestingly, the frequency of the dark morph (36.0, 45.8, and 31.6% at each collection source, respectively) was significantly lower than that of the light morph (64.0, 54.2, and 68.4%, respectively). Dark males accounted for only 3.5-7.4% of the populations, significantly less abundant than light males (28.8-32.0%) from each collection source. The morph frequency changed significantly with season in females, but not in males. Female-biased sex ratios were observed with the proportion of females to males being 1.5, 2.1, and 1.9 from each collection source, respectively. In most collections, ovarian development and mating status were similar between the females of different

morphs, suggesting that elytral morph in this weevil might not be related to female reproductive development.

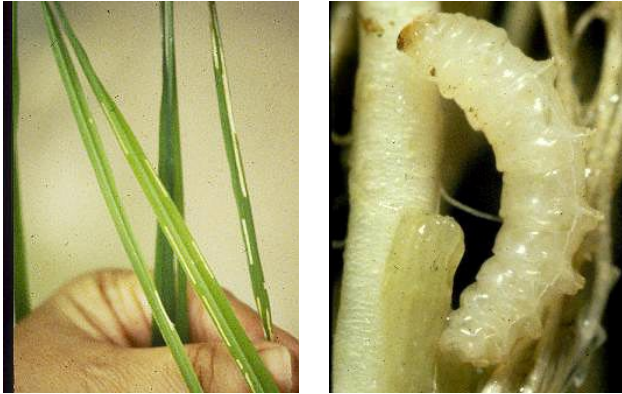
Locomotor activity (pattern of speed and movement), mating success, and reproductive capacity of the two elytral morphs were also compared. Females of the two morphs were collected near rice fields during April and May.

In the laboratory, light females were found more active than dark ones. Females mated successfully with males, regardless of morph. For females supplied with males for 2 d or kept solitary, and then reared on rice seedlings for 48 d, no significant differences were found between the two morphs in oviposition period, number of eggs deposited, or survival rate. In both morphs, a proportion of mated females did not oviposit throughout the rearing period, implying that a mating experience might be necessary before reproductive development can be initiated. However, oviposition occurred in a proportion of females in which no mating experience could be detected, and their eggs produced larvae. This suggests the existence of parthenogenetic females (the ability to produce viable progeny without the benefit of males) in southeast Texas.

We also observed the reproductive biology of summer and autumn populations of rice water weevil. Females were collected from flooded rice plots and a light trap placed in grassy vegetation and fallow fields from early July to late September. Their mating and ovarian developmental stage were monitored, and their reproductive capacity was determined by providing rice seedlings in the laboratory. Ovipositing individuals occurred consistently throughout the

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Rice Water Weevil continued...



Left: Rice water weevil damage on rice. Right: Rice water weevil larva.

observation period. In fact, over 50% the females laid eggs, where less than 10% of females produced eggs parthenogenetically. The percentage of reproductive females decreased as the season progressed. Females with high reproductive capacity occurred in ratoon rice from early August to early September, and in the light trap during early September, indicating the great ability of this insect to utilize host plants in Southeast Texas.

Some of the above results have been published in journals of the Entomological Society of America (1, 2). This work was supported financially by the National Basic Research and Development Program (2002CB111403), National Natural Science Foundation of China (30400290), and the Texas Rice Research Foundation. *

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1. Jiang, M. X., M.O. Way, R. Yoder, W. J. Zhang, J. A. Cheng, Elytral color dimorphism in rice water weevil (Coleoptera: Curculionidae): occurrence in spring populations and relation to female reproductive development. *Annals of the Entomological Society of America*. 99: 1127-1132.
2. Jiang, M. X., M.O. Way, W. J. Zhang, J.A. Cheng, Rice water weevil females of different elytral color morphs: comparisons of locomotor activity, mating success, and reproductive capacity. *Environmental Entomology*. 36(5) (in press).

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Norman Borlaug continued...

crops. Crops were shuttled between the climates of the highlands and the plains; thus planting of two generations each year could be completed. From test results in both environments, Borlaug and his colleagues developed a drought-hardy, rust-resistant strain of wheat, then crossed it with a dwarf Japanese strain to produce a hybrid short enough to survive the wind, and channel growth into grain. From total dependence on wheat imports, Mexico had within a few years shifted to being a net exporter of wheat.

In 1963, the Rockefeller Foundation and the government of Mexico established CIMMYT, as an outgrowth of their original program, and sent Borlaug to Pakistan and India, which were then descending into famine. Borlaug argued that India and other nations should switch to cereal crops. He failed in his initial efforts to persuade the seed and grain monopolies to switch to high-yield crop strains.

Despite the institutional resistance, Borlaug stayed in Pakistan and India. By 1965, famine on the subcontinent was so bad that governments made a commitment to wheat. Borlaug arranged for a convoy of thirty-five trucks to carry high-yield seeds from CIMMYT to a Los Angeles dock for shipment. The convoy was held up by the Mexican police, blocked by U.S. border agents attempting to enforce a ban on seed importation, and then stopped by the National Guard when the Watts riot prevented access to the L.A. harbor. Finally the seed ship sailed. Borlaug says, "I went to bed thinking the problem was at last solved, and woke up to the news that war had broken out between India and Pakistan."

Nevertheless, Borlaug and many local scientists who were his former trainees in Mexico, planted the first crop of dwarf, rust-resistant wheat on the subcontinent, often working within sight of artillery flashes. Sowed late, the crop germinated poorly, yet yields still rose 70 percent. This prevented general wartime starvation in the region, though famine did strike parts of India. There were also riots in the state of Kerala in 1966, when a population, whose ancestors had for centuries eaten rice, was presented with sacks of wheat flour originating in Borlaug's fields.

Owing to wartime emergency, Borlaug was given the go-ahead to circumvent the traditional seed companies. "Within a few hours of that decision, I had all

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Norman Borlaug continued...



Photo taken in 2000, when Dr. Borlaug visited maize demonstration plots in Kaduna, Nigeria. Photo courtesy of Chris Dowswell.

the seed contracts signed and a much larger planting effort in place,” he says. “If it hadn’t been for the war, I might never have been given true freedom to test these ideas.” The next harvest was a 98 percent improvement. By 1974 India was self-sufficient in the production of all cereals.

Borlaug’s accomplishment came to be labeled the Green Revolution, and in 1970, Norman Borlaug received the Nobel Peace Prize, in recognition of his contributions to world peace through increasing food supply. At the time, there was no award specifically designed to honor those who made advancements in agriculture.

Borlaug created the World Food Prize, an international award recognizing the achievements of individuals who have advanced human development by improving the quality, quantity or availability of food in the world. The prize recognizes contributions in all fields involved in the world food supply — food and agriculture science and technology, manufacturing, marketing, nutrition, economics, poverty alleviation, political leadership and the social sciences. As well as recognizing personal accomplishments, Borlaug saw the prize as a means of establishing role models who would inspire others.

Past recipients include Prof. Yuan Longping, for the development of hybrid rice varieties, and Dr. Monty Jones, for the development of New Rice for Africa (NERICA).

Laureates are honored and officially awarded their prize in Des Moines, Iowa, United States, in a televised award ceremony held in the House Chamber of the Iowa State Capitol. The winners receive \$250,000. The Award Ceremony coincides with the Norman E. Borlaug International Symposium, which addresses a topic related to hunger and food security each year. The topic in 2006 was “The Green Revolution Redux: Can We Replicate the Single Greatest Period of Hunger Reduction in All Human History?” The 2007 event will be held October 18-19 and will focus on the global implications of biofuels and other emerging technologies in food and agricultural science.

Borlaug’s most recent project is the Sasakawa-Global 2000. This project was originally funded by Japanese business baron Ryoichi Sasakawa. He approached Borlaug to ask why his work in Mexico, India and Pakistan could not be applied in Africa. Borlaug was at first hesitant to take on a project of such proportions so late in his career, but Sasakawa, along with President Jimmy Carter, were very persistent. Borlaug agreed, and the team began to teach African farmers how to better feed themselves using high yielding varieties, and commercial fertilizer. Traditional farming in Africa involves ‘slash and burn’ agricultural, which is very destructive to the native forests, and only marginally productive in producing food. The project has been successful, and continues in twelve African nations.

Besides the Nobel, Borlaug has received numerous honors and awards, including the Presidential Medal of Freedom, the Public Service Medal, the Rotary International Award for World Understanding and, America’s highest civilian award: the Congressional Gold Medal. Most recently, The American Phytopathological Society named Borlaug the recipient of the APS Award of Distinction. This award, the highest honor the Society bestows, is presented on rare occasions to persons who have made truly exceptional contributions to plant pathology.

Through his work, Dr. Borlaug has saved more lives than any other person who has ever lived. Today Borlaug divides his time among CIMMYT, where he teaches young scientists seeking still-more-productive crop strains for the developing world; Texas A&M, where he teaches international agriculture every fall semester; and the Sasakawa-Global 2000 project. *

Integrated Agricultural Information and Management System (*iAIMS*)

Agriculture in Texas and U.S. is facing increasing challenges. Continued urban expansion is competing with agriculture for land, water, and other resources. Global competition, combined with trade inequities, continues to shrink U.S. agriculture profit margins.

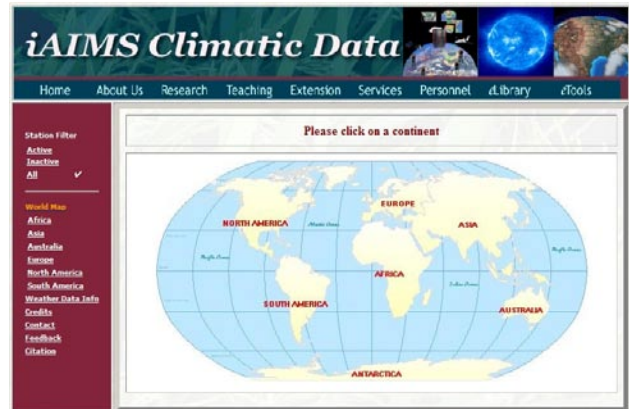
To maintain economic competitiveness and viability, U.S. agriculture must continue to strive for increased efficiency with limited resources. Achieving increased efficiency depends on our understanding of cropping systems. The multidisciplinary nature and inherent complexity of cropping systems, pose challenges to both producers and researchers require integration of data, knowledge and skills from different disciplines, and the effective delivery of technologies. In cooperation with several state and federal institutions, our team has developed an Integrated Agricultural Information and Management System (*iAIMS*). *iAIMS* consists of foundation class climatic and soil databases and applications that address different aspects of cropping systems management.

The focus of *iAIMS* is the consolidation and integration of data and the effective delivery of research results as decision tools. The *iAIMS*' climatic and soil databases are independent of the overlaying crop systems. These databases provide a common foundation for developing diversified applications that require dynamic access to near real-time data. A number of applications have been developed that seamlessly access the foundation class databases. Most of these applications also provide several interfaces targeted at different user levels to hide unnecessary complexity. Collectively, these applications address water conservation, and rice production and management problems.

Climatic Data

(<http://beaumont.tamu.edu/ClimaticData>)

The climatic data program provides easy access (view, plot, and download) to both daily and hourly data for over 20,000 stations for rice countries in the world, with near real-time data for some stations. *iAIMS* has a graphical interface that allows a user to select a continent, country, state/province, and in many cases, sub-region. The user can view the data as graphs or



tables, or download data as Excel or text files.

The *iAIMS* climatic database is automatically updated every 1 to 2 days depending on access speed to data sources, with an automated filtering program eliminating impossible data points and filling in data gaps with estimated values using temporal and spatial interpretation algorithms. The climatic database is structured to allow dynamic access from application programs described later in this paper.

Soil Data

(<http://beaumont.tamu.edu/SoilData>)

The soil data program currently provides soil data for the six U.S. rice producing states, but will soon provide data for the entire U.S. When completed, users will be able to view and download a range of soil properties for each soil layer. As with the climatic database, the soil database is structured to allow dynamics access from application programs described later in this paper.

Rice Development Advisory

(<http://beaumont.tamu.edu/RiceDevA>)

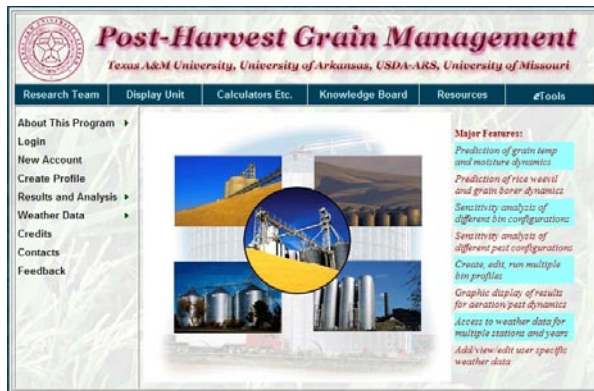


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iAIMS continued...

The Rice Development Advisory is an interactive web-based program that predicts rice growth stages, and provides advice on rice production. The program allows the user to select advanced options for creating, running, and displaying multiple field growth forecasts for different rice varieties, planting/emergence dates, and counties.

Post-Harvest Grain Management (<http://beaumont.tamu.edu/RiceSSWeb>)



The Post-Harvest Grain Management (RiceSS-Web) is a web-based program that allows users to predict temperature and grain moisture change during rice storage and the population dynamics and damage by insects (the lesser grain borer and the rice weevil) inside the storage bins. It was jointly developed by Texas A&M University System, University of Arkansas, USDA-ARS Manhattan Kansas, and University of Missouri.

Rice Water Conservation Analyzer

The Rice Water Conservation Analyzer (RiceWCA) is a web-based program that allows users to rapidly estimate the costs and water savings associated with implementing a wide range of rice on-farm conservation measures, including precision grading of fields, lateral improvements (weed control and buried pipe), multiple inlet systems, tail-water recovery systems, and conservation tillage practices. RiceWCA is one of the strategic planning tools used by LCRA to determine how to best conserve water to meet demands for water in the Lower Colorado River basin and surrounding cities.

The analysis can be done at the levels of irrigation districts, sub-districts, canals, and turnouts. The



ultimate beneficiary of this study will be the rice producers who implement the most cost-effective conservation measures. Initially targeted users of the program include personnel in LCRA, SAWS, and other study teams directly involved in the Colorado River water project. *

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TRIA Update



The Texas Rice Improvement Association has been harvesting around the rain, as everyone else in this area has been doing. We have also been delayed a few times due to combine repairs. As of September the 11th we have harvested Presidio, Carolina Gold, Jasmine, 2 Demo's of RiceTec hybrids, and Sierra. At this time we don't have the yields on each variety but with the large amount of rain that Beaumont has been experiencing, they may be down.

We will continue harvesting, as weather permits, Sabine, Hildago, and our organic fields of Carolina Gold, Sierra, IAC 600 with TX 1184 being the last variety to harvest. The season started with two weak cold/wet fronts, then rain at peak flowering (June/early July) and at harvesting as well. We will make a report on a yield/ac basis, but as of right now, we know that the yields are going to be down. *

Article by Brenda Setliff and Julio Castillo

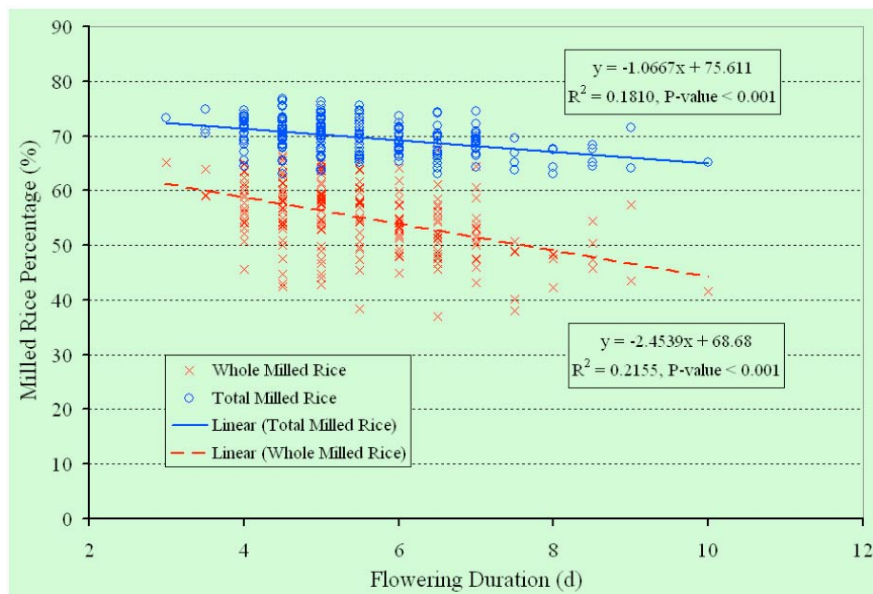
Flowering Traits and Head Rice Yield

Head rice yield is one of the determinants of the market grade of rice, as it indicates the economic value of harvested grains. Head rice or whole kernel of milled rice is the unbroken kernel or broken kernel with at least three fourths of the length of an unbroken kernel. Head rice may be worth twice as much as the broken rice since end-users are willing to pay premium price for whole kernels. Breeders, producers, and millers aim for high head rice recovery to produce quality products for the consumers and to increase profitability.

Yield of head rice, however, is influenced by several environmental and genetic factors. It has been shown that cultural practices, drying and milling processes, and genotype affect head rice yields. Environmental factors that were reported to affect head rice yield include meteorological conditions, such as relative humidity, air temperature and rainfall, while cultural practices include nitrogen fertilization and time of draining and harvesting. Factors within the milling process that influence head rice include the type of mill, speed of milling cylinder, degree of milling, tempering temperature and duration, cooling methods, and head rice separating methods. Drying, as it relates to grain moisture content (MC), is critical in getting a high percentage of head rice and this postharvest activity may be affected by the above factors. Grain MC of 15 to 18% is ideal for milling rice kernels.

Cultivars differ significantly in their head rice yields. Genotypic traits reported to affect head rice include tillering and kernel weights at lower seeding rates, kernel thickness, panicle type and length, grain weight, and maturity. N fertilization has been shown to increase head rice yield, but this increase was also found to be genotype-dependent. The optimum N rates and harvest grain MC to obtain the maximum head rice percentage varies among cultivars.

Flowering in rice, also known as anthesis, generally starts at the top of the panicle and ends at the bottom, and the entire process may occur for a period of 15 days or longer in a rice field. Rice kernels attain full length first, then full width, and finally full thickness. The onset of flowering of the main tiller of a rice plant



is ahead by several days relative to the rest of the tillers in a plant, and some plants may start flowering earlier than the rest of the plants in the field. The rice kernels from a rice panicle or from the entire plant and field, therefore, will develop and mature asynchronously.

The growth and development of the kernel is associated with the position of the kernel on the panicle. The volume, density, dimension (length and width), and rate of filling of the kernel decreases from the upper to lower part of the panicles in rice. Variation in size and shape of kernels contribute to variation in the rate of kernel filling, which in turn causes the variation in the duration of kernel filling. Kernel filling affects the final kernel traits such as weight and density, and the non-uniformity of these traits have a negative impact on head rice recovery. Panicle type also affects the differences in kernel weight and quality within a rice panicle as it affects source-sink relation. Longer and compact panicles have larger variability within panicle for kernel weight, percent kernel filling, amylose content and chalky grain, compared to shorter and loose panicles. Longer panicles have difficulty in maintaining a uniform kernel filling process. Furthermore, they are more vulnerable to the micro-environment variation that may affect kernel filling among kernels in the panicle. Kernel weight and filling of upper kernels differ significantly between compact and loose panicles.

Large grain MC variability is critical in both pre

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Flowering Traits continued...

and post-harvest as it affects rice milling traits. MC variations of up to 46% between kernels from the bottom of the least mature panicle to the top of the most mature panicles have been reported. Furthermore, there is a multi-modal distribution of grain MCs as shown in studies of panicles from main, primary, secondary and tertiary tillers. Grain MC range depends on the overall maturity of the kernels, and this range becomes narrower as the kernels mature and MC decreases. Among panicles, rice with an average of 22% MC has less than a 10% difference within the most mature panicle and has more than a 10% difference on the most immature panicles.

The onset and completion of flowering varies with genotype and this can add up to the variation mentioned above that can affect head rice recovery. Since 2005, we have been looking at flowering traits and their relationships with head and total rice recovery. Two years' of data from 105 genotypes grown at the Texas A&M University Agricultural Research and Extension Center at Beaumont, indicated that the duration of flowering had a strong negative relationship with head and total milled rice percentages. The duration from onset to 50% flowering, 50% to 100% flowering, and onset to 100% flowering were all negatively correlated with head rice recovery, indicating that rice genotypes with shorter flowering duration had higher head rice and total milled rice percentages (Fig. 1). Moreover, it was found that rice genotypes with early heading had relatively shorter flowering durations. The differences in flowering duration may result to wider variation in kernel development, final weight, and quality of the kernels. Non-uniformity in kernel size and shape, kernel filling, and maturity can have negative effects on rice milling traits, and variation in these traits are increased by longer flowering duration. Currently, we are evaluating some of these traits to determine their relationship with head rice and total milled rice.

Considering the initial relationship found between duration of flowering and head rice yield, the duration from start of flowering to heading can be a selection criterion in the indirect evaluation and selection of breeding lines with high head and total milled rice percentages. *

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From the Editor continued...

have the ability to reduce yields by up to 50%, when not controlled. Twenty years ago, this problem would not have existed.

Just a few years ago, Louisiana and Texas rice growers saw for the first time, another new insect pest called the South American rice leaf miner. Although this species is normally not economically important in Texas, the tattering of leaves caused by larvae feeding can be disconcerting to field scouts. In the 1990's, a native pest of rice, called the rice stinkbug, also began to appear in greater abundance. This insect causes injury by feeding on the grain, producing a condition called peck, due in part to enzymes injected by the stinkbug during probing with its "beak", and in part due to the introduction of bacteria from the stinkbug's beak. The increase in stinkbug prevalence across much of the western part of the Texas rice belt may be due to increased planting of sorghum, which is an alternative host for this pest.

In 2007, the rice panicle mite was discovered in greenhouses at RiceTec facilities near Alvin, Texas. As it turns out, this was actually a rediscovery twice over. This mite was first discovered in 1960, in Baton Rouge, Louisiana, by Dr. Smiley. The mite is so small as to be invisible to the "naked" eye. Dr. Smiley discovered the mite while examining a plant hopper using a microscope. A single mite was found attached to the plant hopper's leg, where it presumably was using to disperse. This new species was given its name due to it normally inhabiting the inside of the leaf sheath where the panicle emerges from the "boot".

From 1960 to 1993, no further reports of this mite were made in the U.S. In 1993, Olga Mejia, a Ph.D. student training under Dr. Way's supervision, discovered a specimen on a plant, presumably from her greenhouse experiments at the Beaumont Center. The slide that contained her specimen ended up in Canada in the hands of a systematist (a scientist who studies how different species are related), and was eventually identified as the rice panicle mite. Another 14 years elapsed before this mite was again recorded in the U.S. in 2007.

Following the 2007 rediscovery of this mite in Texas, greenhouses that contain rice plants were sampled in Arkansas, California, Texas, Louisiana, Mississippi, Missouri, Ohio New York, and the USDA -APHIS

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

The most widely accepted method for evaluating rice for sheath blight susceptibility is to inoculate densely-planted field plots with *Rhizoctonia solani*, the fungus that causes sheath blight disease, allow the pathogen to grow over time, then rate the plots for severity of disease symptoms.

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

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

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



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

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

While visiting watery, foggy, Bangladesh, where rice is hand transplanted to fields out of densely planted nursery plots, we saw seedling nurseries dying from infection by *R. solani*. We observed researchers using soda bottles as inexpensive “dew chambers” for studying rice seedlings under highly humid conditions. This

continued on next page

new method, known formally as the micro-chamber method, but informally referred to as the “Coke bottle method”, offers several advantages over the previously used field-plot evaluations, including requiring less seed, less labor, and less plant-growth time. Furthermore, the new method is conducted under controlled lab conditions, freeing breeders from the previous restriction of a single growing season per year under variable field conditions.

In 2003, USDA-CSREES approached U.S. rice researchers as a community, asking them what collaborative research they would like to accomplish if funding were provided for 4 years (the RiceCAP grant program). It was jointly decided that a portion of funds would be used to collaboratively develop and validate a micro-chamber sheath blight screening method. RiceCAP funding and collaboration allowed the rapid collection of numerous field and micro-chamber replications, and all participants were excited to see just how well micro-chamber data matched field-plot data for sheath blight tolerance ratings.

Not only were differences clear and fairly consistent between highly tolerant lines such as Jasmine 85 and TeQing, and susceptible lines like Lemont, but also the moderate levels of tolerance exhibited by Saber and Maybelle were detectable with the new seedling evaluation method.

Plant-to-plant variability in the micro-chambers is still high enough that replications are still recommended, but now each replication requires only 5 to 10 seed and 2 months to accomplish. The micro-chamber method was recently shown to be even more repeatable when conducted under well-controlled lab conditions rather than in the greenhouse where daily and seasonal changes in temperature and light intensity occur.

The micro-chamber or “Coke Bottle” method for evaluating sheath blight response will speed the progress of the ongoing RiceCAP efforts to molecularly tag genes conferring tolerance to rice sheath blight disease.

This work is being jointly supervised in Beaumont by Drs. Shannon Pinson, Bob Fjellstrom, Dante Tabien and Anna McClung, with daily focus from Dr. Yueguang Wang, a postdoctoral scientist. *

Article by Shannon Pinson

NRCS Texas Accepts Applications for EQIP Funding

Texas agricultural landowners interested in participating in the Environmental Quality Incentives Program (EQIP) need to apply by Nov. 16, 2007, if they have not already done so to be eligible for the next round of funding, according to the Natural Resources Conservation Service (NRCS).

“Although EQIP is a continuous sign-up program, some producers may not have signed up yet,” said Don Gohmert, NRCS state conservationist for Texas. “We will rank all eligible applications received by the end of the ranking period on Nov. 16 for 2008 funding. There is a strong possibility that EQIP funds will become available in October.”

EQIP promotes agricultural production and environmental quality. Through EQIP, farmers and ranchers receive financial and technical assistance to help install conservation practices and to implement management systems that promote conservation. Financial assistance is on a cost-shared basis with the producer. The technical assistance is provided at 100 percent of the cost by NRCS.

According to Gohmert, there are a few changes in EQIP for 2008. NRCS is adding another statewide resource concern to the program at the recommendation of the State Technical Committee. Funding will be provided in 2008, specifically for conservation practices that improve habitat for the pronghorn antelope in west Texas.

Also new in 2008 will be a process to streamline payments. Instead of the traditional percentage-of-cost rates, NRCS will offer flat-rate payments based on a schedule for each conservation practice. “Landowners will know up-front what the payment in dollars will be,” Gohmert said. “One important component of EQIP that remains the same is the input needed from the local level to make EQIP address the most pressing resource concerns there,” Gohmert said. “Our local offices may be holding program development group and local working group meetings very soon to gather that input.” NRCS offices and local soil and water conservation district officials will have more information about local meetings.

To sign up for EQIP or to get more information, contact the NRCS office serving your county or find your service center on the Web at <http://offices.sc.egov.usda.gov/locator/app>. *

From the Editor continued...

facility in Baltimore, MD. While rice fields were sampled in Arkansas, California, Texas, Louisiana, Mississippi, Missouri and Puerto Rico. Rice panicle mites were found in all of the greenhouse locations where the results have been reported to date (AR, TX, LA, OH), with the exception of Missouri, and, so far, it has been found in at least one field, but at extremely low numbers, in all of the states where results have been reported to date (AR, LA, TX, NY, MD), and in high numbers in Puerto Rico fields. While dead mites have been found in grain samples from the RiceTec facilities, live specimens have not been founded in any harvested rice seed from any rice fields. While it may be possible for some mites to survive a harvest operation, it is very likely impossible for this mite to survive the drying process that commercial brown rice goes through at rice mills or with on-farm dryers.

Data have not been developed showing that the rice panicle mite causes economic loss to either greenhouse grown rice plants or commercial rice fields in the U.S. If economic loss were to occur, it would be most likely to occur in greenhouses in the southern U.S., where high temperatures and the often lack of a host free period, allow the size of mite populations to grow to be rather large. While we cannot say with 100% certainty that this mite will not become an economic pest in commercial rice production and management systems in the U.S., evidence to date suggests it will not. The initial discovery of this mite in 1960, rediscovery in 1993, and second rediscovery in 2007 in the U.S., suggested it will not and that this species has in fact been associated with rice in the U.S. for a very long time. While this mite obviously has the ability to survive in our temperate/semi-tropical Gulf

Coast climate, it obviously does not do well. Evidence suggests the rice panicle mite is a non-pest in climatic regions such as ours.

Over the last 20 years, a number of new or existing plant pathogens, weeds, and insects have appeared on the scene or greatly increased in abundance compared to their historic levels. This has required that our scientists quickly develop management solutions to these new problems. One thing for certain, the insect, weeds, and diseases that are found in managed biological systems will continue to change. I am equally certain that our scientists will be there to address them.

Please keep on sending us your suggestions.

Sincerely,

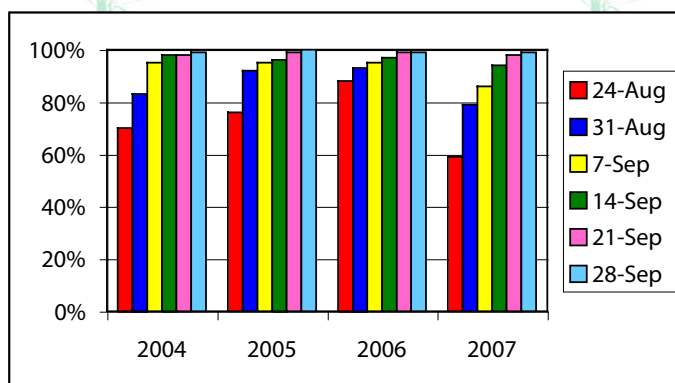
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Rice Crop Update

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