Texas Rice

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Recent Advances in Insect Management of Rice in Texas

A number of advances in insect control and economic injury levels have been developed for rice in Texas, representing significant changes or additions for the 2009 growing season. While these changes are summarized herein, this article does not replace the more detailed information that will be provided in the next release of the Rice Production Guidelines, which is scheduled for January 2010. A copy of the 2008 issue of the Rice Production Guidelines can be obtained from the following web site http://beaumont.tamu.edu/eLibrary/Bulletins/2008_Rice_Production_Guidelines.pdf. If you would prefer to receive a hard copy, please contact Mo Way (409-658-7394; moway@aesrg.tamu.edu).

Recent Insecticide Regulatory Actions

Dermacor X-100

For the 2008 growing season, Dermacor X-100 (active ingredient rynaxypyr/chlorantraniliprole) was approved for use in Texas under a Section 18 Emergency Exemption. This seed treatment was used on 4,000 acres of rice in Texas in 2008, but under a recently approved Section 18 Emergency Exemption, basically all Texas rice acreage can be treated with Dermacor X-100 in 2009. The target pest for this seed treatment is the rice water weevil. Texas data from several years show Dermacor X-100 provides excellent control of rice water weevil (Fig. 1), as well as stalk borers (sugarcane borer and Mexican rice borer) when applied to seed at the recommended treatment rate for rice seedings (Table 1). Data from 2008 show combinations of seeding and Dermacor X-100 treatment rates less than 0.06 lb ai/acre will compromise control. Data from Texas also suggests Dermacor X-100 controls fly larvae (e.g. South American rice miner) activity. In addition, data from studies by DuPont indicate good activity against fall armyworm. However, results of experiments in Texas show minimal activity against chinch bug or other

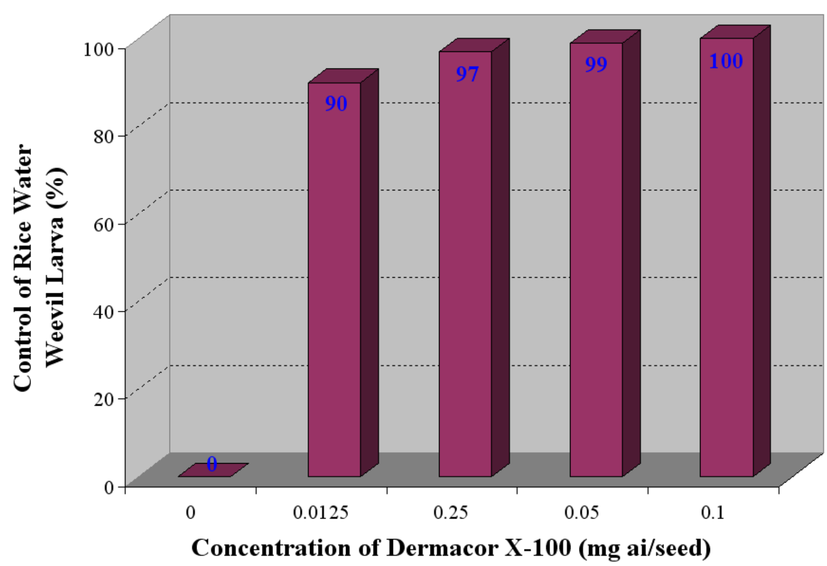

Fig. 1. Control of rice water weevil by Dermacor X-100 in Texas in 2008.

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From the Editor ...

Pest Control and Nitrogen Fertilizer Management Revisited

Welcome to the Winter Issue of *Texas Rice*. Repairs have finally started on the Center buildings damaged during hurricane Ike. The machine shop is the first building being repaired. The outside walls are all up and the ceiling replaced and insulated. Once the ventilation systems and "large" metal doors are in place, it will allow our farm services crew to resume work on field equipment, and it will provide them a warm dry place to work during cold and wet winter and spring days. Once the moldy drywall is replaced inside of the office area, we can fully resume using the building. Repair has started on the entomology/ plant breeding building and will probably be completed before the machine shop is fully repaired. Greenhouse repairs are expected to begin as early as late next week. All of us at Beaumont will be glad when the repairs are completed. Thanks for all the help and funding from Texas AgriLife Research administration in College Station.

This issue of *Texas Rice* contains two research articles; the first by Dr. Mo Way provides an update on some of his current findings with the management of the rice water weevil and the rice stink bug. Dr. Way's efforts have largely been responsible for Texas obtaining Section 18 Emergency Exemption for Dermacor X-100 and Trebon 3G, with emergency exemption for Tenchu 20SG pending. Dermacor provides effective control against the rice water weevil, sugarcane borer, Mexican rice borer, and the South American leafminer. Trebon is effective again the rice water weevil, while Tenchu is effective against the rice stink bug.

In the second research article, Dr. Omar Samonte provides a review of literature that discusses how the composition of reflected light from a rice canopy is related to the nitrogen content of the rice leaves. Dr. Samonte cites an article by Xue and Yang (2008) that shows how fertilizer application rates can be determined based on the characteristics of light reflected by the leaves, with nitrogen deficient plants producing different wavelengths than plants having optimal levels of nitrogen. The authors provide data showing that by using what they refer to as an "N fertilizer optimization algorithm" they can increase the efficiency of nitrogen uptake by 20% and provide a slight yield increase.

While the price of nitrogen fertilizer has eased a bit since its peak in 2008, there remains a considerable benefit for a farmer to strive to optimize the efficiency with which his rice uses fertilizer. The economic savings achieved by a crop producer who uses best management fertilizer practices reoccurs each year and increases as the price of fertilizer increases. To put this in perspective, in 1980, which was a couple of years before rice prices and acreage had almost everyone wanting to plant rice, anhydrous ammonia averaged \$220-229/ton for U.S. farmers (Fig. 1). In 2005, near the front end of the period of rapid increase in fertilizer prices, the cost of anhydrous ammonia averaged \$416/ton. By 2008, the average price of anhydrous ammonia reached \$755/ton, nearly double the price from 3 years earlier and nearly quadruple the price from less than 30 years earlier.

It is not unusual for a high yielding U.S. rice producer to apply 230 lbs of nitrogen per acre. With

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Inside This Issue

Cover Story: Recent Advances in Insect Management of Rice in Texas

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.

Potential for Improving Nitrogen Recovery Through Remote Sensing

In the article Nitrogen Recovery in Rice, which was published in the October issue of *Texas Rice* 2008 (http://beaumont.tamu.edu/eLibrary/Newsletter/2008_October_Newsletter.pdf), several methods to increase uptake of fertilizer N by the rice plant were discussed (split N fertilization, banding and point-placement application, urease and nitrification inhibitors, slow-release fertilizers, and high N recovery genotypes). Site-specific nutrient management (SSNM) for N is another method. SSNM aims to reduce the loss of fertilizer by minimizing fertilization rates to the amounts needed by the plants and by avoiding fertilization when the crop does not require nutrient inputs. In a study by Wang et al. [4], N recovery was higher in SSNM plots (0.29 lb/lb) than in plots (0.18 lb/lb) that were fertilized using farmer fertilization practices, with the former having 30 to 50% less fertilizer N applied. N application rates were adjusted based on N leaf status monitored using SPAD (chlorophyll meter) or LCC (leaf color chart) readings. Site-specific nutrient management for N requires fast, accurate, and nondestructive estimation of N status of the rice crop. SPAD meters [3] can be used to estimate the N status of a single leaf, with several readings performed to achieve an accurate estimate, making its use time-consuming. In contrast, remote sensing of canopy spectral reflectance is used to sample a plant population or crop canopy, making the measurement of a crop's N status quicker than using the SPAD meter.

Reflectance of Leaves for Visible Light and Near Infrared

The reflectance of radiant energy incident to the leaf depends on the wavelength of the radiant energy. There is low reflectance for the visible spectrum of light (near the 400- to 700-nm wavelength region) from vegetation because chlorophyll and other pigments absorb the light, resulting in reflectance peaks to only about 10% at the 550 nm wavelength. This peak accounts for the green color of plants as seen by the human eye. In contrast, there is high reflectance (40 to 60%) for near infrared (NIR, around 800- to 1300-nm wavelength) light because of internal leaf scattering and no absorption of NIR [2].

Relation of Reflectance of NIR and Red to Green Crop Biomass

During the course of a growing season, the reflectance of a rice crop for NIR or red varies depending on green biomass. In general, NIR reflectance of rice over water is directly related to green biomass during the vegetative stage of the growing season. NIR reflectance increases from a low reflectance (7 to 11%) during seedling stage, to about 15% at early tillering, to a maximum of 50% at heading [1]. Post-heading NIR reflectance decreases to about 33% [1] due to leaf structural deterioration caused by advanced leaf senescence [2], death and loss of leaves, and due to an increase in the background water signal through the canopy due to a loss in biomass. In contrast to NIR reflectance in rice canopies, red reflectance is inversely proportional to the green biomass. It decreases from about 10% at seedling emergence to about 2% at flowering, and then increases to about 16 to 18% at maturity due to leaf senescence [1]. The increase in red reflectance from flowering to senescence is due to the deterioration of chlorophyll and the yellowness of rice grain, resulting

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in less absorption of red [1, 2].

Relation of Reflectance to N Accumulation and Concentration in Rice

In a study by Xue et al. [5], spectral reflectance of the plant canopy was measured using a portable ground MSR16 radiometer (instrument to measure radiant energy), the data was recorded using a data logger equipped with sun angle cosine correction capability, and N concentration of leaves was determined using the micro-Keldjahl method. Their results show the NIR/green ratio (R810/R560) is the best index for leaf N concentration, being positively related to leaf N concentration for each growth stage. In contrast, NIR/green ratio is linearly related to leaf N accumulation, independent of growth stage and N treatment [5]. Zhu et al. [7] determined that the normalized difference vegetation index (NDVI) of 1220 and 710 nm is highly correlated with leaf N concentration, while the ratio vegetation index (RVI) of 950 and 660 nm and the RVI of 950 and 680 are the best spectral indices for the estimating leaf N accumulation in rice. NDVI ranges from -1 to +1 and is calculated as NDVI = (NIR – RED)/(NIR + RED), while RVI ranges from zero (no vegetation) to infinity (complete healthy vegetation cover) and is calculated as RVI = NIR/RED, where RED and NIR stand for the spectral reflectance measurements acquired in the red and near-infrared regions, respectively.

Using Reflectance to Estimate of N status and N Fertilization Rate in Rice

Recent studies show the potential application of using rice canopy reflectance in estimating the N fertilizer rates required by the crop in research plots. Leaf N concentration and accumulation are the main indicators of N nutrition status in rice plants, and Xue et al. [5] and Zhu et al. [7] showed that these can be potentially monitored non-destructively and quickly using canopy spectral reflectance. In a study by Xue and Yang [6], grain yields were not significantly different between the standard total N application rate (223 lb N/ac) and a lesser total N rate (148 to 200 lb N/ac), which had its topdressing rate based on rice canopy reflectance. Three methods of estimating topdressing rates were tested - canopy density (LAI), a nitrogen nutrition index (NNI), and a N fertilizer optimization algorithm (NFOA). A nonsignificant trend suggests the NFOA method resulted in higher grain yield than the other estimation methods and the standard N application rate. Furthermore, the NFOA approach without basal fertilization resulted in the highest N recovery efficiency (amount of N taken up per amount of N fertilizer applied), which was 58% compared to 43% for the standard N application rate. Research that investigates and validates the potential of the technology of using canopy reflectance in estimating N fertilizer rates and improving N recovery efficiency are necessary before it can be successfully applied in commercial rice fields.

For more information, please consult the following references:

[1] Casanova D, G.F. Epema, and J. Goudriaan. 1998. Monitoring rice reflectance at field level for estimating biomass and LAI. Field Crops Res. 55: 83-92.

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[7] Zhu, Y., D. Zhou, X. Yao, Y. Tian, and W. Cao. 2007. Quantitative relationships of leaf nitrogen

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Improving N Recovery ...

status to canopy spectral reflectance in rice. Aust. J. Agric. Res. 58: 1077-1085. *

* Article by Dr. Stanley Omar PB. Samonte, Texas AgriLife Research and Extension Center, Beaumont, TX 77713.

Insect Management ...

insects with piercing-sucking mouthparts.

Dermacor X-100 is relatively safe to mammals, birds and fish, but not crayfish. The current Section 18 label prohibits use of Dermacor X-100 in a water-seeded culture. Since Dermacor X-100 is applied as a seed treatment, its drift is minimal compared to liquid formulations that are foliar-applied.

Table 1. Grower guide for Dermacor X-100 seed treatment rates.

Dermacor X-100 (fl oz/100 lb seed)	Seeding Rate (lb/acre)		Active Ingredient (lb ai/acre range)
	Low	High	
1.50	100	120	0.06 – 0.07
1.75	90	100	0.06 – 0.07
2.00	80	100	0.07 – 0.08
2.50	60	80	0.06 – 0.08
5.00	30	40	0.06 – 0.08
6.00	n/a	30	0.07

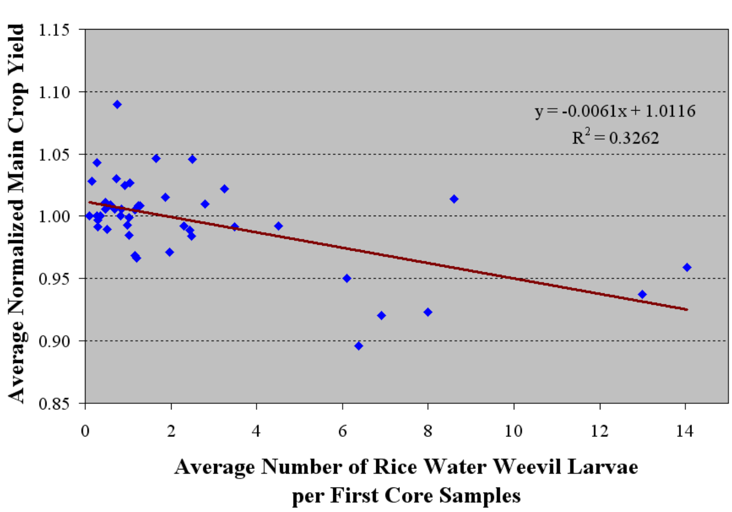

Fig. 2. Relationship between rice water weevil density and main crop grain yield at Beaumont, TX, averaged across 2002 to 2006.

Trebon 3G

This rice water weevil insecticide received a Section 18 Emergency Exemption in 2007, but not in 2008. However, the U.S. Environmental Protection Agency recently approved a full federal Section 3 label, which means Trebon 3G can be used in 2009 and successive years. The active ingredient in Trebon 3G is etofenprox, which is relatively safe to mammals, birds, and fish. The label calls for its application 1 to 7 days after flood at 6 to 9 lb Trebon 3G/acre. The above application rates and timings provide control comparable to other labeled rice water weevil products. Research in Texas also has shown preflood application of Trebon 3G gives good rice water weevil control, but this timing of application is not currently labeled.

Tenchu 20SG

For the 2008 growing season, Tenchu 20SG (active ingredient dinotefuran) received a Crisis Exemption and was applied to about 25,000 acres. The target pest is rice stink bug. A Section 18 Emergency Exemption for use of Tenchu 20SG in 2009 was recently submitted to the Texas Department of Agriculture. At the time of writing, this Section 18 was under review at the U.S. Environmental Protection Agency. Reports from the field and data from Texas indicate 7 to 11 days residual control, which is significantly longer than other labeled products. The submitted recommended rate of application is 7.5 to 10.5 oz/acre (0.094 to 0.131 lb ai/acre). A decision to accept or reject the submission will be made before the 2009 field season.

Economic Injury Levels

Rice Water Weevil

Research in Texas conducted over a 6-year period from 2002 to 2007 using the variety Cocodrie revealed that 1 larva per core (4-

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inch diameter x 4-inch deep soil core containing at least 1 rice plant) reduces yield by about 1%. This relationship is linear, but highly variable (Fig. 2). Thus, given a yield of 7,500 lb/acre, an average of 1 larva per core will reduce yield 75 lb/acre. Ten larvae per core will reduce yield 750 lb/acre. Table 2 shows the economic injury levels for varying rice price and cost of control.

Table 2. Economic injury levels (no. larvae per core† – 4-inch diameter x 4-inch deep plug of soil containing at least 1 rice plant) for rice water weevil.

Estimated Main Crop Yield (lb/acre)	Rough Rice Price ($/cwt)	Cost of Control ($/acre)				
		10	15	20	25	30
5,000	6	4.0	6.1	8.1	10.1	12.1
	12	2.0	3.0	4.0	5.0	6.1
	18	1.3	2.0	2.7	3.4	4.0
	24	1.0	1.5	2.0	2.5	3.0
6,000	6	3.0	4.5	6.1	7.6	9.1
	12	1.5	2.3	3.0	3.8	4.5
	18	1.0	1.5	2.0	2.5	3.0
	24	0.8	1.1	1.5	1.9	2.3
7,500	6	2.4	3.6	4.8	6.1	7.3
	12	1.2	1.8	2.4	3.0	3.6
	18	0.8	1.2	1.6	2.0	2.4
	24	0.6	0.9	1.2	1.5	1.8
8,500	6	2.1	3.2	4.3	5.3	6.4
	12	1.1	1.6	2.1	2.7	3.2
	18	0.7	1.1	1.4	1.8	2.1
	24	0.5	0.8	1.1	1.3	1.6

† Core samples taken 3 weeks after flood

Higher yields and higher rough rice prices mean lower economic injury levels, while higher control costs mean higher economic injury levels. Although these economic injury levels are based on larval densities 3 weeks after flood and current recommended insecticide applications target adults, the relatively low larval densities throughout the table show the importance of controlling rice water weevil.

The varieties CL 151, Clearfield XL729, Catahoula, and Neptune were tested in 2008 and are all rated susceptible to rice water weevil (Table 3).

Table 3. Relative susceptibility of selected rice varieties to rice water weevil.

Very Susceptible	Susceptible	Moderately Resistant
Bengal, Cheniere, CL 121, Cocodrie, Cypress, Francis, and Saber	Bolivar, Catahoula, CL 151, CL 161, CL 131, Clearfield XL730, Clearfield XL729, Dixiebelle, Gulfmont, Jupiter, Neptune, Pirogue, Presidio, Trenasse, Wells, and XL723	Clearfield XL8, Jefferson, Lemont, and Priscilla

Panicle Rice Mite

Although this mite was detected in greenhouses and a few commercial rice fields in Texas in 2007, none was found in 2008. *

* Article by Dr. M.O. Way (Texas AgriLife Research and Extension Center, Beaumont, TX) and Dr. Luis Espino (Rice Farm Advisor, University of California Cooperative Extension, Colusa, CA)

a ton of anhydrous ammonia containing 920 lbs of 'N', which would be sufficient for 4 acres of rice, at a cost of ca. $188/ac. In contrast, in 1980, the fertilizer would cost only $56/ac, ignoring for the moment that farmers applied less 'N' per acre in 1980 than they do now. If best management practices were developed that reduced fertilizer use by 20%, the average savings to a grower would be ca. $38/ac in 2008 (only $11 in 1980). For a rice operation that farms 2,000 acres per year, the savings would be ca. $76,000/yr, which begins to add up to real money. Although more research is needed to determine whether the spectral signature method can be used to develop an "N fertilizer optimization" program for the U.S., the results of Xue and Yang are encouraging and warrant a further look.

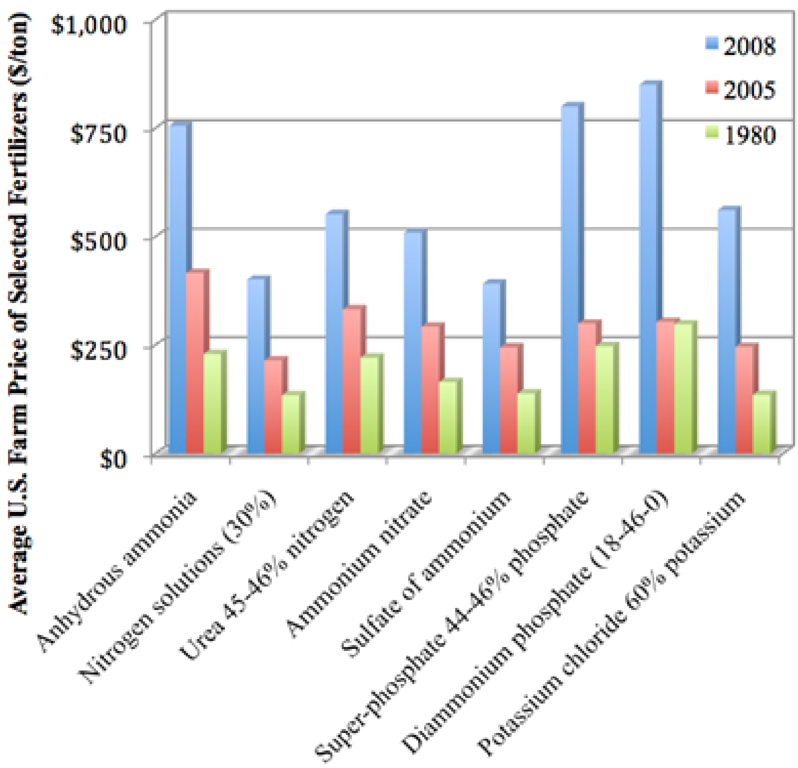

Fig. 1. Average U.S. farm price of selected fertilizers in 1980, 2005, and 2008 (USDA/ERS, 2008).

Please continue to send me your comments and suggestions.

Sincerely,

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