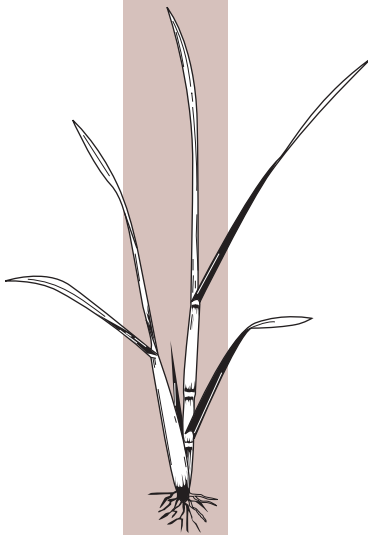


# 2002 RICE PRODUCTION GUIDELINES



# 2002 TEXAS RICE PRODUCTION GUIDELINES

Revisions compiled and incorporated by:  
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These guidelines are based on rice research conducted by Texas Agricultural Experiment Station, Texas Cooperative Extension and United States Department of Agriculture Agricultural Research Service research personnel located at the Texas A&M University Agricultural Research and Extension Center at Beaumont and Eagle Lake. Sections were prepared and reviewed by Dr. Arlen D. Klosterboer, Extension agronomist; Dr. Joseph P. Krausz, Extension plant pathologist; Dr. Lawrence L. Falconer, Extension economist–management; and Dr. David P. Anderson, Extension economist. This cooperative publication, with distribution by county Extension agents–agriculture, was undertaken to provide Texas rice farmers and landowners with the latest production and economic information for the 2001 rice crop. Contributions and manuscript review by Dr. Ted Wilson, Dr. J. K. Olson, Dr. F. T. Turner, Dr. Anna M. McClung, Dr. G. N. McCauley, Dr. Jim Stansel and Dr. M. O. Way are greatly appreciated.

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\*These members are also on the Texas Rice Research Foundation (TRRF) Board.

# TRRF Proposals Funded for 2001-02

**Project Title:** Biology and Management of Stem Borers in the Texas Rice Belt

**Project Investigator:** M. O. Way

**Amount:** \$46,679

**Objective:** The objectives of these experiments and activities are to 1) determine the basic biology of stem borers attacking Texas rice, 2) evaluate promising insecticides emphasizing proper timing, 3) evaluate selected rice varieties for susceptibility to stem borers, and 4) support registration of effective management tools.

**Project Title:** Determining the Physical, Chemical and Genetic Mechanisms of Fissure Resistance

**Project Investigator:** Scott Osborne and Shannon Pinson

**Amount:** \$34,800 for three years; \$11,600 - first year

**Objective:** The overall objective of this project is to create a reliable, effective technique for developing fissure-resistant rice varieties. The detailed objectives of this proposed work involves a systematic approach to overcoming the limitations that currently prevent direct genetic manipulation of rice to increase fissure resistance.

**Project Title:** Development of Improved Breeding Methods and Rice Cultivars for Texas

**Project Investigator:** Anna McClung and Robert Fjellstrom

**Amount:** \$96,485

**Objective:** The objectives for this project are to 1) develop improved conventional and specialty varieties that meet current and future needs of the Texas rice industry using traditional breeding approaches, 2) continue to develop molecular markers associated with milling yield and verify their usefulness in new breeding population, and 3) develop markers that can be used to fingerprint commercial cultivars in quality control of foundation seed fields and determine if outcrosses in seed fields come from other cultivars or red rice.

**Project Title:** Farm Level Analysis for the Evaluation of Farm Policy Options

**Project Investigator:** Richardson and Abner W. Womack

**Amount:** \$75,000

**Objective:** The objective is to assess the local and regional economic implications of farm program safety net modifications on U.S. rice farms and corresponding crop farms. This funding would allow rice-specific issues to be examined in-depth.

**Project Title:** Funding of 2002 Rice Production Guidelines and Rice Update Newsletter

**Project Investigator:** Dale A. Fritz

**Amount:** \$7,687

**Objective:** Rice Production Guidelines—A multi-disciplinary, interagency effort to summarize and present the most recent research and technical information about variety selection, planting, fertility management, weed management, disease management, and insect management. Rice Update Newsletter—To enable rice specialists and researchers to quickly report changing field conditions, regulations, and technology to rice producers during the production season.

**Project Title:** Integrated Ratoon Management System

**Project Investigator:** Garry N. McCauley

**Amount:** \$36,352

**Objective:** The objectives of this project are to 1) determine the degree that tillage, fertilizer management, cutting height, and seed rate affect growth and yield potential of a subsequent ratoon crop and verify the test results in the field, and 2) evaluate the interactions between variety, seeding rate and row spacing under field conditions and define the optimum seeding rate by variety.

**Project Title:** Integrated Weed Management System for Herbicide Tolerant Rice

**Project Investigator:** Garry N. McCauley

**Amount:** \$37,709

**Objective:** The objectives of this project are to 1) develop a management system to control weeds and red rice in commercial production of herbicide tolerant/resistant rice, 2) develop a cultural management system for and evaluate the performance of CLEARFIELD rice lines, 3) develop a cultural management system for and evaluate the performance of Liberty Linked rice lines, and 4) screen rice germplasm for natural tolerance/resistance to different classes of herbicides.

**Project Title:** Physiology Research to Improve Combined First and Second Crop Yield

**Project Investigator:** Lee Tarpley

**Amount:** \$41,514

**Objective:** Quantify carbohydrate and nitrogen allocation and metabolism of the various parts of Cypress variety rice plants from establishment to maturation. Also, quantify the effects of triacantanol and Ryz-Up (a representative gibberellic-acid type plant growth regulator), applied as foliar sprays at late-flowering to early-grain filling of the main or ratoon crop, upon this allocation and metabolism and upon yield of the main and ratoon crops.

**Project Title:** The Physiological Basis for Superior Yield Performance in Texas Rice

**Project Investigator:** L.T. Wilson and Guowei Wu

**Amount:** \$39,710

**Objective:** The objectives of this research are to 1) quantify, through detailed field measurements, primary plant traits for dominant rice varieties grown in Texas, and 2) predict the expected yield performance of the dominant rice varieties and a limited number of advanced Texas breeding lines.

**Project Title:** A Rapid Method for Determining Carbohydrates and Nitrogen at Different Stages of Rice Development

**Project Investigator:** C. Bergman, L.T. Wilson and S.R.M. Pinson

**Amount:** \$12,650

**Objective:** The objectives of this research are to 1) scan the remaining 2,400 samples proposed in 2000, develop additional NIR calibration equations for TNC and N and determine the effect of season, genotype, crop growth stage, and plant structure type on their reliability, and 2) determine whether measurements of TNC and N levels at successively earlier stages of crop growth can reliably predict TNC and N levels at main crop harvest.

**Project Title:** Rice Growth, Development, and Yield Educational Series and Survey for Current Texas Rice Crop Statistics

**Project Investigator:** James W. Stansel

**Amount:** \$40,000

**Objectives:** The objectives of this research are to 1) develop a Rice Growth, Development, and Yield Educational Series to improve rice production efficiencies, enabling Texas rice farmers to compete more effectively in an increasingly complex technological environment, 2) expand the current Texas Rice Crop Statistics survey to provide growers with information on crop develop and rice surplus values, and 3) update the DD50 program to predict crop development on individual fields for producer's management use.

**Project Title:** Screening Potential Rice Varieties and Their Management for Texas

**Project Investigator:** Fred T. Turner

**Amount:** \$46,000

**Objective:** The objectives of this research are to 1) measure each variety's and each advanced experimental line's main and ratoon crop response to plant population, nitrogen rate and sheath blight reaction at two locations on contrasting soil types, 2) identify potential or commercial varieties with best yield and milling when planted beyond the optimum date for ratoon crop production, 3) provide an economic analysis of each variety's main and ratoon crop yield response to location and plant population, 4) identify stand establishment, plant population and nitrogen management principles for each variety, and 5) collect plant development data others can use for developing DD-50 values for predicting critical growth stages and timing inputs of each variety.

**Project Title:** Stem Carbohydrates Research to Expand Ratoon Crop Acreage and Income

**Project Investigator:** Fred T. Turner

**Amount:** \$21,500

**Objective:** The objectives of this research are to 1) determine the interactions between main crop stem TNC, main and ratoon crop disease, fungicide, P and N on ratoon yield when the main crop is harvested 8" to 10" high, and 2) examine the "TNC sampling kits" to provide farmers, consultants and Extension agents a tool for improved ratoon crop yield and consistency.

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# Land and Seedbed Preparation

A. D. Klosterboer

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## Leveling and drainage considerations

Fields for growing rice should be relatively level but gently sloping toward drainage ditches. Ideally, land leveling for a uniform grade of 0.2 percent slope or less provides the following: (1) necessary early drainage in the spring for early soil preparation which permits early seeding, (2) uniform flood depth which reduces the amount of water needed for irrigation, and (3) fewer levees.

## Importance of early land preparation

Timely land preparation is essential for successful rice production. Therefore, plow fields in the summer or early fall. Early land preparation is particularly critical when high residue crops such as grain sorghum or corn are planted the year before rice. If land has been out of production and is grown up in weeds and brush, prepare the land as early as possible. Early land preparation allows several stands of grass and red rice to be killed by surface cultivation before planting.

Early land preparation incorporates the crop residue to assure good decomposition of plant material to prevent early-season nitrogen deficiency. If early land preparation is not possible, decomposition will not be at advanced stages at time of planting. Since the soil's microorganisms (bacteria, fungi, etc.) that decompose crop residue are competing with rice plants for nutrients, particularly nitrogen, the rice plant will show nitrogen deficiency. If this situation arises, an additional 10 to 20 units of nitrogen may be required when the base fertilizer is applied at or near planting.

## Land preparation for rice following soybean production

Planting rice following soybeans usually does not require as much land preparation since the soil is normally left in fairly good condition. It may even be feasible in water-seeded areas, where land is weed-free and firm, to plant rice following minimum tillage (one or two cultivations) of the crop land.

## Seedbed preparation

Seedbed preparation is particularly critical in the coarser-textured soils. The seedbed should be well pulverized and firm to maintain proper moisture conditions for drilling to ensure rapid germination and emergence of the

rice plant. Although seedbed preparation is not as critical in areas where rice is not drilled, it is still important to ensure that the desired soil condition is achieved to allow rapid emergence of the rice plant. In all situations it is important to have a weed-free seedbed.

To reduce costs, minimize the number of times a field is cultivated before planting. Avoid "recreational" passes over the field. Research has shown that fields cultivated five times have about the same average yields as fields more intensely cultivated. The cost of operating large tractors used in rice production means that one cultivation can cost up to \$5 per acre. Therefore, some farmers are adding as much as \$30 per acre to land preparation cost and may not be realizing a corresponding yield increase.

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## Stand Establishment

J. Stansel and F. T. Turner

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Uniform seedling emergence and optimum seedlings per unit area, evenly distributed, are very important to achieving good yields and quality on both main and ratoon crops. Quality of seedbed, level of seed germination, vigor of germinating seedlings, degree of uniform distribution of seed (both in depth and across the field), soil moisture, soil texture characteristics, drainage, and temperature conditions all affect stand uniformity and density. Variability in these characteristics is responsible for the wide diversity in planting methods used across the rice belt. Rice seed germination characteristics also dictate planting methods on some soil types. For example, if rice seed are covered by soil (resulting in low light) and water (low oxygen condition) for extended periods, germination will not occur or will be slow and uneven. These germination restrictions are why seedbed preparation and soil drainage affect stand levels and uniformity. Rice can be drilled to moisture in coarse textured soils but must be planted shallow (or uncovered) on heavier textured soils, requiring rain or irrigation to supply moisture for germination. Most coarse textured soils will crust when drying after being water saturated.

The following are guides to assist farmers in achieving proper stands for high yield and grain quality. Farmers' experience on each field is important in getting economical results. For example, farmers who have been successful in getting good uniform stands consistently have had some success in reducing their seeding rates. However, farmers need to be aware of the hazards of low seeding rates under their conditions before taking such measures.

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# Varieties

A. D. Klosterboer and A. M. McClung

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## Long Grain Varieties

### Very early maturing – reduced height

#### *Bolivar*

Bolivar is a very early maturing, semi-dwarf, long-grain cultivar that has superior canning and processing quality like Dixiebelle. It is earlier maturing and taller than Dixiebelle. Bolivar has better resistance to blast and has lower yield losses from infection by sheath blight as compared to Dixiebelle. Bolivar has a larger grain size and slightly lower whole grain milling yields than Dixiebelle.

#### *CL121*

CL121 is a very-early, semi-dwarf, long-grain variety that provides good yield potential. It displays characteristics similar to Cocodrie but is shorter and 5-8 days earlier to maturity. Milling results are very good. CL121 appears susceptible to sheath blight and blast but is moderately resistant to straight-head. Performance indicates good adaptability across the entire southern rice growing area with excellent second crop potential.

#### *Cocodrie*

Cocodrie was developed by Louisiana State University from a cross of Cypress/L202/Tebonnet. It is a semi-dwarf, long-grain variety that has a maturity similar to Jackson. Main crop, ratoon crop and milling yields have been similar or better than Gulfmont. It has improved blast resistance similar to that of Jefferson. Sheath blight is better than Gulfmont and Cypress but less than Jefferson. Like Cypress, it is more susceptible to panicle blight than Jefferson and Gulfmont.

#### *Jefferson*

Jefferson is a very early-maturing, semi-dwarf, long-grain variety. Main crop yields of Jefferson are similar to those of Cypress and greater than Gulfmont. Jefferson's ratoon yield is greater than that of Gulfmont. Due to its earlier maturity, the likelihood of harvesting a second crop is greater. Milling yields are similar to those of Gulfmont but slightly less than those of Cypress. Seedling vigor of Jefferson is similar to other semi-dwarf varieties such as Lemont and Gulfmont, but not as strong as Cypress. Jefferson's grain is about 5 to 10 percent larger than Lemont and 15 percent larger than Cypress. Due to its earlier maturity, it may develop fewer tillers than later maturing varieties. Therefore, seeding rates of Jefferson may need to be increased to achieve adequate panicles per unit area. An important advantage of Jefferson is its disease resistance. It has the best combination of blast and sheath blight resistance of any semi-dwarf rice variety.

### Early maturing – reduced height

#### *Cypress*

Cypress is an early-maturing semi-dwarf variety. It was developed from the cross L202/Lemont by the Louisiana Agricultural Experiment Station. It is slightly taller than and has maturity similar to Lemont. Cypress has excellent seedling vigor for a semi-dwarf variety. It is moderately resistant to blast but very susceptible to sheath blight. It is more susceptible to panicle blight than Jefferson and Gulfmont. Field results from growers indicate that Cypress has better and more stable yield and milling quality than Lemont and Gulfmont.

#### *Dixiebelle*

Dixiebelle is an early-maturing, semi-dwarf, long-grain variety. In addition to conventional long-grain characteristics, Dixiebelle has special qualities, like Rexmont, that make it preferable for the canning and parboiling industry. It is a significant improvement over its predecessor Rexmont in many agronomic characteristics. Yield of Dixiebelle is superior to that of Rexmont and intermediate to that of Gulfmont and Cypress. Dixiebelle has excellent milling yield and is intermediate to Cypress and Gulfmont. It is slightly less susceptible to sheath blight than Lemont and similar to Lemont for blast resistance. Ratoon yield is intermediate to Gulfmont and Cypress.

#### *Gulfmont*

Gulfmont is a semi-dwarf long-grain variety that is similar to Lemont in all aspects except that it is 3 or 4 days earlier in maturity in the main crop and as much as a week earlier in the ratoon crop. Because of the earlier maturity, it is better for ratoon cropping than Lemont.

#### *Lemont*

Lemont is an early-maturing, long-grain, semi-dwarf variety with very high main crop yielding ability and superior milling potential. When seeded early, it can produce good ratoon yields. Lemont has moderate field resistance to blast and is moderately resistant to straighthead. It is very susceptible to sheath blight.

#### *Madison*

Madison is an early-maturing long-grain variety that was developed from a cross of Lemont and Katy. It has a plant type like Lemont but improved resistance to blast and sheath blight diseases like Katy. Madison is a lodging resistant semi-dwarf plant type that has the same excellent blast resistance that is found in the conventional height varieties Drew and Kaybonnet. It is similar to Cypress in maturity. Main crop yields have been better than Gulfmont but ratoon yields and milling quality have been similar to Gulfmont.

#### *Priscilla*

Priscilla is an early-maturing long-grain variety developed by Mississippi State University from a cross of L201/Tebonnet/Bellmont. It is taller than most semi-dwarfs but not as tall as the conventional height varieties.

Its maturity is similar to Cypress. Main crop and ratoon crop yields have been better than Gulfmont, but milling yields have been less. Priscilla has improved resistance to sheath blight similar to Jefferson, but blast resistance is less than most common commercial long grains.

### ***Saber***

Saber is a conventional long-grain cultivar released from the Texas program in 2001. It was developed from the cross Gulfmont/RU8703196/Teqing. It is a semi-dwarf cultivar similar in height to Cypress and similar to Gulfmont in maturity. Main crop yields of Saber are similar to Gulfmont, but ratoon crop yields have been superior. Milling quality has been the same as Cypress. Saber possesses improved resistance to blast that is comparable to Jefferson and improved resistance to sheath blight that is better than most commercial cultivars.

### ***Wells***

Wells is a long-grain variety that was developed by the University of Arkansas from a cross of Newbonnet/3/Lebonnet/CI9902//Labelle. It averages 2 inches taller than Cypress and is similar in maturity to Gulfmont. It has a higher main crop yield than Gulfmont or Cypress and also has good ratoon crop potential. The milling yield of Wells averages 4 percent lower than Gulfmont. It has blast resistance similar to Gulfmont and Cypress; sheath blight resistance is slightly better.

## **Conventional height**

### ***Drew***

Drew is an early-maturing, long-grain, conventional height variety, taller than Kaybonnet. It was developed from the cross Newbonnet/Katy by the University of Arkansas. It has high yield potential and excellent milling yields similar to Kaybonnet. It is slightly taller than Kaybonnet, but in Arkansas it is reported to be more resistant to lodging than Kaybonnet. It is also slightly later than Kaybonnet. Drew has the same excellent blast resistance as Kaybonnet and is moderately susceptible to sheath blight like Kaybonnet.

### ***CL141***

CL141 is a very early long-grain variety that provides good yield potential. It most resembles Drew in appearance but reaches maturity and 50 percent heading 6-10 days earlier. Lodging potential and seedling vigor are similar to Drew. Milling results are very good. CL141 appears very susceptible to sheath blight, susceptible to blast, but moderately resistant to straighthead. Preliminary results indicate excellent second crop potential due to its earliness and yield.

## **Medium Grain Varieties**

### ***Bengal***

Bengal is an early-maturing, reduced height, medium grain variety. It is about 10 inches shorter than Mars. Yields of Bengal are higher than those of other currently grown medium grain varieties. Milling yields are very

good and comparable to those of Mars. It has a larger grain size than other medium grains. Bengal is moderately resistant to blast and to sheath blight but susceptible to straighthead.

### ***Lafitte***

Lafitte is an early-maturing, reduced height, medium grain variety developed by the Louisiana Agricultural Experiment Station. It has good yield potential and milling yield similar to Bengal. However, Lafitte has better blast resistance than Bengal and is about 5 days earlier in flowering. It is taller than Bengal and also more susceptible to lodging. The grain size of Lafitte is not as large as that of Bengal.

## **Specialty Rices**

### ***Della***

Della is an aromatic long-grain which, like Dellmont, is dry and flaky when cooked. It has lower yield and milling yield than Dellmont and Gulfmont. It is very tall and very susceptible to lodging. Della is susceptible to blast and moderately resistant to sheath blight.

### ***Dellmont***

Dellmont is essentially the same as Lemont in all respects except that the grain is aromatic (scented). It was developed from backcrosses of Della and Lemont and has the same aroma as Della. Aromatic varieties cannot be co-mingled with other non-scented varieties. Unless they have an assured market, producers should not grow aromatics. Dellmont has much higher yield potential than Della and better whole-grain milling yields. In respect to disease reaction and lodging resistance, Dellmont is similar to Lemont. Dellmont differs from the aromatic variety Jasmine 85 in cooking quality. When cooked, Dellmont is dry and flaky like typical U.S. long-grain varieties, whereas Jasmine 85 is a softer rice, similar to U.S. medium and short grain varieties.

### ***Dellrose***

This cultivar was developed from a cross between Lemont and Della by the Louisiana Agricultural Experiment Station, and it has the same aroma and cooking quality as Della and Dellmont. It has an intermediate height and is about 5 inches taller than Dellmont. Dellrose is very early-maturing, similar to Della, and has greatly improved yield and milling quality. Blast and sheath blight resistance are similar to Dellmont.

### ***Jasmine 85***

Jasmine 85 is an aromatic rice possessing the flavor and aroma of the fragrant rices of Thailand. It is a long-grain variety, but the cooked grains are soft and sticky. Under good management, Jasmine 85 has excellent yielding ability. The milling yields of Jasmine 85 are lower than other southern U.S. long grain varieties. It is about 2 weeks later in maturity than Lemont and is a hairy type. It is tall and susceptible to lodging. Jasmine 85 seed appear to have some level of dormancy and may volunteer in following years.

## Rice Grower Main Crop Yield and Quality Results of Predominant Varieties Produced in Texas

Variety	2001						2000					
	Number of fields reported	Reported acres	Yield lbs./acre	Milling yield %H	Milling yield %T	Grade	Number of fields reported	Reported acres	Yield lbs./acre	Milling yield %H	Milling yield %T	Grade
Cocodrie	234	25,321	6,548	61	70	2	149	14,631	6,919	60.2	70.7	1.7
Cypress	60	6,520	5,706	63	70	2	164	18,635	6,138	60.7	70.0	1.5
Gulfmont	8	1,088	5,367	52	67	3	14	1,388	6,256	54.4	69.5	1.7
Jefferson	9	859	5,228	56	68	2	18	2,211	6,382	54.3	67.6	2.0
Lemont	15	1,418	4,847	56	68	2	48	4,853	5,701	54.7	69.3	1.8
CL121/141	7	622	6,442	65	71	2						
CFX 18	22	971	7,035	66	71	2						
Saber	5	227	6,856	64	70	2						
Wells	4	239	6,446	57	72	2						
Total:	364	37,265					415	43,368				
Weighted Av.:			6,283	61.0	69.8	2.0			6,343	59.2	70.0	1.6

Compiled by Cynthia Tribble, Robin Clements, and Jim Stansel, TAES-Beaumont  
 Data are compiled from Texas rice belt grower reports, rice dryers and marketing offices.  
 All yields are adjusted to 12 percent moisture.

**2001 Texas Rice Acreage by Variety**

County	2000 Acreage	2001 Acreage	Long grains								Other*		
			Cocodrie	Cypress	Jefferson	Gulfbmont	Lemont	CL 121	Dixiebelle	Wells			
<b>East zone</b>													
Brazoria	17,363	15,279	13,933	135	220	0	145	615	0	0	231		
Chambers	11,432	13,428	10,780	1,373	118	355	1116	0	288	0	408		
Galveston	1,360	768	768	0	0	0	0	0	0	0	0		
Hardin	1,093	801	801	0	0	0	0	0	0	0	0		
Jefferson	18,519	18,575	12,571	2,593	388	1,726	0	991	0	0	306		
Liberty	8,740	12,705	10,763	389	251	0	1,282	0	0	0	20		
Orange	531	354	89	0	0	0	0	0	0	0	265		
<b>East Total</b>	<b>58,838</b>	<b>61,920</b>	<b>49,705</b>	<b>4,490</b>	<b>977</b>	<b>2,081</b>	<b>1,543</b>	<b>1,606</b>	<b>288</b>	<b>0</b>	<b>1,230</b>		
<b>Northwest zone</b>													
Austin	2,435	2,601	1,242	321	1,038	0	0	0	0	0	0		
Colorado	31,336	32,110	24,271	5,417	1,686	321	0	383	0	0	32		
Harris	2,957	1,975	1,975	0	0	0	0	0	0	0	0		
Lavaca	2,523	1,746	1,425	120	201	0	0	0	0	0	0		
Waller	6,206	6,951	6,343	0	0	0	0	0	0	0	608		
Wharton	52,205	50,520	31,150	10,318	6,009	500	1,230	331	0	250	732		
<b>Northwest Total</b>	<b>97,463</b>	<b>95,903</b>	<b>66,406</b>	<b>16,176</b>	<b>8,034</b>	<b>821</b>	<b>1,230</b>	<b>714</b>	<b>0</b>	<b>250</b>	<b>1,372</b>		
<b>Southwest zone</b>													
Calhoun	1,568	1,468	1,070	267	73	529	29	0	0	0	0		
Ft. Bend	8,894	8,652	7,788	0	677	0	0	0	20	0	167		
Jackson	16,208	14,953	8,677	4,696	974	32	483	0	0	91	0		
Matagorda	23,036	24,958	16,930	3,874	1,978	777	55	0	1,023	111	210		
Victoria	1,937	1,977	1,277	75	625	0	0	0	0	0	0		
<b>Southwest Total</b>	<b>51,643</b>	<b>52,008</b>	<b>35,742</b>	<b>8,912</b>	<b>4,327</b>	<b>838</b>	<b>567</b>	<b>0</b>	<b>1,043</b>	<b>202</b>	<b>377</b>		
<b>Northeast zone</b>													
Bowie	1,600	1,435	951	214	0	0	0	0	0	270	0		
Hopkins	1,470	1,473	1,473	0	0	0	0	0	0	0	0		
Red River	1,100	965	724	0	0	0	0	0	0	241	0		
<b>Northeast Total</b>	<b>4,170</b>	<b>3,873</b>	<b>3,148</b>	<b>214</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>511</b>	<b>0</b>		
<b>2001 Total acreage</b>		<b>213,704</b>	<b>155,001</b>	<b>29,792</b>	<b>14,238</b>	<b>3,740</b>	<b>3,340</b>	<b>2,320</b>	<b>1,331</b>	<b>963</b>	<b>2,979</b>		
<b>2001 Percentage</b>		<b>100.0%</b>	<b>72.5%</b>	<b>13.9%</b>	<b>6.7%</b>	<b>1.8%</b>	<b>1.6%</b>	<b>1.1%</b>	<b>0.6%</b>	<b>0.5%</b>	<b>1.4%</b>		
<b>2000 Total acreage</b>	<b>212,113</b>		<b>71,323</b>	<b>94,412</b>	<b>15,856</b>	<b>7,856</b>	<b>10,943</b>	<b>5</b>	<b>600</b>	<b>0</b>	<b>2,118</b>		
<b>2000 Percentage</b>	<b>100.0%</b>		<b>33.6%</b>	<b>44.5%</b>	<b>7.5%</b>	<b>3.7%</b>	<b>5.2%</b>	<b>0.0%</b>	<b>0.3%</b>	<b>0.0%</b>	<b>1.0%</b>		

Compiled by Dr. James Stansel, Cynthia Tribble and Robin Clements, Texas A&M University System at Beaumont. Survey data from dryers, sales offices, agribusiness, USDA/CFSA and county Extension agents as appropriate. \*Other varieties include: CL 141, Saber, Maybelle, XL 6&8, RT1008, Texmati, Jasmine 85, Risotto, and Bengal (medium grain).

**Variety Information Update for 2002 Production Guidelines:** The table below provides a comparison of various characteristics of several rice varieties based upon experimental plot data. All varieties are *compared with Lemont* for main crop yield, ratoon crop yield and milling yield.

Variety	Maturity	Height (inches)	Main crop yield	Ratoon crop yield	Milling yield	Blast	Sheath blight
Bolivar	Very early	37	Similar	Higher	Lower	R	MS
Jefferson	Very early	37	Higher	Higher	Similar	R	MR
Cocodrie	Very early	38	Higher	Higher	Similar	R	VS
CL121	Very early	37	Similar	Higher	—	S	S
CL141	Very early	43	Similar	Higher	—	S	VS
Dixiebelle	Early	34	Similar	Higher	Higher	MS	MS
Gulfmont	Early	36	Similar	Higher	Similar	MR	VS
Lemont	Early	36	—	—	—	MR	VS
Wells	Early	39	Higher	Higher	Lower	MR	MS
Cypress	Early	38	Higher	Higher	Higher	MR	VS
Madison	Early	35	Similar	Similar	Similar	R	MS
Drew	Early	44	Higher	Similar	Similar	R	MS
Priscilla	Early	40	Higher	Higher	Lower	MS	MR
Saber	Early	38	Similar	Higher	Higher	R	MR
Lafitte (M)	Early	38	Higher	Similar	Similar	MR	MR
Bengal (M)	Early	36	Higher	Similar	Similar	MR	MR
Dellrose (A)	Very early	41	Similar	Similar	Higher	MR	S
Della (A)	Very early	52	Lower	Lower	Lower	S	MR
Dellmont (A)	Early	36	Lower	Similar	Lower	MR	VS
Jasmine 85 (A)	Late	43	Higher	Similar	Lower	R	R

Disease Reaction: **VS** = very susceptible; **MS** = moderately susceptible; **S** = susceptible; **MR** = moderately resistant; **R** = resistant; **(M)** medium grain variety; **(A)** aromatic.

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## Planting Dates

A. D. Klosterboer, F. T. Turner and J.W. Stansel

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Optimum planting dates vary with location. They range from March 15 to April 21 in the western area and from March 21 to April 21 in the eastern area. However, planting after April 15 reduces ratoon crop potential and is not recommended when the 4-inch daily minimum soil temperature falls below 65 degrees F. The 4-inch minimum soil temperature is an indicator of residual heat in the soil, which is very important for normal seed germination and seedling growth. The 4-inch soil temperatures are available daily on week days at the Research and Extension Center at Beaumont, (409) 752-2741, and Western Area Operations headquarters at Eagle Lake, (979) 234-3578. Your county Extension agent will also have access to these soil temperatures.

Varieties with low seedling vigor should not be planted before the recommended planting dates and soil temperatures. They are more susceptible to environmental hazards, such as disease, cool temperature and salt damage associated with planting too early in the stress growing season.

Planting earlier than March 15 can result in good yields but higher production costs. These costs are associated with greater nitrogen requirements because of poor or reduced nitrogen utilization, under cool conditions greater water needs due to additional flushings, and greater herbicide cost due to the difficulty of controlling weeds and the longer time until permanent flood. In addition to higher production costs, plantings made before March 15 can lead to reduced stands from seedling diseases and salt accumulation at the soil surface following cold, drying winds.

Planting after the optimum planting dates reduces the opportunity to produce high yields. It has been estimated that a 5 percent reduction in first crop yield can be expected for each week's delay in planting after April 21.

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## Seeding Rates

A. D. Klosterboer and F. T. Turner

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Uniform stands of healthy rice seedlings pave the way to a productive rice crop. The desired plant population of 15 to 20 seedlings/ft<sup>2</sup> (9-12 seedlings/7 inch drill row foot) can generally be achieved by drill-seeding 70 to 90 pounds of rice seed per acre the first week of April. Lower seeding rate and plant populations (15 seedlings/ft<sup>2</sup>) are preferred when planting high-tillering varieties like Cypress and Jasmine 85 and when disease pressure is expected to be high after canopy closure. These recommendations assume average seed size (Lemont, Gulfmont, Cypress at 17 to 18 thousand seed per pound), good prepared seedbeds, planting at recommended depths, good quality seed and near optimum conditions

for April 1 planting.

### Adjusting seeding rate for variety

When planting a variety with larger-than-average seed size (Jefferson with 16,000 seed per pound) or smaller than average seed size (Dixiebelle with 20,000 to 22,000 seed per pound), seeding rate needs to be adjusted to ensure that the desired number of seed/ft<sup>2</sup> is achieved. For example, it is recommended that Jefferson be planted at a rate 10 percent over the seeding rate used for Lemont and Gulfmont, 15 percent over the seeding rate used for Cypress and Cocodrie and 25 percent over that used for Dixiebelle, assuming similar germination and survival of each variety. This will help ensure that varieties with lower than average seed per pound (i.e. Jefferson) will have a plant population similar to other varieties. See the table at the end of this "Seedling Rates" section illustrating the seed size effect on seed/ft<sup>2</sup>.

Further increases in Jefferson seeding rate can be justified due to its lower tillering and vigor. Compared to Cypress, Jefferson has lower tillering capacity, which makes it difficult for Jefferson to yield as well when stands are less than the recommended 20 to 25 seedlings/ft<sup>2</sup> for Jefferson. Low plant populations of Jefferson (i.e. 12 live seedlings/ft<sup>2</sup> or approximately 40 pounds of seed per acre, assuming 80 % seedling emergence) will yield well if seedlings are uniformly distributed and enough nitrogen is applied early.

The basic recommended seeding rates adjusted for seed size and tillering for March 20 and April 1 planting on

Variety	Seeding rate (lbs./A)		
	Drill seeded	Broadcast (dry)	Water planted
Jefferson	90-100	110-120	120-130
Lemont, Gulfmont	80	100	120
Priscilla, Wells	70-80	100	120
Cypress, Saber, Bolivar and Cocodrie	60-70	80-90	110

good seed beds are:

### Adjusting seeding rate for planting conditions

An additional 20 pounds of seed per acre, above the 70 to 90 pounds per acre of drilled seed, is recommended for broadcast seeding and 10 pounds or more increase for rough or poorly prepared seedbeds. An additional 10 pounds of seed may also be required for each week the crop is seeded before March 15, because earlier planting usually means cooler weather. If soil and air temperatures are 70 degrees or above, increases in seeding rate may not be warranted. However, if a grower has had problems achieving recommended stands, higher seeding rates should be used. Also, the use of gibberellic acid as a seed treatment can increase seedling vigor and reduce the need for higher seeding rates.

Replanting is not recommended unless stands have fewer than 10 plants per square foot over most of the field for conventional varieties and fewer than eight plants per square foot for semidwarf varieties. Increasing early nitrogen application by 30 to 50 pounds per acre has improved plot yields when there are fewer than 15 plants/ft<sup>2</sup>. Rice producers who commonly achieve optimum planting density recognize that actual plants/ft<sup>2</sup> (plant population) is a better method for comparing field performance than seeding rate because plant population is the final product of:

- 1) Seeding rate.
- 2) Live seed per pound of seed (determined by percent germination and seed size).
- 3) Percent emergence (determined by planting conditions, such as seed depth and vigor, soil wetness, temperature, seedling disease and bird feeding).

Growers are encouraged to make seedlings/ft<sup>2</sup> counts to know the plant population levels being achieved. This information becomes very important when adjusting the seeding rate for variety and planting conditions.

**Table 1. This table illustrates how seed/pound (i.e., seed size) can influence the number of seed/ft<sup>2</sup> at various seeding rates. The number of live seedlings/ft<sup>2</sup> will depend on germination rate and planting conditions.\*\***

Variety	Seed/lb.*	Seeding rate (lbs./A)										
		40	50	60	70	80	90	100	110	120	130	140
		Seed/sq. ft.**										
Ahrent	20,500	19	24	28	33	38	42	47	52	56	61	66
CL121	19,200	18	22	26	31	35	49	44	48	53	57	62
CL141	19,100	18	22	26	31	35	39	44	48	53	57	61
Cocodrie	19,200	18	22	26	31	35	40	44	48	53	57	62
Cypress	18,400	17	21	25	30	34	38	42	46	51	55	59
Dixiebelle	20,500	19	24	28	33	38	42	47	52	56	61	66
Earl	16,100	15	18	22	26	30	33	37	41	44	48	52
Gulfmont	16,800	15	19	23	27	31	35	39	42	46	50	54
Jacinto	21,300	20	24	29	34	39	44	49	54	59	64	68
Jefferson	16,200	15	19	22	26	30	33	37	41	45	48	52
Madison	20,000	18	23	28	32	37	41	46	51	55	60	64
Priscilla	17,000	16	20	23	27	31	35	39	43	47	51	55
RT XL-6	18,000	17	21	25	29	33	37	41	45	50	54	58
Saber	20,800	19	24	29	33	38	43	48	53	57	62	67
Bolivar	18,500	17	21	25	30	34	38	42	47	51	55	59
TX 5072	19,300	18	22	27	31	35	40	44	49	53	58	62
Wells	18,000	17	21	25	29	33	37	41	45	50	54	58
XP 1003	21,500	20	25	30	35	39	44	49	54	59	64	69
XP 1015	21,300	20	24	29	34	39	44	49	54	59	64	68

\*Seed/lb values are averages and can vary as much as 10% depending on yield and degree of seed processing.

\*\*100% to 60% of the seed would be expected to emerge depending on % germination and planting conditions.

## Gibberellic Acid Seed Treatment

A. D. Klosterboer and G. N. McCauley

Several years of study have indicated that seed properly treated with gibberellic acid will cause rice seedlings to elongate and may accelerate emergence. This is particularly true with the semidwarf varieties such as Gulfmont, Lemont and Jefferson, and may result in a more uniform stand of rice. This more rapid emergence is specifically evident where rice is planted deep (more than 1.5 inches) under cool, wet soil conditions. However, where rice is planted shallowly (less than 1.5 inches) in warm, damp soil, more rapid emergence is not always observed. Gibberellic acid should be used only for drill and dry broadcast planting methods. Do not use in water-seeded systems since the floodwater washes the treatment off the seed. Its greatest potential use would be for deep-planted, early-season rice.

## Seeding Methods

A. D. Klosterboer and F. T. Turner

Seeding methods depend on soil type, weather conditions and producer preference. The main factors to consider in selecting seeding methods are uniformity of seed distribution and seedling emergence. These factors promote good yields as well as grain quality. There is no evidence of yield advantages for drilled versus broadcast seeding or dry versus water seeding if stands are adequate.

On fine clay soils, several seeding methods can be used, including dry and water seeding. A well-prepared, weed-free seedbed is important when rice is dry seeded. When dry seeding with a drill on fine clay soils, flush the field immediately after planting to ensure uniform emergence. Seed can be broadcast on a rough, cloddy seedbed if followed immediately with a flushing so soil clods disintegrate and cover the seed. This allows good germination and uniform emergence. Broadcasting seed on a well-prepared seedbed, followed by dragging to cover the seed, is possible in some areas. This also requires immediate flushing of the field so that emergence is uniform. If rice is water seeded, the seedbed may be left in a rough, cloddy condition since flushing breaks up clods and provides some seed coverage.

On sandy soils, plant seed in moist soil 1 to 2 inches deep. Seeding depth varies with moisture conditions and variety.

Although all of these planting methods can be used for the semidwarf varieties, experience shows that shallow planting is much better for good stand establishment of semi-dwarf varieties. For example, on coarse soils do not drill any deeper than necessary. Although soil crusting conditions cannot always be avoided, use proper management to prevent this condition.



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# Early Flood Rice Culture

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## Definitions

Two different systems are used to produce rice with early flood culture. One system is **continuous flood**; the other is **pinpoint flood**. In the continuous flood system, seed coated with calcium peroxide or sprouted seed are dropped into a flooded field that is maintained until near harvest. In the pinpoint system, dry or preferably sprouted seed are dropped into floodwater. The field is drained after 24 hours and left dry for 3 to 5 days to provide oxygen and allow the roots to anchor or “peg” to the soil. Then the flood is re-established and maintained until near harvest. For the rice plant to continue growth, a portion of the plant must be above water by at least the fourth leaf stage.

The advantages of applying water to a field and retaining it throughout the growing season are: (1) easier water management and less water use, (2) red rice and grass suppression, (3) less seedling stress from cool weather, (4) elimination of early-season blackbird problems, (5) reduction in seedling loss due to salt, and (6) increased nitrogen efficiency, when nitrogen is applied to dry soil before flooding.

## Land preparation and stand establishment

A problem that may be encountered with both systems is the presence of aquatic weeds late in the season and stand establishment in unlevel cuts where water may be too deep or seed is covered with too much soil. In addition, the continuous flood technique has the following disadvantages: 1) possibility of seedling damage from rice seed midge, 2) seedling drift, especially in large, open cuts, and 3) cost of calcium peroxide coating.

**Prepare land** in fall or as early as possible in the spring so that vegetation can be turned under and decomposed prior to planting to prevent oxygen depletion during germination when soil is flooded. Since cool water contains more oxygen than warm water, it is desirable to plant early in the season before floodwater gets warm. Suggested planting dates are from April 1 to April 20.

**To minimize seedling drift** in the continuous flood technique, it is suggested that the soil surface be “grooved” before flooding by pulling a spike-tooth harrow to create ridges in soil. A compacting groover also can be used to create ridges. The groover compacts the soil surface to stabilize the ridges for more uniform stand establishment and efficient field drainage. Seeds usually settle between ridges, where they are less likely to drift.

Muddying floodwater just before applying seed is another method for minimizing seedling drift. The suspended soil will slightly cover and help anchor the seed. A relatively cloddy soil surface minimizes seedling drift better than a “mirror smooth” soil surface.

## Water management

It is important to flood the soil immediately after seedbed preparation. A delay in flooding allows red rice and other weeds to establish before flooding, and increases seed midge development.

Keep the area between the levees as uniformly level as possible. If the water depth in a cut is less than 2 inches in the shallow area and greater than 6 inches in the deep area, the crop will not emerge and mature uniformly. Try to maintain a uniform flood depth of fewer than 4 inches (1 or 2 inches is preferable) before rice emergence. Then increase to 4 inches as rice gets taller.

## Fertilization

When soil is dry before planting, apply all of the phosphorus and potassium, if needed, and about 70 percent of the nitrogen. If possible, incorporate the fertilizer into the soil; if not, apply the fertilizer and flood the field immediately. Apply the remaining nitrogen in the floodwater at panicle differentiation or earlier if plants become nitrogen deficient.

## Weed control

Although continuous flood and pinpoint flood culture should suppress red rice and other weeds, they do not provide adequate control; therefore, the following suggestions should help in controlling weeds.

Apply Bolero® 8EC preplant at 4 pints per acre for the suppression of red rice and the control of certain other weeds. Apply immediately after soil preparation and flood the field within 3 days. Do not seed the field any sooner than 24 hours after the field has been brought to flood level.

Apply Ordram® 8E preplant at 3 to 4 pints per acre depending on soil texture. Use ground application equipment only, incorporate immediately and flood as soon as possible. Ordram® 15G preplant incorporated at 20 pounds per acre also can be used. Mechanically incorporate within 6 hours of application and flood as soon as possible.

Grandstand® at 0.67 to 1 pint per acre can also be used to control certain broadleaf weeds. Permit®, Basagran® or Londax® alone or in combination with propanil also can be used to control certain aquatic weeds. Rates are dependent on growth stage.

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## Minimum Tillage

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Minimum tillage is a field preparation technique in which conventional tillage is employed in the fall to the extent that the field is ready for planting without spring cultivation. Prior to spring planting, winter weeds are killed using herbicides. Minimum tillage differs from stale seedbed technique in that, in the stale seedbed procedure, the herbicides are applied following several cultivations in the spring. See Red Rice Control section for more details regarding stale seedbed technique.

The major advantage of minimum tillage is that it ensures optimum early plantings, particularly in a wet year when conventional spring field preparation is delayed because of wet field conditions. Equipment and labor costs can be reduced since fields are not cultivated as often with minimum tillage; however, the use of “burn down” herbicides can increase total herbicide cost.

A concern associated with minimum tillage is stand establishment, since the seedbed may not be ideal for planting. The seedbed could have excessive weed residue, be too hard for optimum planting and, if a conventional drill is used, non-uniform seed depth could occur. Planting methods are limited to drill or water seeding because broadcast seeding requires incorporation of seed with tillage equipment. Since the use of a minimum till drill is suggested, additional investment in equipment may be necessary. Also there is the potential for extra herbicide use. Although water seeding can be used, weed residue can cause oxygen deficiency, increase seedling diseases and expose seed to birds.

Minimum tillage can have an impact on fertilizer management prior to establishing the flood, particularly if there is significant vegetative residue on the soil surface restricting contact between soil and fertilizer. Apply the nitrogen to a dry soil and flush into the soil as soon as possible to reduce potential nitrogen loss. Nitrogen applied to a wet soil cannot be effectively washed into the soil and is subject to more loss. Preplant nitrogen can be placed into the soil with the no-till drill or knifed in below the soil surface.

Several herbicides are labeled as preplant burndown herbicides in a minimum tillage situation. Rates of application depend on weed species and their size. Follow label directions for rate, method of application, control of specific weeds and other restrictions.

The effect of minimum tillage on rice yields has not been fully determined. However, since minimum tillage allows planting at optimum dates in wet years, it should increase yield potential under these conditions. After the flood is established, cultural practices for minimum tillage are the same as for conventional tillage rice production.

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## Blackbirds

M. O. Way

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### Description of damage

Blackbirds, primarily the red-winged blackbird, are pests during the planting season, the seedling stage and the ripening period. The birds consume seed and seedlings on and under the soil, which can result in inadequate plant stands. In some cases, fields must be replanted. Reseeding is expensive and results in planting delays. Late plantings may reduce yields and quality and hinder harvesting operations. Also, late main crop harvest can make ratoon cropping impractical and increase chances of blackbird damage on the ripening main and ratoon crops.

Blackbirds also damage the ripening crop by “pinching” grains (squeezing a grain with the beak to force the milky contents into the mouth) in the milk stage, hulling grains in the dough stage and consuming the contents and breaking panicles by perching and feeding. A study by Texas Agricultural Experiment Station and Texas Cooperative Extension personnel in Matagorda County found this type of damage to the ripening main crop to be insignificant. However, damage to the ripening ratoon crop was severe, particularly along field margins. Yield losses ranged from about 4 to 15 percent, even in fields that were patrolled using firearms. Cost of control was as high as \$46 per acre. Many producers do not ratoon crop, simply because of potential bird problems. Producers have had to abandon parts of fields hit hard by birds and/or have had to harvest too early in order to save the ratoon crop from bird attacks. For both damage periods (planting and heading to harvest), fields close to wetlands or roosts usually suffer more damage.

Unfortunately, no easy solution is available, although a combination of control tactics can reduce the problem.

### Bird control on emerging rice

- 1) Delay planting until large flocks of birds move north, and try not to plant at a time when your field is the only one in the area that has seeds and seedlings available for the birds.
- 2) Increase the seeding rate if you usually experience bird problems at planting and cover the seed to make it more difficult for the birds to find.
- 3) Probably the most effective tactic is early and consistent patrolling of fields using firearms and scare devices.\* Laborers can be hired to perform this tedious but important job. If possible, make sure all margins of the field are accessible for patrol. Start patrolling immediately after planting to scare away “scout” birds. Once birds establish in a field, they are more difficult to move. Most feeding occurs during the early morning and late afternoon.

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\*Contact the Texas A&M Agricultural Research and Extension Center at Beaumont for ordering information on scare devices.

However, patrol the fields as long as birds are present.

- 4) Use of continuous flood can deter blackbirds from feeding on seeds and seedlings. However, other birds, such as ducks, geese, ibises and dowitchers, feed on and/or trample submerged sprouts.
- 5) If possible, destroy roosts and loafing sites on the margins of fields.

Presently, no chemical repellents are registered for blackbirds in rice. However, research is underway to evaluate the efficacy of repellents applied to seed to protect seedling rice. DRC 1339, a blackbird toxicant formulated as a bait, can be used to kill blackbirds threatening rice. It must be applied only by authorized governmental personnel. For more information, contact the Texas Wildlife Damage Management Service at (979) 845-6201 or (979) 234-6599.

### Control on ripening rice

- 1) For the ripening ratoon crop, plant an early-maturing variety so that ratoon crop harvest occurs before flocks increase to damaging numbers. Late plantings increase the chance of bird damage to the ratoon crop.
- 2) Again, habitat management and early, consistent patrolling are most important.
- 3) Harvest as soon as grain moisture is appropriate. The longer rice remains in the field, the greater the chance for bird damage.

Protecting ripening rice is imperative since production inputs have already been invested in the crop. Current research is aimed at determining if insecticides with existing rice labels also repel blackbirds.

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## Seedling Disease Control

J. P. Krausz

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Seed rot and seedling blight are caused by various soil-borne and seed-borne fungi. This disease complex can cause irregular, thin stands and weakened plants. Cool, wet soils and any condition that delays seedling emergence favors the development of seed rots and seedling diseases. In early planted rice (late February to mid-March), seedling diseases are often more severe and may result in the need to replant if not adequately controlled.

The organism that causes brown leaf spot, *Bipolaris oryzae*, is a common pathogen that infects the glumes as the rice grain matures. When the infected rice is planted the following spring, diseased seedlings often occur. It is best that rice crops with a high incidence of brown leaf spot not be used for seed production.

Fungicide seed treatments have been shown to significantly increase stands in both drilled and water-seeded rice, especially in early plantings. In addition to fungi-

cide seed treatments, other practices that aid in obtaining a healthy, uniform stand include 1) planting in a well-prepared, uniform seedbed, 2) not planting too deeply, 3) not planting excessively early, and 4) using healthy seed with a high germination level.

The following fungicides are registered for use on rice seed. The trade names are listed for information only and do not constitute an endorsement of the product over other products containing the same active ingredient. Follow label instructions carefully to avoid problems and obtain maximum efficacy.

Common name	Trade name	Rate/ 100 lbs. seed
carboxin + thiram	Vitavax <sup>®</sup> 200	3-4 fl. oz.
	RTU Vitavax <sup>®</sup> -Thiram <sup>®</sup>	5-6.8 fl. oz.
mancozeb	Dithane <sup>®</sup> DF	2.1-4.3 oz.
	Dithane <sup>®</sup> F 45	3.2-6.4 fl. oz.
	Manzate <sup>®</sup> DF	2-4 oz.
	Manzate <sup>®</sup> 200	2-4 oz.
metalaxyl*	Apron <sup>®</sup> Flowable	0.1-0.15 fl. oz.
	Allegiance FL	0.1-0.37 fl. oz.
PCNB + terrazole thiram	Terra-Coat <sup>®</sup> L-205 N	2-4 fl. oz.
	Thiram <sup>®</sup> 425	1.5 oz./bu.

\*Use in combination with another material to broaden spectrum of control.

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## Irrigation and Water Management

A. D. Klosterboer and G. N. McCauley

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### Reducing irrigation costs

Two general possibilities exist for reducing irrigation costs: (1) reduce the amount of water used to produce the rice crop, and (2) pump each unit of water at the lowest possible cost. Major factors affecting pumping cost are fuel price, pumping head or lift and pumping plant (power unit and pump) efficiency. Individual producers can do little to control the price of fuel or pumping lift. However, pumping efficiency can be controlled through careful selection of pumping equipment and timely maintenance of the pump and power unit. Irrigation costs also can be reduced by maintaining canals and laterals free of leaks and unwanted vegetation.

### Evaluating pump unit performance

Procedures for evaluating pumping unit performance are described in the publications L-1718, "Evaluating Irrigation Pumping Plant Performance" (Texas Cooperative Extension); BCTR-86-10-12, "Evaluating Pump Plant Efficiencies" and BCTR-86-10-13, "Using Airlines," which are available from your county Extension agent. Evaluation of pumping performance requires measurement of three values: pumping rate, total pumping head (pumping lift plus head or pressure at the

pump discharge) and fuel use per hour. Performance of two or more pumping plants with similar pumping lift or head can be compared by measuring only pumping rate and fuel use. Measuring the amount of water pumped is essential to any evaluation of the pumping plant or of water management practices. Use a propeller-type irrigation water meter, or some other appropriate method, combined with an accurate record of fuel used to calculate fuel cost per unit of water. This is the minimum valid figure for making management decisions on pumping plant operation, repair or replacement.

### **Precision land forming**

Precision land forming, with laser-controlled or manually controlled equipment, facilitates good water management. This does not mean that the land surface is absolutely level or flat. "Land grading" is a better, more descriptive term since some grade, or slope, is desirable for surface drainage. Shallow flood depth decreases the amount of water required and increases yield if grass and weeds are controlled. Land leveling or grading makes it possible to maintain uniform, shallow flood depth, improve uniformity of water distribution when the field is flushed and improve surface drainage.

### **Temporary shallow flooding**

An adequate water supply and timely flushing (temporary shallow flooding) are essential for maximum yields. Early-season water management is important but often overlooked. Appropriate early-season water management practices are largely determined by the planting method. Flushing encourages uniform, rapid emergence with the broadcast, dry-seeded method of planting. Flushing is normally not used to obtain emergence when rice is drilled into coarse-textured soils since these soils are prone to crusting, thus impeding seedling emergence. Flushing may be necessary if insufficient moisture is available for germination and/or emergence is hindered by soil crusting following a rain. Do not allow the soil to dry or a soil crust to form on shallow-planted, semidwarf varieties.

Research indicates that a large portion of the irrigation water applied in flushing leaves the field as runoff. Improved management in the flushing operation could reduce the amount of water required and reduce irrigation pumping costs. Introduction of exactly the right amount of water to accomplish the desired flushing with little or no runoff from the bottom of the field is difficult with single inlet irrigation systems.

**A multiple inlet system**, which introduces irrigation water to each individual cut, makes efficient flushing much easier to accomplish and also makes it possible to maintain freeboard on each levee for storage of rainfall. The use of an inflow meter also allows precise control of the amount of inflow.

### **Water-seeded rice on heavy soils**

When rice is water seeded on heavy soils, establish a 2- to 4-inch flood as soon as possible after land preparation. Plant rice immediately to minimize seed midge damage and ensure a good stand. Drain water to a low level or drain completely when seed has sprouted to enable rice seedlings to become well anchored. If cuts (areas between levees) are completely drained, flushing will eventually be necessary to prevent soils from drying out and reducing seedling stand. Floods that last longer than 7 to 10 days may lead to seed midge damage.

### **Early-season water management**

Early-season water management should provide soil moisture for growth of the rice seedlings, discourage germination of weed seeds and maintain high nitrogen fertilizer efficiency. Young rice plants grow well under alternating moist and dry soil conditions, but denitrification can seriously reduce the soil's nitrogen level under these conditions. If possible, keep soil moist to increase nitrogen efficiency, decrease germination of weed seed and reduce salt damage in areas subject to such damage. Keeping the soil moist appears to be especially important with semidwarf varieties.

Delay flushing until 24 hours after propanil is applied (alone or in combination with a preemergence herbicide). Flushing immediately after propanil application washes off the propanil.

### **Permanent flood**

Do not put on permanent flood until plants are actively tillering (assuming continuous flood culture is not being used). To maintain the permanent flood, apply additional water to replace that lost by evaporation, transpiration, seepage and runoff. The permanent flood is drained during mid-season only when the rice is subject to straight-head. If application of a mid-season herbicide is necessary, lower the flood level to obtain better exposure of broadleaved weeds.

Maintaining a permanent flood is critical during panicle development. The rice plant uses water at a high rate during this period and moisture stress reduces yield. Maintain a constant flood to provide adequate water for normal plant growth and development. To ensure availability of water during the reproductive stage, apply the permanent flood 7 to 10 days before anticipated panicle differentiation or sooner.

Maintain the permanent flood at the minimum depth necessary to control weeds. Shallow flood depth minimizes the quantity of water required and increases yield if weeds are controlled. Field storage of rainfall can also reduce the amount of irrigation water required. However, rainfall can be stored in the field only if some freeboard is available on each levee gate.

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# Fertilization

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A. D. Klosterboer and F. T. Turner

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Research and experience have shown there is a great deal of flexibility in how a farmer can manage his fertilizer program provided basic nutrient requirements are met. These suggestions provide basic information on which the farmer can build an economic rice fertilizer program and make adjustments to fit particular situations.

Fertilizer can profoundly influence rice yield and is a major cost input for rice production. Of the three primary nutrients (nitrogen, phosphorus and potassium), nitrogen has the greatest effect on Texas rice yield; therefore, a critical review of fertilizer practices can mean increased income without sacrificing yields. For maximum net profit apply only those fertilizer materials needed for maximum economic yields.

## Soil testing to predict fertilizer needs

The rapid and constant changes in soil nitrogen availability make soil testing not useful in determining nitrogen rates for rice. Recommended nitrogen rates for each rice variety are determined by nitrogen fertilizer response in research tests. The general nitrogen recommendations are given in Table 1 of this section. Soil testing is useful in predicting phosphorus, potassium and micronutrient needs for rice and in developing economical fertilizer rates. Accurate fertilizer management calls for a knowledge of soil nutrient availability (soil test information), crop management practices, climatic conditions, and past fertilizer response.

Proper collection of soil samples is extremely important. The sample must be representative of the soils in the field. Sample soils in the fall or early winter months so that test results may be obtained from the soil testing laboratory in time to plan the coming year's fertilization program.

Take one composite sample from each uniform area in the field. Sample separately any portion of the field that varies due to soil texture, organic matter and/or slope. Take a minimum of 10 or 15 samples randomly selected from each uniform area. Take the cores or slices from the plow layer (5 to 6 inches). Thoroughly mix all samples from each uniform field or area and remove a pint as a composite sample.

Send a "control soil" or "reference" sample with your field samples to provide a way to determine the accuracy of the soil test. Obtain and maintain a control soil sample for your farm by collecting several gallons of soil, drying and crushing it into aggregates and storing it in a dry place for future use. When the "control sample" analysis doesn't match previous soil test results, ask the soil test lab to rerun your samples. An accurate soil test gives you confidence in your fertilizer recommendations and helps you develop an economical fertilizer management program.

**Critical soil test levels established in research tests help determine how much phosphorus and potassium to apply.**

- 1) Apply phosphorus when soil test shows:  
15 ppm phosphorus or less on sandy soils  
10 ppm phosphorus or less on clay soils
- 2) Apply potassium when soil test shows 50 ppm potassium or less.

Using this approach to develop your rice fertilizer program for each field helps you take advantage of the fact that fertilizers applied when needed will increase income but when applied in excessive rates and when not needed will decrease income.

Complete the appropriate form and send it with the composite soil samples and your control soil sample to a soil testing laboratory. Address and phone numbers of three soil testing labs:

Soil Test Laboratory  
Texas Cooperative Extension  
Texas A&M University System - Soil & Crop Sciences  
Department  
College Station, TX 77843-2474  
Phone: (979) 845-4816

A & L Plains Agricultural Labs, Inc.  
302 34th Street (P. O. Box 1590)  
Lubbock, TX 79408  
Phone: (806) 763-4278

Wharton County Jr. College  
Soil and Forage Testing Lab  
911 Bolling Highway  
Wharton, TX 77488  
Phone: (409) 532-6395

## Efficient fertilizer management

Understanding the behavior of plant nutrients in flooded soils is important to establishing plant nutrition efficiency and developing economical fertilizer programs. The interaction of nutrient source, water management, application rate and timing determine the fertilizer efficiency.

### *Nitrogen*

Although rice can use both ammonium and nitrate sources of nitrogen, the nitrate form is not stable under flooded conditions and is lost from the soil by leaching and by denitrification (a microbial process which converts nitrate to nitrogen gas). However, ammonium nitrogen (urea and ammonium sulfate) below the flooded soil surface away from air is stable and can be used by the rice plant. Ammonium on the soil surface or in floodwater gradually changes to nitrate and is lost by denitrification. Ammonium sulfate and urea sources of ammonium are about equally efficient for rice and much more efficient than nitrate nitrogen.

Draining soils for several days can result in the conversion of urea and ammonium sulfate to the nitrate nitrogen form. Upon flooding the soil, the nitrate nitrogen is lost

primarily through denitrification. Therefore, to conserve and maintain nitrogen efficiency, nitrogen fertilizer should be incorporated or flushed into the soil with irrigation water and the soil should remain water saturated or as moist as possible.

### **Phosphorus**

Flooding soils (saturating with water) increases the phosphorus availability. Flooding releases native soil phosphorus and increases phosphorus mobility. Flooding results in a soil pH change toward neutral, which converts unavailable phosphorus to the more available form. Phosphorus fertilizer will usually increase yields on clay soils testing below 10 ppm phosphorus and on sandy soils testing less than 15 ppm phosphorus.

### **Potassium**

Potassium, unlike phosphorus, is not greatly activated by flooding but is more available upon flooding. Most Texas rice soils do not require additional potassium. If potassium fertilizer is needed, it is on the very coarse (sandy) soil types testing less than 50 ppm potassium.

### **Micronutrients**

Soil flooding increases the availability of many micronutrients. Generally, iron, manganese, boron and molybdenum become more available under flooded soil conditions, but zinc usually becomes less available. Although iron and zinc deficiency may occur at any location in the rice belt, the area most likely to be affected, historically, is west of a line from Bay City to Wharton to East Bernard.

Environmental conditions that contribute to deficiencies of iron and/or zinc include:

- Alkaline soils with a pH above 7.2.
- History of chlorotic (yellow) seedlings.
- Excessively high rates of native phosphorus.

Symptoms of iron and zinc deficiencies in rice seedlings include:

- Entire leaves become chlorotic, then start dying after 3 to 7 days (iron).
- Midribs of the younger leaves, especially the base, become chlorotic within 2 to 4 days after flooding (zinc).
- Chlorosis is usually more severe where the flood is deepest and water is coldest (zinc).
- Leaves lose sturdiness and float on the floodwater (zinc).
- Brown, bronze, and eventually black blotches and streaks appear in lower leaves followed by stunted growth (zinc).
- Rice plants start to recover soon after the field is drained (zinc).

In these situations, apply 10 pounds of zinc sulfate and/or 100 pounds of iron sulfate per acre at the seedling stage. If other proven sources are used, select rates according to the zinc and iron content and availability. Soil applications are more effective than foliar sprays.

### **Soil and plant additives**

Soil additives, foliar-applied growth stimulators and yield enhancers have not increased rice yields in research tests or demonstrations conducted throughout the rice belt.

### **General fertilizer recommendations**

Although soil testing is highly recommended to determine fertilizer needs, the following general recommendations can be used in the absence of a soil test for the first crop, assuming semidwarf varieties planted the first week of April.

170-40-0\* on fine (heavy) soils  
150-50-20 on coarse (light) soils

(\*Units of nitrogen, phosphorus and potassium, respectively, with 1/3 of nitrogen and all phosphorus and potassium applied preplant, or by the 3-leaf growth stage, 1/3 of nitrogen on dry soil just prior to flood and remaining nitrogen at panicle differentiation [PD]).

### **Nitrogen rates**

Using these generalized recommendations, adjusting nitrogen rates may be needed for nitrogen, depending on planting date, variety grown, water management location and soil conditions. See location and variety adjustment in Table 1.

Yield potential of the semidwarf plant types is decreased each day they exhibit nitrogen deficiency (yellowing); therefore, do not delay nitrogen topdressing when plants become nitrogen-deficient. Make further adjustments in nitrogen recognizing that early-planted rice grows slowly in cool temperatures and may require five to 15 more units of nitrogen than late-planted rice.

If a field has a history of severe lodging or has not been cropped recently, reduce the suggested nitrogen rates. An additional 10 to 15 pounds of nitrogen may be necessary when an excessive amount of low nitrogen foliage or plant residue has been plowed under just before planting. The straw can cause temporary unavailability of the initially applied nitrogen. If rice is to follow grain sorghum or corn in rotation, shred or disk the grain sorghum or corn stubble immediately after harvest to decrease the nitrogen immobilization during the growing season. Depending on the rate of straw decomposition, the immobilized nitrogen will begin to become available to rice plants at a later growth stage.

### **Symptoms and characteristics of nitrogen deficiency include:**

- Rice on levees is darker green than rice between levees.
- Rice between levees has dark green areas as well as light green rice.

- Plants have yellowish lower (older) leaves with possible brown tips, and green upper (younger) leaves with yellow tips.
- Low chlorophyll reading.

### ***Phosphorus and potash rates***

Phosphorus and potash rates above the general recommendations previously mentioned have not proven profitable. Mixing potash with topdress nitrogen has not increased yields. Applying excessive phosphorus and potash fertilizer needlessly increases production costs. Also excess phosphorus can lower yields by increasing weed competition and by reducing micronutrient availability.

### **Timing fertilizer applications for main crop yield**

There are many options as to the number of nitrogen applications required to produce maximum economic yield. Maximum yields have been obtained by applying all fertilizer in one preplant application (late plantings) or in multiple applications when planting at recommended times. Nitrogen applied at or near heading has not increased main crop yields when sufficient nitrogen is available but can maximize ratoon crop potential. (See the ratoon crop section for a discussion of ratoon crop nitrogen rates and timing.) The following recommended nitrogen timings consistently provide maximum economic yield over a wide range of soil types and planting dates.

#### ***March plantings (three applications)***

- Apply approximately 20 to 25 percent of the nitrogen and all of the needed phosphorus and potassium just before planting or by the three-leaf stage of rice growth.
- Apply 35 to 40 percent on dry soil just prior to flooding.
- Apply 40 percent at PD or before if needed.

#### ***April plantings (three applications)***

For April planting increase early-season nitrogen applications over those for March plantings, because April plantings usually grow faster due to warmer temperature and require more nitrogen early. Apply approximately one-third of the nitrogen at each of the three application times.

#### ***May plantings (two applications)***

Apply about two-thirds of the nitrogen and required phosphorus and potassium just before planting. Apply the remaining one-third at PD or earlier if needed to correct nitrogen deficiencies.

### ***Nitrogen timing rates for continuous flood, pinpoint flood or “knifed-in” or “banded” preplant fertilizer application***

Use the two applications described under May planting above.

### **Other factors influencing nitrogen timing**

Generally, to reduce the total nitrogen required, nitrogen applications made after flood establishment should be less than 60 pounds nitrogen per acre. This limitation may influence the number of nitrogen applications. Also consider nitrogen formulations and the application cost per unit of nitrogen applied by comparing applicator rates for various weights of fertilizer and adjusting these to economize costs.

### ***Fertilization management for main and ratoon crop Jefferson planted April 1***

Nitrogen fertilizer management for Jefferson will be similar to fertilizer management for Lemont and Gulfmont but adjusted for the following conditions. A uniform and recommended plant population of 20 to 25 Jefferson seedlings/ft<sup>2</sup> with good water management will require a minimum of 150 pounds nitrogen per acre in sandy loam and 170 pounds nitrogen per acre on clayey soils on the main crop. Apply approximately 33 percent of the nitrogen preplant, approximately 33 percent on dry soil just prior to flooding and the remaining nitrogen at PD or earlier if needed. When ratoon yield potential is high, 100 pounds nitrogen per acre is recommended. Applying 20 to 40 pounds nitrogen per acre near main crop heading and the remainder just before ratoon flood optimizes ratoon yields.

Adjusting recommended nitrogen rates and timing for specific conditions:

- Increase main crop early nitrogen applications (and total nitrogen) 20 to 30 pounds per acre when plant populations are less than the optimum 20 to 25 seedlings/ft<sup>2</sup> to increase tillering and ensure canopy closure by heading stage.
- Be aware that Jefferson, like Gulfmont, has broad dark green leaves compared to Cypress, so don't base topdress nitrogen rate solely on leaf color. Vegetative cover can also be used as an indicator of the need for topdress N, with the goal of achieving 95 percent canopy closure by heading. Also using the chlorophyll meter to help maintain a reading of 41 to 42 at PD stage will identify the need for topdress nitrogen.
- Low seedling rates (plant populations of 15 or fewer seedlings/ft<sup>2</sup>) and low initial nitrogen rates prevent excessive vegetation and suppress sheath blight in Cypress without restricting yield. However, these practices are not recommended for Jefferson because excessive vegetation in Jefferson is generally not likely unless plant population exceeds 30 plants/ft<sup>2</sup>. Also, Jefferson has some sheath blight tolerance.

**Table 1. Main crop nitrogen requirements for specific varieties on various soil types.**

Variety	Western rice belt*		Eastern rice belt	
	fine (clayey)	coarse (sandy)	fine (clayey)	coarse (sandy)
<b>Long grain</b>				
Cypress**	170	150	170	150
Bolivar	170	150	170	150
CL 121	160	145	160	145
CL 141	150	135	150	135
Dellmont	170	150	170	150
Gulfmont	170	150	170	150
Lemont	170	150	170	150
Jefferson	170	150	170	150
Dellrose	170	150	170	150
Dixiebelle	170	150	170	150
Priscilla	170	150	170	150
Madison	170	150	170	150
Cocodrie	170	150	170	150
Saber	170	150	170	150
Drew	150	130	150	130
Wells	150	130	150	130
Jasmine 85	150	130	150	130
Della	100	80	110	100
<b>Medium grain</b>				
Bengal	150	120	150	130

\*NOTE: Research results from Matagorda County indicate that the semidwarf varieties growing on clayey, high pH (6.7 +) soils such as Lake Charles clay may require significantly more units of nitrogen for maximum yields, especially when nitrogen fertilizer is lost in runoff or top dressing cannot be applied to dry soil just prior to flooding. Sandy (light-colored) soils in this area do not require extra nitrogen.

\*\*Cypress leaves tend to be a lighter green than other semidwarfs and it is more likely to lodge when excess nitrogen rates are applied.

## Maximizing benefits of preplant, pre-flood and panicle differentiation (PD) fertilizer application

### *Preplant or initial fertilizer application*

Apply initial fertilizer (nitrogen, phosphorus, potassium) just before planting, at planting or before the three-leaf stage of rice growth. To increase nitrogen efficiency, incorporate or drill preplant fertilizer applications into the soil. If the initial fertilizer application is made at seeding time or before the three-leaf stage of rice growth, be sure the application is on dry soil and the field is flushed as soon as possible to move the fertilizer into the root zone. After seedling emergence and after initial fertilizer application, keep the soil moist until time for the preflooding application. High weed populations may make a postemergence nitrogen application more economical than a broadcast preplant application by not stimulating early weed growth.

### *Preflood application*

To gain the most from pre-flood nitrogen application, apply the nitrogen on dry soil just prior to flooding and allow the floodwater to carry the fertilizer into the root zone away from air — where it has more protection from loss. If the soil is so wet just prior to flooding that the applied floodwater will not carry fertilizer nitrogen into the soil, establish the flood and apply 50 percent of the pre-flood nitrogen in the floodwater and the remaining

pre-flood nitrogen 10 days later. Some producers prefer applications in floodwater because fertilizer application streaks are less evident. However, in doing so up to 20 percent of the applied nitrogen may be lost. (Splitting the pre-flood nitrogen application converts a three-way nitrogen split into a four-way split, and, if a heading top-dressing is justified for the ratoon, the conventional three-way becomes a five-way split of nitrogen.)

### *Panicle differentiation (PD) application*

The PD application (when 30 percent of the main stems have 2-mm or longer panicles) is efficiently used (taken up within 3 days) by plants during this growth stage since roots cover the flooded soil surface. Apply nitrogen prior to the PD stage if rice plants appear nitrogen-deficient prior to PD. The chlorophyll meter is very useful for determining the need for PD nitrogen. If fields are very uniform in stand emergence (emergence within 2 days), applications earlier than PD might be warranted.

### **Use of chlorophyll meter to determine topdressing needs**

Since the green color of rice plants as detected by the human eye varies with the time of day and cloudiness, it is sometimes difficult to tell if nitrogen topdressing will be economical. Minolta's model 502 chlorophyll meter provides a quick and unbiased estimate of the need for additional nitrogen during panicle differentiation (PD) and 2 weeks prior to PD. For example, research data



show (see figure shown at the end of this section) that, for Lemont plants with chlorophyll readings of 40 or more, topdressing will not increase yields enough to justify the cost. The critical chlorophyll level above which there are commonly no yield benefits to additional nitrogen fertilizer are:

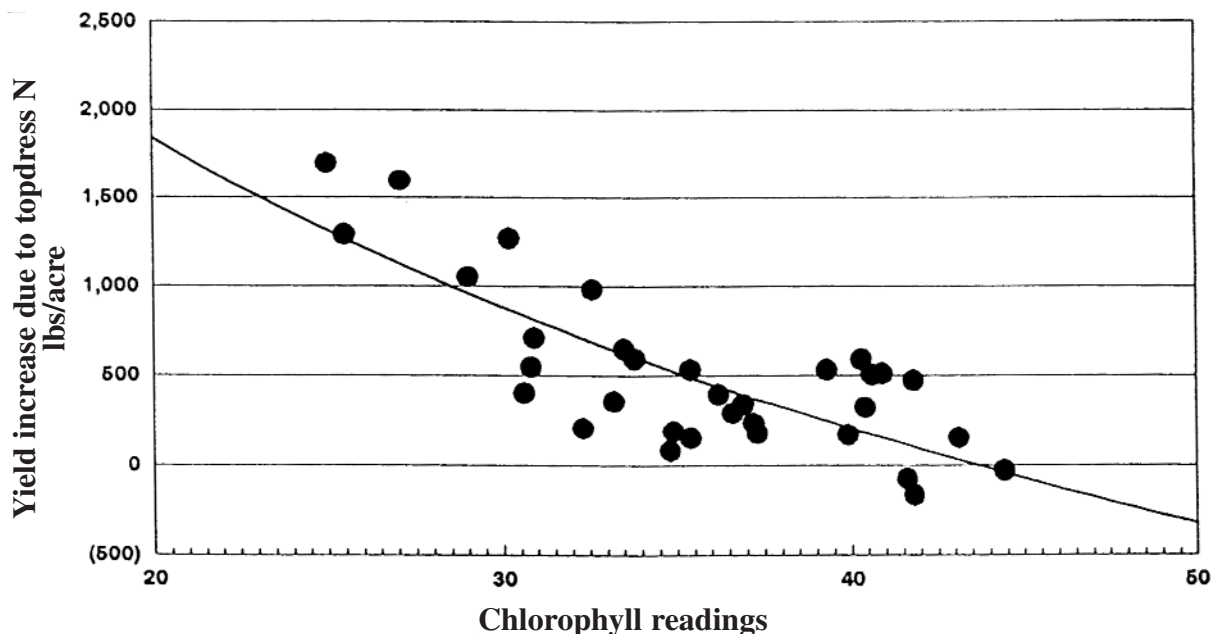
Variety	Chlorophyll reading
Gulfmont and Jefferson .....	41-42
Lemont, Dixiebelle and Priscilla .....	39-40
Cocodrie, Saber, Bolivar, CL 121 and CL 141 .....	38-39
Cypress .....	37-38

The procedure for using a Minolta model 502 chlorophyll meter to determine the average chlorophyll reading in a rice field is to walk into representative areas of the rice field and insert the edge of a most recently matured leaf, at a point three-fourths of the way up the leaf, into the measuring head of the meter. When the measuring head is clamped on the leaf, the meter will provide an instant

three-digit chlorophyll value. The meter will store and average up to 30 readings. Fields having chlorophyll readings above the critical levels given above are not likely to benefit from nitrogen topdressings. Fields having lower chlorophyll values will benefit from topdressing nitrogen (see figure which follows).

Although plant density can influence chlorophyll readings in rice fields, plant density usually has to be less than 10 to 12 plants per square foot before affecting the chlorophyll value. Another factor influencing chlorophyll readings of rice leaves is that the leaf midrib frequently does not divide the leaf down the center. The narrow side of the leaf tends to read one or two chlorophyll values higher than the wide side. Therefore, to reduce variation in chlorophyll readings within a field, take readings only from leaves having centered midribs, or take an equal number of readings on each side of the midrib. Other factors that influence chlorophyll readings include rice cultivar, position of leaf on plant and location on leaf where reading is taken. It also is important to keep in mind that cool weather as well as deficiencies of phosphorus, zinc and iron may influence chlorophyll readings.

**Relationship between yield increase and chlorophyll readings**



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# Weed Control

A. D. Klosterboer

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## Background information

The best approach to controlling weeds in rice involves a combination of good cultural, mechanical and chemical practices. Cultural and mechanical practices include:

- Using certified seed that is relatively free of weed seed.
- Using crop rotations and preparing a good seedbed to eliminate all weeds before planting rice.
- Leveling land in combination with good water management.
- Developing weed maps or records for individual fields as an aid in determining which herbicides can be used most effectively.

It is particularly critical with the semidwarf varieties to maintain good early-season weed control, since early competition from weeds can significantly reduce rice yields. Therefore, it may be advisable to use a residual herbicide to obtain good initial weed control.

Residual herbicides applied in combination with specific post emergence herbicides provide good to excellent control of emerged weeds and provide an additional 4 to 6 weeks of residual control of susceptible species. Since they are soil-active herbicides, either long-term rice injury and/or poor weed control can occur if they are not applied at correct rates. Residual herbicides require more precise application than postemergence herbicides. Certain herbicides have label restrictions associated with methods of planting and limitations related to soil texture and water management.

## Recommendations and strengths/weaknesses

The following is a chronological list of the suggested rates, strengths and weaknesses of the recommended herbicides available for rice. **READ THE LABEL** for specific instructions and precautions.

### Preplant incorporated

#### *Ordram*<sup>®</sup> 3.0-4.0 lbs. A.I./acre

Strengths:

- Suppresses red rice with proper water management
- Broad spectrum weed control

Weaknesses:

- Requires immediate soil incorporation
- Soil must stay moist to retain herbicide
- Water management critical
- Restricted to water-seeded rice

### Preplant surface-applied

#### *Bolero*<sup>®</sup> 4.0 lbs. A.I./acre

Strengths:

- Suppresses red rice with proper water management
- Broad spectrum weed control

Weaknesses:

- Restricted to water-seeded, pin-point flood rice
- Water management critical

### Preemergence herbicides

#### *Facet*<sup>®</sup> 0.25-0.50 lb. A.I./acre

Strengths:

- Can be applied pre-emergence, delayed pre-emergence and postemergence
- Season-long control of susceptible weeds
- Water management not critical
- Safe on rice

Weaknesses:

- Narrow spectrum control
- Rate dependent on soil texture
- Do not apply pre-emergence to water-seeded rice.

#### *Bolero*<sup>®</sup> 4.0 or 2.0 lbs. A.I./acre followed with 2.0 lbs. postemergence in combination with propanil at 2.0-3.0 lbs. A.I./acre

Strengths:

- Rate not dependent on soil factors (texture, organic matter, etc.)
- Safe on rice as soil-applied herbicide
- Can be used on water-seeded rice
- Residual control

Weakness:

- Poor control of broadleaf signalgrass, Texasweed and hemp sesbania

#### *Command*<sup>®</sup> 0.4 to 0.6 lb. A.I./acre

Strength:

- Provides excellent control of grassy weeds
- Very economical

Weaknesses:

- Use rate dependent on soil texture
- Application technique critical
- Does not control nutsedge, broadleaf and aquatic weeds

#### *Prowl*<sup>®</sup> 0.75 to 1.0 lb. A.I./acre

Strengths:

- Good control of grassy weeds
- Residual control

Weaknesses:

- Narrow spectrum control
- Short residual control of grassy weeds
- Water management critical

***NewPath® 0.0625 lb. A.I./acre + surfactant***

Strengths:

- Excellent control of red rice, grassy weeds and nutsedge
- Residual control

Weaknesses:

- Application timing critical
- Water management important
- Provides fair control of broadleaf and aquatic weeds
- Clearfield varieties must be grown

**Postemergence herbicides**

***Aim® 0.025 lb. A.I./acre + surfactant***

Strengths:

- Good control of many broadleaf weeds
- Low use rates
- Very economical

Weaknesses:

- Timing of application critical. Must be applied to small weeds for efficacy
- No residual control
- Occasional temporary crop injury

***Facet® 0.25-0.50 lb. A.I./acre + surfactant***

Strengths:

- Can be applied pre-emergence, delayed pre-emergence and postemergence
- Season-long control of susceptible weeds
- Water management not critical
- Safe on rice

Weaknesses:

- Narrow spectrum control
- Rate dependent on soil texture
- Do not apply pre-emergence to water-seeded rice.

***Propanil 3.0-4.0 lbs. A.I./acre***

Strengths:

- Safe on rice
- Fairly broad spectrum weed control
- Used in combination with many other herbicides to increase spectrum of weed control

Weaknesses:

- No control of sprangletop or dayflower
- No residual control
- Performance dependent on environmental conditions
- Phytotoxic interaction with certain insecticides

***Basagran® 0.75-1.0 lb. A.I./acre***

Strengths:

- Very safe on rice
- Excellent control of yellow nutsedge and dayflower

Weaknesses:

- No residual control
- Very narrow weed control spectrum when applied alone

***Blazer® 0.25 lb. A.I./acre + surfactant***

Strengths:

- Excellent control of hemp sesbania
- Timing of application not critical

Weaknesses:

- Very narrow spectrum weed control
- No residual control

***Storm® 1.5 pints/acre***

Strengths:

- Safe on rice
- Excellent control of yellow nutsedge, dayflower and hemp sesbania

Weaknesses:

- No residual control
- Does not control grassy weeds

***Duet® 2-4 qts./acre***

Strengths:

- Broad spectrum weed control
- Safe on rice

Weaknesses:

- No residual control of weeds
- Performance dependent on environmental conditions

***Regiment® 11.25-15.0 gm/acre + COC***

Strengths:

- Broad spectrum weed control
- Excellent control of large barnyardgrass

Weaknesses:

- No residual control
- Occasional temporary crop injury

***Whip® 360 0.059-0.067 lb. A.I./acre***

Strengths:

- Excellent control of large sprangletop and barnyardgrass

Weaknesses:

- Water management critical
- Can injure rice, particularly certain varieties
- Performance dependent on environmental conditions

***Grandstand R® 0.25-0.38 lb. A.I./acre + surfactant***

Strengths:

- Good control of broadleaf weeds
- Environmental conditions do not have large impact on performance
- Excellent broad spectrum control of weeds when applied in combination with Propanil or Arrosolo

Weaknesses:

- Water management critical—delay flushing for 72 hours after application.

- Does not control grasses
- May injure rice if applied to young plants

***Ordram® + propanil 2.0-3.0 + 3.0-4.0 lbs. A.I./acre***

Strengths:

- Broad spectrum weed control
- Stage of rice growth not critical

Weaknesses:

- Stage of weed growth critical
- Performance dependent on environmental conditions

***Basagran® + propanil 0.75-1.0 + 3.0-6.0 lbs. A.I./acre***

Strengths:

- Safe on rice
- Broad spectrum weed control

Weaknesses:

- No residual control
- Does not control sprangletop

***Londax® 0.6-1.0 oz. A.I./acre***

Strengths:

- Safe on rice
- Timing of application not critical
- Provides some residual control

Weaknesses:

- Narrow spectrum weed control
- Water management critical

***Permit® 0.5 to 1.0 oz. A.I./acre***

Strengths:

- Excellent control of nutsedges
- Safe on rice

Weaknesses:

- Does not control grassy weeds
- Narrow weed spectrum

***Arrosolo® 3.0-4.0 qts./acre***

Strengths:

- Broad spectrum weed control
- Stage of rice growth not critical

Weaknesses:

- Stage of weed growth critical
- Performance dependent on environmental conditions

**Post permanent flood**

***Ordram® 15G 2.0-3.0 lbs. A.I./acre***

Strength:

- Controls barnyardgrass and dayflower with proper water management

Weaknesses:

- No residual control when applied postemergence
- Narrow spectrum weed control
- Deep water depth must be maintained

***Basagran® 0.75-1.0 lb. A.I./acre***

Strengths:

- Very safe on rice
- Excellent control of yellow nutsedge and dayflower

Weaknesses:

- No residual control
- Very narrow weed control spectrum when applied alone

***Blazer® 0.25 lb. A.I./acre + surfactant***

Strengths:

- Excellent control of hemp sesbania
- Timing of application not critical

Weakness:

- Very narrow weed spectrum

***Storm® 1.5 pts./acre***

Strengths:

- Safe on rice
- Excellent control of yellow nutsedge, dayflower and hemp sesbania

Weaknesses:

- No residual control
- Does not control grassy weeds

***Londax® 0.6-1.0 oz. A.I./acre***

Strengths:

- Safe on rice
- Timing of application not critical
- Provides some residual control

Weaknesses:

- Narrow spectrum control
- Water management critical
- Water must cover weeds and remain static in field for minimum of 5 days

**Late tillering to panicle differentiation**

***2,4-D 0.75-1.25 lbs. ai/acre***

Strengths:

- Very economical
- Good control of broadleaf weeds

Weaknesses:

- Timing of application critical
- No residual control

***Grandstand R® 0.25-0.38 lb. A.I./acre + surfactant***

Strengths:

- Good control of broadleaf weeds
- Environmental conditions do not have large impact on performance

Weaknesses:

- Water management critical-delay flushing for 72 hours after application
- Does not control grasses

Herbicides	Weed response ratings for rice herbicides (0 - no control; 9 - excellent control)																							
	Barnyardgrass <sup>a</sup>	Crabgrass	Signalgrass <sup>b</sup>	Sprangletop app.	Red Rice	Yellow Nutsedge	Flatsedges	Spikrush	Fimbristylis	Ammania <sup>c</sup>	Cocklebur	Dayflower	Ducksalad	Eclipta	False Pimpernel	Gooseweed	Jointvetch	Morning Glory	Hemp Sesbania <sup>d</sup>	Smartweed	Water Hyssop	Texasweed	Alligatorweed	
Ordram <sup>®</sup> ppi (water-seeded rice) <sup>e</sup>	7	7	6	7	8	4	7	6	6	0	0	4	0	2	2	2	0	0	0	5	0	0	0	0
NewPath <sup>®</sup> pre <sup>f</sup> and post	9	9	9	8	9	8	8	-	-	6	-	5	8	6	-	-	0	7	0	-	-	7	5	5
Bolero <sup>®</sup> delayed pre	9	9	3	9	6	4	6	5	5	7	4	8	7	9	8	6	5	5	5	3	7	3	6	6
Prowl <sup>®</sup> delayed pre <sup>f</sup>	9	9	9	8	0	0	0	0	0	0	0	0	0	3	0	3	0	5	0	7	0	4	0	0
Command pre/delayed pre	9	9	9	9	-	0	0	0	0	-	3	4	3	-	-	-	3	3	3	-	-	0	3	3
Facet <sup>®</sup> pre/delayed pre	9	9	9	0	0	0	0	0	0	4	3	4	4	8	4	4	6	8	8	0	5	3	6	6
Facet <sup>®</sup> +COC post	9	9	9	0	0	0	0	0	0	4	3	3	4	8	4	4	7	9	9	0	5	3	7	7
Propanil early post (weeds less than 2")	9	9	9	2	0	5	8	9	9	8	6	4	7	9	7	7	8	6	9	7	8	8	2	2
Aim <sup>®</sup> early post	0	0	0	0	0	2	2	1	0	5	8	7	4	8	-	-	9	9	9	8	-	9	2	2
Storm <sup>®</sup> post	0	0	0	0	0	9	8	8	8	9	9	9	7	6	7	7	3	8	9	8	8	5	0	0
Propanil + Ordram <sup>®</sup> early post	9	9	9	9	0	6	8	9	9	8	7	8	7	9	7	7	8	7	9	8	8	8	3	3
Basagran <sup>®</sup> early post	0	0	0	0	0	8	8	8	8	9	9	9	7	6	7	7	3	6	7	8	8	3	0	0
Basagran <sup>®</sup> + Propanil early post	9	9	9	2	0	9	9	9	9	9	9	9	8	9	7	7	8	7	9	8	8	8	2	2
Londax <sup>®</sup> post flood	0	0	0	0	0	8	8	8	8	9	0	8	9	8	9	9	0	0	0	0	0	9	7	8
Permit <sup>®</sup> post	0	0	0	0	0	9	8	9	8	-	9	6	7	-	-	-	8	3	7	8	-	8	3	3
Duet <sup>®</sup> post	9	9	9	2	0	8	8	9	9	9	6	8	9	8	9	9	8	6	9	7	8	8	8	8
Regiment <sup>®</sup> post	9	5	5	3	0	5	9	8	8	8	-	8	8	8	7	9	9	6	9	8	8	7	7	7
Ordram <sup>®</sup> 15G into flood (3'-5' barnyardgrass)	9	9	6	5	0	4	4	6	5	0	0	7	0	7	0	1	0	0	0	5	2	0	0	0
Ordram <sup>®</sup> 15G into flood (5'-12' barnyardgrass)	7	7	5	4	0	0	2	4	4	0	0	2	0	4	0	0	0	0	0	2	0	0	0	0
2,4-D midseason	0	0	0	0	0	4	7	7	7	9	9	9	9	9	9	7	5	8	9	8	8	7	7	7
Grandstand R <sup>®</sup> midseason	0	0	0	0	0	6	5	5	5	9	9	8	4	9	9	6	8	9	8	6	4	8	8	8
Blazer <sup>®</sup> midseason	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	9	0	0	0	0	0
Whip <sup>®</sup> 360 pre-flood	9	9	9	9	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

<sup>d</sup>Hemp Sesbania = coffeebean

<sup>e</sup>Water seed rice and maintain continuous flood culture.

<sup>f</sup>Most plant clearfield rice variety.

<sup>a</sup>Barnyardgrass = jungle rice

<sup>b</sup>Signalgrass = broadleaf signalgrass, brachiaria

<sup>c</sup>Ammania = red stem

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# Metering Ordram® 8EC in the Floodwater

A. D. Klosterboer

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Ordram® 8EC can be metered into the irrigation water as the permanent flood is being established. A metering device or spigot (see Fig. 1) is used to apply the Ordram® 8EC at the point where the water enters the field. It is important to get good agitation of the Ordram® 8 EC in the water at the point of entry to ensure uniform distribution of the herbicide in the field.

Proper calibration of the metering device is important. A disc orifice in the metering device is used to regulate the flow of Ordram® 8 EC. A chart can be acquired from a local dealer or distributor to determine the correct orifice size to meter the herbicide. Two factors must be known to determine the proper orifice size: the size of the field and an estimate of the number of hours needed to flood the entire field. It may be necessary to monitor the metering device and water discharge rate to ensure proper application of the herbicide.

The major advantage of this application technique is the minimal application cost. This method can be used in situations when conventional methods cannot be used because of poor weather conditions.

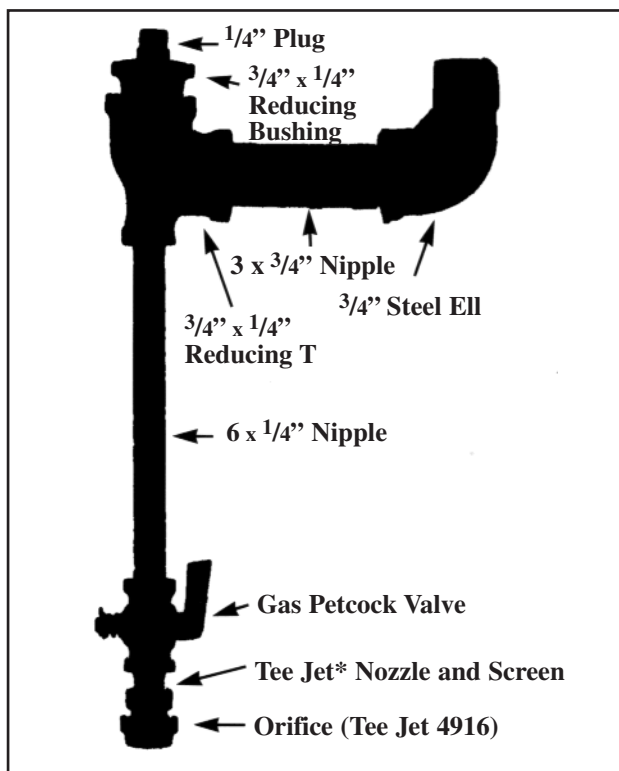


Figure 1. A metering device or spigot used to apply the Ordram® 8EC at the point where the water enters the field.

Disadvantages include:

- Requires monitoring the application of the herbicide during the period of establishing the flood.
- Requires special calibration of equipment and a knowledge of time required to flood the field.
- Weed control performance could be erratic and rice injury is possible, particularly if the Ordram® 8 EC is not uniformly applied in the field.

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## Red Rice Control

A. D. Klosterboer

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Control of red rice requires a program approach that uses good management — a combination of preventive, cultural and chemical methods in conjunction with crop rotation.

### Preventive measures

Preventive measures include planting high-quality rice seed and using clean equipment and machinery in farm operations. Use of high quality rice seed free of red rice is extremely important in preventing the introduction of red rice into a field. After working a field infested with red rice, whether during field preparation or harvesting, clean machinery before moving to the next field to prevent the introduction of red rice seed into other fields. Mud and other debris that clings to tractors and cultivating equipment can contain red rice seed that can be moved into a red rice free field.

### Culture methods

In addition to preventive practices, certain cultural methods can be used. During seedbed preparation it is important to **destroy all red rice plants** in the field before planting.

Since red rice is more vigorous and grows faster than commercial rice, give commercial rice an opportunity to compete effectively with red rice by **planting at the suggested or slightly higher seeding rate**. Red rice tillering and seed production are decreased when competition from commercial rice is high.

Use **proper water management** to effectively suppress red rice. Permitting soil to cycle (dry out and rewet) encourages the germination of weed and red rice seed.

**Water seeding** in combination with good water management helps suppress red rice. Two suggested techniques are continuous flood culture and the pinpoint flood system (see **Early Flood Rice Culture - Definition**). In these two cultural systems, it is important to flood immediately after seedbed preparation. A delay in flooding allows red rice seed to germinate and get established before flooding, resulting in a loss of red rice suppression.

## Herbicide use

Although both continuous and pinpoint flood culture suppress red rice, they may not provide adequate control. Therefore, the use of herbicides in combination with specific water management techniques can be used. These herbicides are Ordram<sup>®</sup> and Bolero<sup>®</sup>.

Apply Bolero<sup>®</sup> 8EC preplant at 4 pints per acre for the suppression of red rice. Make the application immediately after soil preparation and flood the field within 3 days. Do not plant the field any sooner than 24 hours after the field has been brought to flood level.

Apply Ordram<sup>®</sup> 8E preplant soil incorporated at 3 to 4 pints per acre depending on soil texture. Use ground application equipment only, incorporate immediately and flood as soon as possible. Ordram<sup>®</sup> 15G preplant incorporated at 20 to 27 pounds per acre also can be used. Mechanically incorporate within 6 hours of application and flood as soon as possible.

Newpath<sup>®</sup> applied in fields planted to Clearfield rice varieties is a very effective herbicide for controlling red rice in commercial rice. Research has demonstrated that nearly all red rice can be controlled. Suggested rates and application timing are 4.0 oz. of Newpath applied pre-emergence followed by 4.0 oz. applied early post-emergence, when rice is in the 2-3 leaf stage of growth. It is important that the herbicide be activated immediately following application with a flush or rainfall.

## Stale seedbed technique

Another method of red rice control is to cultivate the rice field in early spring and keep it idle or stale to allow germination and growth of red rice. If possible, fields should be flushed to maximize red rice seed germination. When red rice is actively growing and 4 inches or less in height, apply 1 quart of Roundup UltraMax<sup>®</sup>. When applying by air, apply 3 to 5 gallons of water per acre. (Application to red rice growing in saturated soils will not be as effective as on dry soils.) For the most effective control of red rice, wait at least 6 days but not more than 9 days after application. Then, when the red rice is killed, the field should be reflooded and planted using the water-seeded method. Normal production practices are then followed.

## Crop rotation

The most practical and economical way of controlling red rice is to rotate grain sorghum and soybeans with rice. Two suggested 3-year crop rotations are soybeans-soybeans-rice or grain sorghum-soybeans-rice. When growing soybeans in these rotations, use a herbicide such as Frontier<sup>®</sup>, Lasso<sup>®</sup>, Dual<sup>®</sup> or Treflan<sup>®</sup> at recommended label rates. Planting grain sorghum in the rotation and using atrazine is also effective.

Although red rice can be controlled with these herbicides, early cultivation and application of a selective postemergent soybean herbicide such as Poast<sup>®</sup>, Select<sup>®</sup>, Fusion<sup>®</sup>, Assure<sup>®</sup> II or Fusilade<sup>®</sup> DX are necessary to control any red rice that escapes the soil-applied herbi-

cide. It is important to plant alternate crops for at least 2 years before rice to achieve satisfactory control of red rice.

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## Disease Control

J. P. Krausz

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Rice diseases are a serious limiting factor in the production of rice in Texas. It is estimated that diseases annually reduce rice yields an average of 12 percent across the Texas rice belt. Since disease losses must be subtracted from that relatively small portion of potential yield that would contribute directly to net return, the average percent loss in potential net return due to diseases would be considerably greater than 12 percent.

Unfortunately, over the past decade many changes in rice production practices designed to obtain maximum yields also have created conditions favorable for diseases. Some of these practices include increased nitrogen fertilization, widespread use of varieties very susceptible to sheath blight, shortened rotations, more dense plant canopies, and the decline of moldboard plowing in favor of shallow disking. Rice producers must seek to manage disease losses through an integrated use of sound cultural practices, resistant varieties and chemical controls.

## Rice blast

Rice blast, caused by the fungus *Pyricularia grisea*, can result in severe losses to susceptible varieties when environmental conditions such as warm, moist weather favor disease development. The blast fungus causes leaf symptoms on young plants and panicle blast or rotten neck symptoms later in the growing season. Leaf lesions are spindle-shaped and elongated with brown to purple-brown borders and grayish centers. The rotten neck phase of the disease is commonly observed. With rotten neck, a brownish lesion on the internode at the base of the panicle often prevents the grains from filling or weakens the neck of the panicle so that filled heads break off before harvest.

The rice blast fungus is a highly variable pathogen, and many pathogenic races exist. In recent years, the race IC-17 has been the most prevalent in Texas, followed by IB-49. The adoption of varieties with resistance to the races of blast prevalent in Texas has greatly reduced losses caused by blast. At present, chemical control of blast usually is not recommended when moderately resistant varieties of rice are planted. When moderately susceptible or susceptible varieties are grown in areas where blast has historically occurred, preventative applications of Benlate<sup>®</sup> or Quadris<sup>®</sup> fungicide may be necessary. The rotten neck phase of blast can occur in the absence of leaf blast symptoms, since the spores of the pathogen can become air-borne and blow into the field from a distant source. If leaf blast lesions are present in the field, the potential for the rotten neck phase of blast is greatly increased.

For optimum blast control, a Benlate® or Quadris® application should be made at late boot to reduce sporulation on leaf lesions and protect the collar of the flag leaf, and again at about 80 to 90 percent heading to protect the panicles and panicle neck.

The late boot application is most important if leaf lesions caused by blast have been observed. The heading application is more important to protect panicles from spore showers. Blast is favored by excessive nitrogen fertility, thick stands, lighter soils and inadequate flooding.

### Kernel smut

Kernel smut is a serious disease caused by the fungus *Tilletia barclayana* (*Neovossia horrida*). The disease causes the endosperm of the rice grain to be replaced completely or partially by a black mass of smut spores. Usually only one to five grains per panicle are infected. Although yield losses are insignificant, monetary losses can be very high if the rice can't be sold or the price is reduced at the mill. Infested lots of grain often have a dull, grayish cast caused by the smut spores. Rice lots exceeding 3 percent kernel smut infection presently will not qualify for government loan.

The disease is not systemic. The smut spores fall to the soil surface, where they remain dormant until the following rice crop, or they can be introduced into a field on the surface of infested rice seed. The smut spores float to the surface of the irrigation water where they germinate and produce air-borne spores which infect individual rice florets. Disease development is favored by frequent light showers and high relative humidity.

Kernel smut is difficult to control. Fungicides have not been very effective. However, field tests indicate that a boot application of Tilt® reduces the number of smutted kernels. The semidwarf varieties Lemont and Gulfmont are less susceptible to the disease than most of the commercially recommended, long grain varieties. Heavy nitrogen fertilization favors the disease. A 3-year crop rotation should help reduce the quantity of smut spores present. Seed that is contaminated with smut spores should not be planted.

### Sheath blight

Sheath blight, caused by the fungus *Rhizoctonia solani*, has rapidly become the most important rice disease in Texas and probably the second most important rice disease worldwide. A change in cultural practices during the 1980s is the reason for this. The increased use of sheath-blight-susceptible semidwarf varieties, along with the recommended high nitrogen fertilization required to obtain their maximum yield potential, has resulted in much greater losses due to sheath blight. Also, the trend toward shorter crop rotations has made the disease more troublesome by allowing the fungus to increase in quantity within fields. As a result, rice producers have increased their reliance on fungicides to manage sheath blight.

### Cultural control

To most effectively and economically reduce losses from sheath blight, an integrated package of management practices should be used. Some practices may be economical only where sheath blight is a persistent, significant problem. Others are recommended in all situations as sound production practices that will help to prevent the buildup of a sheath blight problem or limit its impact where the problem exists. Some recommended cultural practices include:

- Avoiding excessive seeding rates, which result in an excessively dense canopy that creates a microclimate favorable to disease development.
- Avoiding excessive rates of nitrogen fertilization, which have been shown to increase disease severity.
- Where possible, increasing the time interval between rice crops to at least 1 year of rice in every 3 years. Research has shown that rotations of pasture-pasture-rice, soybean-soybean-rice and rice-soybean-rice had average incidence of sheath blight of 0.4, 2.7 and 5.4 percent, respectively, at panicle differentiation. In addition, more sheath blight inoculum for future rice crops tends to be produced in drilled soybeans than in row-planted soybeans.
- Controlling grass weeds that can serve as hosts of the sheath blight fungus. Barnyardgrass, crabgrass and broadleaf signalgrass are known hosts of the pathogen.

### Variety selection

Long-grain rice varieties differ in their susceptibility to sheath blight. Among those considered very susceptible are Lemont, Gulfmont and Cypress. Less susceptible (moderately susceptible) are Jefferson, Maybelle, and most of the medium grain varieties. Taller varieties tend to sustain less loss than semidwarf varieties.

### Chemical control

In many situations, foliar fungicides may be economically justified for reducing losses from sheath blight if 1) the disease pressure is sufficiently high, 2) susceptible varieties of rice are grown, 3) the crop has a high yield potential in the absence of sheath blight, and 4) environmental conditions are favorable for the disease to spread to the upper leaves of the rice plant.

It is difficult to estimate the potential severity of sheath blight in a field in order to determine the economic feasibility of applying a fungicide. However, with the high costs of fungicide spray programs and the need to reduce production costs, this should be done. The severity of sheath blight infestation can be estimated by monitoring the field at the panicle differentiation (PD) growth stage (Fig. 1). It may not be necessary to precisely monitor a field with a recent history of severe sheath blight which is on a short crop rotation (more than one rice crop in a 3-year interval).



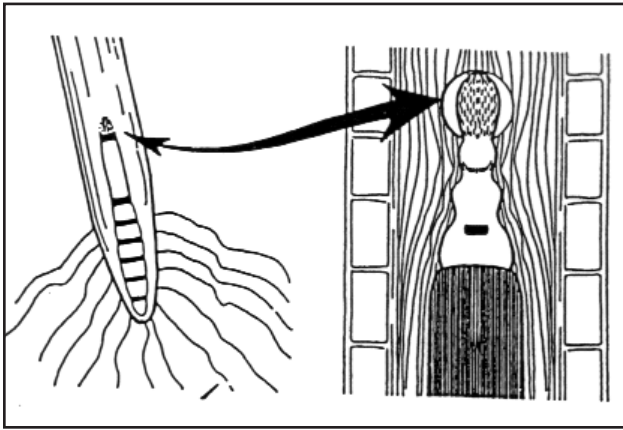


Figure 1. Panicle differentiation (PD).

### Monitoring for sheath blight

Sheath blight develops at an amazingly rapid pace during favorable environmental conditions. Begin scouting for evidence of sheath blight during panicle differentiation (PD) by walking across the field in a zigzag pattern (Fig. 2), periodically observing rice at and several inches above the water line for any evidence of early sheath blight lesions. If no sheath blight is found, wait a week and monitor again. If some sheath blight is found, a more precise monitoring is necessary to accurately estimate the amount of sheath blight present. A very helpful checking tool can be made from a 3/4-inch PVC pipe fashioned into the shape of a “T,” with a 4-foot handle connected by a “T” joint to two 14-inch lateral tubes. The device is used to push open the rice canopy and is a back-saver.

To perform a more precise monitoring, divide large fields into 45- to 50-acre sections and monitor each section separately (Fig. 2). Walk the field sections in a “U” pattern, randomly stopping to check for the presence of sheath blight. Record the stop as positive for sheath blight even

if only one small sheath blight lesion is found on a single plant. The stop is considered negative if absolutely no sheath blight is found. The total number of stops should be at least equal to the number of acres in the area scouted (i.e., 45 acres = 45 or more stops). Finally, divide the number of positive stops where sheath blight was found by the total number of stops and multiply by 100. This will give the percentage of positive sheath blight stops.

The thresholds for economic fungicide application are based on the amount of sheath blight present at panicle differentiation and the variety planted. The following threshold guidelines are suggested:

Sheath blight susceptibility	Positive stops	Infected tillers
Very susceptible varieties: Gulfmont, Lemont, Cypress, Cocodrie	35%	5%
Moderately susceptible to moderately resistant varieties: Maybelle, Jefferson, Madison, Saber	45%	10%

Several other factors to consider in deciding whether or not to use a fungicide include plant density, prevailing weather, and ratoon cropping. The denser the canopy, the more favorable the conditions for sheath blight to develop. The thresholds suggested do not take into account the possibility of second cropping (ratoon cropping) the field being evaluated. They are based on only one harvest. It is well documented that when sheath blight is controlled by fungicides in the first crop, a significant increase in yield also can occur in the second crop. Therefore, if a ratoon crop is planned, the suggested thresholds might be reduced to 25 percent positive stops for very susceptible varieties or 30 percent positive stops for moderately susceptible varieties.

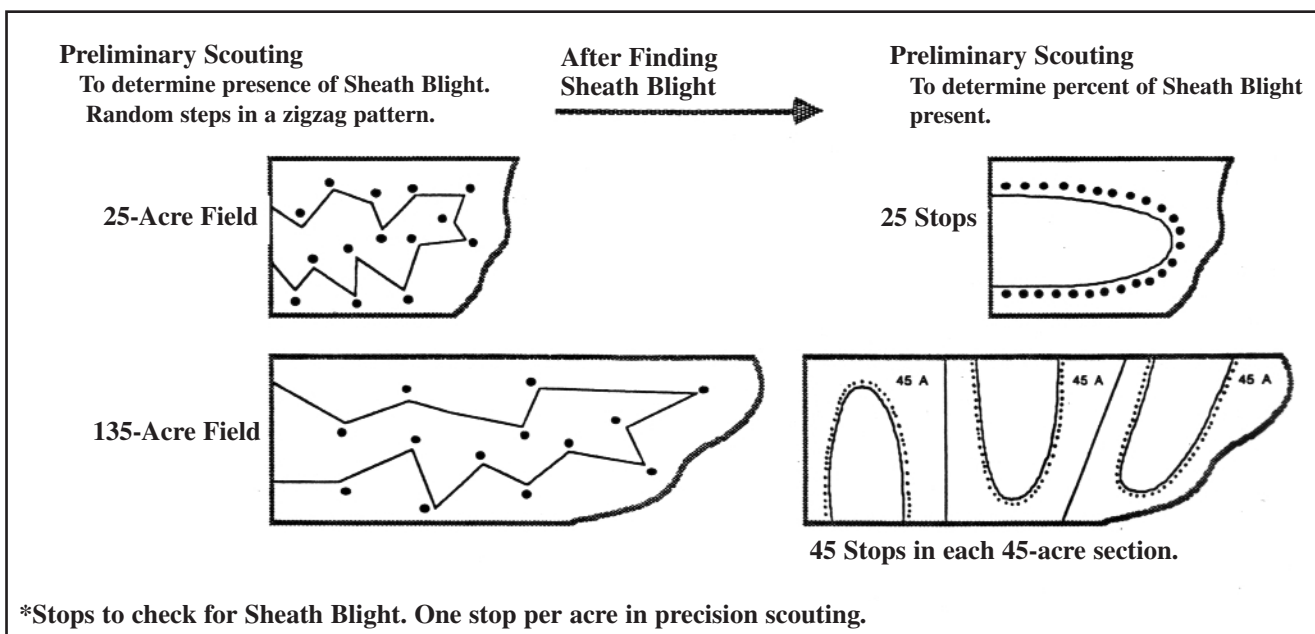


Figure 2. Suggested scouting procedure.

Fungicides for foliar disease control*			
Material	Rate/acre and timing	Sheath blight	Efficacy against blast
Gem <sup>®</sup> 25WG	8.0 to 9.8 oz. @ PD to boot split	good	good
Moncut <sup>®</sup> 50WP	11 to 16 oz. @ PD and PD + 10 to 14 days	good	poor
Quadris 2F	9.2 to 18 fl. oz. @ PD to 2" panicle	very good	very good
Stratego <sup>®</sup>	14 to 16 fl. oz. @ PD to late boot	good	good
Tilt <sup>®</sup>	6 fl. oz. @ PD to 2" panicle + boot	good	poor
Tilt <sup>®</sup>	10 fl. oz. @ PD to 2" panicle	good	poor

\*See product label for details of application rate and timing.

The thresholds are estimates based on information and conditions occurring at the time of evaluation, preferably at panicle differentiation. If very favorable weather conditions should later develop and persist, sheath blight could develop at a rapid pace and make the original threshold determination obsolete. Sheath blight should be periodically monitored during the development of the rice crop and management alternatives evaluated at each step.

### Stem rot

Stem rot is caused by a soil-borne fungus (*Sclerotium oryzae*) and is a significant problem in all southern rice-producing states and California. The pathogen survives the winter as tiny resistant structures called sclerotia which can remain alive in the soil for up to 6 years. Stem rot is initiated when the sclerotia float to the water surface and infect the rice plant at the waterline. At first, small, rectangular, black lesions develop on the sheath. Later these lesions enlarge as the fungus penetrates inward toward the culm. In the later stages of crop maturity, large areas within infested fields may begin to lodge soon after drainage has begun. Within infected culms and sheaths, numerous tiny, black sclerotia can be seen. Although commercial long grain rice varieties lack significant levels of resistance to stem rot, the newer semi-dwarf varieties tend to be more tolerant to stem rot because of their resistance to lodging. Currently registered fungicides do not adequately control stem rot and are not recommended for this purpose. Quadris, Tilt and Benlate, when applied for sheath blight, can suppress stem rot moderately. Crop rotation and reduced rates of nitrogen fertilizer in fields with a history of stem rot are recommended control practices. In California, moldboard plowing has been shown to reduce losses from stem rot, but the economics of this practice have not been evaluated in Texas.

### Narrow brown leaf spot

Narrow brown leaf spot, caused by the fungus *Cercospora janseana*, causes more yield and grain loss than is often suspected. The fungus attacks the leaf, sheath, uppermost internodes and glumes. On leaf blades, it causes short, linear, narrow, brown lesions parallel to the leaf veins. As plants approach maturity, leaf spotting

can become severe on the more susceptible varieties and result in severe leaf blighting and premature death. Infection of the leaf sheaths result in a large brown blotch or "net blotch." The fungus also can cause a "neck blight," where the internodal area above and below the node at the base of the panicle becomes light brown to tan. The affected area dies and the kernels in the lower portion of the panicle fail to fill. Low nitrogen levels seem to enhance the disease. Tilt<sup>®</sup> and Quadris<sup>®</sup> fungicides applied in the mid- to late-boot stage have been effective in suppressing the diseases caused by *C. janseana*.

### Panicle blanking complex

Florets that do not pollinate or fill properly can be the result of a number of biological and environmental factors. Often "blanked" florets can be numerous and result in significant yield losses. Completely empty florets indicate that they never successfully pollinated. Research at Texas A&M and the International Rice Research Institute (IRRI) has shown that temperatures above 95 degrees F during the pollination process (anthesis) cause floret sterility. Another high-temperature sensitive period that can cause pollen sterility occurs about 10 days before pollen shed. Early planting may be one way to reduce heat-induced sterility. Heat sterility should not be confused with panicle blight.

With true panicle blight, florets are pollinated but developing embryos abort, leaving a small embryo or undeveloped seed between the glumes. Upon close observation a few days after panicle exertion, a lack of luster in the green glumes of the affected panicle can be noticed. Within 1 to 2 weeks, the glumes turn various shades of tan to light brown and lack the turgidity and brightness of healthy glumes. Two important characteristics of panicle blight separate it from other panicle disorders: 1) panicle blight does not appear to prevent successful pollination, and 2) the rachis or branches of the panicle remain green right to the base of each floret, even after the glumes desiccate and turn tan. Pollination takes place, a small grain begins to form, but it aborts and remains small and underdeveloped. Research suggests that panicle blight might be caused by interaction of environmental stress, such as high evening temperatures, and a bacterium,

*Burkholderia glumae*. Varieties with California germplasm, such as Cypress, Maybelle and Cocodrie, seem to be more prone to serious damage by panicle blight. Currently, the best way to manage panicle blight involves the use of timely planting, proper varietal choice and avoiding excessive seeding and nitrogen rates. The product Top-Cop® applied at 2 quarts per acre at late boot has significantly reduced panicle blight in field tests.

Ear blight is a disease complex caused by several fungi, including those that cause narrow brown leaf spot (*Cercospora janseana*) and brown leaf spot (*Cochliobolus miyabeanus*). These fungi can cause discoloration and blight of the uppermost internodes, the neck below the panicle, the branches of the rachis, and spikelets of the panicles. This often results in poorly developed grains. Quadris® and Tilt® applied in the mid- to late-boot stage help suppress this disease complex.

Fusarium sheath rot, caused by *Fusarium proliferatum*, appears as small clumps of plants with blanked panicles (10 to 20 per clump). The central tillers are most obviously affected and often have long, dark brown lesions on the sheath of the flag leaf. The lesions may have pinkish-white powdery fungal sporulation on them, and the panicles of infected plants will be blanked. Hot, stressful summers appear to favor the disease.

### Black sheath rot

Black sheath rot or crown sheath rot is caused by the soil-borne fungus *Gaeumannomyces graminis* var. *graminis* and has been in Texas rice fields for at least several decades. Previously considered a minor disease of rice, it is becoming more of a problem with the increasingly intensive production systems and shorter rotations. The disease is widespread in the Texas rice belt and can cause reduced tillering, poor grain fill and lodging. The disease usually is observed late in the main crop, but also has been found to infect the ratoon crop to some extent. Affected plants show a brown to black discoloration of the leaf sheaths from the crown to considerably above the water line. In the early stages of the infection a dark, reddish-brown web of fungal mycelia (filaments) may be seen on the inward-facing surface of diseased leaf sheaths. As the discolored, infected sheath tissue ages, fungal reproductive structures (perithecia) form within the tissue. The perithecia are tiny, black, globose structures imbedded in the sheath tissue, often with short beaks protruding through the surface. These perithecia are barely visible to the naked eye and are about the size of a grain of black pepper. Crop rotation, especially with nongrass crops, will help reduce the carryover of fungal inoculum. Thorough disking and maintenance of a clean fallow field from the summer prior to planting rice will decompose plant residue and eliminate weed hosts upon which the pathogen survives.

### False Smut

False smut is a disease caused by the fungus *Ustilagoidea virens*, which infects the rice flowers during booting to early heading. The infected florets are transformed into a globose, velvety “smut ball” measur-

ing up to 1/2-inch in diameter. Immature smut balls appear orange and are covered with a thin membrane. At maturity, the membrane ruptures and exposes a mass of greenish-black powdery spores. False smut has historically been a minor disease in Texas, but the recent disease spread in Arkansas, from a few counties in 1997 to 26 counties by 2000, has raised concern in Texas. Rice significantly contaminated with false smut spores could be docked in price. False smut management suggestions include:

- Plant rice as early as practical, because late maturing fields seem to have more false smut.
- Use recommended rates of nitrogen. The disease is more severe under high nitrogen fertility.
- Limited data suggest that Tilt® and Quadris® applied at late boot have given some control of the disease. The applications would probably not be economical unless mills start to dock growers for contaminated rice.

### Other diseases

The rice plant is attacked by many fungi that cause diseases of relatively minor economic importance. A disease may be considered minor if it rarely occurs or if it causes little or no loss in net profit even when it is commonly observed. Leaf smut and brown spot are often considered minor diseases. When brown spot is prevalent, it usually indicates that a rice crop is nutritionally deficient or stressed by unfavorable soil conditions. Crop rotation, use of high-quality planting seed and balanced fertility are recommended controls. Foliar fungicides are not economical for control of either leaf smut or brown spot.

Narrow brown leaf spot is one of the most common rice diseases in the Upper Gulf Coast and varies in severity from year to year. The brown blotch phase of the disease occurs when the causal fungus attacks the uppermost sheath an inch or so below the panicle. Narrow brown leaf spot can cause significant yield loss, and fungicide applications have resulted in increased yields. However, in the absence of other yield-limiting diseases that respond to fungicide treatments, it often is not economical to treat rice crops for narrow brown leaf spot alone. Its erratic nature also makes it difficult to predict severe infections. The fungicides Benlate® and Tilt®, when used to control sheath blight, aid in controlling narrow brown leaf spot, although pathogen resistance to Benlate® has occurred in some areas. Crop rotation, residue management and varietal resistance should aid in managing narrow brown leaf spot.

### Straighthead

Straighthead is a physiological disorder that causes the entire head to be blank and remain upright at maturity. Straighthead generally occurs in spots scattered throughout a field. It is most easily recognized near harvest when normal plants have downturned heads from the weight of the grain in the panicle, while affected plants remain upright. Hulls of affected grain are distorted into a cres-

cent shape or “parrot beak.” Affected plants are darker green through the growing season and often produce shoots from lower nodes on the plant.

The disorder is more frequently found on sandy loam than on clay soils and has been associated with arsenic residues remaining in fields that were at one time planted to cotton. Other, as yet unknown, soil factors also are involved in causing straighthead. Often it is found in fields where excessive non-decaying vegetation has been plowed under soon before planting. Control of straight-

head is mainly achieved by planting resistant varieties. When planting a susceptible variety on fields with a history of straighthead, draining the field just before internode elongation has also provided control. Caution must be exercised when draining fields planted to a variety susceptible to blast disease, as leaf blast can intensify in fields that are temporarily drained mid-season.

For more information on rice diseases, see the Texas Cooperative Extension publication B-1182, “Rice Disease Atlas.”

**Disease Reaction of Currently Grown Long Grain Varieties as Assessed in Commercial Fields in the Texas Rice Belt**

Rice variety	Blast	Kernel smut	Sheath blight	Stem rot	Brown leaf spot	Narrow brown leaf spot	Straighthead
Bolivar	R	–	MS	S	–	R	R
CL 121	S	–	S	β	–	–	S
CL 141	S	–	VS	S	–	–	–
Cocodrie	R	S	VS	S	–	–	S
Cypress	MR	S	VS	S	R	S	MR
Della	S	–	MR	S	–	–	–
Dellmont	MR	–	VS	S	–	–	MR
Dellrose	MR	–	S	S	–	–	–
Dixiebelle	MS	–	MS	S	–	MS	MR
Drew	R	–	MS	–	S	–	–
Gulfmont	MR	MR	VS	S	MR	VS	MR
Jasmine 85	R	MS	R	–	S	R	VS
Jefferson	R	–	MR	S	MR	MR	MR
Lemont	MR	MR	VS	S	MS	S	MR
Madison	R	–	MS	–	–	MR	R
Saber	R	S	MR	S	–	MS	R
Wells	MR	–	MR	S	–	R	MR

VR = very resistant; R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; VS = very susceptible. These ratings are relative. Varieties rated S or VS for a disease may show extensive disease development under favorable conditions. Varieties rated R or MR show significantly less damage under similar conditions.

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# Insect Management Alternatives

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M. O. Way

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## Management practices and cultural control

Insecticides should be applied only when a pest infestation reaches or exceeds levels high enough to economically justify or pay for the treatment in terms of increased yield and/or quality. Many other rice production practices influence insect populations and their associated damage. Cultural practices can greatly reduce the number of insecticide applications required.

**Water management** is critical for rice production and influences insect populations. The rice water weevil is an aquatic pest that requires saturated soil for survival of the larvae. One method of suppressing an infestation is to drain the field and allow the soil to dry during larval development. However, soil must dry until it cracks before larval mortality occurs. Also, in general, applying the permanent flood early relative to rice emergence can increase the severity of rice water weevil damage. Fall armyworm and chinch bug populations could be much more damaging in the absence of standing water. Timely flushing or flooding can help alleviate fall armyworm and chinch bug problems.

**Planting dates** influence the abundance of insect pests. Late planted rice is more vulnerable to attack by armyworms. Rice planted early or late in relation to the emergence of adult rice water weevils is likely to escape heavy infestation. Early-maturing rice also may escape high populations of adult rice stink bugs that move into late-planted rice from declining alternate hosts such as sorghum.

**Fertilization practices** can affect the damage caused by rice water weevil larvae. Producers should be careful not to overfertilize, which increases the potential for lodging and disease problems. Data from a recent 3-year study in Texas showed that increasing nitrogen fertilizer at panicle differentiation did not compensate for rice water weevil damage. In other words, when rice water weevil damage is observed after the permanent flood, do not apply "extra" nitrogen at panicle differentiation to make up for the damage.

**Variety selection** is important, not only because varietal response to nitrogen also affects the plants' response to root damage from larval rice water weevil, but also because certain varieties show some resistance to rice water weevil and rice stink bug feeding. Resistance may result from plant characteristics which make certain varieties less attractive to pests than others. Of the recently released varieties in Texas, Lemont, Gulfmont, Jefferson and Cypress are relatively resistant to the rice water weevil compared to medium grain varieties such as Mars and Bengal.

**Weed control** practices can reduce the number of alternate hosts in a rice field. Rice stink bug populations build up on other grasses in rice fields, in grassy areas around field margins and in adjoining pastures and sorghum fields. They begin breeding in rice as rice heads develop. Thus, sound weed control can delay or reduce rice stink bug infestation in rice fields.

## Insecticide-herbicide interactions

Phytotoxicity, or plant damage from the use of certain insecticides and herbicides in close sequence, is well documented in rice. Applying propanil within 15 days of a carbaryl (Sevin®) application or within 14 days of a methyl parathion application, as is often contemplated for fall armyworm control, can cause foliar burn.

## Recent insecticide regulatory actions

**Be aware that granular carbofuran (Furadan® 3G) cannot be applied on rice in 2000 and beyond.** The U.S. Environmental Protection Agency withdrew the use of granular carbofuran after the 1999 growing season.

### *Karate®Z registered*

For the 1998 growing season, lambda cyhalothrin (Karate®) was registered by the U.S. Environmental Protection Agency for control of rice water weevil, fall armyworm, chinch bug, rice stink bug, grasshoppers, leafhoppers and selected aphid species. For the 2002 growing season, Karate® may be replaced by Karate®Z, which is more concentrated (2.08 versus 1.0 lb. A.I./gal.), less susceptible to breakdown by sunlight, safer for handlers and more rainfast than Karate®. Texas data show Karate®Z to be as, if not more, effective as Karate® (for more information see "Insecticides for Rice Water Weevil Control," "Insecticides for Chinch Bug Control," "Insecticides for Fall Armyworm Control," "Insecticides for Grasshopper Control," and "Insecticides for Rice Stink Bug Control" tables).

### *Icon™6.2FS registered*

Recently, fipronil (Icon™6.2FS) was registered by the U.S. Environmental Protection Agency for control of rice water weevil, chinch bug and stem borers. Texas data show that Icon™6.2FS, when applied as a seed treatment, provides excellent control of rice water weevil and chinch bug. Texas data collected in 1999 and 2000 indicate that Icon™6.2FS also provides some control of stem borers. Icon™6.2FS can be applied to dry or pregerminated seed. Texas data show that rice fields to be pinpoint flooded and planted with Icon™6.2FS-treated, pregerminated seed should be drained as soon as possible after seeding. Delaying field drainage may decrease the effectiveness of the insecticide. Also, Texas data show that pregerminated seed should not be treated with Icon™6.2FS while seed is dripping wet. Wait until seed is drier to ensure maximum effectiveness of the insecticide. In addition, Texas data indicate that water seeding Icon™6.2FS-treated seed immediately after application of insecticide may reduce efficacy of the seed treatment. Give the treatment time to adsorb to seed before water seeding (for more information, see "Insecticides for Rice

Water Weevil Control” and “Insecticides for Chinch Bug Control” tables).

### Fury®

In the fall of 2001, the U.S. Environmental Protection Agency approved the use of Fury for rice water weevil, rice stink bug, fall armyworm, chinch bug, leafhopper, grasshopper and oat birdcherry aphid control. Fury is in the same class of insecticide—pyrethroid—as Karate®, so timing of application for the above pests is similar for both insecticides. For more information see “Insecticides for Rice Water Weevil Control,” “Insecticides for Chinch Bug Control,” “Insecticides for Grasshopper Control” and “Insecticides for Rice Stink Bug Control” tables.

### Dimilin® 2L registered

In the spring of 1999, the U.S. Environmental Protection Agency approved the use of Dimilin® 2L for rice water weevil control. Texas data from several years show that Dimilin® 2L is as effective as other rice water weevil insecticides when applied at the proper rates and times. The active ingredient in Dimilin® 2L is diflubenzuron, which sterilizes eggs developing in female adult rice water weevils and prevents larval emergence from eggs. Thus, Dimilin® 2L must be applied shortly after application of the permanent flood when adult rice water weevils invade rice fields (for more information, see “Insecticides for Rice Water Weevil Control”).

## Rice Water Weevil

### Identification and damage recognition

These 1/8-inch-long, brown beetles move into rice fields from overwintering habitats while fields are being flushed and flooded. They appear to be attracted to areas with deep water and thin plant stands. Adult feeding

activity produces characteristic slit-like scars on the leaves. High numbers of egg-laying adult females in the field soon after flooding can subsequently produce high larval (root maggot) populations. Root maggots are aquatic, requiring saturated soils to survive, and feed on the roots of young plants. They are white and grow to nearly 1/3 inch long just before pupating inside mud cells attached to the roots.

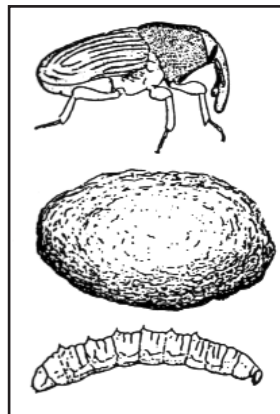
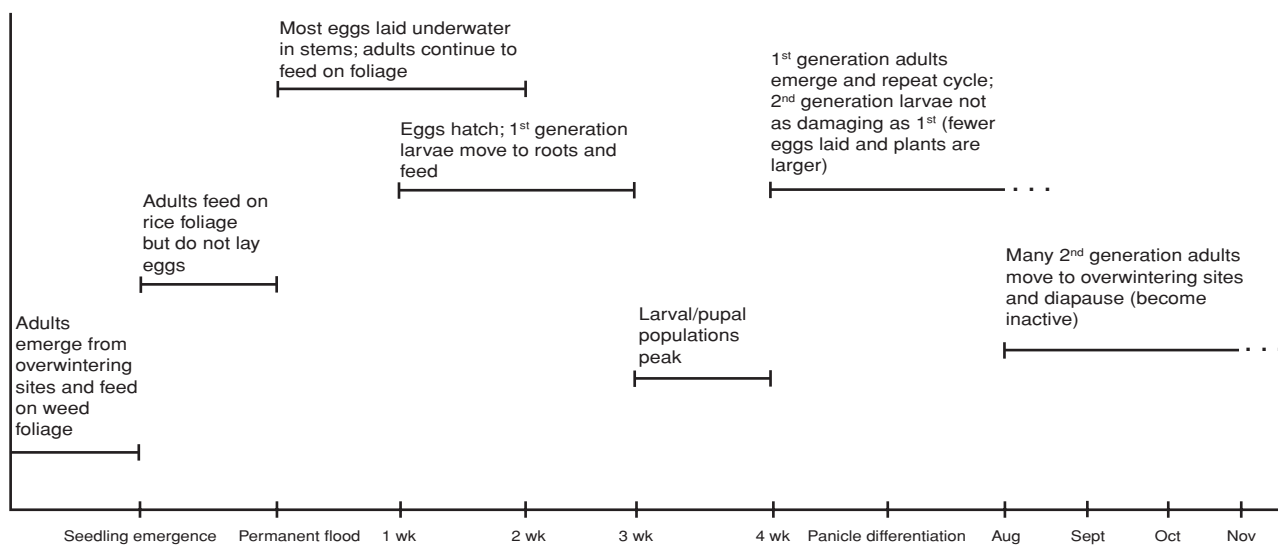


Figure 1. Rice water weevil life stages: adult, 1/8 inch long (top); pupal cell, 1/3 inch long; and larva, 1/3 inch long (bottom).

The life cycle is from 35 to 65 days. Adult weevils emerge from pupal cells throughout the reproductive stage of rice plant development. They are most active during the evening and night. They cause some additional leaf damage before leaving the field to find alternate host plants and either begin another generation or overwinter.

The root damage caused by high numbers of root maggots reduces yield. Damage caused during the main crop can adversely affect yield of the ratoon crop. In general, if rice in a field harbors an average of one larva per plant then yield losses of about 80 and 20 pounds per acre for the main and ratoon crops, respectively, can be expected. This relationship is linear, which means that an average of five larvae per plant will reduce yield about 400 and 100 pounds per acre for the main and ratoon crops, respectively. Data indicate that rice water weevil feeding does not affect milling quality.

## Generalized Life Cycle of Rice Water Weevils



Time line not to scale

Figure 2. Rice water weevil occurrence during rice production in Texas.

## Sampling for Larvae

The rice water weevil **core sampler** and **screen bucket** (Fig. 3) can be used to sample for root maggots directly. The core sampler is made from a 4-inch diameter PVC pipe. The business end of the pipe can be beveled or sharpened to make coring easier. The handle can be long or short, bolted to the sides of the pipe, and made of durable metal. The screen bucket can be made from a 6-quart galvanized metal bucket with the bottom removed and replaced with a fine (40-mesh) screen.

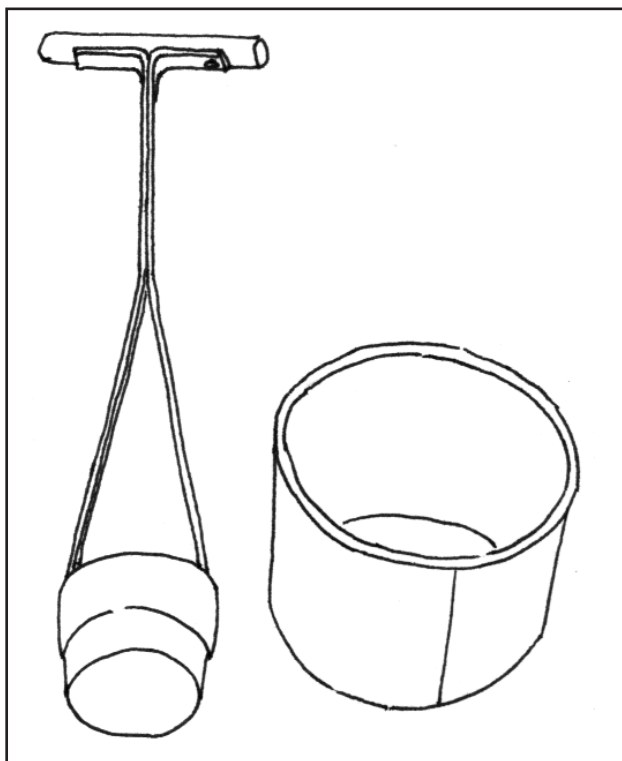


Figure 3. Core sampler and screen bucket.

The core sample containing plants and soil is placed in the bucket, which has been placed in the flood water so that it is partially filled with water. The sample is washed vigorously in the bucket by separating the plant material and rinsing the debris by lifting and lowering the bucket. Dislodged weevil larvae float and are caught in the surface tension, where they are counted. Samples should be taken 3 to 4 weeks after the permanent flood in a delayed flood system and 2 to 3 weeks after rice emergence through the permanent flood in a pinpoint or continuous flood system. This procedure can be used over time to monitor the development of weevils and evaluate the effect of a treatment. This direct larval sampling method is accurate and often used in rice water weevil research. However, it is labor intensive and messy. Furthermore, close inspection is necessary to identify the small larvae.

### Sampling for adult feeding activity

Sampling for adult feeding activity was recommended when Furadan® 3G was available. **Now that Furadan® 3G cannot be applied on rice, adult sampling is not recommended.** Currently registered rice water weevil

insecticides are applied as seed treatments or close to the time of the permanent flood. Texas data have not shown a good correlation between adult feeding activity or adult densities early post-flood and subsequent larval densities. **Thus, sampling for adult activity to predict larval populations and damage is not recommended.**

### Rice water weevil control alternatives

Occasionally, populations of root maggots can be reduced by draining rice fields and allowing the soil to dry. This practice can be effective if there is no rain. However, the cost of this method may be prohibitive. Furthermore, drying rice fields during this phase of plant development can affect fertilization, encourage blast development and delay plant maturity, reducing the probability of producing a ratoon crop. In general, delaying application of the permanent flood can reduce rice water weevil populations and damage. Recent research shows that applying the flood 4 weeks or longer after emergence can dramatically reduce rice water weevil populations and damage compared to applying the flood 2 weeks after emergence. (See Table on page 32.)

## Chinch Bug

### Identification, Biology and Damage

Chinch bugs overwinter as adults that are about 1/8 to 1/6 inch long (females are larger than males), elongate (about three times longer than wide), and black. When viewed from above, the adult appears to have a white “x” on its back. These insects have piercing-sucking mouthparts that they insert into the food-conducting tissues of plants and withdraw fluids. Turn the insect on its back to see the long, strawlike mouthparts usually held between its legs. Adults overwinter and can move into fields upon emergence of rice. Females lay elongate orange eggs about 1/16 inch long on rice stems, between leaf sheaths and stems, and in soil. In the spring, eggs typically hatch in about 12 days. First instar nymphs are orange and about 1/16 inch long. Five instars are completed in about 40 days with each successive instar being larger and darker. The last instar is black, has conspicuous wing pads, and is almost as large as the adult.

Newly emerging rice is most susceptible to damage and death. Symptoms of damage include striping, stippling, and yellowing of leaves. Severely affected seedlings turn brown and die. Inspect rice frequently for chinch bugs from emergence to about 3 weeks later. Look for adults on foliage and behind leaf sheaths, then inspect the stem, and finally probe the soil around the plant. Also, bend the seedling from side to side and closely inspect the gap between soil and stem for chinch bugs. **Recent Texas data show that as few as an average of one chinch bug per two seedlings can cause significant mortality, reduction in height, and delay in maturity of surviving plants. If populations on seedling rice approach an average of one adult per two plants, quick control is suggested.** Timely flushing or flooding of fields can minimize chinch bug damage in paddy rice but not on levee rice. If timely flushing or flooding is not possible, apply an appropriate insecticide. Chinch bugs on levee rice can be controlled with direct application of insecti-

## Insecticides for Rice Water Weevil Control

Active ingredient/product	Rate per acre		Timing of applications
	Active ingredient	Product	
diflubenzuron Dimilin®2L	0.19-0.25 lb.	12.0-16.0 fl. oz.	<b>Delayed flood:</b> 2 to 5 days after permanent flood.
	0.13 lb. per application	8.0 fl. oz. per application	<b>Pinpoint/continuous flood:</b> at time of emergence through water to 5 days later, when adults are active in field, and a second application 5 to 7 days after the first application
fipronil Icon™6.2FS	adjust rate of seed treatment to ensure each acre is treated with 0.025 to 0.05 lb.	0.5-1.0 fl. oz.	<b>Dry-seeded:</b> seed treatment applied to dry seed.  <b>Water-seeded:</b> seed treatment applied <u>after soaking</u> to pregerminated seed.
lambda-cyhalothrin Karate®Z Karate®	0.025-0.04 lb.	1.6-2.56 fl. oz.	<b>Delayed flood:</b> at time of permanent flood to 5 days later. Texas data show application immediately before permanent flood also provides good control.  <b>Pinpoint/continuous flood:</b> at a time of emergence through water to 1 week later, when adults are active in field; a second application may be necessary 7 to 10 days after first application.
		3.2-5.1 fl. oz.	
zeta-cypermethrin Fury®	0.04-0.05 lb.	3.4-4.3 fl. oz.	<b>Delayed flood:</b> at time of permanent flood to 5 days later.  <b>Pinpoint/continuous flood:</b> at time of emergence through water to 1 week later, when adults are active in field; a second application may be necessary 7 to 10 days after first application.

### Remarks and Restrictions

#### diflubenzuron

- Use at least 5 gallons total volume per acre.
- Do not apply Dimilin® 2L if flooding is in progress.
- Do not disturb flood for at least 7 days after application.
- Do not release treated flood water for at least 2 weeks after application.
- Do not apply within 80 days of harvest.
- Do not drain treated water into crawfish ponds or fields intended for crayfish farming.
- Do not enter treated fields for 12 hours after application.

#### fipronil

- Icon™6.2FS can only be applied by selected commercial seed treatment facilities that have seed treatment machines to accurately apply chemicals.
- Drain pregerminated rice seed for at least 4 hours after removal from soak tank so seed no longer drips. Pregerminated seed treated with Icon™6.2FS can be stored for up to 48 hours before planting.
- Exposed treated seeds may be hazardous to birds and other wildlife. Cover, incorporate or clean up treated rice seeds that are spilled during loading or are visible on soil surfaces in turn areas. Do not store excess treated seed beyond planting time. Dispose of excess treated seed by burial away from streams and bodies of water. Treated seed should not be planted in rice cultivation areas where local drainage is released to estuarine water bodies. Do not contaminate water when disposing of equipment wash waters or rinsate.
- Hydrogen sulfide production, which is related to high organic material, can interfere with the efficacy of Icon™ 6.2FS insecticide and has been linked to poor plant vigor and significant yield reductions. Rice seed treated with Icon™ 6.2FS should not be planted under the following conditions:
  - Fields cropped the previous year with rice, pasture, or maintained as weedy fallow that have produced a buildup of organic material.
  - Newly land formed fields, leveled fields, or planed fields that produce a buildup of organic material in the drop area.
  - Fields with a history of hydrogen sulfide production.
  - Fields maintained under a continuous flood following rice pegging where a buildup of organic material exists.
- To prevent treated rice seed from drifting into crayfish ponds in production during aerial seeding, maintain a 100-foot buffer zone between crayfish ponds and the treated portion of the rice fields.
- After seeding, hold water in treated rice fields for 24 hours before release into drainage ditches.



## Insecticides for Rice Water Weevil Control (continued)

- Do not release water from treated rice fields directly into crayfish ponds.
- Do not fish or commercially grow fish, shellfish or crayfish in treated rice fields prior to harvest.
- Do not plant leafy vegetables within 1 month following planting of treated rice seed.
- Do not plant root crops within 5 months following planting of treated rice seed.
- Do not plant small grains, other than rice, within 12 months following planting of treated rice seed.

### lambda-cyhalothrin

- Economic thresholds are in the process of being developed for early post flood applications. Karate<sup>®</sup>Z kills adults, which prevents egg laying. Thus, timing of Karate<sup>®</sup>Z is critical for control. Texas data show applications later than 10 days after the permanent flood are ineffective.
- Lambda-cyhalothrin does not interact with propanil.
- Do not release treated flood water within 1 week of application.
- Do not apply more than 0.12 lb. A.I. per acre per season.
- Do not apply within 21 days of harvest.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not enter treated fields for 24 hours after application.

### Zeta-cypermethrin

- Zeta-cypermethrin does not interact with propanil.
- Do not release treated water within 1 week of application.
- Do not apply more than 0.2 lb. A.I. acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.

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For additional information on Dimilin<sup>®</sup>2L, Icon<sup>™</sup>6.2FS, Fury<sup>®</sup> or Karate<sup>®</sup>/Karate<sup>®</sup>Z, read the labels or contact Texas Cooperative Extension (979/845-1461) or Texas Agricultural Experiment Station (409/752-2741).

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Recent Texas data show that chinch bug damage to and mortality of young rice can be dramatically increased before or after applications of propanil. The combination of chinch bugs and propanil can cause much greater damage and death to young rice than either factor alone. So, if rice is infested with chinch bugs or suffers from chinch bug damage, use caution in selecting a postemergence herbicide.

Although chinch bugs occur on older rice (tillering to maturation), no data are available regarding the relationship between chinch bug densities and damage to older rice.

## Fall Armyworm

### *Identification, biology and damage*

All life stages of the fall armyworm can survive along the Gulf Coast during winter months when the larvae feed on grain crops, grasses and other weeds. Rice is most often attacked during the seedling and tillering stages, before flooding. Caterpillars hatch from egg masses deposited by female moths in the field, or move into rice from adjoining areas. Caterpillars or larvae are light tan to greenish or brownish and are about 1 1/2 inches long when fully grown. They have three yellowish-white, hair-like stripes on the back, a conspicuous inverted "Y" on the head, and prominent black tubercles on the body from which hairs arise.

Small larvae are difficult to detect. They feed in groups near the ground, especially in the hearts of plants. Older larvae feed on leaf blades and can severely reduce plant stands. Research indicates that a 25 percent leaf loss in the seedling stage decreases rice yields an average of 130 pounds per acre. Most producers detect infestations of partially grown larvae by observing cattle egrets in the field or by observing larvae adhering to rubber boots when walking through fields during morning hours.

When an infestation is detected, the field can be flooded to force larvae up onto foliage and restrict feeding and movement from plant to plant, thereby reducing plant damage. Infestations are generally more severe in late-planted rice fields and in fields adjacent to pasture or grassy areas.

### *Sampling methods and economic threshold levels*

Caterpillars attacking rice seedlings before flooding can reduce stands. Yield reductions can occur when defoliation is greater than 25 percent 2 or 3 weeks before heading. In Arkansas, control is recommended when there are three or more worms per square foot. In Texas the suggested time for using an insecticide for fall armyworm control is **prior to flooding when larvae are present and stands are threatened or after flooding when larvae are present and average defoliation approaches 25 percent.**

## Insecticides for Chinch Bug Control

Active ingredient/product	Rate per acre		Timing of application
	Active ingredient	Product	
carbaryl Sevin® 50W Sevin® 80WSP Sevin® 80S Sevin® XLR Plus Sevin® 4F	1.0-1.5 lbs. 1.0-1.5 lbs. 1.0-1.5 lbs. 1.0-1.5 lbs. 1.0-1.5 lbs.	2-3 lbs. 1 <sup>1</sup> / <sub>4</sub> -1 <sup>7</sup> / <sub>8</sub> lbs. 1 <sup>1</sup> / <sub>4</sub> -1 <sup>7</sup> / <sub>8</sub> lbs. 1-1 <sup>1</sup> / <sub>2</sub> qts. 1-1 <sup>1</sup> / <sub>2</sub> qts.	Apply when adult populations approach an average of one per two seedlings.
fipronil Icon™6.2FS	adjust rate of seed treatment to ensure each acre is treated with: 0.025-0.05 lb.	0.5-1 fl. oz.	<b>Dry-seeded:</b> seed treatment applied to dry seed. <b>Water-seeded:</b> seed treatment applied <u>after soaking</u> to pregerminated seed.
lambda-cyhalothrin  Karate® Karate®Z	0.025-0.04 lb.	3.2-5.1 fl. oz. 1.6-2.56 fl. oz.	Apply when adult populations approach an average of one per two seedlings.
zeta-cypermethrin Fury®	0.033-0.5 lb.	2.8-4.3 fl. oz.	Apply when populations approach an average of one per two seedlings.

### Remarks and Restrictions

#### carbaryl

- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply propanil within 15 days of a carbaryl application.
- Do not enter treated fields for 12 hours after application.
- Do not apply more than 4 lbs. A.I. per acre per crop.
- Up to two applications per crop may be made but not more often than once every 7 days.
- Do not apply within 14 days of harvest.

#### fipronil

- Icon™6.2FS can only be applied by selected commercial seed treatment facilities that have seed treatment machines to accurately apply chemicals.
- Drain pregerminated rice seed for at least 4 hours after removal from soak tank so seed no longer drips. Pregerminated seed treated with Icon™6.2FS can be stored for up to 48 hours before planting.
- Do not plant small grains, other than rice, within 12 months following planting of treated rice seed.
- Do not fish or commercially grow fish, shellfish or crustaceans in treated rice fields prior to harvest.
- Protect treated seed from sunlight and extreme temperatures that degrade the insecticide.

(See other remarks and restrictions for fipronil use under "Insecticides for Rice Water Weevil Control.")

#### lambda-cyhalothrin

- Lambda-cyhalothrin does not interact with propanil.
- Do not release treated flood water within 1 week of application.
- Do not apply more than 0.12 lb. A.I. per acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not enter treated fields for 24 hours after application.
- Do not apply within 21 days of harvest.

#### Zeta-cypermethrin

- Zeta-cypermethrin does not interact with propanil
- Do not release treated water within 1 week of application
- Do not apply more than 0.2 lb. A.I. acre per season
- Do not use treated rice fields for aquaculture of edible fish and crustaceans

For additional information on carbaryl products, Icon™6.2FS or Karate®Z or Fury® read the labels or contact Texas Cooperative Extension (979/845-1461) or Texas Agricultural Experiment Station (409/752-2741).

## Insecticides for Fall Armyworm Control

Active ingredient/product	Rate per acre		Timing of application
	Active ingredient	Product	
<i>Bacillus thuringiensis</i> var. <i>kurstaki</i> Biobit® FC Javelin® WG Biobit® HP Biobit® XL	– – – –	2.0 - 5.5 lbs. 0.25 - 1.5 lbs. 0.5 - 1.5 lbs. 1.5 - 4.0 lbs.	Apply when larvae are present and rice stands are threatened or when excessive defoliation occurs; use highest rates when larvae are large.
carbaryl Sevin® 50W Sevin® 80WSP Sevin® 80S Sevin® XLR Plus Sevin® 4F	1.0 - 1.5 lbs. 1.0 - 1.5 lbs. 1.0 - 1.5 lbs. 1.0 - 1.5 lbs. 1.0 - 1.5 lbs.	2 - 3 lbs. 1 <sup>1</sup> / <sub>4</sub> - 1 <sup>7</sup> / <sub>8</sub> lbs. 1 <sup>1</sup> / <sub>4</sub> - 1 <sup>7</sup> / <sub>8</sub> lbs. 1 - 1 <sup>1</sup> / <sub>2</sub> qts. 1 - 1 <sup>1</sup> / <sub>2</sub> qts.	
lambda-cyhalothrin Karate® Karate®Z	0.025 - 0.04 lb.	3.2 - 5.1 fl. oz. 1.6 - 2.56 fl. oz.	
methyl parathion	0.5 - 0.75 lb.	1 - 1 <sup>1</sup> / <sub>2</sub> pts. (for 4 lbs./gal. product)	
pyrethrins Pyrenone® Crop Spray	≤0.05 lb.	≤12 fl. oz.	
zeta-cypermethrin Fury®	0.04-0.05 lb.	3.4-4.3 fl. oz.	

### Remarks and Restrictions

#### *Bacillus thuringiensis* and Pyrenone® Crop Sprays

- Inclusion of *Bacillus thuringiensis* products and Pyrenone® Crop Spray acknowledges the registration and availability of these products. However, they have not been adequately tested in Texas for armyworm suppression. Manufacturers suggest *Bacillus thuringiensis* products only for small worms (first and second instars, up to 1/4 inch). A spreader-sticker should be used, and the product applied in no less than 5 gallons of finished spray (by air) during early morning or evening. No herbicide interactions have been reported.

### Remarks (continued)

- Do not enter treated fields for 4 hours after application.

#### carbaryl

- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply propanil within 15 days of a carbaryl application.
- Do not enter treated fields for 12 hours after application.
- Do not apply more than 4 lbs. A.I. per acre per crop.
- Up to two applications per crop may be made but not more often than once every 7 days.
- Do not apply within 14 days of harvest.

#### lambda-cyhalothrin

- Lambda-cyhalothrin does not interact with propanil.
- Do not apply more than 0.12 lb. A.I. per acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not release treated flood water within 1 week of application.
- Do not apply within 21 days of harvest.
- Do not enter treated fields for 24 hours after application.

#### methyl parathion

- Do not apply within 14 days of a propanil application.
- Do not enter treated fields for 48 hours after application.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply within 15 days of harvest.

## Insecticides for Fall Armyworm Control (continued)

### Zeta-cypermethrin

- Zeta-cypermethrin does not interact with propanil
- Do not release treated water within 1 week of application
- Do not apply more than 0.2 lb. A.I. acre per season
- Do not use treated rice fields for aquaculture of edible fish and crustaceans

For additional information on the above products, read the labels or contact Texas Cooperative Extension (979/845-1461) or Texas Agricultural Experiment Station (409/752-2741).

cides.

### Grasshoppers

#### Identification, biology and damage

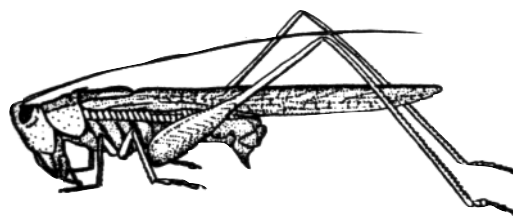
Several grasshopper species attack rice. The most common and abundant is the meadow grasshopper, *Conocephalus fasciatus* (DeGeer). This green insect, 7/8 to 1 1/8 inches long, feeds on rice leaves and flowers but causes no appreciable yield losses.

A larger (1 1/4 to 1 1/2 inches long), light brown to yellowish grasshopper with two black bands on the inside of each jumping leg can be more serious. This species is called the differential grasshopper, *Melanopsis differentialis* (Thomas). It enters rice fields from surrounding pasturelands as food becomes scarce. Winged adults chew on the stems of rice plants. When plants are attacked just before or at panicle emergence, injured

plants produce white or “blasted” heads.

#### Sampling methods and economic threshold levels

In Arkansas, control is recommended when seven to 10 grasshoppers are observed per square yard, accompanied by excessive leaf loss. In Mississippi, control measures are suggested only after grasshoppers occur on 10 or more heads per 100 heads inspected.



Insecticides for Grasshopper Control			
Active ingredient/product	Rate per acre		Timing of application
	Active ingredient	Product	
carbaryl			Generally, grasshoppers do not cause economic damage, apply when defoliation or stem and panicle damage is excessive
Sevin® 50W	0.5 - 1.5 lbs.	1 - 3 lbs.	
Sevin® 80WSP	0.5 - 1.5 lbs.	5/8 - 1 7/8 lbs.	
Sevin® 80S	0.5 - 1.5 lbs.	5/8 - 1 7/8 lbs.	
Sevin® XLR Plus	0.5 - 1.5 lbs.	1/2 - 1 1/2 qts.	
Sevin® 4F	0.5 - 1.5 lbs.	1/2 - 1 1/2 qts.	
lambda-cyhalothrin			
Karate®	0.025 - 0.04 lb.	3.2 - 5.1 fl. oz.	
Karate®Z	0.025 - 0.04 lb.	1.6 - 2.56 fl. oz.	
methyl parathion	0.5 lb.	1 pt. (for 4 lbs./gal. product)	
PennCap-M®	0.5 - 0.75 lb.	2 - 3 pts.	
zeta-cypermethrin			
Fury®	0.04-0.05 lb.	3.4-4.3 fl. oz.	

#### Remarks and Restrictions

##### carbaryl

- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply propanil within 15 days of a carbaryl application.
- Do not enter treated fields for 12 hours after application.
- Do not apply more than 4 lbs. A.I. per acre per crop.
- Up to two applications per crop may be made but not more often than once every 7 days.
- Do not apply within 14 days of harvest.

## Insecticides for Grasshopper Control (continued)

### lambda-cyhalothrin

- Lambda-cyhalothrin does not interact with propanil.
- Do not apply more than 0.12 lb A.I. per acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not enter treated fields for 24 hours after application.
- Do not apply within 21 days of harvest.
- Do not release treated flood water within 1 week of application.

### methyl parathion and PennCap-M®

- Do not apply within 14 days of a propanil application.
- Do not enter treated fields for 48 hours after application.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply within 15 days of harvest.

### Zeta-cypermethrin

- Zeta-cypermethrin does not interact with propanil
- Do not release treated water within 1 week of application
- Do not apply more than 0.2 lb. A.I. acre per season
- Do not use treated rice fields for aquaculture of edible fish and crustaceans

For additional information on the above products, read the labels or contact Texas Cooperative Extension (979/845-6800) or Texas Agricultural Experiment Station (409/752-2741).

## Rice Stink Bug

### *Identification, biology and damage recognition*

Adult rice stink bugs overwinter near the ground in grasses. In spring, the straw-colored, 3/8- to 1/2-inch-long adults become active and deposit light green egg clusters containing 10 to 50 cylindrical eggs on foliage and panicles of grasses that are in the process of producing seed. Nymphs hatching from these eggs are at first bright red with black markings, but as they grow they become tan-colored with an intricate red and black pattern on their abdomens. Unlike adults, nymphs have neither wings nor the forward-pointing spines behind their heads. As rice panicles emerge, nymphs and the very mobile adults migrate from their alternate host plants into rice fields and are generally much more abundant along field margins.

Rice stink bug feeding reduces the quality and quantity of yield. With their sucking mouthparts, they can completely remove a grain's contents in the milk stage of development. Grains attacked later become shriveled kernels or develop spots (associated with microorganisms), light yellow to black, commonly called "peck." The pres-

ence of discolored grains lowers the grade and market value of the rice. The damage is much more pronounced on milled, parboiled kernels. High percent "peck" has also been correlated with reduced head yield and increased percent of broken kernels in milled rice.

The percent "peck" in a graded lot of rice represents a broad range of grain imperfections that may not be caused solely by the rice stink bug. Research has shown that even when preventive rice stink bug control programs are conducted, graders often find some level of "peck." Other causes could include plant pathogens, genetic imperfections, environmental conditions during grain development, untimely harvest or a combination of factors.

### *Sampling techniques and economic thresholds*

Because single applications of labeled pesticides (carbaryl, lambda-cyhalothrin, zeta-cypermethrin, malathion or methyl parathion) do not have sufficient residual activity to protect the kernels during their entire development, preventive treatments are usually not justified and their cost can be prohibitive except for seed crop production. Rice fields should be scouted from heading to dough and insecticides applied only when rice stink bug populations exceed economic thresholds.

### *Direct observation method*

In Arkansas, an economic threshold has been established that can be determined by randomly checking 100 heads of rice with binoculars. They recommend treating with insecticides when 10 or more stink bugs per 100 heads are found. The structure of semidwarf rice varieties may make this method unreliable.

### *Sweep net sampling and economic thresholds*

The only recommended technique for sampling stink bug populations is the use of a 15-inch-diameter insect sweep net. When 50 percent of the panicles have emerged (headed), sample fields weekly or twice a week until har-

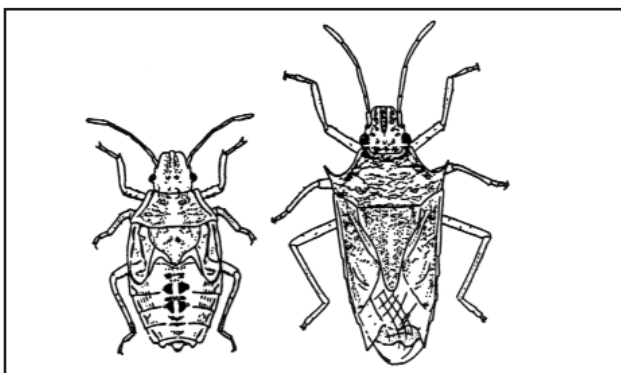


Figure 4. Rice stink bug, nymph and adult.

vest. Rice stink bugs are most active and abundant on rice heads in the early morning or late evening hours. These are the best times for sampling (sample when foliage is not wet from dew). Make 10 consecutive (180-degree) sweeps while walking through the field. Swing the net from side to side with each step. Be sure to sweep so that the top of the net is even with the top of the panicles. After 10 successive sweeps, count the **adult** rice stink bugs as they are removed from the net. Normally, 10 samples of 10 consecutive sweeps are made in a field to determine the population. Then, calculate the average number of stink bugs caught per 10 sweeps. Avoid sampling field margins and during mid-day.

Formerly, an insecticide application was justified when infestation levels reached or exceeded five or more stink bugs (nymphs and adults) per 10 sweeps during the first 2 weeks after 75 percent panicle emergence. Thereafter, insecticides were applied when 10 or more bugs per 10 sweeps were present. In 1988, variable economic threshold levels were developed using a method called dynamic programming analysis. Validation of these levels in commercial fields is a continual process. New threshold levels respond to changing marketing and production conditions.

***Directions for using variable economic thresholds***

1. Fields must be monitored with a standard 15-inch-diameter heavy-duty sweep net. Ten-sweep samples are made in at least 10 randomly selected sites within the field, and the average number of ADULT rice stink bugs per 10-sweep sample is determined. Sample at least once each week beginning at heading.
2. Determine the stage of average plant development within the field (heading, milk or soft dough) and find the appropriate section of Table 1 (A, B or C). The milk stage occurs approximately 15 days after heading.
3. Estimate your expected yield (4,500, 6,000 or 7,500 pounds per acre) and find appropriate columns in Table 1.

4. Find the column within the appropriate yield level that represents marketing conditions: a) rice moving into the government loan program (low price situation), b) rough rice selling for \$9.00/cwt (moderate price situation), or c) rough rice selling for \$11.00/cwt (high price situation).
5. Estimate the cost of an insecticide application (\$5.20, \$8.35 or \$11.50 per acre) and find the row in Table 1 that most closely corresponds to that spray cost.
6. Select the line within the proper spray cost row that corresponds to the approximate planting date of the rice field (April 1, May 1 or June 1).

The number at the intersection of the specific column (representing expected yield and marketing conditions) and row (representing spray cost and planting date) is the minimum level of adult rice stink bugs that should be present during a rice growth stage to economically justify the application of an insecticide.

Example: At **heading**, where a **6,000-pound yield** is anticipated, where the crop is going into the **loan** program, where the cost of an insecticide plus application (**spray cost**) is expected to be about \$8.35, and where the field was **planted** around May 1, the average number of **adult** rice stink bugs per 10-sweep sample must be **five or more** to justify the cost of the application. Under similar conditions, except for a 4,500-pound yield expectation, the appropriate threshold is six adult rice stink bugs. Under the same conditions, except for a 7,500-pound yield and high expected market price (\$11/cwt), the threshold is four adult rice stink bugs. These examples indicate the sensitivity of the thresholds to different rice production situations, thus encouraging producers to be flexible in their management programs.

These threshold levels should be considered only as a guide. In general, if the market price of the product increases (such as in seed rice production) or the cost of an insecticide application decreases, the economic threshold level should be decreased.

**Table 1. Economic thresholds for the adult rice stink bug (RSB) based on Dynamic Programming Analysis for 1989. The numbers in the table indicate the average level of adult RSB per 10-sweep sample at which treatment is economically warranted. A value of 15+ indicates that the threshold exceeds 15 adult RSB.**

**(A) Adult RSB thresholds at heading**

Spray cost (\$/a)	Plant Date	Yield -----								
		4500 lbs./A			6000 lbs./A			7500 lbs./A		
		Rice price			Rice price			Rice price		
Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt		
5.20	4/1	5	4	4	4	3	3	3	3	3
	5/1	4	4	4	3	3	3	3	3	3
	6/1	4	4	4	3	3	3	3	3	3
8.35	4/1	7	6	5	6	4	4	5	4	4
	5/1	6	5	5	5	4	4	4	4	4
	6/1	6	5	5	5	4	4	4	4	4
11.50	4/1	9	7	7	7	6	6	6	5	5
	5/1	8	7	7	6	6	6	5	5	5
	6/1	8	7	7	6	6	6	5	5	5

**(B) Adult RSB thresholds at milk**

Spray cost (\$/a)	Plant Date	Yield -----								
		4500 lbs./A			6000 lbs./A			7500 lbs./A		
		Rice price			Rice price			Rice price		
Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt		
5.20	4/1	12	9	9	10	7	7	8	6	6
	5/1	12	9	9	8	7	7	6	6	6
	6/1	11	9	9	8	7	7	7	6	6
8.35	4/1	15+	14	13	14	11	11	12	9	9
	5/1	15+	13	13	14	11	11	12	9	9
	6/1	14+	13	13	12	11	11	10	9	9
11.50	4/1	15+	15+	15+	15+	14	14	15	12	12
	5/1	15+	15+	15+	15+	14	14	15+	12	12
	6/1	15+	15+	15+	15+	14	14	13	11	12

**(C) Adult RSB thresholds at soft dough**

Spray cost (\$/a)	Plant Date	Yield -----								
		4500 lbs./A			6000 lbs./A			7500 lbs./A		
		Rice price			Rice price			Rice price		
Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt	Loan	\$9/cwt	\$11/cwt		
5.20	4/1	9-13	10	10	8-12	8	8	8-11	7	7
	5/1	11-15+	10	10	10-12	8	8	7-11	7	7
	6/1	9-15+	10	10	8-12	8	8	7-11	7	7
8.35	4/1	11-15	14	14	10-14	11	11	9-13	10	10
	5/1	13-15	14	14	12-15+	11	11	11-15	10	10
	6/1	15+	14	14	10-15+	11	11	9-15	10	9
11.50	4/1	15+	15+	15+	11-15+	14	14	10-14	12	12
	5/1	15+	15+	15+	13-15+	14	14	12-15+	12	12
	6/1	15+	15+	15+	15+	14	14	11-15+	12	12

## Insecticides for Rice Stink Bug Control

Active ingredient/product	Rate per acre		Timing of application
	Active ingredient	Product	
carbaryl			Apply from heading to near harvest when adult rice stink bug populations reach threshold level.
Sevin® 50W	1.0 - 1.5 lbs.	2 - 3 lbs.	
Sevin® 80WSP	1.0 - 1.5 lbs.	1 1/4 - 1 7/8 lbs.	
Sevin® 80S	1.0 - 1.5 lbs.	1 1/4 - 1 7/8 lbs.	
Sevin® XLR Plus	1.0 - 1.5 lbs.	1 - 1 1/2 qts.	
Sevin® 4F	1.0 - 1.5 lbs.	1 - 1 1/2 qts.	
lambda-cyhalothrin			
Karate®Z	0.025 - 0.04 lb.	1.6 - 2.56 fl. oz.	
methyl parathion	0.25 - 0.5 lb.	1/2 - 1 pt. (for 4 lbs./gal. product)	
PennCap-M®	0.25 - 0.5 lb.	1 - 2 pts.	
zeta-cypermethrin			
Fury®	0.033-0.0516 lb.	1.8-4.3 fl. oz.	

### Remarks and Restrictions

#### carbaryl

- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply propanil within 15 days of a carbaryl application.
- Do not enter treated fields for 12 hours after application.
- Do not apply more than 4 lbs. A.I. per acre per crop.
- Up to two applications per crop may be made but not more often than once every 7 days.
- Do not apply within 14 days of harvest.

#### lambda-cyhalothrin

- Karate®Z does not interact with propanil.
- Do not apply more than 0.12 lb A.I. per acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not enter treated fields for 24 hours after application.
- Do not apply within 21 days of harvest.
- Do not release treated flood water within 1 week of application.

#### methyl parathion and PennCap-M®

- Do not apply within 14 days of a propanil application.
- Do not enter treated fields for 48 hours after application.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.
- Do not apply within 15 days of harvest.

#### Zeta-cypermethrin

- Zeta-cypermethrin does not interact with propanil.
- Do not release treated water within 1 week of application.
- Do not apply more than 0.2 lb. A.I. acre per season.
- Do not use treated rice fields for aquaculture of edible fish and crustaceans.

For additional information on the above products, read the labels or contact Texas Cooperative Extension (979/845-1461) or Texas Agricultural Experiment Station (409/752-2741).

### *Choosing insecticides for rice stink bug control*

No resistance to carbaryl, lambda-cyhalothrin or zeta-cypermethrin or methyl parathion has been documented. Control may fail when large numbers of adults are migrating into rice, often when nearby sorghum fields are maturing or are being harvested. None of the registered products is known to have a repellent effect on stink bugs.

Methyl parathion provides rapid kill with little or no residual activity. Karate®Z/Karate® (lambda-cyhalothrin), Fury® (zeta-cypermethrin), Sevin® (car-

baryl) products and PennCap-M® (methyl parathion) provide 3 to 9 days of residual activity. After initial knock-down, these products act primarily as contact insecticides, killing stink bugs only when they crawl across treated surfaces. If the field cannot be scouted properly, select one of the products with residual activity. There is no documented advantage to using a tank mix of methyl parathion and carbaryl.

Treatment decisions may be complicated by uneven stands. Stink bugs prefer developing grain. In fields where much of the rice has matured, more stink bugs will be found on less mature panicles. Populations are also



usually higher around field margins and in weedy areas. Sampling these areas may cause artificially high estimates of stink bug populations in the field. Unless spot treatments are feasible, decisions are best made using average sweep net sample results, as these are representative of the population across the entire field.

Try to avoid applying insecticides to wet foliage or when rain may occur before the product has dried. Rice stink bugs are more abundant on rice heads in the early morning or late evening hours. These times are best both for sampling and for applying insecticides. The objective of managing stink bugs on rice should be to maintain populations at or below the threshold levels; do not expect to completely eliminate stink bug activity.

## Stalk Borers

Texas rice is attacked by three species of stalk borers—the sugarcane borer (SCB), *Diatraea saccharalis*; the rice stalk borer, *Chilo plejadellus*; and the Mexican rice borer (MRB), *Eoreuma loftini*. Recent studies (2000 and 2001) using pheromone traps detected MRB in all rice-producing counties south and west of Houston. MRB has not been found east of Harris County. In Calhoun, Jackson and Matagorda Counties, the MRB is becoming an increasingly damaging pest. All three species lay eggs on rice foliage. Upon hatching, larvae move to the protected areas between leaf sheaths and culms. Eventually, larvae bore into culms and feed inside, which causes whiteheads and deadhearts. Occasionally, larvae will feed on developing panicles within boots, causing partial blanking of panicles. Pupation occurs within damaged culms followed by emergence of adult moths.

Low winter temperatures, heavy pasturing of stubble, and fall plowing or flooding fields during the winter may help reduce borer populations. An egg parasite effectively controls the SCB in parts of Texas.

Icon 6.2FS is currently the only insecticide registered for stalk borers in Texas. The recommended rate of the seed treatment is 0.025 - 0.05 lb (AI)/acre. Recent Texas data indicate this treatment is partially effective.

## Leafhoppers

The blackfaced leafhopper, *Graminella nigrifrons* (Forbes), is commonly found in rice but is not usually abundant. Localized high populations have occurred in Brazoria County. Infested foliage becomes discolored, and yield and quality can be adversely affected. An economic threshold level has not been developed for this pest. However, several products have been evaluated for control. Of the insecticides registered for use on rice, carbaryl, applied at 1.0 pound A.I. per acre, has provided good suppression. In field trials, both carbaryl and the 4E formulation of methyl parathion significantly reduced leafhopper populations, while PennCap-M® did not suppress leafhopper numbers significantly. Karate®Z (lambda-cyhalothrin) and Fury® (zeta-cypermethrin) are also registered at 0.025 to 0.04 and 0.04 to 0.0516 A.I. per acre, respectively.

## Rice Seed Midges

The larvae of these insects (Order Diptera, Family Chironomidae, Genera *Tanytarsus* and *Chironomus*) are aquatic and can be very abundant in rice fields. The adults are small, gnat-like flies which typically form inverted pyramidal, mating swarms in the spring over stagnant or slow-moving water. Female flies lay eggs in ribbons on the water surface. Larvae hatch and move downward to the flooded substrate where they construct protective “tubes” of silk, detritus and mud. These brown, wavy “tubes” are easily observed on the mud surface of rice paddies. Occasionally larvae will exit tubes and swim to the surface in a whip-like fashion similar to mosquito larvae. Midge larvae damage water-seeded (pinpoint or continuous flood) rice by feeding on the sprouts of submerged germinating rice seeds. Damage can result in retardation of seedling growth or seedling mortality; however, the window of vulnerability to midge attack is rather narrow (from seeding to when seedlings are about 3 inches long).

Rice seed midge problems can be controlled by dry-seeding followed by delayed flood or by draining water-seeded paddies soon after planting. Thus, a pinpoint flood should reduce the potential for rice seed midge damage relative to a continuous flood. For water-seeded rice, increasing seeding rate and planting presprouted seed immediately after flooding will help reduce rice seed midge problems.

Although no Texas data are available, rice seed midge control is currently on the Icon™ 6.2 FS label (use rate: 0.025 to 0.05 lb. A.I. per acre). Rice seed midges are important pests of rice in Australia where fipronil (active ingredient in Icon™ 6.2 FS) is effective against these insects.

Research will continue to be conducted in an effort to obtain Texas data regarding insecticidal control of rice seed midges.

## Other Arthropod Pests

Many other insects have been reported to be rice pests, but are of undetermined or minor importance:

### Coleoptera:

- Flea beetles
- Grape colaspis
- Billbugs
- Scarab beetle, *Euethola rugiceps*
- Twelve-spotted cucumber beetle (Southern corn rootworm)

### Lepidoptera:

- Rice skipper, leaf roller, *Anacyloxrpha numitor*

### Diptera:

- Rice leaf miner, *Hydrellia griseola*

### Hemiptera:

- Hemipteron, *Paromius longulus*
- Hemipteron, *Leptocorixa tipuloides*
- Sharpshooter, *Draeculacephala portola*

**Thysanoptera:**

Thrips, species undetermined

**Acari:**

Spider mite, *Schizotetranychus oryza*

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## Causes of “White Heads” in Rice

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R.S. Helms and J. L. Bernhardt

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The term “white head” describes rice panicles having unfilled grain. Weather tends to bleach and desiccate the damaged panicles so that they may appear as “white flags” against a green canopy of growing rice. Damaged heads are not always white. Sometimes secondary diseases attack the damaged panicles causing a grey, brown or black color in some of the tissue. Some causes, such as straighthead or herbicides, may distort the panicle or grains although they remain green until late in the season. This article is intended to reduce the confusion caused by the many factors associated with empty panicles.

**Insects**

The large, yellow differential grasshopper, often abundant along field margins, will chew the stems of rice. When plants are attacked just before panicles emerge, injured plants produce white or “blasted” heads. In Arkansas, billbugs (*Sphenophorus* spp.) also can cause whiteheads. The female of this beetle chews a small cavity near the base of a plant in which to deposit a single egg. As the grub grows, it hollows out the interior of the rice stalk about 2 inches above and below the soil surface. The “white head” is a result of larval feeding that deprives the panicle of nutrients. Billbug damage is limited to levees or unflooded areas of a rice field. Grubs can not survive if submerged.

Rice stalk borer, sugarcane borer and Mexican rice borer larvae (caterpillars) also can produce “white heads.” Caterpillars of the rice stalk borer generally enter the stem by chewing a single hole in the stalk. Larvae hollow out the stalk as they increase in size. Mature larvae are tan, about 1 inch long, and have one dark brown and one light brown stripe along each side of the body. Slicing the stalk will reveal several small larvae, but usually only one mature larva is found per stalk. Other larvae exit and infest other nearby rice plants. The “white head” is the result of larval feeding that deprives the panicle of nutrients. Infested plants are usually found along field edges, along levee margins, in areas with thin stands or, occasionally, randomly scattered in the field interior. Research has shown that large-stemmed cultivars and late-seeded fields are most susceptible to the stalk borer. However, “white heads” caused by stalk borers usually are not numerous enough to cause economic damage. Some control of rice stalk borers is accomplished by timely destruction of rice stubble. Stubble destruction limits the number of larvae that survive and emerge as

adults in the spring. No pesticide is registered for control of stalk borer larvae.

**Diseases**

Rice panicles will turn white when the blast fungus infects the stems and the nodes on the necks of panicles. Sometimes only part of the panicle is affected. Rice tissue will die above the point of infection. If infection occurs before grain filling, the panicle will turn white from desiccation caused by drought stress. Close examination of the “white heads” caused by blast will reveal a white head on a green plant that has no other symptom other than a small sooty area (about 1/4 inch wide) that girdles the stem or node. This usually occurs at the first node below the panicle. Some varieties, such as Lemont and Gulfmont, are moderately resistant. Fungicides such as Benlate® and Quadris®, applied before infection as a preventive measure, will reduce damage. Fungicides can be overwhelmed by a spore shower at the critical heading stage of rice development if weather conditions are favorable for blast at that time.

Stem rot organisms infect rice plants near the water line and eventually kill the entire plant. When this occurs before grain filling, the rice panicles will sometimes bleach out. These organisms are soil-borne and overwinter in crop stubble and as sclerotia in the soil. The sclerotia, or resting bodies, float into close contact with rice stems at the water line, the point of infection. Look for dead, unfilled or partly filled panicles scattered in the field. Close examination of damaged panicles will reveal that the entire plants are dead. This differs from blast damage, in which plants and leaves remain green. Control consists of stalk destruction after harvest.

Only rarely will sheath blight cause “white heads” because plants die slowly. Panicle damage usually consists of stunted kernels or blanking at the base of the panicle. The keys to identification are the “rattlesnake”-like lesions on leaf sheaths and the white or brown sclerotia (about 1/8 inch in size) on the outside of the stem. Straighthead, caused by a physiological disorder, is characterized by the empty florets and distorted grain in the panicles. Seldom does it cause a “white head” because the disease does not kill the plant. Panicles remain erect, but blank or partially filled, and retain a green color until late in the season. Straighthead can be controlled by thoroughly drying the soil during the period predicted by the DD50 program.

**Desiccation**

If the soil or flood water contains a high concentration of soluble salts (salinity) at heading, the emerging panicles will be white. The rice plant will be healthy except for desiccated panicles, which is very similar to the damage caused by blast. However, there are no blast lesions at the bases of desiccated panicles (“white heads”). Salts interfere with the uptake and transfer of water through cell walls at heading, a time when the plant has a high water requirement. The result is drought stress even though the rice plants are flooded. The key to diagnosis is the absence of any symptoms except desiccated pani-

cles. An electroconductivity (EC) test of the water will often indicate salt levels above 1,000 micromhos per centimeter.

Rice plants can be mechanically injured when workers wade through fields prior to heading, partially breaking stems. This stem breakage will cause "white heads." Close examination will reveal the injury that restricted water uptake.

Drought stress, or insufficient water at heading, will cause "white heads," especially if the weather is hot and windy. Keeping the soil wet may be sufficient until the heading stage, but then the demand for water is so great that flooding is the only sure way to provide enough water on most soils. "White heads" are often found in sprinkler-irrigated fields. Several days of extremes in temperature, such as above 100 degrees F during daytime or below 50 degrees at night, will cause sterility. However, panicles will rarely turn white. Usually the florets will be empty but remain green until late in the season. If temperature is the suspected cause of "white heads," check weather records for highs and lows 2 weeks prior to and at heading. This is the most critical time when temperature extremes can seriously interfere with grain pollination and fertilization. The DD50 printouts will help pinpoint rice stages.

The rice desiccant sodium chlorate will cause "white heads" when applied to immature rice. This occurs when

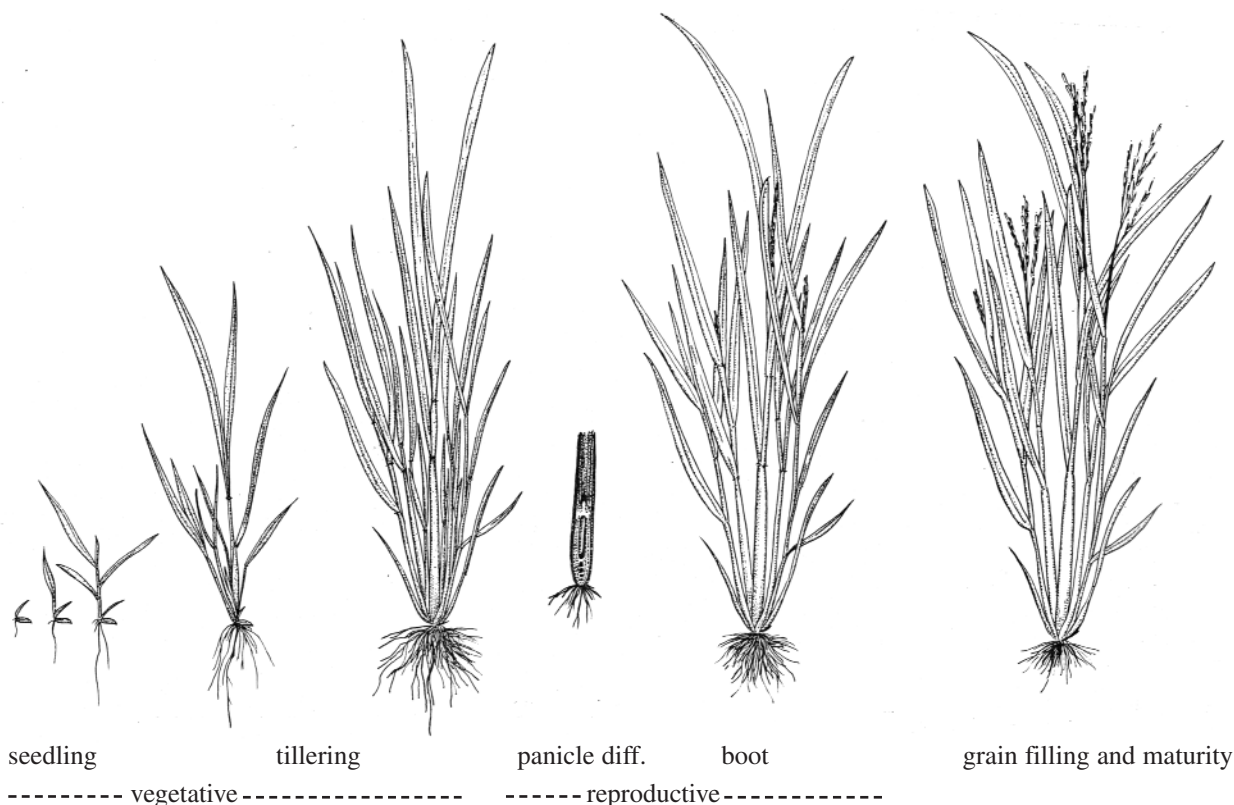
an immature field is accidentally sprayed. Uneven emergence or overseeding into a thin rice stand can cause immature plants in a mature field of rice. If a desiccant is the suspected cause of "white heads," check for spray patterns.

Herbicides that burn foliage will cause "white heads." These are sometimes accidentally applied to or drift into fields as rice panicles begin to emerge. Minute amounts of some herbicides such as Classic<sup>®</sup>, Scepter<sup>®</sup>, Poast<sup>®</sup>, Fusilade<sup>®</sup> DX, etc., that remain in unrinsed spray tanks or drift from nearby application sites, will distort grain in various ways, but usually the damaged panicles will remain green. When herbicides are suspected, look for an application pattern effect and check pesticide application records and the DD50 printout for stages.

When nitrogen solution is applied too late or tank-mixed with fungicides such as Benlate<sup>®</sup> or herbicides such as propanil, 2,4-D, Blazer<sup>®</sup>, etc., it will cause foliage damage. Panicles may also be damaged if they have emerged at the time of application. Rather than the "white head" symptom, the florets and developing grain usually appear black or brown. When suspected, look for an application pattern and check records of application and rice stages.

Note: This chapter has been partially modified for Texas and is reprinted with permission from R.S. Helms and J.L. Bernhardt, Rice Information, No. 114, April 1990, by Cooperative Extension Service, University of Arkansas.

### Rice Plant Development



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# Draining for Harvest

A. D. Klosterboer and G. N. McCauley

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Properly timed drainage for harvesting is important in obtaining good-quality, high-yielding rice. The timing depends on crop maturity, soil type, weather conditions and field drainage efficiency.

## Draining

To conserve water, discontinue irrigation 7 to 10 days before the anticipated drain date. Enough moisture must remain in the soil to ensure that the lower grains on the panicle fill properly before harvest, but the soil must be dry enough to support combines without severely rutting the field if the field is going to be second-cropped. The table below can be used as a guide for draining fields for harvest. Since Labelle has a smaller grain, drain fields with this variety slightly earlier (2 to 4 days).

Research from Eagle Lake Station on a Nada fine sandy loam soil indicates that a dry period of 20 days is required for optimum ratoon crop yields. On these coarse soil types, drain 10 days prior to harvest (25 days after first crop heading) for highest yields and quality. It appears that a short dry period after the first crop is harvested does not adversely affect second crop yields on fine sandy loam soils.

On fine (clay and clay loam) soils such as a Beaumont clay, drain 15 days prior to harvest (20 days after first crop heading) for highest yields and quality. These fine soil types can be flooded immediately after first crop harvest without adversely affecting ratoon crop yields, in contrast to the coarse soil types.

Drain time must be based on experience. Fields with historic internal and external drainage problems must be drained a few days earlier. Drain may be delayed a few days for fields with shallow coarse textured soils that dry out quickly.

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### Maturity and Appearance of Rice Panicles

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Soil type	When field is ready for drainage
Heavy soils that dry out slowly (clays)	Top half of panicles are yellow and turned downward
Lighter soils that dry out quickly (silt loams and sandy soils)	Top two-thirds or three-fourths of panicles are yellow and turned downward

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# Harvesting

A. D. Klosterboer

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Several important factors affect the harvesting of rice with a combine. The following factors must be considered in every instance of combining:

- Timing of harvest.
- Condition of the crop and field.
- Adjustment of the combine.
- Skill of the operator.

## Timing of harvest

If the rice crop is harvested too early or too late, the quality of the rice may suffer, cutting profits considerably. Rice is a crop that fruits and matures over a long period of time, and the grain moisture content varies greatly. Rice is usually harvested when moisture content is between 18 and 23 percent or when the grains on the lower panicle are in the hard dough stage. Research has shown that a harvest moisture between 20 and 24 percent results in maximum yield.

## Quality

Rice quality is an important factor over which producers have some control. Whole grain is worth more than broken grain. In some instances, whole grain sells for 50 to 100 percent more than broken grain. Rice breakage is preceded by fissuring of the individual grains.

Once rice grains dry to 15 percent moisture content or lower, they will fissure when subjected to a moist environment. Such environments may be found in the fields before harvest, in the combine hopper or in the holding bin after harvest. A rice field may look the same to a producer from one day to the next, but the ambient environment has the potential to cause a considerable loss in quality within one night.

Fissured grains in the field or in harvested rough rice are hidden inside the hull and are not visible without close inspection of individual grains. This damage does not become apparent until these grains are combined, dried and milled. Many times this damage is attributed to a mechanical operation and not to the real cause.

## Adjusting the combine

Rice is harvested by direct combining and is difficult to thresh because it is hard to strip from the straw. A spike-tooth threshing cylinder is usually used because of its aggressive threshing action. Rice may be down or lodged, making harvesting more difficult.

Semidwarf cultivars such as Lemont are more difficult to combine than conventional cultivars because the panicle does not emerge above the canopy. Combines must cut extra green foliage to harvest the panicles, thus reducing threshing and separation efficiency. This requires that

combine ground speed be reduced for semidwarf varieties. A harvest aid such as sodium chlorate applied at 4.5 pounds per acre may increase harvest efficiency by desiccating green foliage and weeds.

**Caution:** Desiccation of the first crop may reduce tillering and therefore yields of the second crop.

It is important to adjust the combine properly to maintain quality and reduce losses. Consult the operator's manual for proper adjustments of the header, reel, cylinder, sieves and fan for the crop and field conditions. After these adjustments are set and a trial run is made, be sure to measure harvest losses.

Unless the operator knows the source of grain losses, he or she cannot reduce them. Some losses are due to improper operation and others are caused by improper adjustment. Preharvest losses are those that occurred prior to harvesting. Such losses show up as a result of weather conditions and include shatter loss, grain left attached to the stubble and cut stalks not delivered into the header. Threshing losses occur when grains or panicles are not separated from the chaff and stalks in the combine.

### How to determine losses in rice

1. To determine preharvest losses, select a typical unharvested area of the field well in from the edges (see table below). Place a frame 12 inches square in the standing crop. Count all the kernels lying on the ground within the frame. Make several random samples and average them to find average bushels lost per acre. Approximately 21 to 24 rice kernels per square foot equals 1 bushel per acre.
2. When checking machine losses, do not use any straw spreading device, such as a straw chopper or straw spreader, because the loss count will be inaccurate. Harvest a typical area. Allow the machine to clear itself of material and then back the combine a distance equal to the length of the machine and stop the combine. This will allow the checking of all loss points without starting and stopping the combine several times.
3. To determine header losses, after backing the length of the machine, place the 1-square-foot measuring frame on the ground in front of the combine within the harvested area. Count the number of kernels found in the frame. Check several other sample areas and average the kernel count. Finally, subtract the number of kernels found in the preharvest loss check. For example, a combine has a 14-foot cutting platform and 39 kernels are within the frame. Subtracting 5 grains per square foot preharvest loss gives 34 kernels. Dividing the 34 kernels by 22 gives a header loss of 1 1/2 bushels per acre.
4. To determine threshing unit loss, after backing the length of the machine, check the ground in a few places directly behind the separator, using the 1-square-foot frame. Count all the kernels remaining on partially threshed heads. Do not include kernels lying loose on the ground. Then check the Machine Loss Chart for Small Grain (below) to determine the loss in bushels per acre. For example, if a combine with a 14-foot cutting platform and 38-inch separator were used to harvest rice and 85 kernels were found on partially threshed heads, the loss would be 1 bushel per acre. Typical threshing unit loss ranges from 1/2 to 1 percent of the average yield. Acceptable losses are largely a matter of operator preference.
5. To determine straw walker and shoe losses, after backing the length of the machine, place the 1-square-foot measuring frame on the ground directly behind the separator. Then count the kernels lying loose within the frame. Do not include kernels on partially threshed heads. Subtract the number of kernels found in the header loss check and the preharvest loss check. The remaining figure will be the number of kernels lost over the straw walker and shoe. Check the Machine Loss Chart For Small Grain to find the loss in bushels per acre. Typical straw walker and shoe losses should be less than 1 percent of the average yield.

### Machine Loss Chart for Small Grain

		Approximate number of kernels per square foot to equal one bushel per acre								
		----- Cutting width (ft.) -----								
Crop	Separator width (in)	10	13	14	15	16	18	20	22	24
Rice	29	81	106	114	122	–	–	–	–	–
	38	–	80	86	92	98	110	123	–	–
	44	69	74	79	85	95	106	117	–	–
	55	–	55	60	64	68	76	85	94	102

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# Ratoon (Second) Crop Production

A. D. Klosterboer, G. N. McCauley  
and F. T. Turner

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Several key factors are critical in successful ratoon crop production. The earlier the ratoon crop matures, the higher the potential yields. Therefore, fast stimulation of regrowth is an important factor. Apply the total recommended nitrogen rate immediately after harvesting the main crop and flood it into the soil to stimulate regrowth. Keep soils moist with a shallow flood until regrowth has advanced and retillering has occurred. After retillering, maintain a flood sufficient to control weeds.

## Fertilization

The recommended nitrogen rate for ratoon crop production is dependent on the anticipated yield potential. That is, if all or most of the following conditions can be met, rates as high as 70 pounds of nitrogen per acre for conventional varieties and 100 pounds per acre for semi-dwarf varieties can be recommended. These conditions include: 1) harvest before August 15, 2) absence of disease in main crop, 3) limited field rutting by equipment; 4) good weed control in main crop, and 5) yield of main crop lower than anticipated but good growth potential.

As harvest date is delayed and disease incidence, field rutting and weed infestation increase, decrease the nitrogen rate or eliminate nitrogen. Remember, any delay in nitrogen and water application reduces the yield potential of ratoon crop rice.

## Nitrogen timing on fine (heavy) soils

Splitting the second crop nitrogen by applying one-third to one-half at main crop heading and the remainder immediately after the main crop harvest has not consistently increased yields of the ratoon crop. If nitrogen deficiency occurs during late stages of main crop development, top dressing of the main crop at this time may hasten ratoon crop tiller development and maturity. However, a near heading application on the main crop that has sufficient nitrogen can produce excessive green foliage at main crop harvest.

## Nitrogen timing and water management on (light) coarse soils

Several years of research data on a coarse soil at Eagle Lake suggest that, when these types of soils remain dry for approximately 20 days after main crop harvest, ratoon crop yields can be increased by splitting the ratoon crop nitrogen (i.e., applying one-half immediately after harvest). However, if the ratoon crop flood is delayed more than 10 days after the main crop harvest, splitting the ratoon crop nitrogen does not increase ratoon crop yields. A dry period longer than 30 days between main crop and ratoon crop can devastate ratoon crop yields on coarse soils. A dry period of 10 days or less can reduce ratoon crop yields, indicating that coarse soils, particularly those at Eagle Lake, need a dry period of 15 to 20 days and split nitrogen application to achieve optimum yields. Splitting ratoon crop nitrogen does not increase yields when the dry period between the main and ratoon crops is greater than 25 or less than 10 days.

## Herbicide use

Broadleaved weeds, particularly dayflower, are of the most concern in ratoon crop rice. Several herbicides are currently labeled for use in ratoon crop rice. These include 2, 4-D, Grandstand R<sup>®</sup>, and Basagran<sup>®</sup>. Check the label for rates, timing and weeds controlled.

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# Texas Rice Production Practices

A. D. Klosterboer and J. P. Krausz

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The table below is a composite of the major disciplines and operations generally practiced by rice producers in Texas. The practices of land preparation, variety selection and second-crop production are not included. However, the sequence of operations through the production season has been correlated to rice plant development.

Note that the procedures listed represent the maximum level of inputs and that these practices should not be implemented unless the need arises or unless implementation can be economically justified. This table does not constitute a recommendation of one production sequence by Texas Cooperative Extension. The scheme shown represents common rice production practices. Alterations in one discipline can greatly alter other practices. This is a generalized tabulation of rice production to provide producers with an overview and enable them to consider combining management practices when possible to make efficient use of costly trips across the fields.

Production practice	Stage of rice plant development when action is taken
<b>Water management</b>	
Flush as needed	Preplant to 1st tiller
Permanent flood	3rd tiller to 4th tiller
Stop pumping	Soft dough to hard dough
Flood stubble	After harvest
<b>Fertilization</b>	
Apply N, P and K	Preplant to 3rd leaf
Apply N	3rd leaf to (and) panicle differentiation
<b>Weed control</b>	
Apply Propanil, Bolero <sup>®</sup> , Ordram <sup>®</sup> and/or Basagran <sup>®</sup>	Planting to panicle differentiation
Apply Bolero <sup>®</sup>	Planting to 3rd leaf
Apply Prowl <sup>®</sup>	2nd to 4th leaf
Apply Phenoxys or Londax <sup>®</sup>	2nd tiller to panicle initiation
<b>Disease control</b>	
Seed treatments	Planting
Scout fields for sheath blight	Panicle differentiation
First application:	Panicle differentiation and 14 to 21 days later (heading)
Second application: sheath blight treatments rice blast treatments	Full boot and 10 to 14 days later at heading
<b>Insect management</b>	
Scout and apply insecticide as needed for:	
armyworms	Germination to permanent flood (panicle initiation)
rice water weevil	3rd tiller through panicle initiation (7 days after applying permanent flood)
rice stink bug	Flowering to maturation
grasshoppers	Panicle initiation to flowering

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# Texas Rice Basis

Mark L. Waller, David P. Anderson  
and Philip L. Maass

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One of the most important aspects of using the futures markets to hedge your rice production is to have a proper understanding of the basis. Prices were low last spring, and many producers were unwilling to hedge at what they considered to be very low prices. However, with a record large crop in 2001 and an anemic demand situation, prices have declined to historically low levels as the year has progressed. Hedging returns of \$1.50-\$2.00/cwt. were possible for producers who were willing to hedge during the spring and early summer months.

This article discusses Texas rough rice basis, factors that may have been partially responsible for the changes that occurred over the last couple years, and what might be expected in the future.

## Calculating the Basis

Basis is calculated as the cash price minus the futures market price (cash - futures = basis). In this case, it is calculated using the nearby futures contract. The cash price is the El Campo weekly cash price as reported by Data Transmission Network (DTN). The Chicago Board of Trade rough rice futures contract is used for the futures contract price. The contract calls for U.S. No. 2 or better long grain rough rice with a base 55/70 milling yield. Premiums and discounts are included for head rice above or below 55 percent and broken kernels above or below 15 percent. Contract months are September, November, January, March, May and July. For more thorough, up-to-date information on futures contract specifications, refer to the Chicago Board of Trade's Web Site <http://www.cbot.com>.

## Results

Table 1 contains the basis from 1997 through September 2001. January 2000 is missing because there were no reported cash sales in the series we used here for that month. The monthly basis in table 1 is followed by the average, minimum, maximum, range and standard deviation of the basis.

In most months from January 1997 to June 2000, the basis was positive, with the cash price exceeding the futures price. That positive basis completely eroded with the new crop harvest beginning in July 2000. Normally, July has had the largest positive basis, yet it's declined to a \$- 0.51/cwt. in 2000. This basis collapse is shown more

clearly in Figure 1. Industry participants suggested that most of the basis decline experienced in the Summer/Fall of 2000 was an adjustment due to changes in the delivery specifications of the rough rice futures contract which reduced the amount of stained rice acceptable for delivery. There was also concern that the size of the 2000 U.S. crop, early selling, and reduced export activity were also impacting the market.

In the year since the change in delivery specifications was instituted, the rice industry appears to have adjusted, and basis behavior appears to have returned to a more normal pattern. While basis moved to a slightly negative average figure of \$- 0.09/cwt. in June 2001, it recovered to an average of plus \$1.23/cwt. in August and a plus \$0.70/cwt. in September. If we assume a return to a more normal basis pattern, we might expect the nearby basis to strengthen slightly as we move through the winter months and into spring.

While the future is always an unknown, one marketing opportunity that may be presenting itself this year is the ability to hedge a storage return this winter by storing the cash rice crop and selling July 2002 futures contracts. There is currently about \$1.00/cwt. carry in the futures market between the November 2001 and July 2002 contracts. If we expect the basis to stay the same or improve and we can pick up a \$1.00/cwt. from a storage hedge, that should more than cover the cost of carrying the grain. The main risk you face as a hedger in the situation would be the risk of a decline in basis. A thorough understanding of storage costs, hedging, and basis are necessary before you attempt to use this strategy. While this won't work for everyone, there may be an opportunity here for some producers.

## Summary

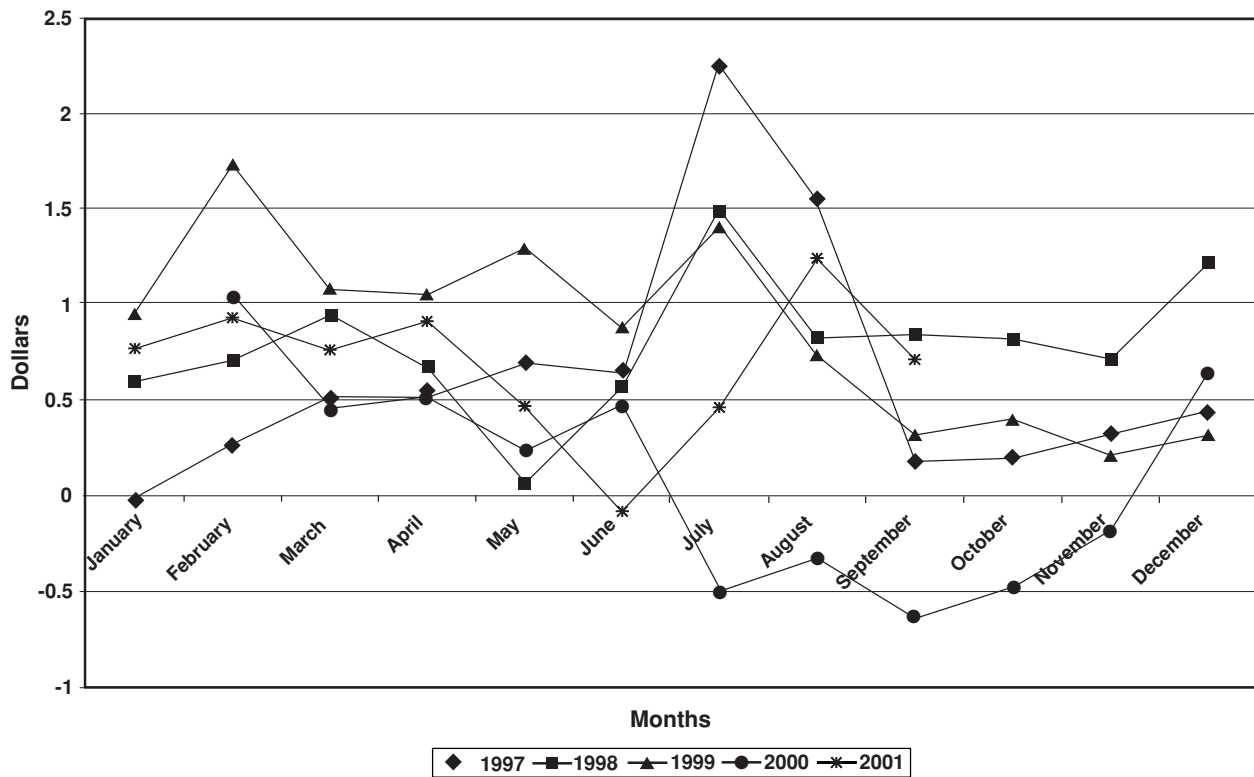
It is vital to have a reasonable estimate of the basis relationship when pricing any crop. While knowing the historical relationships doesn't eliminate the potential for surprises such as what happened in 2000, it does provide an important base for comparison and gives some perspective about what level the relationship between cash and futures prices might return to over the longer run. For more information about basis and hedging refer to the Extension Risk Management Curriculum Guide series publications which can be obtained from your County Extension Agent, or which can be found on the Internet at [http://mastermarketer.tamu.edu/cur\\_lum.htm](http://mastermarketer.tamu.edu/cur_lum.htm).

The authors would like to thank Jay Davis at East Bernard Rice Marketing for his assistance in the development of this article.



**Table 1. Average monthly rice basis for the nearby futures contract, 1997-2001.**

	1997	1998	1999	2000	2001	Avg.	Std. Dev.	Min.	Max.	Range
Jan	-0.03	0.59	0.95		0.77	0.5700	0.4261	-0.03	0.95	0.98
Feb	0.26	0.71	1.73	1.04	0.93	0.9340	0.5360	0.26	1.73	1.47
Mar	0.51	0.94	1.08	0.45	0.76	0.7480	0.2705	0.45	1.08	0.63
Apr	0.5	0.67	1.05	0.51	0.91	0.7280	0.2448	0.5	1.05	0.55
May	0.69	0.06	1.29	0.23	0.46	0.5460	0.4790	0.06	1.29	1.23
Jun	0.63	0.56	0.87	0.47	-0.09	0.4880	0.3556	-0.09	0.87	0.96
Jul	2.24	1.48	1.4	-0.51	0.45	1.0120	1.0618	-0.51	2.24	2.75
Aug	1.54	0.81	0.72	-0.34	1.23	0.7920	0.7138	-0.34	1.54	1.88
Sep	0.16	0.83	0.3	-0.66	0.7	0.2660	0.5866	-0.66	0.83	1.49
Oct	0.18	0.8	0.38	-0.69		0.1675	0.6273	-0.69	0.8	1.49
Nov	0.3	0.69	0.19	-0.2		0.2450	0.3661	-0.2	0.69	0.89
Dec	0.42	1.19	0.29	-0.62		0.3200	0.7419	-0.62	1.19	1.81



**Figure 1. Rice basis data Jan. 1997 to present.**

# Rice Production Economics and Marketing

D. P. Anderson, L. L. Falconer, J. L. Outlaw and M. L. Waller

## Characteristics

Average rice production costs in Texas are higher than most of the other major rice-producing states. In spite of higher costs, producers have been able to remain viable because Texas average rice yields are equal to or above the U.S. average and from 0 to 20 percent above yields in Mississippi and Louisiana (Fig. 1). Even with good yields, Texas rice producers' high costs make them vulnerable to changes in economic, agronomic and climatic conditions. This vulnerability is demonstrated by less acreage being planted each year. Figure 2 shows the change in rice acreage since 1987 for the major rice-pro-

ducing states. With lowering unit cost of production as a goal, producers should study the production recommendations in these guidelines very carefully.

## Yield potential and second crop production

Second crop potential has enhanced the economic viability of rice farmers. The additional production obtained from second crop production has provided a buffer against higher production costs.

## Estimated costs of production

Planning budgets are presented in Table 1 for the Eastern and Western Rice Belt areas. For the 2002 crop year the budgets are based on a total dry weight yields of 52.0 cwt (East) and 71.25 cwt (West). For the east side, there is only one crop harvested. On the west side, production of 71.25 cwt per acre is divided between a main and ratoon crop. The budgeted fertilization program consists of three split nitrogen applications for the main crop, followed by one nitrogen application for the ratoon crop. The budgeted insecticide program includes treatments for

Figure 1. Average rice yields, 1986-2001

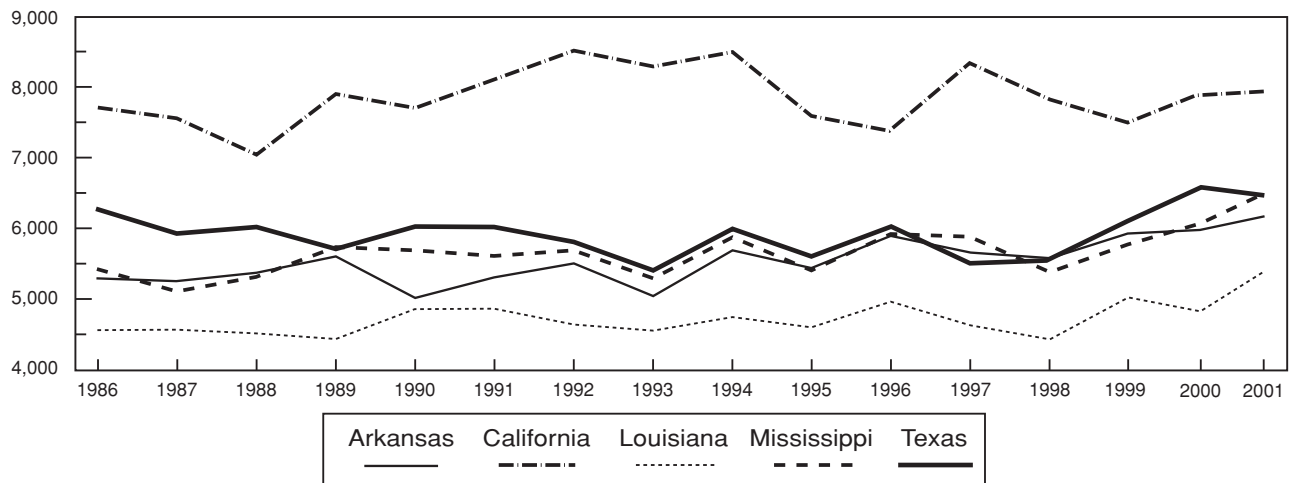
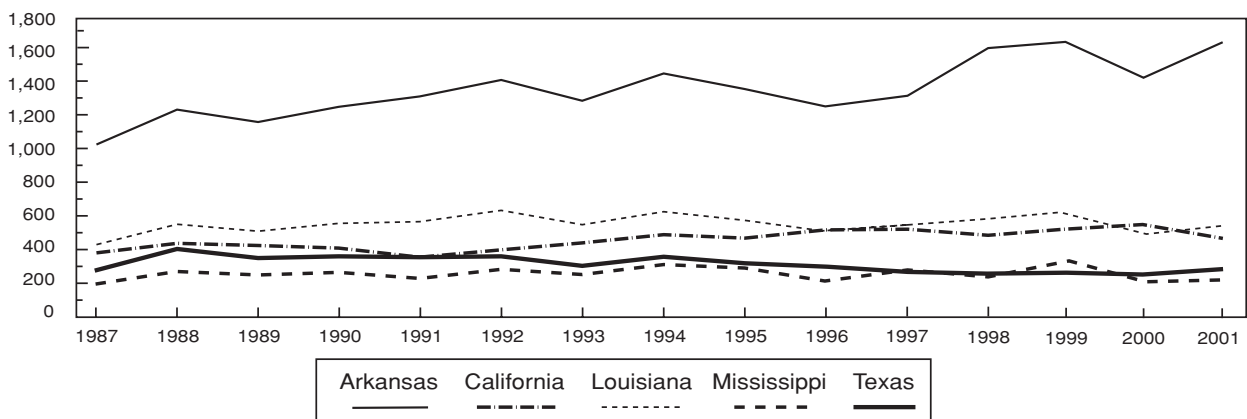


Figure 2. Total area planted to rice, 1987-2001



rice water weevil and rice stink bug control. Budgeted disease controls include fungicide treatments to control sheath blight and blast. Fixed cost estimates are based on a cash lease of \$75.00 per acre. Prices needed to cover all variable and total costs based on this budgeted cost structure are \$8.75 and \$10.93 per cwt on the east side and \$7.46 and \$9.37 per cwt on the west side.

The budgets presented here are general examples only. Any producer wanting to develop a personalized budget should gather cost and revenue information for the most current year and contact the county Extension agent for assistance.

### Rice Marketing

U.S. rice production is estimated to be 208.2 million cwt. World rice production is estimated to be 393 million metric tons. Coupled with increased consumption, world stocks are projected to remain historically tight.

Continued large world production has kept a lid on prices in spite of tighter world stocks. Large positive price movements would likely depend on unforeseen weather events in major producing countries.

**Table 1. Estimated cost of production for Texas rice belt**

Item	East	West
Seed	24.1	28.08
Chemicals		
Fertilizer	55.42	79.04
Insecticide	11.91	14.91
Herbicide	41.76	12.00
Fungicide	10.00	21.42
Custom Services		
Aerial Seed	5.89	—
Aerial Fertilizer	24.79	33.52
Aerial Insecticide	10.86	9.66
Aerial Herbicide	6.33	4.40
Aerial Fungicide	6.59	4.95
Survey Levees	—	—
Drying	49.67	78.65
Hauling	18.54	22.03
Sales Commission & Checkoff	8.00	10.73
Fuel, Lube & Repairs	59.85	75.46
Irrigation	78.19	90.00
Labor	22.15	27.09
Interest	15.60	12.92
Other	5.50	6.73
<b>Total variable cost</b>	<b>455.14</b>	<b>531.59</b>
<b>Fixed cost</b>	<b>113.37</b>	<b>136.28</b>
<b>Total of all costs</b>	<b>568.52</b>	<b>667.87</b>

## Agricultural Policy Update

Joe L. Outlaw and David P. Anderson

By the time *Rice Production Guidelines* is distributed, there may be a new Farm Bill. Although the House of Representatives passed its version of the Farm Bill (The Farm Security Act of 2001) in October, the Senate has yet to do so.

Some key factors (both old and new) will affect any farm policy legislation. First and foremost, the budget resolution passed early in 2001 committed an extra \$79 billion to agriculture for the period ending in 2011. There is concern the budget surplus that led to the extra \$79 billion will shrink and cause Congress to retract that allotment. Second, which is also related to the first, is money needed for the war on terrorism. So far, Congress and the Administration have agreed to provide \$40 billion in emergency spending for defense, intelligence, and disaster relief efforts. A third relatively new factor is commitment to the World Trade Organization (WTO). The new Farm Bill will have to pass the test of not violating the \$19.1 billion WTO cap on annual domestic farm subsidies. And finally, the President would prefer to see Congress wait until 2002 to pass new farm legislation. Speaking for President Bush, Secretary of Agriculture Ann Veneman has stated that it would be “irresponsible” for the Congress to try to move forward in the face of all of the war issues that need to be considered, especially since the 1996 Farm Bill does not expire until the end of 2002.

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# Evaluating Crop Revenue Coverage Crop Insurance: Rice INSure

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David P. Anderson, M. Edward Rister,  
L.G. Raun Jr., Larry Falconer,  
and Joe L. Outlaw

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In early 1999, as in past years, rice producers had the opportunity to purchase revenue coverage for the upcoming rice crop. The available insurance took various forms, but one in particular included a potentially beneficial "buy up" clause. Market prices near loan-level prices associated with projected record rice production and low export demand and a government subsidy on premiums contributed to the effectiveness of the "buy up" clause in protecting Texas rice producers' gross revenue.

To analyze revenue and insurance indemnity outcomes for a rice crop as well as harvest and ratoon-cropping decisions, a new spreadsheet package has been developed. The package allows the user to evaluate a range of possible harvest yields and final settlement prices for the November rough rice contract for different farm insurance unit numbers. This spreadsheet was tested this past fall by Texas rice producers and their advisors.

The software is written in the Lotus 1-2-3 (version 5.0) spreadsheet package. The basic data used in developing and validating the spreadsheet was taken from actual field and farm-level producer costs and yields. This spreadsheet includes two working pages: Data Input and Results. The producer is able to enter the data for individual insured units in the Data Input page. Data for up to a total of 15 individual insured units can be entered at one time. Macros are embedded in the spreadsheet to cal-

culate the insurance indemnities and market returns, facilitate movement from one section of the spreadsheet to another, and provide for printing of selected results.

The spreadsheet can be used to evaluate various crop insurance outcomes simply by changing the price level and Actual Production History yield coverage to reflect other options. Users can identify yields on the basis of total dryweight harvested per acre, including both main and ratoon crops. Share-crop tenant users can identify their share (percentage) of the harvested yield on the designated number of insured acres; similarly, users should indicate their cash insurance premium costs (dollars per acre) on the designated number of insured acres. Besides the specified post-harvest handling per unit costs, additional variable costs such as fertilizing the ratoon crop can be evaluated.

The Results page of the spreadsheet includes the input data for the unit and six tables of results. The input data and sample results are summarized in Tables 1 and 2. To date, where marginal ratoon crops were projected due to field conditions and/or lateness of main crop harvest, this spreadsheet has been used to evaluate the production decision and for supporting information as producers evaluate their insurance options. Other uses have been to evaluate and/or eliminate additional fertilizer applications on the ratoon crop when anticipated additional returns were less than the costs associated with the second application. This included an examination of the revenue gained from increased production and sales, of the lost insurance indemnity due to increased market revenue, and examination of costs including fertilizer.

In summary, this spreadsheet is intended to be useful to Texas rice producers to aid management decisions in the coming year. Instructions are built into the spreadsheet to aid in use. The spreadsheet is available from any of the authors and is provided by Texas Cooperative Extension and the Texas Agricultural Experiment Station and the Texas A&M University System.

**Table 1. General farm input information and insurance calculations.**

<b>Farm A: General input information &amp; insurance calculations</b>	
Farmer's Name: Sam Jones	#1
Farm Serial Number (FSN):	1234
Farm Insurance Unit Number:	One
Farm Unit Description:	100% Share
Producer's share of these insured acres:	100%
Number of Insured Acres:	60
Price Protection Level (\$/cwt):	\$11.50
APH Yield (cwt/ac):	49.85
Yield Coverage Level (%):	75%
Producer's Insurance Premium on these acres (\$/ac):	\$17.00
Producer's total insurance cost for unit:	\$1,020.00
Producer's Gross Revenue Coverage (\$/ac):	\$429.96
Producer's Net Revenue Coverage (\$/ac):	\$412.96
Producer's Net Revenue Coverage (\$ for unit):	\$24,777.38

<b>Farm A: Yield, cash selling price, and harvest &amp; post-harvest per unit cost expectations and net crop</b>	
Revenue Calculations	
Expected Cash Selling Price for Crop Revenue Proceeds, including premium (\$/cwt)	\$7.00
Expected Dry Harvested Yield (cwt/ac)	49.85
<b>Identify below those costs that vary with the amount of yield harvested per acre</b>	
Harvesting costs per dry cwt	\$1.000
Hauling costs per dry cwt	\$0.250
Drying costs per dry cwt	\$0.100
Storage costs per dry cwt	\$0.250
Sales commission per dry cwt	\$0.085
Research, sales promotion, legislative, and other checkoffs per dry cwt	\$0.110
Other costs that vary per dry cwt	\$0.010
Total of per unit costs (\$/cwt)	\$1.805
Net revenue per dry cwt after subtracting per unit costs	\$5.195
Producer's Gross Revenue (\$/ac) before per unit costs subtracted	\$348.95
Producer's Net Revenue (\$/ac) after per unit costs subtracted	\$258.97
Producer's Net Revenue (\$ for unit) after per unit costs subtracted	\$15,538.25

**Table 2. Projected revenues, net of insurance premiums and per unit harvest cost and post-harvest per unit costs, including applicable insurance indemnity for 1 acre and total farm unit.**

		Assumed cash selling price is \$7.00				Per unit harvest & post-harvest costs are \$1.805		
		Expected Futures Price						
		\$4.50	\$5.50	\$6.00	\$6.50	\$7.00	\$7.50	\$8.00
Expected yield Cwt	30	433.81	403.81	388.81	373.81	358.81	343.81	328.81
	42	442.15	400.15	379.15	358.15	337.15	316.15	295.15
	44	443.54	399.54	377.54	355.54	333.54	311.54	289.54
	46	444.93	398.93	375.93	352.93	329.93	306.93	283.93
	48	446.32	398.32	374.32	350.32	326.32	302.32	278.32
	50	447.71	397.71	372.71	347.71	322.71	297.71	272.71
	52	449.10	397.10	371.10	345.10	319.10	293.10	267.10
	54	450.49	396.49	369.49	342.49	315.49	288.49	263.53
	56	451.88	395.88	367.88	339.88	311.88	283.88	273.92
	58	453.27	395.27	366.27	337.27	308.27	284.31	284.31

		Assumed cash selling price is \$7.00				Per unit harvest & post-harvest costs are \$1.805		
		Expected Futures Price						
		\$4.50	\$5.50	\$6.00	\$6.50	\$7.00	\$7.50	\$8.00
Expected yield Cwt	30	26,028	24,228	23,328	22,428	21,528	20,628	19,728
	42	26,529	24,009	22,749	21,489	20,229	18,969	17,709
	44	26,612	23,972	22,652	21,332	20,012	18,692	17,372
	46	26,696	23,936	22,556	21,176	19,796	18,416	17,036
	48	26,779	23,899	22,459	21,019	19,579	18,139	16,699
	50	26,862	23,862	22,362	20,862	19,362	17,862	16,362
	52	26,946	23,826	22,266	20,706	19,146	17,586	16,026
	54	27,029	23,789	22,169	20,549	18,929	17,309	15,812
	56	27,113	23,753	22,073	20,393	18,713	17,033	16,435
	58	27,196	23,716	21,976	20,236	18,496	17,059	17,059

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# Computer Program for Rice Producers

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## DD50 Rice Development Advisory

This program uses current daily maximum and minimum temperatures (which are supplied by the user) and historical weather data (which is supplied on the disk) to calculate useable heat units for each day. Historical air temperature data are used for predicting dates where current weather data are not available. These heat units are accumulated from seedling emergence and used to predict various crop growth stages. These predictions may then be used as a reminder of crop progression and to schedule production practices for any of 10 varieties (Gulfmont, Lemont, Maybelle, Jackson, Bengal, Cypress, Dellmont, Jasmine 85, Kaybonnet and Jefferson).

Primary inputs are: current daily maximum and minimum air temperatures (to calculate actual usable heat units daily), location (to determine which historical weather file to use for dates beyond current daily data), variety (to set differing values for heat unit accumulations), and 90 percent seedling emergence dates (to provide a prediction range similar to emergence patterns).

Primary outputs include: a disease rating for the selected variety and predicted dates for various growth stages and cultural practices during the growing season. This information may be viewed on the screen or printed as a hard-copy (see example on page 53).

This program is available to county Extension agents. There are hardware and software compatibility problems, so this program is not widely distributed. If a grower is interested in obtaining a copy, he/she should contact Jack Vawter, Farm Services Manager at Eagle Lake (409/234-3578), to determine if this software can be run on his/her computer and printer configuration.

# Rice Development Advisory Using Eagle Lake Weather File

John Doe  
Variety: Cypress

Field ID: 6  
County: Colorado

Blast  
MR

Sheath Blight  
VS

Kernel Smut

Straighthead

Planted: March 15

Emergence from March 25 to April 1

T.R.R.F. Rice Hotline \*\* 1-800-238-TRRF \*\* Crop Advisory on  
Weather – Disease – Insects – Production Methods  
Marketing Information – Current Issues

NOTE: All predicted dates must be verified by actual field inspection. Any stress will cause crop development to be altered.

Rice development state	Predicted date	Actual date/stage
Check for rice water weevil within 1 week after permanent flood.		
Hormone herbicides from Panicle diff. N application	May 12 to May 22	(Late Tillering) (To pre-P.D.)
Earliest sheath blight fungicide	May 27 to May 29	To _____
First blast fungicide	May 31 to June 2	(2 inch panicle)
2nd Tilt® application must be made prior to heading!!	June 7 to June 9	(4 inch panicle)
Date field became 15% headed	June 11 to June 13	
Start checking for stink bugs at weekly intervals	June 20 to June 22	To _____
From 50% heading to harvest	June 22 to June 24	(50% heading)
second fungicide application (other than Tilt®)	June 24 to June 26	(80% heading)
Drain alert	July 24 to July 26	To _____
Approximate harvest date	August 3 to August 5	To _____
At 20% moisture		
Actual harvest moisture range		To _____

Remarks: Contact your county Extension agent or the 2001 Rice Production Guidelines concerning fungicide recommendations for varieties.

Please make corrections to predicted dates and send to:  
Texas Agricultural Experiment Station  
Jack Vawter  
P.O. Box 717  
Eagle Lake, TX 77434



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