Missouri Rice Research Update 2006

Southeast Missouri State University
University of Missouri Columbia
University of Missouri Outreach and Extention

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Introduction

This report is a compilation of research projects, demonstration efforts, and additional Missouri rice information. Its purpose is to inform producers, research and extension personnel, industry representatives, agribusiness consultants, farm suppliers, and commodity organizations about rice activities in Missouri. The information resulted from contributions of the University of Missouri Agricultural Experiment Station Personnel, and Southeast Missouri State University, United States Department of Agriculture – Wildlife Services. The use of trade or company names in this report does not constitute recommendation or endorsement.

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For further information on Missouri Rice visit these websites:

Λ Missouri Rice Page on the World Wide Web at
http://www.ext.missouri.edu/agebb/rice/

Λ Missouri Rice DD50 Program on the World Wide Web at
http://www.agebb.missouri.edu/rice/ricemodel.htm

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Registration

Coping with High Nitrogen Prices – Gene Stevens

Phosphorus Deficiency Alert – David Dunn

Rice Weed Control – Andy Kendig

Rice Varieties – Donn Beighley

LLRICE601 and other Issues – Chuck Wilson

Break

Water in Southeast Missouri – Amy Crews

Updates on Rice Fungicides and Soybean Rust – Allen Wrather

Rice Insects to Look for – Kelly Tindall

Rice Policy and Market Update – John Kruse

Missouri Rice Research Council Report – Gary Murphy

Lunch and Door Prize Drawing

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Reactions of Rice Varieties to Major Diseases, Disorders, and Insects												
Variety	Blast	Sheath Blight	Stem Rot	Kernal Smut	False Smut	Narrow Brown Leaf Spot	Leaf Smut	Straight-head	Water Weevil Larvae	Rice Stink Bug	Lodging	Black Sheath Rot
Long Grain												
Cheniere	S-MS	S-MS	S	VS	S	MS	MR	MS-MR	S	S	MR	MS
CL 161	S	VS	S	S	S	MS	MS	S-MR	S	S	S	S
CL 151	VS	VS	S	S	S	S	-	VS	-	-	MR	S
CL 131	S	VS	S	S	MS	R	-	VS	-	-	MR	S
Cocodrie	MS	VS-S	S	VS	S	MR	MS	VS-S	S	S	MR	MS
Cybonnet	MR-R*	VS-S	S	S	S	MR	MS	MS	S	S	MS	S
Cypress	S-MS	VS	MS	S	S	MR	MS	MS-MR	S	S	MS	S
Francis	VS-S	MS	S	VS	S	-	MS	MS-MR	S	S	MS	MS
Jefferson	MS	S	-	-	-	MR	MR	R	S	S	-	-
Spring	S	S	VS	MS	MS	R	-	R	-	-	S	MS
Trenasse	S	VS	S	S	MS	R	-	VS	-	-	MS	-
Wells	S	MS	S	MS	S	R	MR	MS	MR	S	MS	MS
XL8	R*	MS	S	MS	MS	R	R	MS-MR	S	S	MS	MS
CLXL8	MR-R*	MS	S	MS	MS	S	R	MS-MR	S	S	MS	MS
CL 171 AR	MS	S	S	S	S	MS	-	-	-	-	MS	MS
XP710	MR-R*	MR	MS	MS	MS	R	R	VS	S	S	MS	MS
XP723	MR	MS	S	MS	MS	R	R	MS	S	S	MS	MS
CL XP729	MR	MS	S	MS	S	MR	-	MR	-	-	MS	MS
Cl XP730	MR	S	S	MS	S	MR	-	MR	-	-	S	MS
Medium Grains												
Bengal	S	MS	VS	MS	MS	MS	MS	VS	VS	VS	MR	MR
Jupiter	MS	MS	S	MS	MS	R	-	MS	-	-	MR	-
Medark	MS-MR	MS	S	MS	MS	R	S	S	S	S	MR	MR
Piroque	R*	MS	MS	MS	MS	R	-	-	-	-	MS	MS
XP721	MR-R*	MR	S	MS	MS	R	MR	MS	S	S	MS	MR
XP716	R	MR	S	MS	MS	MR	MR	MS	S	S	MS	MR

Reaction: R = Resistant, MR = Moderately Resistant, MS = Moderately Susceptible, S = Susceptible, VS = Very Susceptible

* Resistant to common strains of the rice blast fungus in Arkansas. Susceptible to an unusual variant strain of the rice blast fungus that has been rarely observed in the field to date or reaction to the variant strain not known at the time of publication.

Prepared by Don Groth, Lousiana; R.D. Cartwright & F.N. Lee, Arkansas.

General Characteristics of Rice Varieties.

Variety/Hybrid	Year Released & State	Highlights
Bengal	1992 – Louisiana	A short season, semi dwarf, medium-grain with good yield potential and milling quality. It has a preferred large grain size. Represented about 10% of 2003 rice acreage in Arkansas.
Cheniere	2003 – Louisiana	A very short season, semi-dwarf long-grain with good yield potential, less oil in bran than Cocodrie, and improved straighthead tolerance. It has L202 and Jodon cooking type.
CL 131	2005-BASF, Horizon Ag.	A midseason, semi-dwarf long-grain similar to CL 161 with shorter plant height, similar sheath blight susceptibility, very suceptible to straighthead, and improved grain yield potential.
CL 161	2002 – BASF	A midseason, semi-dwarf, long-grain similar to Cypress with high tolerance to Newpath herbicide. It is susceptible to sheath blight, moderately resistant to blast and moderately susceptible to straighthead.
CL XL8	2003 – Rice Tec, Inc.	A short-season, long grain with excellent yield potential and high tolerance to Newpath herbicide, moderate resistance to sheath blight, and resistance to blast.
CL 171 AR	2006 - BASF, Horizon Ag	A midseason, semi-dwarf, long-grain similar to Wells with high tolerance to Newpath herbicide. It is susceptible to sheath blight, moderately susceptible to blast and straighthead. Yield is similar to CL 161.
CL XP 730	2005Rice Tec, Inc.	A short-season, long grain with excellent yield potential and high tolerance to Newpath herbicide, moderate resistance to sheath blight, and resistance to blast.
Cocodrie	1997 – Louisiana	A short season semi-dwarf long-grain with good yield potential and milling quality. Represented about 21% of the 2003 rice acreage in Arkansas.
Cybonnet	1996-Arkansas	A mid-season, semi-dwarf long-grain with good yield potential and excellent milling quality similar to Cypress. It has blast resistance similar to Katy.
Cypress	1992 – Louisiana	A mid-season, semi-dwarf long-grain with good yield potential and excellent milling quality and excellent seedling vigor.
Francis	2002 – Arkansas	A very sort season, long-grain with excellent yield potential, susceptible to rice blast. Represented about 6.4% of the 2003 rice acreage in Arkansas.
Cybonnet	2004 – Arkansas	A short season, semidwarf long grain with good yield potential and excellent milling quality similar to Cypress. It has blast resistance similar to Katy.
Medark	2004 – Arkansas	A short season, semidwarf, medium-grain with good yield potential and milling quality. It has a preferred large grain size.
Spring	2005-Arkansas	A very short season, long grain with good yield potential and rice blast resistance. It is one of the earliest maturing long-grain rice lines.
Wells	1999 Arkansas	A short season, long grain with excellent yield potential, average milling quality, kernel size similar to Lemont, and susceptible to rice blast. Represented about 47% of the 2003 rice acreage in Arkansas.
XL 8	2002 – Rice Tec, Inc.	A short-season long-grain hybrid with excellent yield potential, average milling quality, and moderate resistance to sheath blight and blast.
XP 710	Experimental – Rice Tec	A short-season long-grain hybrid with good yield potential, average milling quality, and resistance to blast and moderately resistant to sheath blight.
XP 712	Experimental – Rice Tec	A short-season medium-grain hybrid with good yield potential, average milling quality, and resistance to blast and moderately resistant to sheath blight.

Mid-Season Nitrogen Fertilizer Decisions for Rice

Gene Stevens and David Dunn
University of Missouri-Delta Research Center

Managing nitrogen fertilization in rice fields can be challenging for producers. In drill-seeded rice, urea fertilizer is usually broadcast immediately before flooding. Depending on irrigation well pump capacity, field size, and weather conditions, urea can be lost by volatilization while a field is being flooded. Optimum N rates vary by rice variety, soil texture, and previous crop rotations. Nitrogen can also be lost by denitrification if the urea is converted to nitrate in the soil.

For many years, rice agronomists have tried to develop an accurate method of determining whether supplemental nitrogen is needed at internode elongation growth stage. The Plant Area Board has shown good correlation to rice yield response to mid-season N in experiments. However, few growers use it because it is time consuming and requires tedious calculations. Likewise, Minolta SPAD chlorophyll meters have been used successfully in N rice research projects but are too expensive for most growers and consultants.

Yardstick N test

In 2004, we developed and tested a new inexpensive method using an ordinary, wooden yardstick for monitoring rice plant N. The objective of the experiments was to develop critical threshold values using simple yardstick measurements that farmers can use to determine whether midseason N is needed on a rice field. Field tests were conducted at Glennonville, Missouri on a Crowley silt loam soil and Portageville, Missouri on a Sharkey clay soil. At each location, plots were drill seeded (7.5-in row spacing) with Francis and Cheniere varieties. A split-plot design was used with varieties in main plots and N treatments in subplots. Five pre-flood urea nitrogen rates were applied at 0, 35, 70, 105 and 140 lb N/acre. One half of the subplot treatments received mid-season N and one half did not receive additional N. Subplots with mid-season N received 30 lb urea N/acre at internode elongation plus 30 lb urea N/acre one week later. Plots were mechanically harvested with a combine. Rice yields for each pre-flood N rate subplot without midseason N were subtracted from yields in pre-flood N rate subplots with midseason N.

Visual observations with a yardstick were made at green ring growth stage. Two center rows from each plot were selected. A wooden yardstick was placed halfway between the rice rows on the surface of floodwater. (The yardstick was positioned parallel to the rows.) Standing between adjacent rows and leaning over the sampling rows, we counted the inch numbers showing on the yardstick (not hidden by rice leaves) out of the 36 places possible. Two digit inch numbers were counted as one place. When a rice leaf obstructed the view of either of two digit numbers, we did not count that place.

Averaged across varieties, soils, and years; rice yields were highest when 140 lb N/acre was applied before flooding with no midseason N applications (Table 1 and 2). In eight out of twelve (2 varieties X 2 soils X 3 years) field observations, midseason N reduced rice yields in main plots with 140 lb N/acre applied preflood. In Cheniere rice in 2006, plots with only 70 lb N/acre applied preflood produced the highest yields.

Yield response to mid-season N was correlated with yardstick observations made at green ring (data not shown). We found that the most consistent critical yardstick value for making midseason N decision was twelve. In other words, when fewer than 12 digits were showing little or no positive yield response to midseason occurred. Zero or negative rice yield responses were found from midseason when fewer numbers were showing. However, if rice is grown on a freshly graded field or a field with a history of lodging, midseason N may not be beneficial to rice yields unless fewer than 18 to 23 digits are showing at green ring.

Low population N test

A field test was conducted at the Missouri Rice Research Farm in Glennonville, Missouri on a Crowley silt loam soil and the University of Missouri-Delta Center in Portageville, Missouri on a Sharkey clay soil and. The objective was to evaluate the yardstick method in sub-optimum rice plant densities in fields. The field was graded in the spring of 2004 and planted in soybeans. In 2005 and 2006, rice plots were drill seeded (7.5-in row spacing) with Wells cultivar at seeding rates of 5, 15, 25, and 35 seeds ft^2. Three pre-flood nitrogen treatments were applied at 45, 90, and 135 lb urea N/acre. One half of the treatments received mid-season N while the other half received no mid-season applications. Plots with mid-season applications received 30 lb urea N/acre at internode elongation plus an additional 30 lb N/acre one week later. Plots were mechanically harvested with a combine.

Two methods of measuring leaf canopy were tested. For the first method, we used a macro developed at University of Arkansas for Sigma Scan™ image software to evaluate digital pictures based on the percentage of green leaf material in a given area. Digital photos were taken from each plot during the GR growth stage. A digital camera was positioned on 5-ft rod held at a 45-degree angle above the plot. Photos were taken at a downward angle over the rice rows. Photos were analyzed using Sigma Scan to determine the percentage of pixels in each picture that appeared green in color (near 510 nm in wavelength). For the second method, visual observations with a yardstick were also made at GR growth stage. The same procedure was used as in the "yardstick test" above.

At the Delta Center in 2006, yields were high even in low population treatments (Table 3). At the lowest seeding rate (5 seeds per feet), response to 135 lb N preflood plus midseason N was 17 bushels per acre compared to 45 lb N preflood. The reverse occurred at the highest seeding rate (35 seeds per feet). In this plant population, yield was 296 bushels per acre with only 45 lb N preflood. At the Missouri Rice Farm in 2006, rice plots were stunted from Command herbicide and water weevil injury (Table 4). At seeding rates less than 25 seeds per feet, adequate preflood N was needed to promote tillering.

Table 1.

Rice yields as affected by urea preflood and midseason nitrogen rates at the University of Missouri-Lee Farm at Portageville, Missouri on a Sharkey clay soil.

Nitrogen applications		Francis				Cheniere			
Preflood	Mid-season	2004	2005	2006	Avg change	2004	2005	2006	Avg change
-----lb N acre^{-1}-----		------bu acre^{-1}------							
0	0	113	169	160	+8	110	175	142	+23
0	30+30	125	180	162		130	182	183	
35	0	110	191	198	+2	129	194	184	+6
35	30+30	119	199	189		148	187	191	
70	0	118	212	210	0	134	200	205	-5
70	30+30	128	200	213		145	181	196	
105	0	125	208	219	-8	138	205	196	-9
105	30+30	137	184	208		143	168	200	
140	0	138	202	209	-5	145	185	195	-26
140	30+30	143	184	208		130	124	193	

Table 2.

Rice yields as affected by urea preflood and midseason nitrogen rates at the Missouri Rice Research Farm at Glennonville, Missouri on a Crowley silt loam soil.

Nitrogen applications		Francis				Cheniere			
Preflood	Mid-season	2004	2005	2006	Avg change	2004	2005	2006	Avg change
-----lb N acre^{-1}-----		------bu acre^{-1}------							
0	0	142	125	95	+26	141	134	111	+18
0	30+30	164	150	126		164	163	113	
35	0	172	148	124	+21	151	146	133	+20
35	30+30	191	172	142		173	181	135	
70	0	185	172	105	+33	175	165	149	+3
70	30+30	201	197	164		179	190	129	
105	0	202	186	137	-4	182	169	133	+8
105	30+30	204	174	137		175	198	135	
140	0	211	207	152	-13	175	194	129	-14
140	30+30	194	203	135		162	177	117	

Table 3.

Effect of rice seeding rate, preflood N and mid-season on lodging, leaf canopy at green ring growth stage and rice yields at the MU Delta Research Center in 2005 and 2006.

	Mid-	Plant	Height		Yardstick showing		Yield	
Preflood	season	seed	2005	2006	2005	2006	2005	2006
lb N/acre	applied	#/ft^2	----inches---				-----bu/a----	
45	no	5	24	59	27	26	119	176
45	yes	5	24	22	29	27	130	178
90	no	5	24	22	21	24	155	175
90	yes	5	26	37	20	26	157	173
135	no	5	24	36	26	41	151	181
135	yes	5	24	22	25	26	134	195
45	no	15	25	23	23	38	172	199
45	yes	15	26	37	19	23	180	192
90	no	15	26	24	17	22	171	218
90	yes	15	26	24	14	21	175	216
135	no	15	28	23	14	23	153	218
135	yes	15	27	26	11	22	130	202
45	no	25	24	38	24	22	143	200
45	yes	25	26	27	18	21	187	223
90	no	25	26	25	18	20	168	225
90	yes	25	27	27	14	16	190	234
135	no	25	29	41	8	18	149	227
135	yes	25	28	71	9	61	152	216
45	no	35	26	37	19	39	166	212
45	yes	35	26	23	16	26	196	296
90	no	35	26	28	11	20	169	217
90	yes	35	28	28	8	14	175	230
135	no	35	29	28	12	31	169	225
135	yes	35	27	28	10	14	166	224

Table 4.

Effect of rice seeding rate, preflood N and mid-season on lodging, leaf canopy at green ring growth stage and rice yields at the Missouri Rice Research Farm in 2005 and 2006.

Preflood	Mid-season	Plant seed	Height		Yardstick showing		Yield	
			2005	2006	2005	2006	2005	2006
lb N/acre	applied	#/ft^2	----inches---				-----bu/a----	
45	no	5	23	21	36	36	15	25
45	yes	5	23	23	35	34	21	97
90	no	5	24	24	35	32	28	159
90	yes	5	18	24	36	22	29	129
135	no	5	24	23	36	30	25	133
135	yes	5	24	23	36	34	35	133
45	no	15	26	22	25	34	148	78
45	yes	15	28	21	21	34	200	58
90	no	15	30	21	21	36	163	52
90	yes	15	27	23	20	34	229	74
135	no	15	31	35	19	34	207	115
135	yes	15	28	25	21	31	216	104
45	no	25	28	36	24	33	192	116
45	yes	25	28	38	22	35	208	89
90	no	25	32	21	9	39	215	99
90	yes	25	32	20	10	34	245	38
135	no	25	32	23	13	32	248	38
135	yes	25	33	22	12	35	239	37
45	no	35	28	22	15	29	201	119
45	yes	35	29	25	18	30	222	122
90	no	35	31	24	15	25	221	128
90	yes	35	31	21	18	35	237	79
135	no	35	34	36	13	33	227	101
135	yes	35	32	35	11	34	245	90

University of Missouri Soil Test Recommendations for Rice Production

Gene Stevens and David Dunn

Introduction

Most of the Current University of Missouri soil test recommendations have been adopted from Arkansas. During the past 10 years a team of scientists including Dr Gene Stevens, Dr Michael Aide, Dr Paul Tracy, and David Dunn have carried out field evaluations of these recommendations. These evaluations are continuing today thanks to support from the Missouri Rice Research and Merchandising Council.

pH and soil acidity

In Missouri soil acidity is measured on the basis of Salt pH (pH_s). The pH_s indicates the need to apply lime. The lime requirement is measured by the Woodruff Buffer method. Missouri lime recommendations are given in lbs. of Effective Neutralizing Material (ENM) per acre. ENM is an estimate of how much soil acidity the lime will neutralize in a 3 year period.

Currently the University of Missouri does not recommend liming before rice is grown. Liming is necessary to maximize soybean yields in the rice-soybean rotation. Last year soybean yields were increased 25% when 1 ton/a of lime was applied before soybeans were planted at the Missouri Rice Research Farm.

Nitrogen (N)

Currently the University of Missouri recommendations for nitrogen are variety specific. These recommendations are posted on the Ag Electronic Bulletin Board at http:\\agebb.missouri.edu\rice. Table 1 gives the nitrogen recommendations for 4 popular varieties.

Table 1.
Nitrogen recommendations for 4 popular rice varieties.

Variety	Total N	Preflood	Mid-season
Bengal	135	75	30+30
Cocodrie	150	90	30+30
Francis	150	90	30+30
Wells	150	90	30+30

Phosphorus (P)

Phosphorus recommendations are based on a target level of 30 lbs P/a. A rice crop will remove .30 lb of P_2O_5 per bu per acre. To account for this loss a crop removal factor is included for soils testing between 30 and 55 lb P/a. Recommendations are given in lbs of P_2O_5 per acre.

Potassium (K)

In 2003 the University of Missouri changed the target level for K fertilization. The new target level reflects recent research in Missouri. These new recommendations also reflect the higher yield potential of the rice varieties grown in Missouri. Potassium recommendations are based on a target level of 125 + 5X CEC. For silt-loam soils this is about 200 lbs K/a. For gumbo soils this number is about 225 lbs K/a. Rice yields drop off quickly when a soil tests below these levels. For low testing soils a factor for building the soil up to maximum productive levels is included in the fertilizer recommendation added in. The current recommendation package allows the producer to choose how quickly to build up the soil K levels. A rice crop removes 0.2 lb K_2O per bushel per acre. A crop removal factor is included to account for this. Recommendations are given in lbs of K_2O per acre.

Phosphorus Management in a Drill-Seeded, Production System in Missouri

David Dunn & Gene Stevens
University of Missouri-Delta Center

Proper Phosphorus (P) nutrition is critical for producing maximum rice grain yields. Phosphorus promotes strong early plant growth and development of a strong root system. Maximum tillering is also dependent on P. Often times P deficiency in rice is referred to as a "hidden hunger" because the symptoms are not apparent unless deficient plants are directly compared to sufficient plants (Figure 1). When compared to healthy rice of the same age P deficient rice is caricaturized by an abnormal bluish green color of the foliage with poor tillering, slow to canopy, and is slow to mature. When such plant comparisons are not available plant tissue testing is the best tool for diagnosis P deficiency.

Beginning in 2004 a three-year phosphorus evaluation was conducted at the Missouri Rice Research Farm located in Dunklin Co. Missouri, near Qulin, MO. A dry-seeded, delayed flood rice production was employed. The soil type is a Crowley silt loam (fine, montmorillonitic, thermic Typic Albaqualf). This location has been in a rice/soybean rotation for over 15 years. In each year a different research area was used. These areas had similar pH (6.8), K (135 lb/a) organic matter (1.8%), and CEC (10.0) levels. They differed in P levels each year (2004 38 lbs/a, 2005 8 lbs/a, & 2006 32 lbs/a). In 2004 & 2006 a 25 lbs P/a maintenance application was recommended while in 2005 a 85 lbs P_2O_5 application was recommended. A randomized complete block experimental design with four replications was employed each year. The plot size was 25' by 10'. All methods of water management, and weed & insect control were the standard practices for cultivating dry-seeded, delayed flood rice in Southeast Missouri.

Three pre-plant rates of P_2O_5 (25, 50, & 100 lbs/a) as triple super phosphate (TSP) were compared to an untreated check. These treatments were applied and incorporated with tillage immediately before rice was seeded. Additionally a 50 lbs/a rate of TSP applied at one of three times (pre-flood, inter-node elongation, & early boot) was evaluated. Soil and plant tissue samples were collected from each plot prior to flood establishment. Soil samples were collected by compositing 12 individual cores representing a 0-15 cm depth. For tissue samples one row foot was collected from the second drill row from the out side edge of each plot. These samples were dried, ground and digested using H_2SO_4-H_2O_2. The digested sample was then analyzed for P content. At maturity grain was harvested from the center 5 feet of each plot. Moisture percentage was measured from each plot and yields were adjusted to a 12.5% basis.

Pre-plant phosphorus fertilization significantly affected yield in each year studied (Table 1). However, each year visual identification of P deficient plots were only possible with direct comparison with P sufficient plots. The greatest yield in each year was obtained with the 100 lb P_2O_5 rate applied pre-plant. The potential economic value added by P fertilization is also presented in Table 1. While the highest rate of P produced the greatest returns the additional cost of 50 lbs P may not justify the higher rate.

When the 50 lbs pre-plant application was compared to 50 lbs applied later in the growing season an interesting relationship emerged (Figure 2). In terms of relative yields the pre-flood application timing was able to capture 99% of the yield potential of the pre-plant timing and was statistically equivalent. The subsequent timings, inter-node elongation & boot, were averaged across all P rates the pre-plant and pre-flood timings were able to capture progressively less of the yield potential (95 & 92 %). The boot application was statistically equivalent to the untreated check (alpha = 0.10). This indicates that rice producers have a window of opportunity to correct P deficiency, if it can be identified.

In the dry seeded, delayed flood rice production system commonly employed in the USA mid-south region rice is cultivated to the growth stage first tiller, nitrogen fertilizer (urea) is applied to dry soil, and a permanent flood is established. Additional supplemental nitrogen may be applied later in-season as needed. As the pre-flood urea is applied with ground based equipment a piggy back of P fertilizers represents an added material cost only. Subsequent applications must by supplied via air and represent an additional $5-10 cost above materials. This combines to make a pre-flood P application the most cost effective in-season timing. Two methods of evaluating plant P status (soil & tissue sampling) at pre-flood were compared. Of these tissue testing provided a better prediction of yield than soil testing (Figure 3).Tissue P levels greater than 0.18% were consistently correlated with maximum rice yields (relative yields greater than 95%). Soil testing at pre-flood was much less successful at yield prediction (relative yield or absolute yield). As such tissue testing would be the preferred method for P status diagnosis.

To properly collect a tissue sample at pre-flood, rice producers should select areas within each field that are uniform in caricature (crop history, soil texture, fertilization history......). These areas should represent areas which may be fertilized as a unit. The above ground tissue from one foot of drill row at 4 or 5 randomly selected locations within each unit should be collected. Care should be taken that the sample is not contaminated with soil as this will influence the results. The basal portion of the sample may be washed with distilled water if contamination is suspected. Samples should be placed in paper containers (not plastic) to allow drying during subsequent handling. Proper labeling of samples insures consistent identification later. The samples may now be transported to a qualified tissue testing lab for analysis. When selecting a lab, close attention should be paid to turn around time. Results not returned to producers in a timely manner may cause delays in flood establishment or missing the pre-flood application timing window.

Based on this three year study producers have the opportunity to correct P deficiency in rice as late as pre-flood and still obtain maximum yield benefit. In 2004 the untreated check yielded 164 bu/a, which would be an acceptable yield for most producers. That a significant yield increase was obtained with P additions points to a "hidden hunger" situation. The data suggests that tissue testing for P at pre-flood could have indicated a possible P deficiency. Producers should consider tissue testing rice fields at pre-flood and apply P fertilizers if the tissue P level is 0.18% or below.

This research was made possible by the generous and continuing support of the *Missouri Rice Research and Merchandising Council.*

Table 1.

Average rice grain yields for pre-plant P treatments 2004, 2005, & 2006.

P rate	2004	2005	2006	Average	bu +	P cost*	Gross – fertilizer cost**
0	164	119	120	134	-------	-----	$605
25	164	130	135	143	9	$6.25	$637
50	174	133	136	148	14	$12.50	$652
100	183	138	141	154	20	$25.00	$667
LSD 0.10	5	17	10	9	-----	-----	55
CV%	5.8	11.1	5.8	7.6	-----	-----	6.4

* based on P_2O_5 @ $0.25/lb ** based on rice @ $4.50/bu

Figure1.
Direct comparison of P sufficient (left) and P deficient (right) rice plots at pre-flood.

Figure 2.

Average relative yields obtained by adding 50 lbs/a P_2O_5 at midseason timings, 2004, 2005, & 2006. pp = pre-plant, pf = pre-flood growth stage = V5, IE = inter-node elongation growth stage = R0, boot = growth stage R2

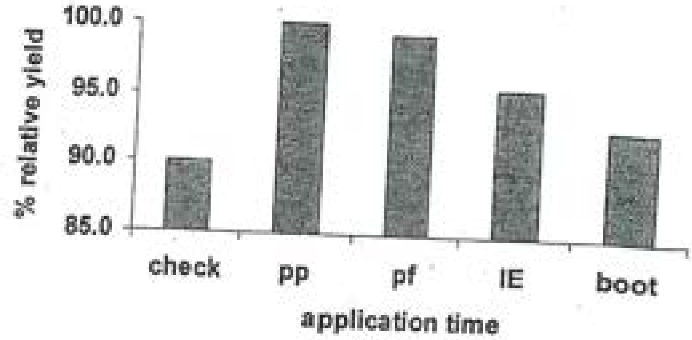
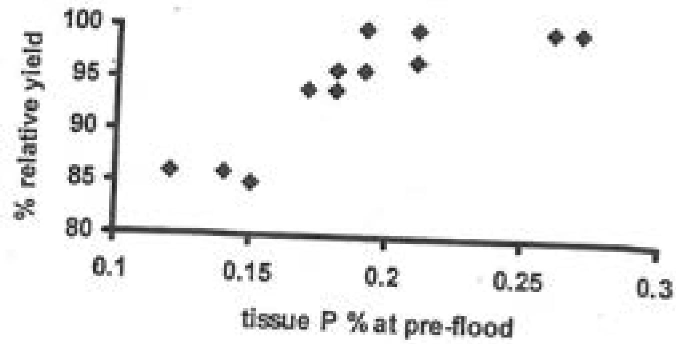


Figure 3.

Relationship between Tissue P% at pre-flood and relative yield.



Ammonium Chloride Evaluation for Rice

David Dunn

Abstract

In this two-year evaluation four rates of Ammonium chloride applied pre-plant were compared to an untreated check. Also included was a pre-plant urea treatment with equivalent N contribution of the highest rate of Ammonium chloride.

Introduction

Chlorine (Cl) is an essential nutrient for plants. It was the last element to be recognized as essential to plants, its vital role only being discovered in 1954. This is probably due to the wide spread occurrence of chlorine in soil environments. Chlorine is however easily leached from soils and may become deficient at the top of soil profiles. Potash fertilizers (muriate of potash) contain 40% chlorine and can be a significant source. In plants chlorine is required in the splitting of water during the photosynthesis process. As such it facilitates the production of oxygen by the plant and enhances oxygen availability to developing rice roots in flooded situations. Chlorine deficiency is rare in natural conditions. When it is present it is often associated with fungal diseases of small grains. Chlorine toxicity is more common. It is caricaturized by premature yellowing and burning of leaf tips and margins. In extreme cases the leaves will fall off prematurely. When chlorine is present in the soil in large amounts it can compete with nitrate and sulfate in plant uptake. The resulting plants may show N or S deficiency.

Ammonium chloride is 66% chlorine and 26% nitrogen with the remainder being composed of hydrogen. This study investigates the use of liquid ammonium chloride as a supplemental fertilizer for rice.

Methods and Materials

This two-year evaluation was conducted on a research area located at the Missouri Rice Research Farm located in Dunklin Co. Missouri, near Qulin, MO. The soil type is a Crowley Silt-loam. The area has been in a rice/soybean rotation for over 15 years. The soil was tested for fertility each year. In 2005 the soil pH was 6.4, Organic matter 1.8%, P 8 lbs/a, K 104 lbs/a, and a CEC 10.0 meq/100gr. . In 2006 the soil pH was 6.2, Organic matter 1.9%, P 38 lbs/a, K 154 lbs/a, and a CEC 10.2 meq/100gr. These soil test indicated that a P & K fertilization would have been recommended each year (2005: 85 lbs P_2O_5 & 40 lbs K_2O/acre; 2006: 25 lbs P_2O_5 & 40 lbs K_2O/acre). These recommendations were not followed ether year. A randomized complete block experimental design with four replications The plot size was 25' by 10'. The rice variety CL 161in 2005 while the variety in 2006 was CL 131. both were planted at a rate of 110 lbs seed/acre. Immediately before establishment of a permanent flood 180 lbs N/acre as urea was applied as a blanket rate to all plots. The variety, seeding rate, and N fertilization rate was chosen to promote disease pressure. All methods of water management, and weed & insect control were the standard practices for cultivating drill-seeded rice in Southeast Missouri.

Four rates of chlorine (10, 20, 30, & 40 lbs/a) applied pre-plant were compared to an untreated check. An additional treatment consisting of 16 lbs N/acre as urea was also evaluated. This treatment represents the equivalent N contribution of the 40 lbs Cl/acre treatment. It was added to distinguish between the Cl and N effect of the ammonium chloride. At maturity grain was harvested from the center 5 feet of each plot. Moisture percentage was measured from each plot and yields were adjusted to a 12.5% basis.

Results and Discussion

Pre-plant fertilization with ammonium chloride produced significant differences in rice yields in 2005 (Table 1). In 2006 there were no statistical differences in rice yields between treatments. However, the untreated check had numerically less rice grain yield that the three lowest chloride treatments. While the 10, 20,& 30 lb Cl/a rate of ammonium chloride all produced statistically equivalent yields the 30 lb rate produced the numerically greatest yields in 2005 and the 20 lb Cl/a the greatest yields in 2006. For the two-year average the 30lb Cl/a treatment produced the greatest yield. The pre-plant urea treatment produced yields which were statistical equivalent to the untreated check both years. This leads to the conclusion that the yield increases associated with ammonium chloride were due to the chloride effect rather than the pre-plant N effect. The highest rate of ammonium chloride however produced yields which were statistically less than any of the other ammonium chloride treatments in both years of the study. This yield was numerically lower but statistically equivalent to the untreated check. Harvest moisture was not affected by ammonium chloride or urea treatments. No diseases were detected in this evaluation during either year.

Table 1.

Average rice grain yields for ammonium chloride treatments 2005 & 2006.

Treatment		Rice grain yield (bu/a)		
#	Description	2005	2006	Average
1	Untreated	116	155	135.5
2	16 lb N pp*	118	157	137.5
3	10 lb Cl pp	121	162	141.5
4	20 lb Cl pp	125	162	143.5
5	30 lb Cl pp	128	160	144
6	40 lb Cl pp	110	153	131.5
LSD 0.10		9.1	11.2	------
CV %		6.4	9.1	------

Can We Predict Rice Yields Using Remote Imaging?

Dunn,D.J., Ottis, B.V., Wrather, J.A., Stevens, W.E.,
Beighley, D., Aide, M.T., and Dickens, C.

Production costs continue to increase and rough rice prices have remained constant or declined. One of the greatest sources of cost increase is nitrogen fertilizer. In field nitrogen management is difficult and time consuming for rice producers and crop consultants (Figure 1). In an ideal situation, drill-seeded rice is fertilized with urea immediately before flooding. In less than ideal situations, field size and irrigation well pump capacity may lead to delays in flood establishment. Under these conditions urea can be lost by volatilization while a field is being flooded. Several methods have been developed to determine if additional nitrogen supplied post flood can increase rice yields. Arkansas Plant Area Board measurements (plant height multiplied by row width) have been well correlated to rice yield response and mid-season N. Many rice producers and crop consultants are reluctant to use it because of time constraints and complicated calculations. Hand held meters which measure the greenness of rice leaves have also been used successfully by university researchers but are too expensive for most rice producers and crop consultants. Tissue testing for N status of rice fields may be useful, but additional expenses and time lag constraints may limit its utility. Field maps produced with remote sensing technology offer an alternative solution. These maps, based on spectral reflectance, are now commercially available to cotton producers. Adaptation of this technology to nitrogen status of rice fields is currently being investigated. The objective of this research was to compare the ability of five traditional methods of assessing plant N status and one remote sensing method to predict rice yields at internode elongation.

In this 3-year experiment reference strips with four different nitrogen fertility regimes were produced (Figure 2). In 2003 & 2004 these strips were located at the Missouri Rice Research Farm near Qulin, MO on a Crowley silt loam. In 2005, the study was conducted at the University of Missouri-Delta Center near Portageville on a Sharkey clay soil, which had recently been graded. The rice variety Cocodrie was planted in early-May of each year. At tillering, plots were treated with 0, 75, 150, or 225 lbs N/acre and immediately flooded. Each plot was 20 feet wide and 400 feet long. Each treatment was replicated 3 times. At internode elongation, a remote sensing image (Figure 3) of the rice was collected with aircraft mounted sensors at a 0.5 mile altitude. In 2003 data were collected by Spectral Visions (Champaign, IL) & in 2004 2005 the data were collected by InTime Corporation (Cleveland, MS). Plant height, plant color by color chart comparison, and plant color by hand held meter readings in were collected from the center area of 8 locations in each strip along with tissue samples for biomass accumulation and nitrogen & potassium analysis. Rice yields for each of the 8 locations in the 12 strips were collected. The resulting data was then compared to see which method was the best predictor of yield.

In all three years the pre-flood nitrogen treatments produced significantly different rice yields. In 2003, four methods were highly correlated to yield (Pearson coefficient>0.50). These methods were remote sensing (0.8515), plant biomass (0.7275), plant height (0.6897), and hand held meter (0.5455). Tissue analysis for N was able to explain only 36% of the variation in yield while K analysis explained 30%. In 2004, five methods were highly correlated to yield. These methods were plant biomass (0.9188), plant height (0.9114), plant color (0.7669), hand held meter (0.6151), and remote sensing (0.5314). Tissue analysis for N was able to explain only 39% of the variation in yield while K analysis explained less than 1%. In 2005, only two methods were highly correlated to yield. These methods were remote sensing (0.6020), and plant height (0.5390). Tissue analysis for N was able to explain only 45% of the variation in yield while K analysis explained 36%. See Table 1.

Of the five methods studied only two, the remote sensing and plant height measurements, were the only two methods successful at predicting rice grain yields each of the three years of this experiment. The results were at times inconsistent during different years. These two methods represent the best choices among the available methods. The remote sensing method gave the best predictions of yield two of the three years studied. Given the amount of time required to measure plant height in the field and the commercial availability of remote sensing data maps, more research and development should be applied to this technique for rice.

This research was conducted by the University of Missouri-Delta Center Rice Research Team. It was made possible by the generous and continuing support of *The Missouri Rice Research and Merchandising Council.*

Table 1.

Pearson correlation coefficients between rice yield and nitrogen status evaluation methods, 2003, 2004, & 2005.

Method	2003	2004	2005
Plant height	0.69	0.91	0.53
Plant color	0.14	0.77	0.47
Hand held meter	0.55	0.61	0.35
Dry matter	0.73	0.92	0.14
Tissue N %	0.36	0.39	0.02
Remote sensing	0.85	0.53	0.60

Comparison of Avail Coated and Non-coated Super Triple Phosphate Fertilizers for Rice

David Dunn and Gene Stevens

Abstract

Three equivalent rates of polymer coated triple super phosphate (TSP) and uncoated TSP were compared to an untreated check. A 25 lbs P_2O_5 application of coated TSP was as effective as 50 lbs P_2O_5 of uncoated TSP. Soil and plant tissue data support this finding.

Introduction

Proper Phosphorus (P) nutrition is critical for producing maximum rice grain yields. Phosphorus promotes strong early plant growth and development of a strong root system. Maximum tillering is also dependent on P. Not all of the P contained in fertilizers is available for plants to utilize. When P fertilizers are added to soil a complex series of reactions follow. These reactions are dependent on soil mineralogy and pH. The end result is that not all of the P contained in fertilizers is available for plants to utilize. This phenomenon, termed P fixation has been documented for over 150 years. In acid or neutral soils when phosphorus fertilizers are applied to soils a percentage of the P may be strongly absorbed on the surface of soil clay minerals. In calcareous soils phosphorus may also strongly bond with soil calcium to form insoluble compounds. The percentage of P becoming unavailable may range from 25 to 90% depending on soil composition, pH and calcium level.

Coating fertilizers with polymers have several potential uses in agriculture. Slow release fertilizers with polymer coatings are commonly applied to turf and horticultural crops to increase efficiency of nutrients. However, use of fertilizer polymer coatings to prevent P fixation by Ca have not been reported in the literature. We investigated a water-soluble, biodegradable dicarboxylic co-polymer of malaic acid with a very high cation exchange capacity of approximately 1800 meq $100g^{-1}$ polymer (Avail™, Specialty Fertilizer Products, Belton, MO). This material is specific to adsorption of di and trivalent cations and is minimally affected by temperature, pH or ionic strength. Typically 1/4 lb of Avail is added to 100 lb of P fertilizer. The added cost of Avail™ is approximately $1-2 per acre. Hereafter, phosphorus fertilizer treated with Avail™ will be referred to as "polymer coated".

The objective of this three-year study was to compare the response of rice yields and net returns to pre-plant applications of non-coated and polymer coated triple super phosphate (TSP) fertilizer.

Methods and Materials

This three-year evaluation was conducted on a research area located at the Missouri Rice Research Farm located in Dunklin Co. Missouri, near Qulin, MO. The soil type is a Crowley Silt-loam. The area, has been in a rice/soybean rotation for over 15 years, was used. In each year a different research area was used. These areas had similar pH (6.8), K (135 lb acre^{-1}), Ca (2000 lb acre^{-1}), organic matter (1.8%), and CEC (10.0 meq 100g) levels. They differed in P levels each year (2004 38 acre^{-1}, 2005 8 acre^{-1}, and 2006 32 Bray-1 P acre^{-1}). In 2004 and 2006 a 25 lb P acre^{-1} maintenance application was recommended while in 2005 an 85 lb P_2O_5 application was recommended. A randomized complete block experimental design with four replications was employed each year. The plot size was 25' by 10'. All methods of water management, and weed & insect control were the standard practices for cultivating drill-seeded rice in Southeast Missouri.

Three pre-plant P_2O_5 rates for both non-coated and polymer coated TSP (25, 50, and 100) were compared to an untreated control. These treatments were applied by hand before planting and immediately incorporated using a field cultivator. The seedbed was then prepared and the rice variety *Cl 161* was seeded at the rate of 90 lbs/acre. Pre-flood nitrogen was applied at first tiller at a rate of 150 N lbs/a to all plots. A permanent flood was then established and maintained until physiological maturity. At maturity grain was harvested from the center 5 feet of each plot. Moisture percentage was measured from each plot and yields were adjusted to a 12.5% basis. Net return was calculated using a rice price of $4.50 per bushel, P cost of $0.25 per lb P_2O_5 and polymer coating cost of $3.00 per 100 lb of fertilizer.

Results and Discussion

Phosphorus fertilization produced significant differences in rice yields each year. Difference in yield response between years reflects the varying levels of background, pre-study soil test P of the three sites (2004=38, 2005=8, and 2006=32 lb Bray-1 P acre^{-1}). Main factor effect of polymer coating was significant at the 0.09 level. At the 25 lb P_2O_5/a rate the polymer coated treatment produced statistical greater yields than the uncoated treatment (Table 1). With increasing P rates this yield advantage diminished. At the 100 lb P_2O_5 acre^{-1} rate, coated and non-coated TSP treatments averaged the same rice yields. When the coated and non-coated treatments were compared it was found that 25 lb of polymer coated TSP and 50 lb P_2O_5 acre^{-1} of uncoated TSP produced statistically equivalent yields, however the yields for the 25 lb were numerically greater. When averaged across all P rates, the polymer coated TSP had a 4 bu acre^{-1} advantage over the uncoated TSP.

When net returns to producers were compared the 25 lb P_2O_5 acre^{-1} rate of polymer coated TSP produced net returns which were statistically and numerically equivalent to the 100 P_2O_5 acre^{-1} rate of uncoated TSP. This reflects the lower input cost of the 25 lb P_2O_5 coated TSP ($6.25 TSP + 1.50 coating) compared to the 100 lb P_2O_5 TSP ($25.00 TSP). The yield advantages obtained with the polymer coated material translated into significantly greater returns per acre for the 25 lb P_2O_5 acre^{-1} rate. When all P rates were averaged the polymer coated TSP treatments provided $14.00 acre^{-1} more net return.

Conclusions

Based on this three-year study, rice grain yields were significantly affected by P rate. Polymer coated TSP was more effective at increasing rice yields than uncoated TSP. A 25 lb P_2O_5 application of polymer coated TSP was as effective as 50 lb P_2O_5 of uncoated TSP. However the 50 lb P_2O_5 rate of coated TSP continued to statistically increase grain yields and to produce a yield advantage over the same rate of the uncoated TSP. However, net returns of 25 lb P_2O_5 coated TSP produced the greatest returns to producers. Soil and plant tissue data support these finding. The polymer coating increased P use efficiency and profitably increased overall yields. At the 25 and 50 lb P_2O_5 acre^{-1} the yield advantage of the coated TSP was great enough to pay for the increased cost of the coated material. Higher yields lead to lower production costs per bushel and increase overall profitability. Rice producers should consider using coated P fertilizers on some of their rice acres where low soil test P is found.

Acknowledgement

Use of trade or product names is for identification purposes only and does not constitute an endorsement or recommendation by the University of Missouri. This research was supported by a grant from Specialty Fertilizer Products Belton, MO Table 1.

Effect of phosphorus rate using triple super phosphate (TSP) and polymer coating on rice yield and net return averaged across years at Qulin, Missouri.

P rate	Yield †		Net return	
	TSP	TSP + polymer	TSP	TSP + polymer
lb P_2O_5 acre^{-1}	-----bu acre^{-1}-----		-------$ acre^{-1}------	
0	134 d	--	603 c	--
25	143 c	150 ab	637 b	668 a
50	149 bc	151 ab	652 ab	666 a
100	154 a	154 a	668 a	663 a

† Yield values followed by the same letter were not significantly different at the P=0.1 level.

Liquid Foliar Fertilizers as Mid-Season Nitrogen Sources for Rice Production

David Dunn
University of Missouri-Delta Center

Abstract

In 2006 a small plot evaluation conducted on two different soil types. This study compared urea and liquid foliar nitrogen fertilizers. The two liquid products were: foliar N (CoRoN® 25-0-0) and foliar N+K (CoRoN® 10-0-10 0.5B) were compared to urea as sources of midseason nitrogen for rice production. Both of these foliar products produced statistically equivalent results.

Introduction

Production rice fields need supplemental nitrogen (N) fertilization to achieve maximum grain yields. Currently the University of Missouri recommends that this supplemental N by supplied in three splits with 2/3 of this being added pre-flood. The remainder is applied by air in two 30 lbs N splits at inter-node elongation and then 10 days later. The mid-season N source has traditionally been urea. However, with the increasing cost of urea rice producers have been looking for more economical sources of N. At times supplying potassium during midseason is advantageous. This study evaluates two commercially available liquid foliar nitrogen sources. These sources are CoRoN® 25-0-0 and CoRoN® 10-0-10 0.5B (Helena Chemical Company, Collierville, TN). In the following discussion these products will be referred to as foliar N and foliar N+K respectively

Methods and Materials

This evaluation was conducted on two different soil types: Crowley Silt-loam soil (pH=5.5, P=39 lb/a , K= 144 lb/a, and CEC=15 meq/100g) and a Sharkey Clay soil (pH = 6.3 K=375 lb/a, P=78 lb/a and CEC=15 meq/100g. In this evaluation two foliar N sources and urea were compared to a untreated check. Prior to planting the seedbed was prepared using a field cultivator. The rice variety *Cl 131* was drill seeded at a rate of 90 lbs per acre (Silt loam 4/28, Clay 4/27). An adequate stand was established at each site (Emergence: Silt loam 5/8, Clay 5/6). Pre-flood nitrogen was applied as urea at the rate of 90 lbN/a to all plots except the untreated check and a permanent flood was established(Silt loam 6/2, Clay 6/1). Mid-season nitrogen treatments were applied to each plot at inter-node elongation (Silt loam 7/2, Clay 7/3), and early boot (Silt loam 7/15, Clay 7/17) growth stages. The rates and type of mid-season N applied to each plot is listed in Table 1. Urea was applied broadcast by hand while the two liquid foliar products were mixed with water and applied using a CO_2 backpack sprayer at a rate of 10 gallons/acre. Each field was drained 2-3 weeks prior to harvest. A plot combine was used to harvest the middle five feet of each plot (Silt loam 10/6, Clay 9/19). The harvested grain was weighed, moisture % measured and yields were adjusted to 12.5% moisture for final yield.

Results and Discussion

Rice grain yields for mid-season N treatments are reported in Table 1. Differences in yield response between the two sites can be attributed to underlying soil fertility conditions at the two sites. At both sites the single mid-season urea treatment produced greater yields than the two mid-season urea applications. At both sites applying foliar N+K at early boot following an inter-node urea application increased yields relative to the two mid-season urea treatments. At the Silt loam site the greatest yields were obtained with two applications of foliar N+K. This reflects the low soil K level found at this site. At the Clay site the numerically greatest yields were obtained with the single urea treatment. There were no differences between the urea treatments, foliar N, and foliar N+K in moisture percentage at harvest. This indicates that the foliar products did not delay rice maturity relative to urea.

No comparison of economic returns for these products was attempted.

Conclusions

Both foliar products produced yields generally equivalent to urea. At the silt loam site the potassium in the foliar N+K worked to overcome low soil potassium levels and increased yields more than the foliar N or urea. Based on this one-year s foliar N+K study rice producers may be able to consider foliar products as an alternative to urea as a mid-season nitrogen source. Further study is needed to draw definite conclusions.

Acknowledgement

Use of trade or product name is for indemnification purposes only and does not constitute an endorsement or recommend by the University of Missouri. This research was made possible by the generous and continuing support of the Helena Chemical Company.

Table 1.

Average rice grain yields for midseason N treatments 2006.

IE Nitrogen	Early boot Nitrogen	Yield (bu/a)	
		Silt-loam	Clay
		100	139
Urea 35 lb N/a	Urea 35 N/a	127	187
Urea 35 lb N/a		131	200
Urea 35 lb N/a	Foliar N+K 2 gal/a	136	199
Urea 35 lb N/a	Foliar N 2 gal/a	134	188
Foliar N+K 2 gal/a	Foliar N+K 2 gal/a	137	199
Foliar N 2 gal/a	Foliar N 2 gal/a	127	192

2006 Missouri Rice Variety Performance Trials

Donn Beighley, Cathy Dickens, Randy Dickens, Janet Dickens,
Andy Kendig, Brian Ottis, Gene Stevens, David Dunn and Allen Wrather

In 2006 the Missouri Rice Council, University of Missouri-Delta Center and Southeast Missouri State University conducted the Missouri rice variety trials as a cooperative effort. These trials are conducted as a service to Missouri rice producers to provide a reliable, unbiased, up-to-date source of information for comparing rice varieties grown in the Southeast Missouri environment.

Experimental Procedure

Location

Rice plots were established at two locations in 2006: the Missouri Rice Research Farm near Glennonville, MO and at the Delta Center Farm at Portageville, MO. The plots at the Rice Research Farm were planted on 17 April on a Crowley silt loam. The plots at the Delta Center were planted on 27 April on Sharkey clay. In addition to the drill trials there was a water-seeded trial planted at the Missouri Rice Farm on 5 May. The seed planted in the water seeded trial were treated with Apron-Maxim-Zinc for rice water weevils. The trial consisted of 30 public, private, and experimental varieties.

Field Plot Design

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches. The water seeded plot size was 12 feet long by 4.4 feet wide.

Entries

Seed of all public varieties were obtained from: Karen Moldenhauer – UA, Stuttgart, AR; Steve Linscombe – LSU, Crowley, LA; Anna McClung – USDA-ARS, Beaumont, TX; Dwight Kanter – MSU, Stoneville, MS, RiceTec and BASF.

Plot Management

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 180 lb nitrogen. No adjustments in rates were made to meet specific requirements of individual varieties. In the water seeded trial 50 lb urea was applied post emergence, 50 lb N applied at panicle initiation and 50 lb N applied 14 days later.
For primary weed control, 17 oz. Command applied post plant, 3 qt. Stam, ½ lb. Facet and 1.33 oz. per acre were applied prior to flooding. There were no insecticides applied. The flood was maintained throughout the growing season. The plots at the Rice Research Farm were harvested with an Almaco research plot combine while Kincaid plot combine was used at the Delta Center. The grain from the plots was weighed and moisture was determined.

Data Recorded

Data was recorded for: emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field. Milling quality was determined in the laboratory. Emergence date was the date there were ten plants per square foot on the drill trial and ten plant per square foot emerged from the water surface in the water-seeded trial. The days to 50% heading was determined from the number of days from emergence to the presence of 50% of the panicles at least partially emerged from the boot. Plant height was taken as the average distance in inches from the soil surface to the top of the panicle on the plant. Lodging, which indicates the degree of erectness, was scored on a scale of 0 to 10 with 0 indicating all plants in a plot were erect (no lodging) and 10 indicating all plants were lodged. Yields were adjusted to 12 percent moisture and reported on a bushel per acre basis. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

Results

The yields in the drill-seeded trial averaged 158 and 228 Bu/A respectively at the Rice Farm and Delta Center while the water-seeded yield average was 103 Bu/A. The Delta Center yields were higher than expected as the plot area was not on newly cut ground. The water-seeded trial yields were not has high as expected and may be due to no nitrogen fertilization prior to flooding thus limit tiller development of the water seeded plots.

Yield (Table 1, 2 and 3)

Long Grain Type (Table 1)

Differences among varieties were observed in the drill-seeded yield trial and the water-seed trial and no one variety yielded well across all trials. The top yielding line across all trials was RT XL723 followed by RT CLXL729 and RT CLXL730. In the drill-seeded trial at the Missouri Rice Farm Cheniere was the top yielding line at 185 Bu /A followed by RT XL723, Cocodrie and Pace. In the drill-seeded trial at the Delta Center RT XL 723 was the top yielding line at 276 Bu /A followed by RT CLXL729, RT CLXL730. The top yielding line in the water-seeded trial was RT CLXL730 at 221 Bu /A followed by RT CLXL729 and RT XL723.

The only new variety release was CL 171 which yielded 164 Bu /A across the three trial locations.

Medium Grain Type (Table 1)

In the drill-seeded trial at the Missouri Rice Farm Jupiter was the top yielding line at 200 Bu /A followed by Bengal and Medark. In the drill-seeded trial at the Delta Center Jupiter was the top yielding line at 238 Bu /A followed by Bengal and Medark. The top yielding line in the water-seeded trial was Jupiter at 124 Bu /A followed by Medark and Bengal.

Multiple Years (Table 2)

When comparing long grain varieties across 2005 and 2006 those drill-seeded varieties that performed well in 2005 performed well in 2006 – RT XL723, Cybonnet, Wells and Francis. Across multiple years (2003 to 2006 Wells and Francis have been the best yielding varieties.

Medark was the best medium grain variety in 2005 – 2006 in the drill-seeded trials and does not yield significantly more than Bengal over four years of testing.

Days to Emergence (Table 3).

In 2006 the difference was five days longer for the water-seeded trial (21 days) as compared to the drill-seeded trials (16 days). There are differences between varieties that ranged from four day difference for Cheniere to six day difference for several varieties. It was noted that Pace and Medark emerged slower than all the other varieties. RT XL723 averaged one day earlier emergence than the other varieties.

The Days to 50% Heading (Table 3).

Days to 50% heading was taken at both of the drill-seeded trial locations and the water-seeded trial. The days to 50% heading for the Rice Farm drill trial and water-seeded trial were greater than in previous years. The difference in the Rice Farm drill trial may have been a result of the cool temperatures that occurred after planting. In the water-seeded trial the average number of days to 50% heading was 85 days, three days less than in the combined location drill-seeded trials, 88 days. The range of the difference between the different trials was two days to 14 days. The average number of days to 50% heading observed for the varieties in the combined trials ranged from 82 days for Spring to 91 days for Bengal.

Plant Height (Table 3)

The 2006 average plant heights for the Rice Farm and Delta Center drill-seeded trial were 40 inches and 43 inches, respectively. No plant height data was taken for the water-seeded trial.

Lodging (Table 3)

Very little lodging was observed in the Delta Center drill-seeded trial or water-seeded trial except in one or two cases and in those cases it was minimal. At the Rice Farm the lodging ranged from 10% for Cybonnet to 90% for Spring and Trenasse. The lodging observed at the Rice Farm was late season lodging that occurred just prior to harvest and after the 12.5 inch rain and wind.

Milling Quality (Table 1 and 3)

The differences between the three locations for percent total rice and percent head rice were small in 2006. The average values were the following: 73/63 - Rice Farm drill trial, 73/64 – Delta Center drill trial, and 73/63 – Rice Farm water-seeded trial. The percent head yield scores in the ranged from 56 to 67.

The highest consist values across the different trials was observed in the medium grain types particularly the variety, Bengal. Spring had the lowest milling quality values across the different trials. This may be a result of its earliness as compared to the other varieties as it is exposed to more environmental conditions once it is mature.

Rice Disease Data

No significant disease symptoms were observed in 2007. There was some late season rice water weevil damage observed on tips of some flag leaves.

Acknowledgements

We would like to thank the Missouri rice producers through their Rice Check-Off contributions, Missouri Rice Research and Merchandising Council, Southeast Missouri State University and the University of Missouri – Delta Center for their support in this research.

Table 1.

2006 Rice Variety Yield and Milling Quality Average

	Bushels / Acre			MO Rice Farm		Delta Center		Water Seeded	
Variety	MO Rice Farm	Delta Center	Water Seeded	% Total Yield	% Head Yield	% Total Yield	% Head Yield	% Total Yield	% Head Yield
Banks	159	203	104	72	56	72	61	72	56
Cocodrie	176	230	90	73	64	73	66	73	64
Cheniere	185	235	78	73	61	73	64	73	61
CL131	144	216	94	72	65	73	66	72	65
Cybonnet	163	217	59	72	61	73	66	72	61
Cypress	140	211	102	72	66	73	67	72	66
Francis	155	226	87	73	62	73	64	73	62
Pace	170	218	74	72	61	72	60	72	61
CL171	160	198	87	73	63	74	67	73	63
Sabine	168	199	77	71	63	72	61	71	63
Spring	101	193	67	71	56	72	60	71	56
Trenasse	115	215	87	72	61	71	59	72	61
Wells	156	256	108	74	60	74	61	74	60
RTCLXL730	129	258	221	74	65	73	61	74	65
~~RTCLXL729~~	~~155~~	~~266~~	~~194~~	73	63	73	62	73	63
RTXL723	183	276	185	73	60	73	63	73	60
RU0001108	170	245	64	72	59	74	66	72	59
RU0102008	155	207	88	72	64	72	64	72	64
RU0202195	190	257	100	74	67	73	66	74	67
STG99F5-02	170	199	100	73	63	73	65	73	63
Bengal	183	208	73	74	70	75	69	74	70
Jupiter	200	238	124	73	66	73	68	73	66
Medark	180	203	113	73	70	72	65	73	70
9902028	179	251	120	73	69	73	68	73	69
RU0002146	185	240	114	73	69	73	66	73	69

Table 2.

Missouri Rice Variety Trial -- Multiple Year Yield Data (Bushels / Acre)

	Drill-Seeded				**Water-Seeded**			
Variety	2006	05-'06	04-'06	03-'06	2006	05-'06	04-'06	03-'06
Banks	181	205	---	---	104	126	---	---
Cocodrie	203	202	188	180	90	107	114	113
Cheniere	210	192	187	179	78	87	105	110
CL131	180	188	---	---	94	119	---	---
Cybonnet	190	212	203	152	59	90	107	80
Cypress	176	184	176	172	102	110	115	115
Francis	191	209	200	193	87	104	117	119
Pace	194	177	---	---	74	83	---	---
Sabine	184	183	---	---	77	91	---	---
Spring	147	163	---	---	67	87	---	---
Trenasse	165	183	---	---	87	100	---	---
Wells	206	212	195	197	108	115	142	133
RTXL723	229	233	---	---	185	164	---	---
Bengal	195	210	191	185	73	108	118	116
Jupiter	219	200	---	---	124	130	---	---
Medark	192	211	203	189	113	113	126	120
RU9902028	215	215	211	209	120	122	143	138

Table 3.

2006 Rice Variety Agronomic Data - Three Location Average*

Variety	Days to Emergence	Days to 50% Heading	Plant Height (Inches)	Percent Lodging	Bushels / Acre	% Total Rice	%Head Rice
Banks	18	90	44	40	170	72	58
Cocodrie	18	88	42	30	173	73	65
Cheniere	18	85	38	10	171	73	62
CL131	17	88	40	20	166	73	65
Cybonnet	19	87	41	10	159	73	63
Cypress	18	90	41	30	167	73	66
Francis	18	88	45	30	169	73	63
Pace	20	87	42	20	164	72	61
CL171	19	87	40	10	164	73	65
Sabine	18	87	40	20	162	71	62
Spring	18	82	41	50	140	72	57
Trenasse	16	85	42	50	155	72	60
Wells	17	88	41	30	182	74	60
RTCLXL730	17	86	47	40	213	73	63
RTCLXL729	18	86	45	20	214	73	63
RTXL723	16	86	43	20	217	73	61
RU0001108	18	87	44	30	166	73	62
RU0102008	18	88	40	20	165	72	64
RU0202195	18	87	42	20	184	74	67
STG99F5-02	19	89	39	10	169	73	64
Bengal	17	91	40	20	164	75	70
Jupiter	19	87	41	20	191	73	67
Medark	20	86	40	20	176	73	68
9902028	19	85	44	40	188	73	69
RU0002146	19	85	42	30	184	73	68

* - Average of Drill-seeded (MO Rice Farm and Delta Center) and Water-seeded trials

The 2006 Effect of Planting Date on Rice Varieties

Donn Beighley, Cathy Dickens, Randy Dickens, Janet Dickens
and Bruce Beck

In southeast Missouri there are a narrrow range of rice varieties grown that represent the range of early short season types (Spring) to medium season types (Wells). They are planted as the weather and the field conditions permit during the period from early April to late June. However, the time of planting may vary from year-to-year based on the planting environment. Little information is being made available concerning varietal performance with respect to harvest date, yield, quality and their agronomic traits when planted at different dates between early April through wheat harvest in mid-June.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO on a Crowley silt loam. The plots were planted on: 3 April (early April), 17 April (mid-April), 15 May (early May), 29 May (late May) and 20 June (mid to late June). The 15 May planting date was dropped due to planting errors. At each planting date there were eight varieties that represent the major rice varieties grown in southeast Missouri. These varieties were: Spring, Bengal, Medark, Cheniere, Cocodrie, Francis, Wells, and Trenasse.

Field Plot Design

Each planting date was evaluated as a separate trial and all varieties were included. Each test was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Entries

Seed of all public varieties were obtained from: Karen Moldenhauer – UA, Stuttgart, AR and Steve Linscombe – LSU, Crowley, LA.

Plot Management

The drill plots were planted with an Almaco no-till plot drill. For primary weed control, 17 oz. Command was applied post plant, 3 qt. Stam and ½ lb. Facet herbicides were applied prior to flooding. A pre-flood fertilizer was applied at a rate of 180 lbs N. The flood was maintained throughout the growing season. There were no insecticides applied. A single row was harvested to determine milling quality. Milling quality was determined on two replications of each variety from each planting date.

Data Recorded

Notes taken on each plot included: Emergence date, days to 50% percent heading, plant height, lodging and any disease reactions observed as well as measuring yield for each variety. Emergence date was noted as the date when ten plants per square foot were emerged. The days to 50% heading is determined by counting the days from emergence to the presence of 50% of the panicles at least partially emerged from the boot[1]. Height was taken as the average distance in inches from the soil surface to the top of the panicle. Lodging, which indicates the degree of erectness, was scored on a scale of 0 to 100 with 0 indicating all plants in a plot were erect (no lodging) and 100 percent indicating all plants were lodged. Total and head milling yield were determined after milling a sample of each variety in the study.

Results

Wet weather conditions prevented the combine yield harvest of the 2006 date of planting study. Agronomic data was collected for days to emergence, days to 50% heading, plant height and lodging. A small sample was hand harvested from each variety in first and second replication for use in measuring milling quality.

Days to Emergence

The number of days from planting to emergence ranged from 25 days at early April to six days at the late May planting date. A nine day average decrease in days to emergence occurred between the early April date (25 day average) and the mid April date (16 day average).

For Spring and Trenasse the emergence date was two to four days later than the average of the varieties at the first two planting dates but were the same at the mid-May planting date.

Days to 50% Heading

The days to 50% heading ranged from 107 days at the early April date down to 71 days at the late May date. The average days to 50% heading decreased from 103 days at the early April date to 80 days at the late May date across all varieties (Table 1). This same trend was observed within varieties. Wells and Medark had the longest average period between emergence and 50% heading date (107 days at the early April planting date) and Spring had the fewest (71 days at the mid-May planting date) (Table 2).

Plant Height

When averaged across all varieties the plant height appeared to increase slightly (one to two inches) as planting dates progressed from early April (41 inches) to mid-April (40 inches). There was a similar trend for the individual varieties. Spring and Wells were the tallest varieties (45 inches) while Cheniere and Bengal were the shortest variety (38 inches) at both planting dates.

Lodging

Lodging was observed in more cases – varieties or planting dates in 2006. The varieties that did not lodge dramatically were Cheniere, Cocodrie and Medark and these cases the lodging was 30% or less across the whole plot. The mid-April planting date

[1] The DD50 Report gives actual calendar dates that correspond to the number of days from emergence.

had the highest lodging scores (50%) when averaged across all varieties although the early April lodging was 40%.

Milling Yield / Quality

The percent head yield values for 2006 were slightly higher than previous years and the percent milling yield was about the same as observed in previous years. This may have been a result of the wet harvest conditions.

The highest overall milling quality was from the mid April date (76 / 66) and the lowest was the mid-May date (75 / 64). There was no clear trend toward higher or lower milling quality between early April and mid-April although the mid-April planting date did have the highest yields of the three dates.

Across varieties Bengal (76 / 73) had the highest average milling quality and Wells had the lowest average (74 / 57). Spring, like, Bengal had higher milling quality as the planting dates got later. The difference was that Bengal was fairly consistent across all planting date.

Summary

The results of the milling quality analysis indicated that the mid-April date had the best values but there were no major differences trends observed across the different planting dates.

The number of days to emergence data and milling quality data indicate there was not any observable loss in milling quality due to planting in early April and would allow one to complete their harvest at a more favorable time during any given fall season.

Acknowledgements

We would like to thank the Missouri rice producers through their Rice Check-Off contributions, Missouri Rice Council, Southeast Missouri State University, the University of Missouri – Delta Center, and the Missouri Outreach and Extension for their support in this research.

Table 1.

2006 Planting Date Averages

Planting Date	Days to Emergence	Days to 50% Heading	Plant Height	Percent Lodging	% Milling Yield	% Head Yield
Early April	25	103	106	40	75	65
Mid-April	16	95	102	50	76	66
Late May	6	80	104	50	75	64

Table 2.

Variety Averages Across Three Planting Dates

Name Variety	Days to Emergence	Days to 50% Heading	Plant Height (Inches)	Percent Lodging	% Milling Yield	% Head Yield
Cheniere	16	92	38	20	75	64
Cocodrie	16	92	40	30	76	67
Francis	15	94	43	70	75	62
Spring	18	83	44	80	74	63
Trenasse	17	85	41	80	74	63
Wells	16	97	43	50	75	62
Bengal	14	94	38	40	76	71
Medark	15	95	39	20	75	68
Average	16	91	41	49	75	65

2006 RiceTec Performance Trials

Donn Beighley, Cathy Dickens, Randy Dickens,
and Janet Dickens

As rice production continues to increase in southeast Missouri new varieties are continually being tested by the rice breeding community. As part of this ongoing cooperation with those in the rice variety industry RiceTec Inc. requested we yield test some of their up and coming varieties. These trials were conducted as a service to Missouri rice producers to provide a reliable, unbiased, up-to-date source of information for comparing private and public rice varieties grown in the Southeast Missouri growing environment.

Experimental Procedure

Location

Rice plots were established at the Missouri Rice Research Farm near Glennonville, MO. The plots at the Rice Research Farm were planted on 17 April on a Crowley silt loam. The trial consisted of four RiceTec hybrid rice lines, two Horizon AG lines and four public check lines.

All the varieties were evaluated within the same trial. The yield trial was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Plots were planted with an Almaco no-till plot drill. Pre-flood fertilizer was applied at a rate of 180 lb nitrogen. No adjustments in rates were made to meet specific requirements of individual varieties. For primary weed control, 17 oz. Command applied post plant, 3 qt. Stam and ½ lb. Facet herbicides were applied prior to flooding. There were no insecticides applied. The flood was maintained throughout the growing season. The plots at the Rice Research Farm were harvested with an Almaco research plot combine. The grain from the plots was weighed and moisture was determined.

Data was recorded for: Emergence date, the number of days to 50% heading, plant height, lodging, and yield for each variety in the field. Milling quality was determined at the Rice Lab located at the Crisp Bootheel Education Center located in Malden, MO.

Results

The average yield of the RiceTec trial was 173 Bu/A with RiceTec XP732 leading the trial with 200 Bu/A. The RiceTec hybrid lines averaged 167 Bu/A while the check lines averaged 184 Bu/A. The average yield of the Clearfield lines was 157 Bu/A.

Looking at the RiceTec hybrids over years it is observed that RiceTec XP723 was the top yielding hybrid at 216 Bu/A followed by RiceTec XP729 and RiceTec CL

XP730. The highest yielding conventional variety was Wells at 182 Bu / A closely followed by Cocodrie at 181 Bu /A.

The milling quality values for percent head yield ranged from 59% to 68% with an average of 63%.

The days to 50% heading ranged from was at 92 days (RiceTec XP723) to 97 days for CL 161 and Wells with the average of the trial 95 days.

The lodging ranged from 0 to 50 percent with an average of 22%.

The plant height of the lines ranged from 34 to 47 inches with an average of 41.

There was no disease observed during the growing season.

Acknowledgements

We would like to thank the Missouri rice producers through their Rice Check-Off contributions, Missouri Rice Research and Merchandising Council, and Southeast Missouri State University for their support in this research.

2006 RiceTec Yield Trial - Missouri Rice Research Farm

Variety	Days to 50% Heading	Plant Height	Percent Lodging	% Milling Yield / % Head Yield	'06 Avg. Bu/A	'05-'06 Avg. Bu/A
RT CL XP730	95	47	30	74 / 60	148	175
RT XP723	92	44	50	74 / 61	200	216
RT XP729	94	44	10	74 / 59	155	189
CCDR	94	38	0	75 / 63	191	181
CHEN	95	38	20	74 / 61	177	162
WLLS	97	43	40	75 / 60	175	182
FRAN	95	43	30	75 / 64	193	----
CL161	97	39	10	74 / 68	152	168
CL131	95	34	10	75 / 68	163	169

2006 Seed Treatment Trials

Donn Beighley, Cathy Dickens, Randy Dickens,
and Janet Dickens

In 2006 the Missouri Rice Council and Southeast Missouri State University conducted the rice variety trials on the effect of various rice seed treatments on rice yield, milling quality and other agronomic traits. These trials are conducted to provide rice producers a reliable, unbiased, up-to-date source of information for comparing treated rice seed versus non-treated rice varieties grown in the Southeast Missouri production area. This trial was initially intended to include different three seed treatments and three seeding rates. Due to harvest weather conditions this trial was not harvested for yield however we did have the seed treatments in the Missouri Rice Variety Trial and will use that data. Agronomic data was collected in the original seed treatment trial for emergence, plant stand number, days to 50% heading, plant height, lodging and milling quality.

Experimental Procedure

Location

As part of the Missouri Rice Variety Trial plots were drill-seeded on 17 April on a Crowley silt loam, water-seeded on 5 May at the Missouri Rice Research Farm near Glennonville, MO, and drill-seeded on 27 April at the U. M. Delta Center Farm near Portageville, MO on a Sharkey clay. The trial consisted of two public varieties – Wells and Cocodrie. The seed treatments were: NT (no seed treatment), M (Apron-Maxim-Release-Zinc) and D (Dynasty-Apron-Maxim). The seed treatments were supplied by Cache River Valley Seed, LLC.

Field Plot Design

All the seed treatments and varieties were evaluated within the same test. The yield trial was arranged in a randomized complete block design with four replications. Each plot consisted of seven rows, 12 feet long, with a between-row spacing of 7.5 inches.

Plot Management

The drill-seeded plots were planted with an Almaco no-till plot drill at the Missouri Rice Farm and with a Kincaid plot drill at the Delta Center. For primary weed control, 17 oz. Command were applied post plant, 3 qt. Stam and ½ lb. Pre-flood fertilizer was applied at a rate of 180 lb urea. There were no insecticides applied. The flood was maintained until fifteen days after the last days to 50% heading notes were recorded.

The water-seeded plots were hand planted. 1.67 oz/A Londax was applied to the water-seeded trial to reduce the incidence of aquatic weeds. The fertility treatment included 50 lbs N applied post emergence, 50 lbs N applied at panicle initiation and 50 lb N applied 14 days later for a total of 150 lbs N.

The plots at the Rice Research Farm were harvested for yield with an Almaco research plot combine. The plots at the Delta Center were harvest with a Kincaid research plot combine. A grain sample from two replications of each of the treatments was obtained for milling quality. Milling quality was determined at the end of the harvest season.

Data Recorded

Data was recorded for: the emergence date, plot plant stand, the number of days from emergence to 50% heading, plant height, lodging, yield and observed diseases in the plots for each variety in the field. Milling quality was determined in the laboratory. The emergence date was noted as the date ten plants per square foot were emerged either from the soil in the drill test or from the surface of the water in the water seeded trial component. The plant stand was the number of plants counted along the length of a 40 inch stick. The days to 50% heading was determined from the number of days from emergence to the presence of 50% of the panicles at least partially emerged from the boot. Plant height was taken as the average distance in inches from the soil surface to the top of the grain on the plant. Lodging, which indicates the degree of erectness, was scored on a scale of 0 to 100 with 0 indicating all plants in a plot were erect (no lodging) and 100 percent indicating all plants were lodged. Yields were adjusted to 12 percent moisture and reported on a bushel per acre basis. Milling quality values are reported as percent total rice and percent head rice.

Results

The 2006 trial indicate that the seed treatments did result in observable differences over the non-treated seed for the drill-seeded trial particularly in the water-seeded trial. There were not significant effects of seed treatment on days to emergence, days to 50% heading, plant height, lodging or milling quality.

Yield

Table 1. When yields were averaged across locations / soil types and planting methods it was observed that the Cocodrie – D seed treatment did result in an eight bushel per acre increase over the untreated Cocodrie while the Cocodrie – M seed treatment showed a two bushel per acre increase over the untreated Cocodrie. The Wells – D seed treatment averaged three bushels per acre more than the untreated Wells while the Wells – M seed treatment averaged four bushel per acre less than the untreated Wells.

Table 2. The results of the individual location yields indicate that in the Missouri Rice Farm drill test the NT treatment was the highest yielding (176 Bu/A) of the Cocodrie variety while the DAM treatment was the highest yielding (172 Bu/A) of the Wells variety. At the Delta Center the DAM treatment was the highest yielding (232 Bu/A) for the Cocodrie variety while the NT treatment was the highest yielding (256 Bu/A) for the Wells. In the water-seeded trial the DAM treatment was the highest yielding (124 Bu/A) for Cocodrie and the MARZ treatment was the highest yielding (115 Bu/A) for Wells.

In the water-seeded trial the seed treatments resulted in higher yield differences with the NT treatments than those observed in both the drill-seeded trials.

Days to Emergence

Table 1. When measuring the number of days to emergence there were no real differences observed between the seed treatments and the untreated seed. Seventeen days was the average number of days for the two drill locations while twenty one days was necessary for emergence in the water-seeded trial.

The only noted seed treatment difference was on the DAM seed treatment on Cocodrie at the Delta Center Sharkey clay which was three days earlier than the NT treatment on Cocodrie.

The Days to 50% Heading

Table 1. When measuring the number of days from emergence to 50% heading across locations the only difference was for the MARZ seed treatment on both Cocodrie and Wells. In that case the MARZ treatment averaged one day later for both varieties. The Missouri Rice Farm location averaged 12 days longer to achieve 50% heading than the Delta Center or water-seeded trial. This may have been as a result of the earlier planting date and the weather conditions after emergence.

Plant Height

Table 1. For plant height there were no observable differences between the treatments or varieties. There were no observable difference at the different locations.

Lodging

For percent lodging there were no observable differences between the treatments or varieties. There was more lodging noted at the Missouri Rice Farm (40% average) than the Delta Center (10% average). This difference may have been a result of weather conditions experienced at the Rice Farm just prior to harvest data collection.

Milling Quality

Table 1 For percent head yield there were no observable differences between the treatments. The Cocodrie variety had a higher average (65% head yield) than the Wells variety (61% head yield) across locations.

Table 2. Within locations differences were observed for percent head yield between the seed treatments. For Cocodrie the DAM seed treatment was marginally higher than the NT treatment at the Rice Farm and water-seeded trial while the NT treatment was higher at the Delta Center. For Wells the only differences were observed at the Delta Center where the MARZ treatment (65%) was four percentage points higher than the NT treatment (61%).

Summary

The 2006 results do indicate that the use of seed treatments do positively effect the yield performance of rice varieties. However the other agronomic traits of days to emergence, days to 50% heading, plant height, lodging, and milling quality are not as positively affected by the different seed treatments. The DAM seed treatment increased the yield of both Cocodrie and Wells when compared across three locations by an average of eight and three bushels per acre, respectively. The seed treatments on Wells resulted in at least a 20% higher stand count while the seed treatments on Cocodrie did not improve the stands.

Acknowledgements

We would like to thank the Missouri Rice Producers through their check-off contributions, Missouri Rice Research and Merchandising Council, Southeast Missouri State University and the University of Missouri – Delta Center for their support in this research.

Table 1.

2006 Non-Treated vs. Treated Rice Seed Agronomic Traits (Three Location Average)

Variety	Seed Treatment	Days to Emergence	Stand Count *	Days to 50% Heading	Plant Height (Inches) **	Percent Lodging **	Bu / A	% Milling Yield / % Head Yield
Cocodrie	NT	18	45	87	42	3	165	73 / 65
Cocodrie	MARZ	18	46	88	42	3	167	73 / 64
Cocodrie	DAM	17	41	87	40	3	173	73 / 65
Wells	NT	18	40	88	41	3	173	74 / 60
Wells	MARZ	17	48	89	40	2	169	74 / 62
Wells	DAM	18	53	88	43	3	176	74 / 61

NT - No Treatment
MARZ - Maxim-Apron-Release-Zinc
DAM - Dynasty-Apron-Maxim

* - MO Rice Farm drill-seeded trial
** - MO Rice Farm and Delta Center drill-seeded trials

Table 2.

2006 Multiple Location Rice Yield and Milling Quality Results

		MO Rice Farm		Delta Center		Water Seeded	
Variety	Seed Treatment	Bu/A	% Milling Yield / % Head Yield	Bu/A	% Milling Yield / % Head Yield	Bu/A	% Milling Yield / % Head Yield
CCDR	NT	176	73 / 64	230	73 / 66	90	73 / 64
CCDR-M	MARZ	168	73 / 65	224	73 / 62	110	73 / 65
CCDR-D	DAM	164	73 / 67	232	73 / 63	124	73 / 67
WLLS	NT	156	74 / 60	256	74 / 61	108	74 / 60
WLLS-M	MARZ	167	74 / 60	227	74 / 65	115	74 / 60
WLLS-D	DAM	172	74 / 60	246	74 / 63	112	74 / 60

NT - No Treatment
MARZ - Maxim-Apron-Release-Zinc
DAM - Dynasty-Apron-Maxim

Alternative Nitrogen Sources in Rice

Michael Aide and Don Beighley, Southeast Missouri State University
David Dunn, University Missouri-Columbia, Delta Center

The increasing cost of N fertilizer is becoming a concern to the producer. A trial was conducted at the Rice Research and Demonstration Farm to compare the N availability from poultry manure and urea on rice.

The objectives were:

(1) is poultry manure an acceptable N alternative,

(2) to compare poultry manure with urea in a side-by-side test,

(3) Does poultry manure add excessive P and is there a P - N interaction.

Field Methods and Sampling

A nitrogen-phosphorus (NxP) trial and poultry litter rice field experiment using the rice variety 'Wells' were performed using randomized complete block designs at the Missouri Rice Research Farm. Crowley silt loam (Fine, smectitic, active, hyperthermic Typic Albaqualfs) constitutes the soil series. For the NxP experiment, the main treatment consisted of three N (0, 75 and 120 lbs of N / acre applied as urea) levels and the secondary treatment consisted of three rates of phosphorus (0, 45, and 90 lbs P / acre applied as concentrated superphosphate). The poultry litter experiment consisted of three rates of poultry manure equivalent to 0, 75 and 120 lbs of N / acre (0, 2200, and 4400 lbs litter product/acre). Both field trials had four replications.

The harvested plot size was 1.54 m x 3.7m (5ft x 12 ft) for the NxP treatments and 1.54 m x 7.5m (5ft x 24 ft) for the litter plots. The litter was incorporated and flood application was within 24 hours of the fertilizer application. All plots received 45 lbs N/acre two weeks after internode elongation.

Final yield and panicle weight (10 samples/individual replication) and seed weight (10 samples/individual replication) measurements were collected. Tillering was visually estimated after flood removal as: very poor, poor or normal. We defined the extent of tillering as: (i) very poor - soil is clearly visible when viewed parallel with the rows, (ii) poor – soil is not generally visible, however the underlying row pattern is apparent from the canopy structure, and (iii) normal – the canopy structure is fully intergrown and no evident of the underlying row structure is evident.

Plant tissue analysis involved N determination using Kjeldahl N and P, S, Ca, Mg, Na, K, Fe, Mn, Cu, Zn, and B determinations using acid dissolution, followed by inductively-coupled plasma-emission spectrometry for element analysis. Plant tissue samples were selected from 20 plants from the uppermost fully developed leaf approximately two weeks prior to internode elongation. The plant tissue analysis was performed by Mid-West Laboratories (Omaha, NE). Soil testing was conducted at the soil testing laboratory at the University Missouri-Columbia Delta Center (Portageville, MO).

Statistical Analysis

Statistical analysis consisted of analysis of variance performed on Excel and Duncan's multiple range performed manually using Spiegel (1992). Significance is warranted at the 0.05 level.

Results and Discussion

tissue analysis from the NxP trial demonstrated that the N content increased progressively from the control to the highest N rate (Rate 2)(Table 1). Potassium demonstrated greater concentrations in the control group and the smallest K concentration in the highest N rate group, suggesting that N promoted plant tissue development and induced a slight K deficiency for the highest N rate group. Phosphorus, S, Zn, Cu, Fe, and Mn did not show any significant differences because of the N treatments. Similarly, P did not show any significant differences because of P treatments within a N treatment, although soil testing revealed the likelihood for a P response.

For the poultry litter study, although the N concentrations were greatest for the highest litter rates, the N concentrations were not significantly different because of poultry litter addition. The N concentrations rice amended with the highest quantity of poultry litter where largely equivalent to the control group of the NxP trial, suggesting at the poultry litter contributed only marginal N amounts. Phosphorus concentrations in poultry amended rice were largely equivalent to those of the NxP trial, suggesting either that (1) the soil fixed that available phosphorus to a greater degree than soil testing would indicate or the P associated with the poultry litter did not sufficiently mineralize to render it plant available.

Table 1. Mean nutrient tissue concentrations pre-internode elongation.

N-rate	P-rate	N	P	K	S	Zn	Cu	Fe	Mn
		------Percent------				------mg/kg------			
				(Synthetic N x P Trial)					
0	0	2.4	0.24	1.5	0.15	18.0	4	103	668
0	1	2.4	0.23	1.4	0.14	18.0	4	95	620
0	2	2.6	0.23	1.4	0.16	17.5	3	126	640
1	0	2.7	0.22	1.1	0.16	17.5	3	114	675
1	1	2.7	0.23	1.4	0.16	20.0	3	107	634
1	2	2.7	0.25	1.3	0.16	20.3	4	127	798
2	0	3.0	0.22	0.9	0.17	19.0	3	113	623
2	1	3.5	0.24	1.0	0.20	21.8	3	102	550
2	2	3.5	0.25	0.9	0.19	19.8	3	108	570
				Poultry Litter					
0	0	2.2	0.23	1.6	0.14	19.5	4	94	953
1	1	2.1	0.22	1.6	0.22	16.5	4	108	792
2	2	2.3	0.23	1.8	0.14	16.5	4	91	710

Panicle weight is a key yield component (Table 2). For the NxP trial, panicle weight was substantially greater for the highest N rate. Seed weight was not different because of the N treatments. Panicles from plots having the highest N rates had greater seed numbers. Phosphorus did not influence panicle development. Poultry litter did not influence panicle development with respect to the control plots.

Table 2. Mean seed weight / panicle.

N-rate	P-rate	(grams/Panicle)	Rate	(grams/Panicle)
(Synthetic N x P Trial)			**Poultry Litter Rates**	
0	0	2.4	0	2.5
0	1	2.6	1	2.4
0	2	2.2	2	2.4
1	0	2.4		
1	1	2.7		
1	2	2.7		
2	0	3.4		
2	1	2.8		
2	2	2.9		

Rice yields from the NxP trial reflected N management. Yield increased progressively from the control plots to the higher N rates. Higher rates of P augmented the yield advantage of N, suggesting that higher rates of N without accompanying P slightly depressed the yield.

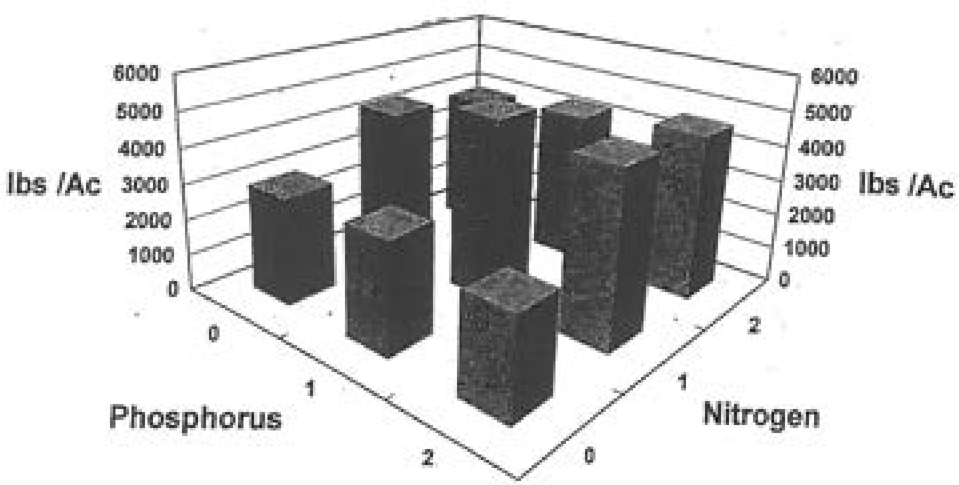
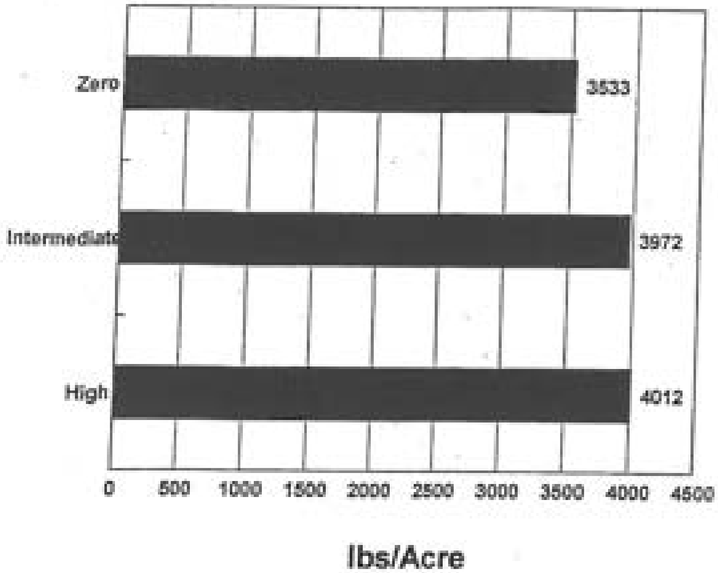


Figure 1. The Yields from the NxP trial.

The rice yields from the poultry trial were substantially smaller than those of the NxP trial. The poultry litter did demonstrate a yield increase from the control to the lowest rate. Yield differences between the low and high rates of poultry litter were not significantly different. Thus, in 2006, poultry litter as a N source was inferior to that of urea.



Conclusions

Poultry litter likely was not sufficiently able to mineralize (decompose) in the flood water system of rice. Typically, organic matter decomposition and the subsequent release of ammonium requires microbial activity in aerobic soils. The flooding of rice excludes oxygen and sufficiently hinders the release of ammonium from poultry litter to impact rice growth and development.

The Effects of Rice Seeding Rate, Nitrogen Rate, and Variety on Sheath Blight Incidence and Severity

Brian V. Ottis, Ralph B. Tanner, and Allen Wrather

Introduction

Previous research has determined that optimum rice yields can be achieved at rice seeding rates of 15 to 30 seeds/ft^2 (approx. 30 to 60 lb/A). Lower seeding rates allow plants to produce more reproductive tillers than at higher densities. Our hypothesis for these experiments was that a lower plant density would allow for more air movement through the rice canopy, thereby impeding sheath blight (SB) development, and possibly negating the need for a costly fungicide application on otherwise susceptible varieties. The positive benefits of such a scheme would be reduced seed and fungicide costs, especially for more expensive rice varieties, such as CLEARFIELD* rice.

Materials and Methods

Two separate studies were established in 2006 at both the Missouri Rice Farm near Glennonville. The first study evaluated the interaction of seeding rate and nitrogen rate on SB incidence and severity on 'Cocodrie' rice. Four seeding rates (7.5, 15, 30, and 60 seeds/ft^2), two preflood nitrogen rates (120 and 180 lb N/A), and three midseason nitrogen rates (0, 30, and 60 lb N/Ac) were evaluated. The second study evaluated the interaction of seeding rate and variety on SB incidence and severity. Four seeding rates (7.5, 15, 30, and 60 seeds/ft^2) and four varieties ('CL131', 'CL161', 'Wells', and 'Banks') were utilized for this study. CL131 and CL161 were considered 'susceptible', while Wells and Banks were considered 'less susceptible.' A single preflood nitrogen application of 150 lb N/Ac was applied in the second study. In both studies, rice was drill-seeded using a cone drill with 9 drill rows on 7.5" centers. The studies were planted on May 16 and harvested October 4. Inoculum was applied to all plots at 1/2" internode. Inoculum consisted of sterilized oats infected with the *Rhizoctonia solani* pathogen. Subsequent disease incidence and severity ratings were taken 2 weeks and 4 weeks after inoculation and again at harvest. SB incidence was rated on a scale of 0 to 100%, with 0 being no infected stems, and 100% indicating all stems having SB infection. Disease severity was rated on a scale of 0 to 9, and an explanation of these ratings is shown in Table 1. Plots were harvested with a small plot combine and weights were adjusted to 12% grain moisture.

Results

Study 1.

The inoculum source used at both locations did not produce the expected amount of disease. Although disease was present in each plot at the rice farm, the severity of the disease did not reach a point to cause lodging or have a devastating effect on rice yield. This may have been due to the inoculum source or the weather conditions following inoculation. Minor differences in SB incidence were observed among the four seeding rates in the first study at each rating date (Table 2). These differences narrowed as the season progressed. Differences among SB incidence 2 weeks after inoculation (2 WAI) may have been due to the differences in plant density, whereby the lower plant density allowed for less infection. However, as the season progressed and the canopy was filled by reproductive tillers, these differences were minimized.

Severity rating	Explanation
0	Plants healthy, no symptoms
1	Restricted dark brown oval lesions at waterline or infection points
2	Few oval or coalesced lesions with broad borders on lower sheaths or at infection points
3	Lesions on lower leaf sheaths or at infection points, lesions coalescing, less than 10% of tissues affected
4	Lesion mainly restricted to sheaths on lower third of plant, lowest leaves, or other infection points, lesions discrete or coalescing with narrow red-brown border, 10 to 15% of leaf and sheath tissues affected.
5	Lesions mainly restricted to sheaths and leaves of lower half of plants, lesions usually coalescing with large necrotic centers and narrow red-brown borders, 15 to 25% of tissues affected
6	Lesions usually coalescing and affecting lower two-thirds of sheath area of plant, lesions extending to blades of lower leaves or lower leaves killed by injury to sheath
7	Lesions usually coalescing and affecting lower three-fourths of sheath area of plant, lesions extending to leaf blades of lower two-thirds of plant, 40 to 60% of tissues affected
8	Lesions reaching to flag leaf, lower sheaths with coalesced lesions covering most of tissue, lower and middle leaves dead or dying, 60 to 80% of tissues affected
9	Lesions reaching to flag leaf, lower leaves mostly dead, sheaths dried, culms brown, collapsing, most tillers lodged, over 80% of tissue affected

Table 1.

Explanation of sheath blight severity ratings. Adapted from Groth (2005).

Differences in SB disease and severity were not related to midseason nitrogen rate and only significant 4 WAI from the main effect of preflood nitrogen. Yield and milling quality were not affected by any of the factors in the experiment. Although differences in SB severity were observed early after inoculation, these differences did not result in a significant yield loss. Previous research has shown that later-planted rice at low seeding rates will yield similarly to higher seeding rates, probably due to the increased germination probably due to higher soil temperatures and less seedling disease pressure.

Study 2.

SB incidence was higher at the 60 seeds/ft^2 seeding rate 2 WAI and at harvest. Seeding rates between 7.5 and 30 seeds/ft^2 did not affect SB incidence at any rating date. SB severity, although stastically significant, did not differ much among the seeding rates. Rice yield was affected by seeding rate, whereby yield declined at the 60 seeds/ft^2 seeding rate, indicating that higher disease ratings may have reduced yield.

Variety had an effect on SB incidence and severity. CL131 and CL161 had a consistently higher SB incidence than Banks or Wells. Similarly, SB severity for CL131 and CL161 was higher 4 WAI and at harvest than it was for Banks or Wells. Yields of CL131 and Wells were similar, and higher than those of CL161 and Banks.

Milling quality was lower for Banks than the other three varieties in the experiment. Likely reductions in milling quality may have been due to lodging of Banks during high wind and rain incurred late in the season.

Table 2.

The main effects of seeding rate, preflood nitrogen rate, and midseason nitrogen rate on sheath blight (SB) incidence and severity on Cocodrie rice at the Rice Farm near Glennonville, MO, 2006.

Main Effect	SB Incidence			SB Severity			Yield	Milling	
Seeding rate (seeds/ft^2)	2 WAI	4 WAI	Harvest	2 WAI	4 WAI	Harvest		Whole	Total
	------------ %------------			------------ %------------			Bu/A	-------- %--------	
7.5	8	76	98	2	5	7	165	66	71
15	13	97	100	2	6	7	167	66	72
30	13	97	100	2	5	7	170	65	71
60	21	100	100	2	6	7	168	64	70
LSD (.05)	5	9	2	NS	1	NS	NS	NS	NS
Preflood N (lb/A)									
120	15	90	99	2	5	7	167	65	72
180	12	96	99	2	6	7	169	65	71
LSD (.05)	NS	6	NS	NS	NS	NS	NS	NS	NS
Midseason N (lb/A)									
0	14	94	99	2	5	7	168	65	72
30	14	94	100	2	6	7	168	65	71
60	12	90	100	2	5	7	167	65	71
LSD (.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Discussion

Previous research has shown that variety selection and nitrogen are the most important factors leading to sheath blight infection. This research determined that preflood nitrogen rate had a significant effect on sheath blight incidence 2 and 4 WAI, but had no effect on SB severity at any point in the season. Seeding rate was similar to nitrogen rate in that SB incidence was lower 2 and 4 WAI at the lower seeding rates of 7.5 and 15 seeds/ft^2; however, SB severity was not affected by seeding rate. These findings provide more evidence of the compensatory nature of rice to fill voids in the canopy by producing more biomass, effectively filling the canopy similar to higher plant densities. This fact may explain why disease severity did not differ during the course of the infection period.

Based on the findings of this research, it doesn't appear that seeding rate or midseason nitrogen rate has a large impact on SB incidence and severity. Variety selection appears to be the most predictable factor for disease, and should be considered when planting a field with a history of sheath blight. Further research is needed to determine the extent to which preflood nitrogen rate factors into SB incidence and severity.

Inevitably, when scouting for SB in rice, the first signs of disease are found on double-planted ends and where preflood fertilizer overlapped in the field. Many times when this is found, a fungicide application will be made when potentially unnecessary for the majority of the field. It is important to recognize potential hotspots for SB infection in the field following preflood fertilizer applications. It may not be necessary to spray the entire field when only a small portion is affected. Current and future research on remote sensing will hopefully be able to detect these areas in fields so that money-saving, site-specific fungicide applications can be made in the future.

Table 3.

The main effects of seeding rate and variety on sheath blight incidence and severity at the Rice Farm near Glennonville, MO, 2006.

Main Effect	SB Incidence			SB Severity			Yield	Milling	
Seeding rate	2 WAI	4 WAI	Harvest	2 WAI	4 WAI	Harvest		Whole	Total
(seeds/ft^2)	----------- % -----------			----------- % -----------			Bu/A	-------- % --------	
7.5	11	91	66	1	5	5	167	62	70
15	10	95	68	1	6	6	166	61	70
30	10	93	77	2	6	5	164	59	69
60	18	97	80	2	6	6	149	62	71
LSD (.05)	7	NS	13	1	1	1	9	2	1
Variety									
CL131	15	100	99	2	7	8	175	63	72
CL161	16	97	92	2	7	7	151	62	70
Banks	7	88	44	1	5	4	145	56	67
Wells	11	91	56	2	4	4	175	62	70
LSD (.05)	6	7	14	1	1	1	9	2	1

Annual Weather Summary for the Bootheel
2006

Annual precipitation averaged above normal in the Bootheel during 2006 with most counties reporting between 55-60 inches. Heavier rainfall occurred over localized spots with Caruthersville and Poplar Bluff reporting 65.33 and 67.58 inches, respectively. Lighter precipitation amounts occurred over portions of Stoddard county where 50-55 inches were more common. Overall, annual precipitation averaged 7-12 inches above normal and it was the wettest year since 1990 for many.

Preliminary numbers indicate it was the 10th warmest year in the Bootheel since 1895 with above normal temperatures reported for 9 of the 12 months. Unseasonably mild conditions were experienced in January, April and December with January an unprecedented 11.5° above normal.

Dry and mild spring weather, especially in April, provided plenty of opportunity for fieldwork activity and rapid spring planting although cooler and wetter conditions in May hindered cotton planting activities and led to poor stands. Crop growing conditions improved toward the latter half of June as hot temperatures and a few rain episodes benefited rice and cotton. Overall, summertime conditions were favorable with above normal rainfall in July and near to slightly above normal temperatures. Dry and warm conditions prevailed during August.

Excessive rainfall, especially during the last week of September, interrupted harvest activities, flooded fields and lead to significant crop damage. Historical and unprecedented heavy rainfall occurred on September 22-23 across portions of the Bootheel. Some two day totals include the Rice Farm (near Glennonville) with 12.56 inches and New Madrid and Qulin with 12.28 and 11.85 inches, respectively. It was the 2nd wettest September in 112 years and the wettest since 1965.

The growing season came to an end during the first week of November when a cold front swept through the region on Halloween. Mild temperatures dominated, however, throughout much of December.

2006 Weather Summary for the Missouri Bootheel

Precipitation (in.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2006	4.72	2.89	4.60	2.55	5.37	3.21	5.37	2.57	9.16	5.63	5.01	4.05	55.13

Precipitation Departure from Normal (in.)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2006	1.59	-0.75	-0.54	-2.18	0.30	-0.51	1.60	-0.72	5.42	2.61	0.57	-0.47	6.92

Average Temperature (°F)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2006	44.6	37.1	50.4	64.9	68.1	77.3	80.2	80.1	69.2	57.4	48.6	41.9	60.0

Temperature Departure from Normal (°F)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2005	11.5	-0.7	2.4	6.4	0.6	1.3	0.4	2.8	-1.2	-1.5	0.3	4.4	2.2