



Texas Rice

AgriLIFE RESEARCH

Texas A&M System

Beaumont, Texas

March 2009 Volume IX Number 1

Summer College Student Interns Make a Difference

The Entomology Project at the Texas AgriLife Research and Extension Center at Beaumont, TX, cooperates with Rebecca Hapes at Texas A&M University and Dr. Richard Harrel and John Louis Bolch at Lamar University in enrolling students in the internship programs offered by their respective institutions. Last spring/summer of 2008, the Entomology Project hired and mentored 3 college interns. These students were: Colleen Menegaz (Fig. 1), Department of Biology at Lamar University; Joe Parish (Fig. 2), Department of Biology at Lamar University; and Tony Brown (Fig. 3), Department of Entomology at Texas A&M University. Each student earned credits for their internship towards their undergraduate degrees, obtained valuable work experience in a field related to their major field, and assisted the Entomology Project in providing relevant pest management information for academic and stakeholder interests. During the internship, the students were trained in the fundamentals of experimental design, data collection and analysis.

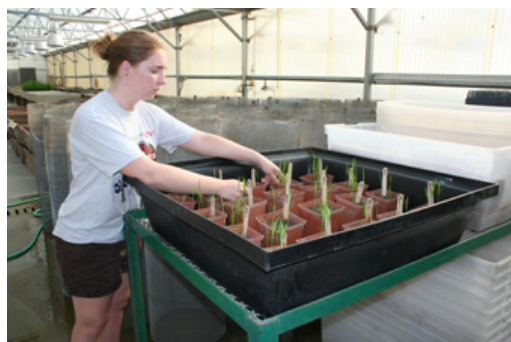


Fig. 1. Colleen Menegaz, currently, is a pre-med major and plans to be a physician.



Fig. 2. Joe Parish, an Army veteran back from Iraq, was enrolled at Lamar University where he graduated with a BS in Environmental Science.

Fig. 3. Tony Brown is enrolled in the Department of Entomology at Texas A&M University, where he will graduate with a BS degree this May. He plans to pursue a PhD in Entomology and eventually work for an agrichemical company.



Study 1. Evaluation of Seed Treatment Control for Chinch Bug and Black Bug

Colleen and Joe were assigned specific field/greenhouse experiments involving three rice seed

Continued on page 6

From the Editor ...

Student Training at the Beaumont Center



Welcome to the March issue of *Texas Rice*. This begins the 8th year of production, with three articles included in this issue. In the first article, Dr. Way describes the summer internship program he helped develop with Dr. Harrel at Lamar University and Rebecca Hapes with the Texas A&M Entomology Department in College Station. In 2008, Dr. Way mentored 3 students on how to conduct research on the management of insect pests of rice. The mentoring program provided each student a glimpse of what is involved with university research. This experience can be invaluable to a young adult who is in the process of deciding their career path. Dr. Way's prominence as our country's leading rice pest management entomologist makes the experience all that much more worthwhile. Dr. Way and our Center also benefit from mentoring young scientists. The inquisitiveness, open questioning by students in the pursuit of knowledge forces our scientists to stay on their toes when designing, implementing, and mentoring each step of a student's project.

If you are interested in attending a Texas university and if you are interested in participating in a summer internship program involving rice research at Beaumont or Eagle Lake, please send an email to one of our Center scientists letting them know which areas of interest you find most fascinating. If the student and one of our scientists "click" and if the scientist has funding, there is a good chance the student will be offered a summer position. Who knows, it might turn out to be a once in a lifetime experience that influences a young person's career path.

The following is a list our Center's Ph.D. level

scientists located at Beaumont and Eagle Lake.

- Ming Chen – Rice Cereal Chemistry and Grain Quality – ming.chen@ars.usda.gov
- Fugen Dou – Integrated Cropping Systems Nutrient Management – f-dou@aesrg.tamu.edu
- Sailaja Koti – Plant Physiology – skoti@aesrg.tamu.edu
- Prabodh Illukpitiya – Agricultural Economics – prabodh@aesrg.tamu.edu
- Xiaobao Li – Agricultural Engineering and Computer Graphics – lxb@aesrg.tamu.edu
- Jiale Lv – Entomology and Systems Modeling – lvjiale@aesrg.tamu.edu
- Garry McCauley – Agronomic, Water, and Weed Management gmccaule@elc.net
- Abdul Mohammed – Plant Physiology – abdulrazack@neo.tamu.edu
- Shannon Pinson – Rice Genetics and Molecular Biology – shannon.pinson@ars.usda.gov
- Omar Samonte – Plant Genetics and Varietal Development – sosamonte@aesrg.tamu.edu
- Dante Tabien – Plant Genetics and Varietal Development – retabien@ag.tamu.edu
- Lee Tarpley – Whole Plant Physiology – ltarpley@ag.tamu.edu
- Yueguang Wang – Molecular Biology – yueguangwang@ag.tamu.edu
- Mo Way – Integrated Pest Management – moway@aesrg.tamu.edu

Continued on page 5

Inside This Issue

*Cover Story: Summer College Student Interns
Make a Difference*

From the Editor	2
Instrumentation for the Study of the Physiological Response of Rice and Other Crops to Global Warming	3
Selection of Parents for Crossing in a Rice Breeding Program Based on Phenotype	8

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.

Instrumentation for the Study of the Physiological Response of Rice and Other Crops to Global Warming

For crop scientists, the biggest challenge is to increase crop production. A 2001 report by the Intergovernmental Panel on Climate Change found that humanity has played an important role in global climate warming. Further increase in global temperature will decrease crop productivity per acreage, thereby increasing demand for global food production. Moreover, as a result of global warming, the nighttime temperatures are predicted to increase more than the daytime temperatures and have been implicated in lowering yields throughout the world [1]. Developing heat tolerant varieties through selection and breeding programs might be one way to maintain current crop yields and to increase future crop production. In order to study the effects of global warming, a method for applying a heating treatment to the plant canopies, which will warm vegetation to the desired temperatures, in the open field or in the greenhouse is needed.

Greenhouses, growth chambers, phytotrons (large walk-in growth chambers), open-top chambers (OTC), and naturally-lit plant growth chambers (known as Soil-Plant-Atmosphere-Research [SPAR] units) are the current available apparatuses to study the effects of high nighttime temperatures and are limited in either the ability to carefully control the elevated temperature, minimize unnatural alteration of other environmental factors, or due to extremely high costs, as with SPAR units. Greenhouses generally have higher humidity, lower wind speed and lower light intensity compared to field conditions [2]. Moreover, it is well known that greenhouse coverings typically transmit only two-thirds to three-fourths of the available sunlight. Similarly, in the artificially-lit growth chambers and phytotrons, plants are subjected to artificial light; however, the

temperature is well controlled [3]. The OTC requires a high rate of ventilation to control temperature and humidity. Many studies have reported higher daytime and nighttime temperatures in the OTC compared to unenclosed areas [4]. The SPAR units, which are sunlit, plexiglass-enclosed environmental chambers, are one of the best in controlling the environmental factors. However, the cost and lack of mobility of these units make them site-specific. In contrast, the use of an infrared heating system does not alter natural environmental conditions, such as light intensity, humidity and wind speed, and can be precise in controlling the set temperatures with minimal perturbation. The concept of using infrared heating for warming the vegetation is not a new concept and was first used by Harte and Shaw in 1995. The use of infrared heating is appealing because it warms the vegetation similarly to normal solar heating and is energetically efficient because it heats the vegetation directly. The concept of Free Air Temperature Increase is based on infrared heating in a controlled fashion, without enclosing the plants [5].

At the Texas A&M University System, AgriLife Research and Extension Center at Beaumont, TX, a plant physiology study was conducted to develop an infrared heating system to provide controlled nighttime temperatures. The heating setup that the study developed and used included 1) infrared heaters, 2) power controllers, 3) i-series temperature controllers, 4) thermocouples, 5) thermocouple wire, 6) an i-server, and 7) i-server software (Fig. 1). Most of the components were obtained from Omega Engineering.

Air temperature in the infrared heating system setup can be set to predetermined temperatures using

Continued on next page

Instrumentation for Global Warming Studies ...

i-Series temperature controllers. In this study, the nighttime temperatures were set at either a constant 80.6°F (ambient) or 89.6°F (hot). When the air temperature is below the set point as determined by the readings from the thermocouple, a signal from the i-Series temperature controller is sent to the power controller, which in turn sends a signal to the infrared

heaters. Upon receiving the signal, the infrared heaters provide short intervals of slightly increased heat output, to raise the temperature to the desired level. If the temperature is above the set point as determined by the readings from the thermocouple, the infrared heating output is reduced for a period.

In this study, the infrared heaters provided stable

nighttime temperatures – the nighttime temperatures averaged 81.1°F at the 80.6°F temperature setting and averaged 89.2°F at the 89.6°F temperature setting (Fig. 2). For most of the time of heat exposure (82%), nighttime temperature was held within 0.9°F. This infrared heating system successfully demonstrated that it can be used in studies that evaluate plant responses to high nighttime temperature. Studies that examine the plant's growth, development, and physiology under high nighttime temperatures or screen germplasm for heat tolerance varieties will find this infrared heating system useful.

Generous funding for the plant physiology projects was provided by the Texas Rice Research Foundation and the Texas Rice Belt Warehouse. For more information, please contact Dr. Tarpley at 409-752-2741 or email at ltarpley@tamu.edu. Furthermore, you may consult the following references:

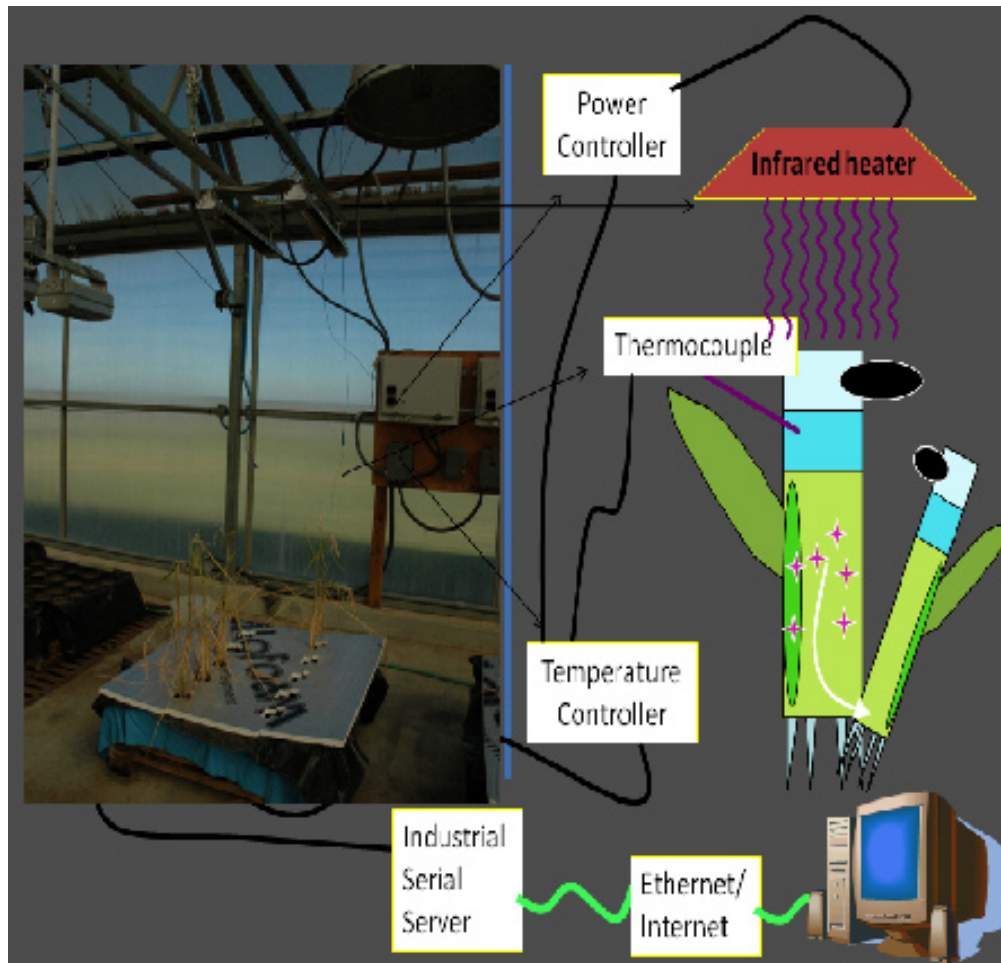


Fig. 1. Infrared heating system setup of the plant physiology project at the Beaumont Center. The thermocouples, which attach to the i-Series temperature controllers by thermocouple wire, are type 'T' grounded-junction probes with Teflon-insulated extensions. The i-Series temperature controller also communicates with the power controller by electrical wire connections and with the i-Server through an RS-485 interface via an RJ45 serial port. The power controllers are connected to infrared heaters by stranded, insulated, nickel-plated copper wire. The i-Server communicates with the Ethernet/Internet via an RJ45 serial port. A COM port connects the Ethernet/Internet and PC. The temperature can be set at predetermined set points using the i-Series temperature controllers, which can be accessed from a remote distance through a PC via the internet and i-Server. This setup allows complex temperature regimes to be programmed.

Instrumentation for Global Warming Studies ...

- [1] Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (Eds). 2001. Climate change 2001: the scientific basis. Contribution of Working Group I of the Third Assessment Report of the Intergovernmental Panel on Climate Change, pp. 555. Cambridge University Press, New York, USA.
- [2] Allen Jr., L.H., B.G. Drake, H.H. Rogers, and J.H. Shinn. 1992. Field techniques for exposure of plants and ecosystem to elevated CO₂ and other trace gases. *Critical Reviews in Plant Sciences* 11: 85-119.
- [3] Thomas, R.B., and B.R. Strain. 1991. Root restriction as a factor in photosynthetic acclimation of cotton seedlings growing in elevated carbon dioxide. *Plants Physiology* 96: 627-634.
- [4] Adros, G., H.J. Weigel, and H.J. Jager. 1989. Environment in open-top chambers and its effect on growth and yield of plants II. Plant responses. *Gartenbauwissenschaft* 54: 252-256.
- [5] Nijs, I., F. Kockelbergh, H. Teughels, H. Blum, G. Hendrey, and I. Impens. 1996. Free air temperature increase (FATI): a new tool to study

global warming effects on plants in the field. *Plant Cell and Environment* 19: 495-502. *

* Article by Dr. Abdul R. Mohammed and Dr. Lee Tarpley, Texas AgriLife Research and Extension Center, Texas A&M System, Beaumont, TX.

From the Editor ...

- Ted Wilson – Plant Physiology, Integrated Cropping Systems Management – lt-wilson@aesrg.tamu.edu
- Dingchun Yan – Plant Pysiology and 3-D Plant Modeling – d_yan@aesrg.tamu.edu
- Yubin Yang – Integrated Cropping System Management and Crop/Pest Modeling – yyang@aesrg.tamu.edu

The second article in this issue of *Texas Rice* described specialized research equipment developed by Abdul Mohammed and his major professor Dr. Tarpley to aid them in their study of whole plant physiology. The authors describe the equipment they used to change the nighttime temperature of the rice canopy. The response of rice to elevated temperatures

provides insight into how rice responds to stress. In a companion set of manuscripts recently written by Abdul and Dr. Tarpley, they determine the potential value of plant growth regulators at alleviating stress caused by high nighttime temperatures, thereby reducing the negative effects of high nighttime temperature on rice yields.

The third article by Drs. Samonte and Tabien and myself provides a general overview of how plant breeders select parent plants used to create new rice varieties. Rice plant breeding involves both narrow

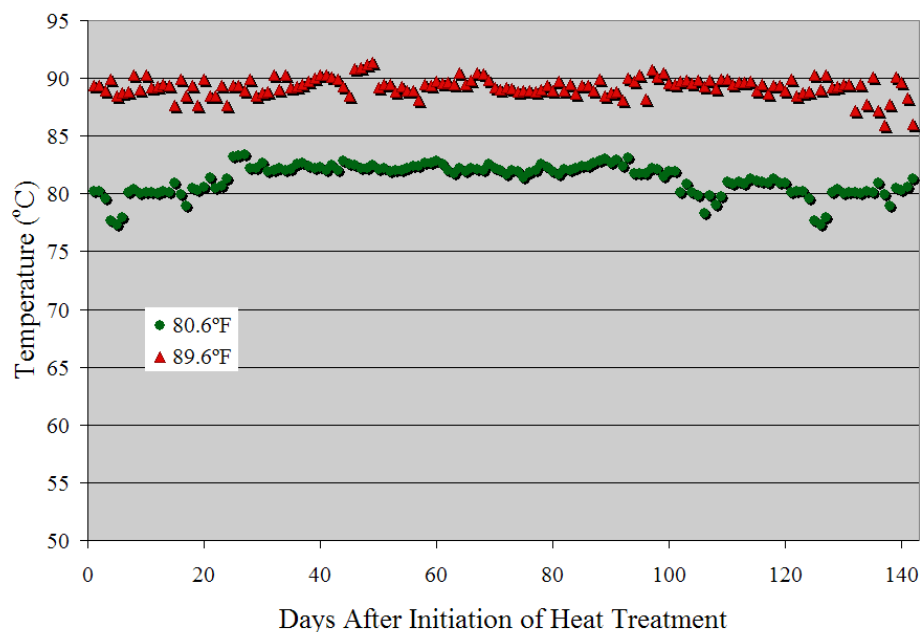


Fig. 2. Stability of air temperatures controlled by the infrared heating system setup at 80.6°F and 89.6°F over at least 125 days.

Continued on next page

From the Editor ...

crosses, where the male and female parents are genetically very similar, and wide crosses where the parents are quite different and may in fact represent different species of rice. For example, if the goal is to improve grain quality in an otherwise high yielding disease resistant variety, the breeder will probably cross a high yielding disease resistant parent with a fairly closely related variety having high grain quality. This might be followed by a number of backcrosses and selection to maintain the high yield and disease resistance, while improving grain quality. Plant breeding research being conducted by Dr. Tabien at Beaumont and Dr. Bill Park at College Station is an example of a wide cross where the goal is to bring desirable traits into commercial rice from distantly related species. Drs. Tabien and Park have crossed *Oryza sativa*, which is the type of rice grown in the U.S., with *Oryza glaberrima*, which is an African species that is genetically very distinct from our cultivated rice. There is evidence to suggest that that *O. glaberrima* can provide rice with genes that afford greater resistance to water stress and promote more aggressive tillering that helps to reduce yield losses due to weed competition.

We hope you find this issue of *Texas Rice* interesting. Keep sending your suggestions.

Sincerely,



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

Summer Student Interns ...

treatment insecticides – rynaxypyr, clothianidin and thiamethoxam. The objective of this study was to evaluate novel insecticide seed treatments for control of the rice seedling insect pests chinch bug (Fig. 4) and black bug (Fig. 5), which can dramatically reduce rice stand if left uncontrolled. The results of one of these experiments were written up and recently submitted to a scientific journal *Arthropod*

Management Tests. Colleen, Joe and Dr. Harrel are co-authors of this manuscript. Basically, Colleen and Joe planted untreated/treated rice in pots, caged the rice in pots with either chinch bugs or black bugs (Family Thyreocoridae) collected from the field and recorded the mortality of the insect pests. The entire report (consisting of materials and methods, results, and discussions) can be accessed through the Beaumont Center Website where the 2008 Entomology Project Annual Report is archived (http://beaumont.tamu.edu/eLibrary/Reports_default.htm). Click on the reports involving chinch bug and black bug. Figures 6 and 7 show the results of the experiments. Basically, rynaxypyr had little effect controlling black bug, while clothianidin was effective. However, both



Fig. 4. Chinch bug (*Blissus leucopterus leucopterus*) infesting rice. Chinch bug adults on seedling rice (left photo). Chinch bug damage on levee rice (right photo). (Photos by Mo Way)



Fig. 5. Black bug of the Family Thyreocoridae. Black bug adult (left photo). Black bug nymph (right photo). (Photos by Becky Pearson)

Continued on next page

thiamethoxam and clothianidin were effective against chinch bug. These results suggest rynaxypyr does not control insects with piercing-sucking mouthparts (both chinch bug and black bugs have these type mouthparts), whereas thiamethoxam and clothianidin do.

Study 2. Rice Varietal Performance in Rice Water Weevil-Treated and -Untreated Plots

Tony helped sample the rice water weevil experiment, process core samples, and harvest plots. The objective of this experiment was to compare rice water weevil populations, and the damage and yield of selected rice varieties that were treated or untreated for this insect pest. He also helped analyze the data (Fig. 8). These data indicate Neptune (a medium grain variety recently released by Louisiana State University), which had high yield potential in the Beaumont area, was very susceptible to rice water weevil. Thus, farmers are strongly encouraged to treat for this insect pest if Neptune is planted. For more details of this experiment, go to the Beaumont Center Website (http://beaumont.tamu.edu/eLibrary/Reports_default.htm) and access this host plant resistance experiment in the annual report above.

In summary, the summer intern program has been a “win-win” situation for the students and the Entomology Project. Not only do the students earn a paycheck, they also earn

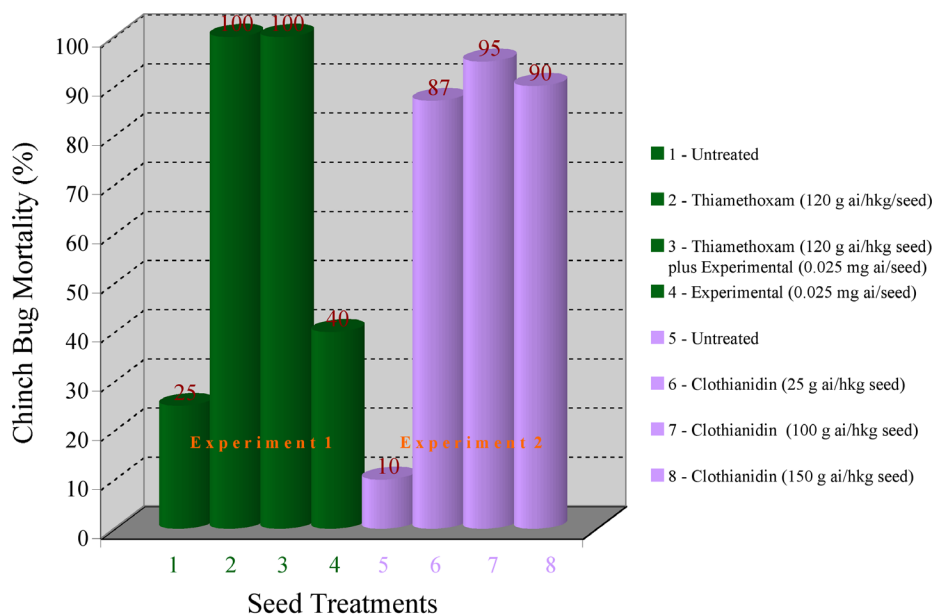


Fig. 6. Evaluation of thiamethoxam (Experiment 1) and clothianidin (Experiment 2) seed treatments for chinch bug control on rice seedlings at Beaumont, TX, in 2008.

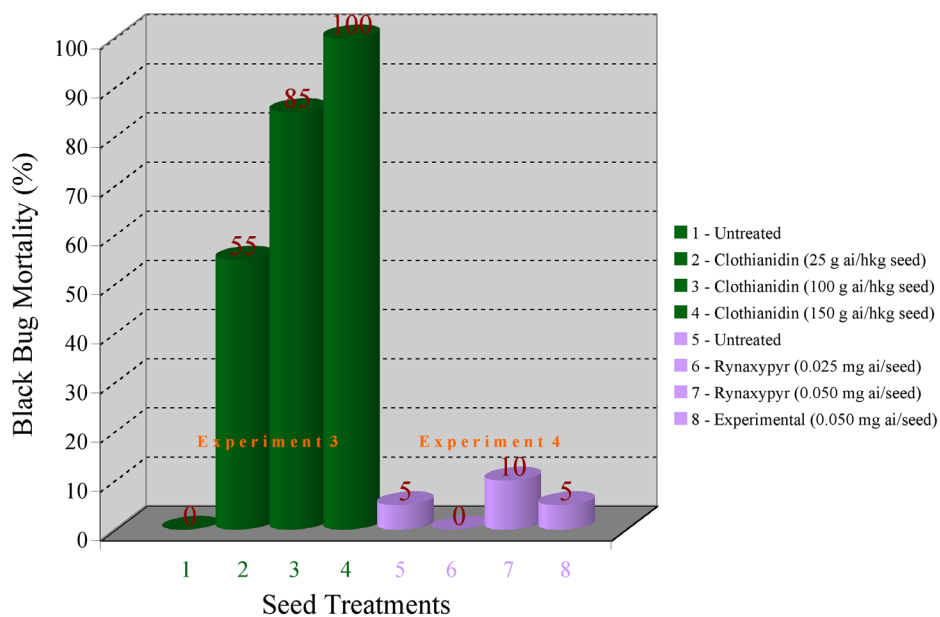


Fig. 7. Evaluation of clothianidin (Experiment 3) and rynaxypyr (Experiment 4) seed treatments for black bug control on rice seedlings at Beaumont, TX, in 2008.

academic credits, participate in hands-on research, and help conduct experiments with potential benefits

to the Texas rice industry. In addition, these students have a vested interest in the research they are involved in (they also work on many other experiments conducted by the Entomology Project), which makes for high quality output! The Entomology Project eagerly seeks more interns for the 2009 and subsequent field seasons. In fact, two interns already have signed on for the 2009 field season! *

* Article by Dr. M.O. Way, Texas AgriLife Research and Extension Center, Texas A&M System, Beaumont, TX.

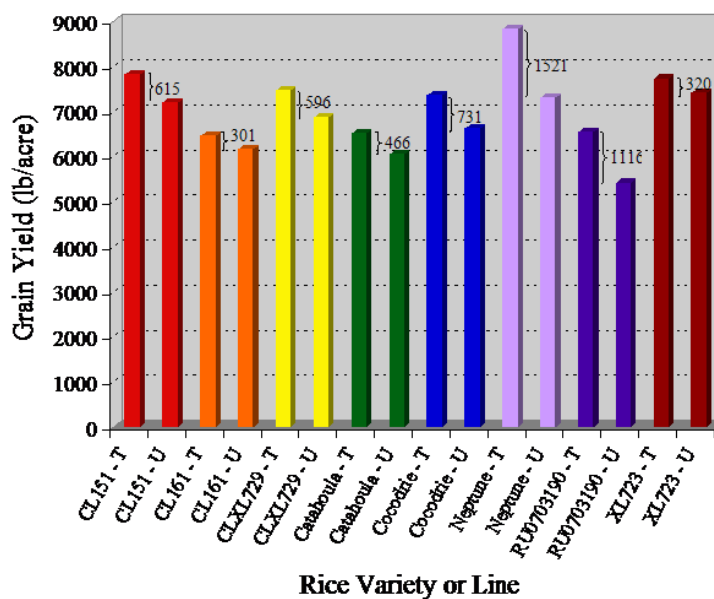


Fig. 8. Grain yield of varieties untreated (U) or treated (T) for rice water weevil using fipronil at 0.05 lb ai/acre at Beaumont, TX, in 2008.

Selection of Parents for Crossing in a Rice Breeding Program Based on Phenotype

The goal of rice breeding programs is to select for varieties that possess the targeted traits for the region and rice culture (e.g. irrigated lowland, rainfed lowland, upland, and deepwater) where they are intended to be grown commercially. In general, these traits usually include high grain yield and resistance to insect pests and pathogens. Varieties can also be bred for specific environments. Salt-tolerant or cold-tolerant varieties enable their successful production in their respective stress environments. But before a breeding program releases these varieties, thousands of rice lines are screened through pedigree and observational nurseries, and hundreds are evaluated in local and multi-location yield trials each year. But where do these thousands of rice lines come from? These lines start from F1 seed (Fig. 1) produced from a cross, it is the product of controlled pollination of a selected female parent by a selected male parent. About 100 to 200 crosses are made each year in most breeding programs. Parental selection in a crossing program is very important to the success of the breeding program. Traits present in the parentals are



Fig. 1. F1 seed of a cross at 30 days after pollination. F1 seed is produced by emasculating the spikelets (removal of anthers of spikelets) of a panicle of the selected female parent and pollinating the emasculated spikelets using pollen from a selected male parent. Selected parents are usually elite lines from the breeding nurseries or yield trials, or U.S. varieties.

Continued on next page

Selection of Parents ...

expected to recombine in the offspring and the best progenies should possess the majority, if not all, of the best traits from both parents. Crosses, therefore, should be made between parents that can serve as donors of the traits targeted by the breeding program. Nowadays, introductions (breeding materials from other countries) are less likely to be released directly as varieties, but these are usually used as parentals to provide useful traits and increase diversity.

Crosses can be intra-specific (e.g. crosses among the subspecies within *Oryza sativa*, such as indica x indica, indica x japonica, and japonica x japonica) or inter-specific (e.g. *Oryza glaberrima* x *O. sativa*). In the U.S., varieties are predominantly japonicas, and crosses in breeding programs are mostly among japonica varieties and elite lines developed by the breeding program. There is also interest in using wild rice such as *O. rufipogon*. At Beaumont, *O. glaberrima* (cultivated rice in Africa) x *O. sativa* crosses are

made to transfer traits not found in *O. sativa* from *O. glaberrima* to *O. sativa* and also to increase the amount of diversity in the breeding program from which to select the targeted variety. There are, however, sterility problems in *O. glaberrima* x indica hybrids, that is, a high proportion of pollen in sterile plants stops developing at an early stage and this decreases seed set [4]. This sterility is due to the presence of S10 sterility allele, and this requires the need to identify the *O. glaberrimas* that do not have the sterility allele, so that when these are crossed with *O. sativa* indicas or japonicas, the hybrids produced are fertile [4]. But regardless of what crosses are made, information about the potential parents are necessary and these are obtained from the research institute or gene bank that provides the seed or by conducting evaluation or characterization nurseries or trials. Some genebanks include the National Plant Germplasm System of the USDA/ARS (<http://www.ars-grin.gov/npgs/index.html>) in the U.S. and the Genetic Research Center (<http://seeds.irri.org/index.php/our-mission>) at IRRI, Philippines.

Table 1. Highest and lowest performing varieties for 20 yield-related traits at Beaumont, TX, in 2005 and 2006.

Trait	Highest Performing Variety		Lowest Performing Variety	
	2005	2006	2005	2006
Plant Height at 34 DAE	Hidalgo	Francis	Trenasse	Dixiebelle
Tiller Density at 40 DAE	Hidalgo	Dixiebelle	Trenasse	Francis
Flag Leaf Length	Wells	Wells	Trenasse	Trenasse
Flag Leaf Width	Hidalgo	Wells	Francis	Trenasse
Flag Leaf Area	Hidalgo	Wells	Trenasse	Trenasse
No. of Days to Heading	Banks	Wells	Dellrose	Trenasse
Flowering Duration	Banks	Wells	Dellrose	Trenasse
No. of Days to Maturity	Banks	Wells	Dellrose	Trenasse
Plant Height at Harvest	Banks	Wells	Trenasse	Dixiebelle
Mass per Main Culm Panicle (MCP)	Banks	Wells	Trenasse	Trenasse
No. of Filled Grain per MCP	Banks	Wells	Trenasse	Trenasse
No. of Unfilled Grain per MCP	Francis	Wells	Hidalgo	Trenasse
No. of Spikelets per MCP	Banks	Wells	Dellrose	Trenasse
Filled Grain Mass per MCP	Banks	Wells	Trenasse	Trenasse
Filled Grain Percentage of MCP	Hidalgo	Dixiebelle	Francis	Wells
Mass per Grain	Hidalgo	Francis	Francis	Dixiebelle
Panicle Type	Trenasse	Trenasse	Hidalgo	Cheniere
Grain Yield	Trenasse	Francis	Banks	Dixiebelle
Total Milled Rice Percentage	Dellrose	Trenasse	Banks	Wells
Whole Milled Rice Percentage	Dellrose	Trenasse	Banks	Wells

In the U.S., high performing long-grain rice varieties are included as checks in the Uniform Regional Rice Nursery (URRN) and serve as a standard for comparison in the release of new varieties. The characterization of these varieties for multiple yield-related traits using genotype x trait analysis assist rice breeders in identifying varieties that perform well for several desirable traits and that are useful as parents of crosses in rice improvement programs. At the Texas A&M University System, AgriLife Research and Extension Center at Beaumont, 17 long-grain rice varieties (Banks, Cheniere, Cocodrie, Cybonnet, Cypress, Dellrose, Dixiebelle, Francis, Hidalgo, L205, Presidio, Priscilla, Saber, Sabine, Spring,

Continued on next page

Selection of Parents ...

Trenasse, and Wells) that were common checks across the 2005 and 2006 URRN at the Texas were observed for 20 traits and analyzed using genotype x trait (GT) biplot analysis [5, 6]. For some traits, it is desired to have high values (e.g. high number of tillers per plant when breeding for high grain yield), while for others, it is desirable to have low values (e.g. early maturity when breeding for early-maturing varieties).

The list of varieties that produced the highest and lowest values for each of the 20 yield-related traits at Beaumont, TX, in 2005 and 2006, are shown in Table 1. Tiller density has a positive direct effect on panicle density and grain yield [1]. The best donors for this trait were Hidalgo and Dixiebelle. For short flowering duration, which was found to be positively correlated with high whole milled rice percentage [3], the best donors were Dellrose and Trenasse. Banks and Wells had the highest numbers of spikelets and filled grain per panicle, respectively. These last two traits have positive direct effects on panicle weight, which in turn has a positive direct effect on grain yield [1, 2]. Trenasse and Francis had the highest grain yields, and Dellrose and Trenasse had the highest whole and total milled rice percentages, respectively. Furthermore, when the GT biplot analysis was used in the combined selection for both high grain yield and high whole milled rice percentage, the top three varieties identified with both traits were Trenasse, Dellrose, and Cocodrie in 2005, and Trenasse, Spring, and Presidio in 2006. Results from studies such as this can be used by rice breeders as a guide in selecting varieties to use as parents in their crossing work to achieve the targeted traits of their breeding program.

For more information, please consult the following references:

- [1] Samonte, S.O.PB., L.T. Wilson, and A.M. McClung. 1998. Path analyses of yield and yield-related traits of fifteen diverse rice genotypes. *Crop Sci.* 38: 1130-1136.
- [2] Samonte, S.O.PB., L.T. Wilson, and R.E. Tabien. 2006. Maximum node production rate and main culm node number contributions to yield and yield-related traits in rice. *Field Crops Res.* 96: 313-319.
- [3] Tabien, R.E., S.O.PB. Samonte, and E.R. Tiongco. 2009. Relationship of milled grain percentages and flowering-related traits in rice. *J. Cereal Sci.* 49: 122-127.
- [4] WARDA. 2002. Breeding for the high-potential irrigated systems. In WARDA Annual Report 2001-2002. [Online] Available at <http://www.warda.org/publications/AR2001/4irrigated%20rice.pdf>
- [5] Yan, W., and I. Rajcan. 2002. Biplot evaluation of test sites and trait relations of soybean in Ontario. *Crop Sci.* 42:11-20.
- [6] Yan, W., and J. Frégeau-Reid. 2008. Breeding line selection based on multiple traits. *Crop Science* 48: 417-423. *

* Article by Dr. Stanley Omar PB. Samonte, Dr. Rodante E. Tabien, and Dr. Lloyd T. Wilson, Texas AgriLife Research and Extension Center, Texas A&M System, Beaumont, TX.

Professor and Center Director: L.T. (Ted) Wilson

lt-wilson@aesrg.tamu.edu

Technical Editor: S.O.PB. Samonte

sosamonte@aesrg.tamu.edu

Texas A&M University System

AgriLife Research and Extension Center

1509 Aggie Drive, Beaumont, TX 77713

(409)752-2741

Access back issues of *Texas Rice* at

<http://beaumont.tamu.edu>

Texas Rice is published 9 times a year by The Texas A&M University System AgriLife Research and Extension Center at Beaumont. Writing, layout, and editing by Lloyd T. Wilson and S. Omar PB. Samonte; with additional support by James C. Medley and Brandy Morace. Information is taken from sources believed to be reliable, but we cannot guarantee accuracy or completeness. Suggestions, story ideas and comments are encouraged.

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



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