Texas Rice

AgriLIFE RESEARCH
Texas A&M System

Beaumont, Texas
March 2008 Volume VIII Number 1

Herbicide Resistance in Weed Populations

Weed resistance to herbicides concerns many sectors of the agricultural community: farmers, advisors, researchers, and the agrochemical industry. The fear exists that in an extreme case of resistance, farmers might suffer economic crop loss and lose a valuable chemical tool that had previously been essential for the effective control of yield-reducing weeds. However, experience has shown that resistance problems are manageable through the integrated use of available weed control technologies. This approach utilizes both cultural methods as well as a diversity of herbicides to prevent further development of resistance.

Effective, reliable, practical and economical management strategies must be devised and communicated to the farmer. To help achieve these goals, the Herbicide Resistance Action Committee (HRAC) fosters cooperation among industry, government researchers, advisors, and farmers, and has provided the following information.

A biotype of barnyardgrass, *Echinochloa crusgalli*, was found to be resistant to the herbicide propanil in Texas.

Definitions

Resistance is the naturally-occurring heritable ability of weed biotypes within a weed population to survive a herbicide treatment that would, under normal use conditions, effectively control that weed population.

Cross-resistance is resistance to two or more herbicides resulting from the presence of a single resistance mechanism. Multiple resistance occurs when resistance to several herbicides results from two or more distinct resistance mechanisms in the same plant.

Resistance Mechanisms

An altered target site may mean that a herbicide no longer binds to its normal site of action (e.g. in acetolactate synthase [ALS] and triazine resistance). Enhanced metabolism means that a resistant plant can degrade a herbicide to non-phytotoxic metabolites faster than a sensitive plant (e.g. various types of fenoxaprop-p-ethyl or 'fop' herbicide resistance in *Alopecurus myosuroides* and in *Lolium rigidum*).

Enhanced sequestration or compartmentalization means that the herbicide is inactivated either through binding (often to a sugar) or is removed from metabolically active regions of the cell, often into a vacuole (postulated for certain types of resistance to fops and paraquat).

Resistance Development

Since resistance is a natural phenomenon, the genes that

Continued on page 4

From the Editor ...

Changes in Texas Rice and in Agriculture

This issue represents the beginning of the 8th year of producing *Texas Rice*. I would like to welcome all of our past readers and any new readers that are just joining us. Several changes have been implemented that impact *Texas Rice*. Beginning with this issue, distribution will be entirely via the internet. Over the past 7 years, the circulation of *Texas Rice* has increased tremendously. *Texas Rice* started in 2001 with ca. 4,000 copies mailed to users, representing 9 issues with ca. 450 copies each. The number of downloads was limited that year because we had only recently added a download feature to the server that housed the electronic copies of *Texas Rice*. In contrast, last year ca. 85,000 copies were downloaded, representing 96.3% of all copies distributed by the Center, with only ca. 3,000 copies distributed by mail. Based on the projected rate of change for the number of downloads, we anticipate ca. 96,000 copies of *Texas Rice* being downloaded in 2008. Had we continued to mail copies, we had projected this number to decrease to around 2,500, with the projected decrease due to an ever increasing number of users gaining internet access.

A fairly large part of the increase in number of copies of *Texas Rice* is from readers accessing older issues. Maintaining access to archived issues provides valuable reference material for interested scientists, producers, and policy makers. As in the past, archived issues can be obtained by going to http://beaumont.tamu.edu/eLibrary/ eLibrary_default.htm. Back issues of *Texas Rice* will also soon be available online from the Texas A&M University Digital Library. We can thank Nancy Duran with the Texas A&M University Library in College Station for suggesting that we provide access in this manner, and Debra Olah at our Center for providing all of the links that enable the Digital Library to access *Texas Rice*. In addition to the copies that can be downloaded from the Center's website, and soon from the Texas A&M University Digital Library, copies of *Texas Rice* can also be downloaded from a number of rice industry websites. In total, it is reasonable to conclude that far greater than 100,000 copies of *Texas Rice* were download from various sources in 2007.

Another major change to *Texas Rice* is the loss of a key support staff position. In late 2000, Jay Cockrell was hired as the Center's Communication Specialist. Jay's primary responsibility was to assist in developing the layout for *Texas Rice*, producing research articles on cutting-edge topics, producing popular articles on rice industry leaders, summarizing current local/national/international news that affect rice producers, and providing monthly Texas crop survey updates (weekly survey results can be downloaded by going to http://beaumont.tamu.edu/CropSurvey/CropSurveyReport.aspx). Jay played an important role, and had hoped to participate in the completion of this issue of *Texas Rice*, but has moved on to a new job. Her enthusiasm will certainly be missed.

Beginning with this issue, Dr. Omar Samonte assumed the role of Technical Editor of *Texas Rice*. Omar received his Ph.D. from Texas A&M University with a focus on rice plant breeding. He is an accomplished scientist and writer and brings with him several years of rice experience. Omar will coordinate the newsletter's production and he will develop many of the research articles, while continuing to spend a major part of his time on rice plant breeding. It is safe to say that *Texas Rice* will benefit in ways that were not previously possible due to Omar's considerable research experience, strong understanding of agriculture, and proven ability to write quality research articles.

The most subtle change to *Texas Rice* can be seen on the first page of this issue. For the first seven years of production, our logo referred to the agency that produced *Texas Rice* as the Texas A&M Uni-

Continued on page 7

Inside This Issue

Cover Story:
Herbicide Resistance in Weed Populations

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.

Seed Treatments for Planting Rice into Cool Soil

Interest in early planting is increasing among U.S. rice producers. Grain yield produced at Crowley, LA, from a March 6 planting is higher by 5 and 10% than when planted on April 9 and 22, respectively, according to research by Dr. Nathan Slaton and his colleagues. With early planting, crop development can often occur before the hottest periods of the rice growing season, and the probability of a favorable season for the ratoon crop is increased. However, cool soil temperatures at rice planting can result in poor germination (both the ability to germinate and the rate of germination) and also in slow plant growth, which sometimes extends into the season. A gibberellic acid (GA) seed treatment is commonly used in the Southern U.S. to stimulate seedling vigor of semi-dwarf rice cultivars. However, the GA treatment can sometimes lead to tall and thin-stemmed seedlings that are prone to lodging in the spring breeze if the GA rates applied are not controlled carefully. My project has been conducting studies to identify plant growth regulator seed treatments that can increase seed germination when the soil at planting is cool without the chance of tall and thin-stemmed seedling growth.

In February to March 2005, 2006 and 2007, seeds were planted 1-inch deep in field soil in pots situated outdoors at the Texas AgriLife Research and Extension Center at Beaumont. Planting was done every 4 to 7 days starting in early February for a number of plantings to promote the chance that at least one planting would be subjected to cool soil conditions. The soil temperature at 1-inch depth was monitored throughout the study.

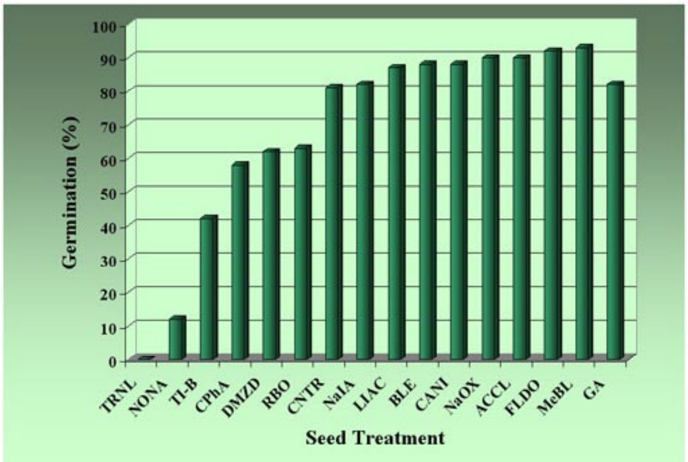
Controlled soil temperature treatments were incorporated into the study in 2007, with the construction and use of a device that cooled the soil. The device chills water to a set temperature and circulates it around potted plants. The pots were constructed from materials that easily transmit heat, but not carbon dioxide and oxygen. This allowed the soil temperature to be controlled without drastically altering its redox potential (a measure of how oxidized or reduced the soil is). This device was situated in the greenhouse to avoid air temperature effects and three soil temperatures were tested: 50ºF, 60ºF, and ambient (avg. 72.5ºF).

The different seed treatments applied to Cocodrie rice seeds included one of several novel plant growth regulators, GA, and the control (no plant growth regulator added). Four to five seeds were planted per pot and there were four to six replicated pots per treatment. Treatments were randomized within planting date or soil temperature. Data recorded included the time to seedling emergence, germination percentage, plant height, number of tillers, and above-ground dry

Continued on next page

Rice seedlings are evaluated under controlled low temperature treatments in the greenhouse.

Seed Treatments continued...



Effect of various seed treatments on rice seed germination percentage in an outdoor potted study, which had an average of 4 planting dates (February to March) at Beaumont, TX, in 2005.

weight at sampling. Each planting was sampled at a set date, and most plants had one tiller at sampling.

In 2005, out of the 16 seed treatments evaluated, five were retained for additional testing, in addition to the GA and "no plant growth regulator added" treatments. Nonanoic acid (NONA), rice bran oil (RBO), sodium hypochlorite (BLE), sodium iodoacetate (NaIA), sodium oxamate (NaOX), triiodobenzoic acid + benzylaminopurine (TI-B), triacontanol (TRNL), chlorophenoxyacetic acid (CPhA), and diaminozide (DMZD) were the treatments eliminated. The primary reason for their elimination from further testing was that their treated seed produced low germination percentage or poor seedling vigor as determined by biomass weight at the 4- to 5-leaf stage. In 2006, the methylene blue (MeBL) treatment was eliminated because of inferior seedling development (too tall). In 2007, a proprietary insecticide was added for testing as a plant growth regulator, and although this insecticide performed well as a growth regulator, repeated testing is still needed. Salicylic acid was also tested for the first time, but it was eliminated because of relatively poor seedling vigor at ambient temperature. After the 2007 controlled-soil temperature study, fluridone (FLDO) was eliminated because of excessive tissue bleaching at the colder soil temperatures. The most promising seed treatments are currently being evaluated in early-planted research plots at the Beaumont Center.

After four rounds of evaluation, two seed treatments (and a potential third one that requires more study) have been identified that provided a germination rate that is at least as high as that of produced by the GA seed treatment when seeds were planted in cool soil (defined as 50ºF or less for the average 3 AM soil temperature over at least the first 10 days after planting), as well as at a constant 60ºF or in relatively warm soil (avg. 72.5ºF). Under these conditions, the two experimental seed treatments also provided as much seedling vigor, as measured by leaf and tiller development, and above-ground plant biomass. Because the seedlings were as vigorous but relatively shorter than those produced by the GA seed treatment, these seed treatments are promising for use in early planting.

Agrochemical-industry research is also underway to develop seed treatments that provide cold tolerance for rice. These will likely complement the treatments that I have been developing, because they are addressing somewhat different chemistries and modes of action. In addition, research is active in developing improved fungicides, insecticides, and seed treatment "packages" for rice. Expect to see the availability of new options for rice seed treatments in the near future. Texas rice producers invest money and time to purchase and plant seed of high-quality cultivars. Please protect your investment by taking advantage of the economical protection afforded by seed treatments.

I appreciate the support of the Texas Rice Research Foundation, and the donation of materials from Valent BioSciences. *

Article by Dr. Lee Tarpley, Texas A&M University, AgriLife Research and Extension Center, Beaumont, Texas.

Herbicide Resistance continued...

determine herbicide resistance may already be present in a weed species before the herbicide is introduced onto the market. For any given weed population, it is currently impossible to predict the occurrence of resistance and its spread, despite the availability of several mathematical models. However, a qualitative estimation of resistance risk can be delivered based on the following factors:

- The initial frequency of the resistance trait can only be predicted if resistance to similar herbicides is already known.

Continued on next page

- Selection pressure depends on several inherent properties of the applied herbicide such as efficacy and specificity of mode of action; properties of the weed such as emergence period, seedbank duration; as well as the utilisation of alternative control measures.
- Population genetics depend on the weed's breeding system, seed production and dispersal.
- Reduced fitness of resistant phenotypes may slow down the development of resistance and allow reversion of populations to sensitive levels if herbicide use is changed. However in many cases fitness is unchanged by resistance (see Tranel, P.J., and T.R. Wright. 2002. Resistance of Weeds to ALS-inhibiting herbicides: what have we learned?. *Weed Science* 50:700-712).

Herbicide Resistant Weeds Summary Table (As of Feb. 27, 2008)

Herbicide Group	Mode of Action	HRAC Group	Example Herbicide	Total
ALS inhibitors	Inhibition of acetolactate synthase ALS	B	Chlorsulfuron	95
Photosystem II Inhibitors	Inhibition of photosynthesis at photosystem II	C1	Atrazine	67
ACCase inhibitors	Inhibition of acetyl CoA carboxylase	A	Diclofop-methyl	35
Synthetic Auxins	Synthetic auxins	O	2,4-D	26
Bipyridiliums	Phososystem-I-electron diversion	D	Paraquat	23
Ureas and amides	Inhibition of photosynthesis at photosystem II	C2	Chlorotoluron	21
Glycines	Inhibition of EPSP synthase	G	Glyphosate	13
Dinitroanilines and others	Microtubule assembly inhibition	K1	Trifluralin	10
Thiocarbamates and others	Inhibition of lipid synthesis - not ACCase inhibition	N	Triallate	8
Triazoles, ureas, isoxazolidiones	Bleaching: Inhibition of carotenoid biosynthesis (unknown target)	F3	Amitrole	4
PPO inhibitors	Inhibition of protoporphyrinogen oxidase (PPO)	E	Oxyfluorfen	3
Chloroacetamides and others	Inhibition of cell division (Inhibition of very long chain fatty acids	K3	Butachlor	3
Carotenoid biosynthesis inhibitors	Bleaching: Inhibition of carotenoid biosynthesis at the phytoene desaturase step (PDS)	F1	Flurtamone	2
Arylaminopropionic acids	Unknown	Z	Flamprop-methyl	2
Nitriles and others	Inhibition of photosynthesis at photosystem II	C3	Bromoxynil	1
Mitosis inhibitors	Inhibition of mitosis / microtubule polymerization inhibitor	K2	Propham	1
Cellulose inhibitors	Inhibition of cell wall (cellulose) synthesis	L	Dichlobenil	1
Pyrazoliums	Unknown	Z	Difenzoquat	1
Organoarsenicals	Unknown	Z	MSMA	1
Total Number of Unique Herbicide Resistant Biotypes				317

From http://www.weedscience.org/in.asp

Incidence of Resistance

At least 300 unique herbicide resistant weed biotypes have been documented worldwide in at least 100 different weed species (see Table). However, the lack of comprehensive survey data means that it is impossible to accurately estimate the areas affected and the economic impact. Only under exceptional circumstances has resistance become a limiting factor for crop production and then only on a local basis within a country or region (e.g. some locations in Australia with resistant *Lolium rigidum* or a few in Europe with resistant *Alopecurus myosuroides*). Generally, there are sufficient alternative herbicides and cultural control measures to ensure that resistant weeds are effectively managed.

Resistance Management Strategies

Herbicide resistance often becomes a problem because of high selection pressure exerted on a weed population over several years. This may be a result of repeated use of the same herbicide or several herbicides with the same mode of action, and this is often associated with crop monoculture and reduced cultivation practices.

The key to resistance management is to reduce selection pressure by using a combination of the following techniques:

- Mixtures or sequences of herbicides with differing modes of action are important especially to prevent or overcome resistance based on target site differences. To be effective, the herbicides used in must have similar efficacy against the targeted weed. If

Continued on next page

the resistance is based on enhanced metabolism, then this technique may also be useful, as the metabolic processes may be specific to certain types of molecules, but field testing is needed to determine the best herbicide combination.

- Crop rotations may allow different herbicides or cultivation techniques to be used and may provide different competitive environments to shift the weed complex. Set-aside programs also allow new opportunities to manage populations of resistant weeds by reducing seed banks and by allowing competition with other weed species.
- Cultivation practices may be adjusted if this fits to general agronomic needs. Measures such as stale seedbeds, plowing or stubble burning (where permitted) can be very effective in reducing weed populations. In some animal production systems, the grazing off of weeds (including the resistant ones) by sheep or cattle may be possible. In some cropping systems it is possible to use mechanical methods of weed control.

A biotype of sedge *Cyperus difformis* was found to be resistant to bensulfuron-methyl in California.

Economic control levels should be the aim, not higher cosmetic levels which increase selection pressure without providing a financial return to the farmer. Generally, the best approach to resistance management is Integrated Cropping Systems Management. This includes the utilization of all available control methods, for weeds and other pest species, in an economic and sustainable manner.

Implementation of Resistance Management

The basic principles of resistance management are similar both in the prevention of resistance in a given population as well as in the limitation of resistance after its first occurrence. However, once problems have been detected, management strategies must be customized to the particular situation.

Over the past several years, there has been a dramatic increase in herbicide resistance in many weed species. For this reason, researchers around the world are working on the problem, looking for answers that go beyond simply rotating herbicide applications.

Dr. Vila-Aiub at the Universidad de Buenos Aires in Argentina has looked at the inheritance of resistance genes. He has found that the appearance of heritable resistance to herbicides in weeds is an evolutionary process driven by human selection. Assuming that spontaneous and random mutations create herbicide resistance genes, which are amplified by selection pressure imposed by herbicides, is the simplest model to understand how this phenomenon appears and increases in weed populations.

The rate of herbicide resistance development is not only determined by the amount of genetic variation within the populations and the selection pressure exerted by herbicides, but also by factors related to genetics, biology and ecology of weeds. The inheritance of the resistance genes, the pollinating systems of the populations, the relative fitness of susceptible and resistant phenotypes, and gene flow processes also control the rate of development.

Dr. Christopher Preston at the University of Adelaide in Australia has found that herbicide detoxification is a factor in many weed populations that show resistance to chemical control. Of the numerous populations of weeds with resistance to herbicides, it appears that most have resistance due to an alteration in the target enzyme. Use of herbicides with alternative modes of action has easily controlled these populations.

In stark contrast are a much smaller number of populations with resistance due to increased rates of herbicide detoxification. These populations may be cross-resistant to herbicides with other modes of action. Such cross-resistance can severely compromise weed control because alternative herbicides may fail

Continued on next page

on their first use.

It is extremely difficult to predict cross-resistance due to increased herbicide detoxification in weed populations and hence, difficult to provide adequate advice to growers on how to avoid or manage the problem. Most commonly, cross-resistance has been selected by certain aryloxyphenoxypropanoate herbicides (such as diclofop-methyl) and phenylurea herbicides (such as chlorotoluron and isoproturon). However, other herbicides can also act as selecting agents for this type of resistance. Illustrative examples from rigid ryegrass in Australia and blackgrass in Europe demonstrate the breadth of the problem and the magnitude of the effort required to understand increased herbicide detoxification as a resistance mechanism.

Recent research work has elucidated the genetic basis of cross-resistance in some populations, but this has so far not provided new predictive tools useful to growers. Despite more than a decade of research aimed at unraveling the complexities of cross-resistance due to increased herbicide detoxification, the management of these cross-resistant populations remains a significant challenge.

As with all great challenges, great minds come together to solve the problem. In this case, the immediate beneficiary would be our farmers, but of course everyone who feeds themselves and their family will ultimately benefit as well. The following references are useful articles for those who are interested in reading more about herbicide resistance:

- Maxwell, B.D., M.L. Roush, and S.R. Radosevich. 1990. Predicting the evolution and dynamics of herbicide resistance in weed populations. Weed Technology 4:2-13.
- Preston, C. 2004. Herbicide resistance in weeds endowed by enhanced detoxification: complications for management. Weed Science 52:448-453.
- Vila-Aiub, M.M., M.A. Martinez-Ghersa, and C.M. Ghersa. 2003. Evolution of herbicide resistance in weeds: vertically transmitted fungal endophytes as genetic entities. Evolutionary Ecology 17:441-456. *

Article by Jaynen Cockrell, formerly with Texas A&M University, AgriLife Research and Extension Center, Beaumont, Texas.

versity System, Agricultural Research and Extension Center at Beaumont. The agency that now produces *Texas Rice* is called Texas AgriLife Research.

Over the past few years, our administration has been debating how best to convey to our clientele the mission and goals of the Texas Agricultural Experiment Station. When the Experiment Station was created many years ago, most of Texas was largely rural. Today, an increasing number of our clientele work and live in cities and do not have a clear understanding of what an Agricultural Experiment Station does. In January 2008, the Texas Agricultural Experiment Station was renamed Texas AgriLife Research. Our sister agency, Texas Cooperative Extension, was renamed Texas AgriLife Extension Service. Our Center was renamed as well and is now called the Texas AgriLife Research and Extension Center. It will take our partners and clientele a while to get used to the name changes, but in the long run it will make it easier to explain to our growers what we do for Texas, U.S., and world agriculture.

From a big picture perspective, the changes to *Texas Rice* are minor, as contrasted with recent changes to commodity prices. Table 1 illustrated this point by summarizing the Chicago Board of Trade (CBOT) July prices for four grain commodities (corn, rice, soybean, and wheat) for 2/22/06 and 2/22/08, and the ratio of the 2008 to the 2006 futures prices. All four of these commodities have seen their prices more than double during the past two years. Two years ago, on February 22, 2006, the CBOT July 06 futures price for rough rice was $8.09. Two years later, the July 08 futures price was $17.22/cwt. This represents a 113% increase in price. Since February 22, the July 08 futures price for rough rice has continued to increase and as of March 14 reached $19.60/cwt. This prices comes very close to validating the August 2006 Bloomberg report forecast that predicted that rice prices would "approach" $20/cwt "within two years".

Why has the price of rough rice increased at a slower rate than observed for the other grain commodities. The lower ratio for rice might suggests that either 1) the other three commodities had relatively suppressed prices in early 2006, therefore the higher ratios, 2) the 2008 rough rice price "July 08" futures

Continued on page 12

Conservation Tillage, Nutrient Management Planning: Top Farmers' Best Management Practices

Nearly 2,000 Farmers Representing 2.5 Million Acres of Cropland Answer Best Management Practices Survey

Farmers are adopting best management practices in record numbers, according to a survey just released by the Conservation Technology Information Center (CTIC, West Lafayette, Indiana) and The Fertilizer Institute (TFI, Washington, D.C.). The survey reached slightly less than 2,000 farmers nationwide to gain a better understanding of environmental management measures on U.S. farms and barriers to adoption. The respondents represent 2.5 million acres of farmed cropland.

"The results of this survey provide us with knowledge of producer practices that will help identify how we can continue to increase adoption rates of best management and conservation practices," said TFI President Ford B. West. "It is satisfying to know that 60% of those surveyed have fully-adopted nutrient management plans and indicators are positive that farmers are using the right nutrient product at the right time, right place and right rate."

Survey respondents had an average of 29 years of farming experience and were typically 52 year-old males. Seventy-five percent of those answering the survey farm a corn-soybean rotation or a corn-soybean-wheat rotation. Seventy-nine percent had at least some college education.

"These survey results show that many farmers are actively engaged in conservation – in fact, conservation tillage was the most adopted practice among row crop producers," said CTIC Executive Director Karen A. Scanlon. "We also have a clear picture about why some producers are not choosing conservation practices. That's important because now we can better address their concerns and work to overcome those barriers."

The comprehensive survey netted great results. The top messages taken from the survey follow:

- Having a conservation plan is a key predictor of additional conservation behavior. More than half of row crop producers who responded to the survey have fully adopted conservation tillage, nutrient management, grassed waterways, and integrated pest management
- Farmers indicated that financial assistance is mostly preferred over education and technical assistance, as related to best management practice adoption. Out of 12 categories evaluated, financial assistance was most preferred in the following six: conservation buffers, GPS yield monitor, irrigation water management, precision agriculture, terraces, and water and sediment control basins.
- The top four respected information sources cited are Cooperative Extension, certified crop advisers, agribusiness, and Natural Resources Conservation Service. Family members and local farming leaders rated amongst the lowest as preferred information sources.
- A positive correlation exists between large-scale farms and adoption of conservation tillage and no-till. The survey also showed that large landowners are more conservation-oriented than small landowners.
- About half of farmer-respondents conducted soil testing according to state recommendations. Economic concerns and time were primary obstacles to testing. Twenty-four percent of corn growers, 23% of soybean growers and 23% of wheat growers cited test costs as their reason for not conducting soil tests.

Based on this nationwide survey, CTIC and TFI anticipate conducting additional surveys that are state- and commodity-specific and with retailers across the country. "This first survey will be used as a starting point in our efforts to better understand farmers' use of nutrient management plans," added West. "As this initiative grows, there's no telling how much information we'll collect that will help us create programs, materials and perhaps legislation to help implement nutrient management plans."

CTIC and TFI worked with the Certified Crop Advisers and the International Plant Nutrition Institute in developing the survey questions. *

Adapted from a press release article of the Conservation Technology Information Center, West Lafayette, Indiana.

Gates Funding to Help Poor Rice Farmers Succeed Amid Climate Change

Rice research community seeks to reach 18 million households with improved rice varieties, increase yields by 50% within 10 years

The Bill & Melinda Gates Foundation announced a grant to International Rice Research Institute (IRRI) for US$19.9 million over three years to help place improved rice varieties and related technology into the hands of 400,000 small farmers in South Asia and sub-Saharan Africa. Farmers are expected to achieve a 50 percent increase in their yields within the next 10 years. IRRI's new project will help develop and distribute improved varieties of rice that can be grown in rainfed ecosystems-where farmers have little or no access to irrigation-and withstand environmental stresses such as drought, flooding, and salinity.

The grant to IRRI was part of a package of agricultural development grants announced by Bill Gates, co-chair of the foundation, at the World Economic Forum in Davos. All of the grants are designed to help small farmers boost their yields and increase their incomes so they can lift themselves out of hunger and poverty.

IRRI will draw on its past success in improving incomes for millions of poor farmers to reach its ultimate goal: more than 18 million households benefiting from improved rice varieties that will generate income increases and help lift farmers out of poverty. IRRI will work closely with other national and international agricultural research centers, including the Africa Rice Center (WARDA). In addition, the project will build the capacity of researchers and seed producers in poor rice-dependent countries.

The success of the Green Revolution in the 1960s and '70s, which sharply boosted production, helped lay the foundation for the economic growth and prosperity in Asia in the two decades that followed. The new funding comes at a vital time for rice farmers, who are now facing major production pressure and rising prices that threaten Asia's continued economic growth.

The project is underpinned by IRRI's new strategic plan *Bringing Hope, Improving Lives*. With its focus on reducing poverty, the plan, which gives fresh impetus to research at the Institute, is now attracting support that will help some of the world's poorest people.

"If we are serious about ending extreme hunger and poverty around the world, we must be serious about transforming agriculture for small farmers, most of whom are women," said Gates. "These investments - from improving the quality of seeds to developing healthier soil, to creating new markets - will pay off not only in children fed and lives saved. They can have a dramatic impact on poverty reduction as families generate additional income and improve their lives."

The grant to IRRI is part of a package totaling $306 million that nearly doubles the foundation's investments in agriculture since the launch of its Agricultural Development initiative in mid-2006. The initiative, part of the foundation's Global Development Program, is focused on a range of interventions across the entire agricultural value chain, from planting the highest quality seeds and improving farm management practices to bringing crops to market. The foundation believes that with strong partnerships and a redoubled commitment to agricultural development by donor- and developing-country governments, philanthropy, and the private sector, millions of small farmers will be able to boost their yields and incomes and lift themselves out of hunger and poverty.

Rice is a staple food for 2.4 billion people and provides more than 20% of their daily calorie intake, and up to 70% for the poorest of the poor. To meet the projected global demand for rice production in the 21st century, the world's annual rice production must increase by nearly 70%, from 520 million tons today to nearly 880 million tons in 2025. With nearly all irrigated rice-growing lands already in production, there is considerable pressure to increase rice yields on rainfed lands.

IRRI's project will target the poorest rice farmers in Africa and South Asia, who have little or no access to irrigation and who are totally reliant on sufficient, timely rains. These farmers are regularly exposed to

Continued on next page

drought, flooding, or salinity conditions that reduce yields, harm livelihoods, and foster hunger and malnutrition. The development and distribution of new rice varieties tolerant of these environmental stresses can help avert hunger and malnutrition while improving livelihoods for millions of farmers and their families. With minimal access to irrigation and fertilizer, these farmers, who own small plots on marginal land, are inevitably the most exposed and most vulnerable to poor soils, too much or too little rain, and environmental disasters.

IRRI Director General Robert S. Zeigler emphasizes that with climate change threatening to worsen the frequency and severity of these problems, the need for insurance, in the form of stress-tolerant crops, is growing ever urgent. “Scientists have been confounded by the challenges of stress tolerance for decades,” said Dr. Zeigler. “But the rice-science community in general and IRRI in particular have recently taken significant steps forward through precision breeding to develop stress-tolerant varieties. As a world-class scientific facility with links throughout the rice-consuming world, we are uniquely positioned to produce crop varieties that can, have, and will benefit the poor.”

A team co-led by IRRI scientists made a key breakthrough in 2006 with the discovery of a gene that allows rice to survive up to two weeks of flooding with minimal yield loss. Varieties without this gene that are subjected to more than a few days of flooding can be completely damaged. The gene, known as *Sub1* (Submergence1), has been bred into several popular varieties, which in the absence of submergence behave exactly as the original variety, and these are already being tested in farmers’ fields in India and Bangladesh.

A United States National Public Radio report in October 2007 visited a field of *Sub1* rice grown by Bangladeshi farmer Gobindra, the only person in his village who planted the seed before an 8-day flood hit and submerged his crop. After the water subsided, his crop recovered and now every other farmer in Gobindra’s village plans on planting the submergence-tolerant variety. A striking time-lapse video showing the relative effects of 10 days of flooding on a *Sub1* rice variety and its nonsubmergence-tolerant counterpart is available at www.irri.org/timelapse.asp.

Even Bangladeshi farmers who were devastated by Cyclone Sidr in November last year - which was so fierce that no rice crop could fully withstand its force - can benefit from new varieties with sufficient tolerance to submergence, salinity, and stagnant flooding. Such varieties can mitigate the immediate effects of severe storms and offer yields that will avert hunger until the next harvest.

Several other major donors have signaled their confidence in IRRI’s research. A series of significant grants has recently come from Japan’s government (US$4.7 million) for flood tolerance in Southeast Asia), Germany’s Federal Ministry for Economic Cooperation and Development in combination with the Eiselen Foundation (US$1.45 million) for salinity tolerance, and the International Fund for Agricultural Development (US$1.5 million) for sub-Saharan Africa, in partnership with the Africa Rice Center.

For information, contact Duncan Macintosh, IRRI, DAPO Box 7777, Metro Manila, Philippines;phone: +63-2-580-5600; email: irrimedia@cgiar.org.

For more information go to:

IRRI Home page (www.irri.org)

IRRI Library (http://ricelib.irri.cgiar.org)

Rice Knowledge Bank (www.knowledgebank.irri.org) *

Adapted from an article by Duncan Macintosh; Source: EurekAlert!

About the Gates Foundation

Guided by the belief that every life has equal value, the Bill & Melinda Gates Foundation works to help all people lead healthy, productive lives. In developing countries, it focuses on improving people’s health and giving them the chance to lift themselves out of hunger and extreme poverty. In the United States, it seeks to ensure that all people-especially those with the fewest resources-have access to the opportunities they need to succeed in school and life. Based in Seattle, the foundation is led by CEO Patty Stonesifer and co-chair William H. Gates Sr., under the direction of Bill and Melinda Gates and Warren Buffett.

Eco-TILLING Detects Herbicide Resistance

A new molecular tool developed by Australian and Japanese researchers is expected to help farmers address what has become one of the major threats to conventional agricultural practices - herbicide resistance.

More than 305 weed biotypes in more than 50 countries have been reported to be resistant to at least one herbicide, and an increasing number of weeds owe their success to their genetic diversity. Scientists say techniques are needed to detect mutations when they first occur, so farmers can test for herbicide resistance in the field and manage weeds accordingly.

A New South Wales (NSW) Department of Primary Industries (DPI) molecular biologist, Dr. Mui-Keng Tan, together with a team of researchers from Japan, investigated a technique called EcoTILLING, which is a new technique of TILLING (Targeting Induced Local Lesions IN Genomes) to determine the extent of natural variation in selected genes in crops. EcoTILLING was found to offer a quick, cheap and reliable means of detecting early signs of herbicide resistance in weeds. Unlike the traditional molecular approach, EcoTILLING uses reverse genetics. Genes are not fully sequenced; instead, mutations in single molecules that make up genes are identified purely on the basis of their position in the genome. Dr. Tan said new mutations can be detected and known ones can be screened for a fraction of the cost of alternative genetic methods. This makes it a powerful, low cost and high throughput alternative to full sequencing.

Dr. Tan has been investigating the technique with Kyoto University's Dr. Guang-Xi Wang, who was funded by the Australia's Grains Research and Development Corporation, at DPI's Elizabeth Macarthur Agricultural Institute at Camden. She says the use of the EcoTILLING technique to test for resistance could help farmers to manage herbicide use in crop rotations more economically and more effectively.

An article on the research in Japan was published in Pesticide Biochemistry and Physiology. *

Adapted from an article by Joanne Finlay, New South Wales DPI, Science and Research Updates.

USDA Regulation of Genetically Engineered Rice

USDA oversight regulations for genetically engineered rice research need to change, according to panelists speaking at the National Alliance of Independent Crop Consultants annual meeting in Seattle.

Emily Pullins, USDA's branch chief, Biotechnology Regulatory Services, and Greg Yielding, U.S. Rice Producers Association, agreed that new rules are needed for genetically engineered (GE) rice research, but he questions whether or not they'll be sufficient to prevent another accidental release of GE rice.

Possible rule changes include stricter record-keeping requirements, according to Pullins, "but we also realized we need to start thinking about the proximity of GE breeding to non-GE breeding. Should we encourage or require that breeding efforts be separated physically? We are pondering this."

The proposed rule changes are to be posted on the Federal Registry in February, for public comment, according to Pullins. To make comments online when new rules are posted, click http://www.gpoaccess.gov/fr/index.html. Panelist Greg Yielding, U.S. Rice Producers Association, Little Rock, Ark., says too much is at stake to not put sufficient resources into regulating GE rice research.

"GE rice is definitely a tool needed by U.S. farmers," Dowdy said. "Our biggest obstacle to acceptance of GE crops is education of the end user and the consumer of the GE product. The stigma applied to GE has got to be changed. We have to move forward. We have to find a way to correct the problems we have."

El Campo, Texas, consultant Dan Bradshaw said, "We need the LibertyLink type of technology because the Clearfield technology could start to break down by crossing with red rice. Once that takes place, red rice will become established and we won't be able to kill those red rice plants with Newpath herbicide. So we need the herbicide technology. These issues need to be resolved where everyone will have confidence in our system." *

Adapted from an article by Elton Robinson, Southwest Farm Press.

From the Editor continued...

Table 1. A Comparison of Summary Statistics for Chicago Board of Trade (CBOT) July Futures Prices for Four U.S. Grain Commodities for 2/22/06 and 2/22/08.

Product	Unit of Measurement	July Futures Prices on 2/22/06	July Futures Prices on 2/22/08	Ratio of Feb 22, 2006 & 2008 July Futures Prices
Corn	Bushel	$2.212	$5.466	2.47
Rough Rice	Cwt	$8.090	$17.220	2.13
Soybean	Bushel	$5.850	$14.526	2.48
Wheat	Bushel	$3.720	$9.864	2.38

price is under valued, or 3) the reduced rate of price increase for rice is a residual effect of the contamination of the U.S. rice with Bayer LL601 that was first reported to the public in August of 2006. Contrasted with corn and soybeans, rice's relatively lower rate could also be due to both of these commodities increasingly being used to produce ethanol and biodiesel. Maybe that's the reason why the rate of increase for both of these commodities is higher than observed for wheat, which in turn is higher than observed for rough rice.

It is difficult to determine which if any of the scenarios listed above was responsible for the lower rate of price increase for rice, but regardless of the cause, the lower rate suggests potential for further short-term increases. Given that the futures price for rough rice has increased an additional $2.38 over the last three weeks, and given that the other four commodities have increased as well, suggests that rice remains under-valued, at this time.

Had the timing of the increase in commodity prices been any later, U.S. agriculture could have been negatively impacted in a major way. Although the increased prices might suggest to some that our producers will make a financial windfall on next year's crop, escalating oil prices over the last three years, culminating in the recent record breaking oil prices, which approached $110/barrel of crude earlier this week, and major increases in fertilizer and pesticide prices, have resulted in extremely rapid increases in production costs. A critical question that each rice producer must address is whether the increased price of rice offsets the increased cost of production. I hope the answer will be yes, but for those whose financing has been maxed out it likely will not. This issue is made that much more complicated for rice producers who farm on lighter soils now having an option of possibly growing beans, sorghum and corn. For those producers who can diversity, more power to them, but for the rice infrastructure it does pose potential challenges.

What would rice prices have to reach to result in a shift of crop acreage towards rice? My prediction is that rough rice prices will have to reach ca. $25/cwt for the rice industry to see a major impact on acreage, assuming fuel, fertilizer and pesticide costs do not increase at an even faster rate and assuming the rate of price increase for competing commodities does not increase at a faster rate either.

Please keep sending me your suggestions.

Sincerely,

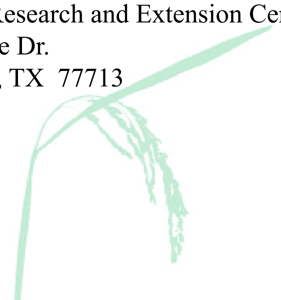
L. T. Wilson

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

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