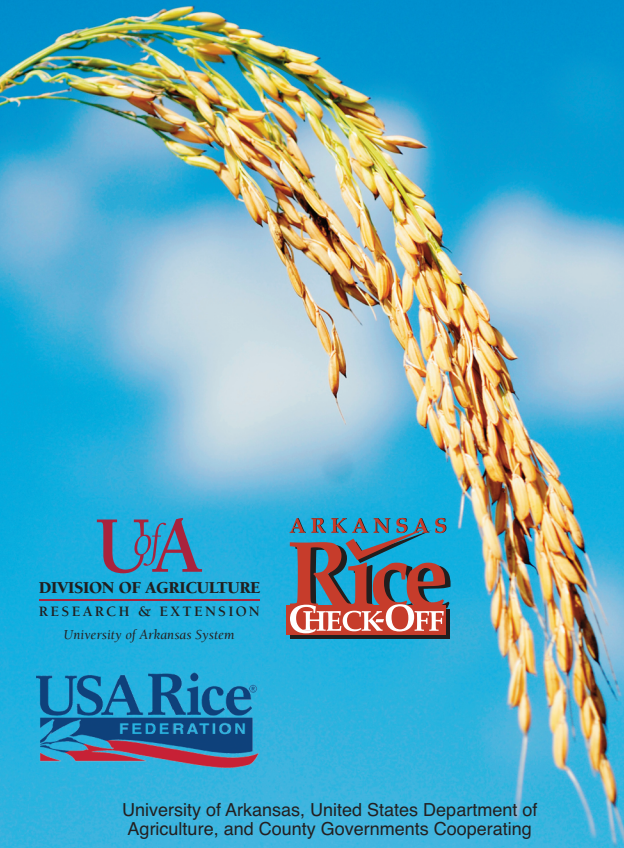
MP533

ARKANSAS RICE POCKET GUIDE

2015 Edition



DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

ARKANSAS Rice CHECK-OFF

USA Rice FEDERATION

University of Arkansas, United States Department of Agriculture, and County Governments Cooperating


1 inch
2 inch
3 inch
4 inch
5 inch

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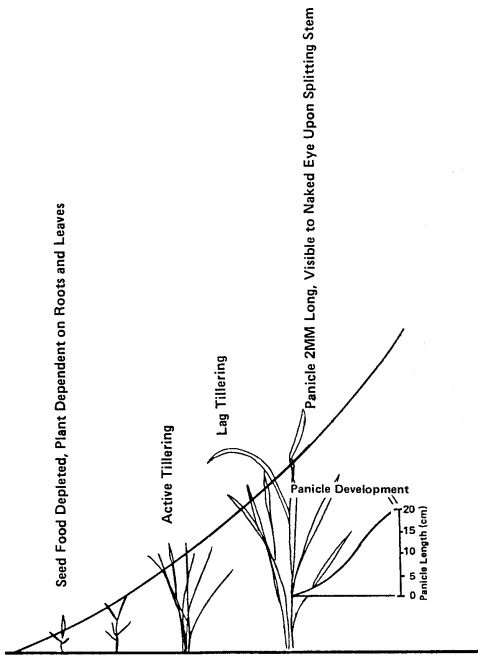
Table of Contents

The *Arkansas Rice Pocket Guide* is designed to be just that – carried in your pocket. Information provided within is not in complete detail. For that information, please consult MP192, *Arkansas Rice Production Handbook*.

Agronomics



5-20 Days*	15 to 25 Days*	24 to 42 Days*	Vari-able ****	†	19 to 25 Days*
STAGE I VEGETATIVE					STAGE II REPRODUCTIVE

† 3 to 5 days

* Under warm conditions, use the lower number of days, and for cool conditions, use the larger number of days.

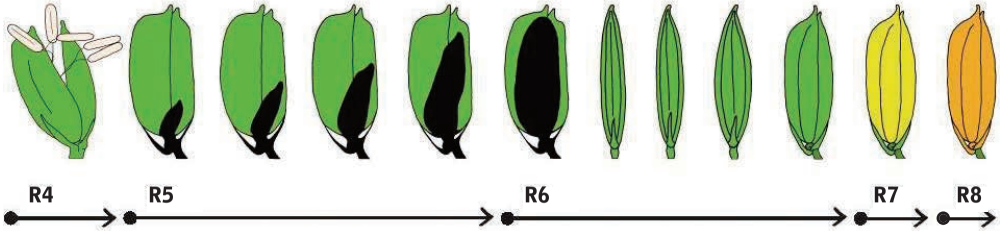
** The reproductive stage begins with panicle initiation.

Vari-able ****	†	19 to 25 Days*	30 to 45 Days*
		STAGE II REPRODUCTIVE	STAGE III GRAIN FILLING & MATURATION

*** Stage II begins when 50% of the florets are pollinated.
**** Variable time – 0 to 25 days (dependent upon variety).

Individual Grain Development

The development of the individual rice grain from anthesis through grain dry-down.



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Cultivar Characteristics

Brief description of commonly grown conventional, Clearfield and hybrid rice cultivars

Cultivar	Year Released and State	Highlights
Antonio	2012 – TX	Short season, semi-dwarf LG variety with good yield potential and milling quality. Similar to Cocodrie in characteristics.
Caffey	2011 – LA	Semi-dwarf, short-season, MG variety with excellent yield potential and milling quality. MS to sheath blight, blast.
Cheniere	2003 – LA	Semi-dwarf, short-season, LG variety with good yield potential, less oil in bran than Cocodrie and better straighthead tolerance.
CL111	2009 – BASF, Horizon Ag	Very short-season, semi-dwarf LG Clearfield variety with good yield potential. VS to sheath blight and S to blast, straighthead.
CL151	2008 – BASF, Horizon Ag	Short-season, semi-dwarf LG Clearfield variety with excellent yield potential. VS to sheath blight, S to blast, straighthead.
CL152	2011 – BASF, Horizon Ag	Short-season, semi-dwarf LG Clearfield variety. Good yield potential and milling. S to sheath blight, MS to blast, straighthead.
CL XL729	2006 – RiceTec, Inc.	Short-season LG Clearfield hybrid with excellent yield potential, good milling yield potential and good disease resistance.
CL XL745	2007 – RiceTec, Inc.	Short-season LG Clearfield hybrid w/ excellent yield potential, good milling yield potentialand good disease resistance.

Cocodrie	1997 – Louisiana	Short-season, semi-dwarf LG variety with good yield potential and milling quality.
Francis	2002 – Arkansas	Very short-season LG variety with excellent yield potential, VS to blast.
Jupiter	2005 – Louisiana	Mid-season MG variety with excellent yield potential, good milling quality and R to bacterial panicle blight.
LaKast	2014 – Arkansas	Short-season LG variety with excellent yield potential and good milling yield. S to blast, sheath blight.
Roy J	2010 – Arkansas	Mid-season, standard-statured LG variety with excellent yield potential and very strong straw. S to blast, MS to sheath blight.
Taggart	2009 – Arkansas	Mid-season, standard-statured LG variety with good yield potential and large kernel size.
Wells	1999 – Arkansas	Short-season LG variety with excellent yield potential and S to blast.
XL723	2004 – RiceTec, Inc.	Very short-season LG hybrid with good yield potential, average milling quality. R to blast, MR to sheath blight.
XL753	2011 – RiceTec, Inc.	Short-season LG hybrid with excellent yield potential, good milling.

LG = long-grain; MG = medium-grain
R = resistant; MR = moderately resistant; MS = moderately susceptible; S = susceptible; VS = very susceptible

Seeding Rates

Seeding rates for different seeds per square foot based on seed weight

Cultivar	Seed Weight[1]	Seeds/lb	Number of Seed/Square Foot							
			10	15	20	25	30	35	40	45
			Seeding Rate, lb/A							
Antonio	21.9	20,731	--	--	42	53	63	74	84	95
Caffey	28.7	15,813	--	--	55	69	83	96	110	124
Cheniere	21.8	20,826	--	--	42	52	63	73	84	94
CL111	26.0	17,462	--	--	50	62	75	87	100	112
CL151	23.3	19,485	--	--	45	56	67	78	89	101
CL152	20.5	22,190	--	--	39	49	59	69	79	88
CL163	24.0	18,940	--	--	46	57	69	80	92	103
CL172	24.0	18,893	--	--	46	58	69	81	92	104
CL261	24.6	18,455	--	--	47	59	71	83	94	106
CL271	25.9	17,529	--	--	50	62	75	87	99	112

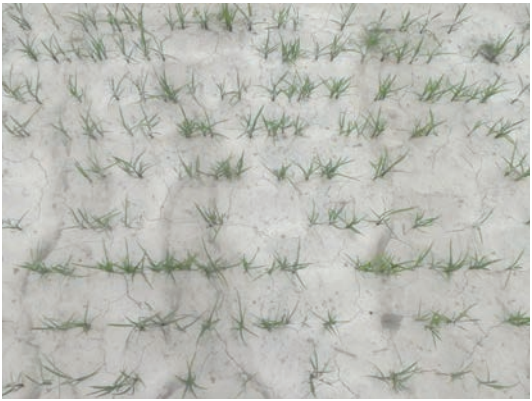
Cocodrie	25.6	17,734	--	--	49	61	74	86	98	111
Francis	22.8	19,912	--	--	44	55	66	77	88	98
Jazzman	25.2	18,016	--	--	48	60	73	85	97	109
Jazzman-2	22.4	20,295	--	--	43	54	64	75	86	97
Jupiter	25.8	17,597	--	--	50	62	74	87	99	111
LaKast	25.2	18,045	--	--	48	60	72	84	97	109
Mermentau	23.3	19,460	--	--	45	56	67	78	90	101
RT CL XL729	21.8	20,835	21	31	42	--	--	--	--	--
RT CL XL745	21.7	20,922	21	31	42	--	--	--	--	--
RT XL723	21.1	21,476	20	30	41	--	--	--	--	--
RT XL753	20.5	22,146	20	30	39	--	--	--	--	--
Roy J	22.9	19,825	--	--	44	55	66	77	88	99
Taggart	27.4	16,569	--	--	53	66	79	92	105	118
Wells	25.2	18,016	--	--	48	60	73	85	97	109

[1]Grams per 1,000 grains or milligrams per seed.

Seed Spacing for Drill Calibration

Seeds Per Row Foot (Varieties)			
Seeds Per Sq Ft	Row Spacing in Inches		
	6	7.5	8
24	12.0	15.0	16.0
27	13.5	16.9	18.0
30	15.0	18.8	20.0
33	16.5	20.6	22.0
36	18.0	22.5	24.0
39	19.5	24.4	26.0
42	21.0	26.3	28.0
45	22.5	28.1	30.0
48	24.0	30.0	32.0

Seeds Per Row Foot (Hybrids)			
Seeds Per Sq Ft	Row Spacing in Inches		
	6	7.5	8
8	4.0	5.0	5.3
9	4.5	5.6	6.0
10	5.0	6.3	6.7
11	5.5	6.9	7.3
12	6.0	7.5	8.0



Example of plant stand from low seeding rate.

Example of plant stand from high seeding rate.

Fungicide Seed Treatments

(apply with commercial seed-treating equipment)

Disease	Fungicide	Active Ingredient	Rate/cwt seed
Pythium diseases	Allegiance FL (Apron)	metalaxyl	0.75-1.5 fl oz
	Apron XL LS[1]	mefenoxam	0. 32-0.64 fl oz
	EverGol Energy[2]	prothioconazole + penflufen + metalaxyl	1-2 fl oz
Rhizoctonia seedling diseases, general seed rots	RTU-Vitavax-Thiram[3]	carboxin + thriam	5.0-6.8 fl oz
	Maxim 4FS[4]	fludioxonil	0.08-0.16 fl oz
	EverGol Energy[2]	prothioconazole + penflufen + metalaxyl	1-2 fl oz
Pythium, Rhizoctonia, general seed rot	RTU-Vitavax-Thiram[3]	carboxin + thiram	5.0-6.8 fl oz
	Allegiance FL or Apron XL	metalaxyl or mefenoxam	0.75-1.5 fl oz or 0.32-0.64 fl oz

Pythium, Rhizoctonia, general seed rot	Apron XL LS + Maxim 4FS[1]	mefenoxam + fludioxonil	0.32-0.64 fl oz + 0.08-0.16 fl oz
	Dynasty[5]	azoxystrobin	0.153-1.53 fl oz
	Trilex 2000	trifloxystrobin + metalaxyl	1-2 fl oz
	EverGol Energy[2]	prothioconazole + penflufen + metalaxyl	1-2 fl oz

Read and follow all label directions when using these products.

[1]Use higher rates for early planting or other severe disease situations.

[2]Must use high rate for moderate to high seedling disease pressure.

[3]Apply with commercial seed-treating equipment or use as a pour-on hopper box treatment.

[4]Use higher rate for severe disease situations.

[5]Usually sold with Apron XL and Maxim on rice to improve seedling disease control. To reduce seedborne blast, use rates above 0.75 fl oz per cwt.

Insecticide Seed Treatments

(apply with commercial seed-treating equipment)

Insecticide	Active Ingredient	Rate/cwt Seed[1]	Comments[2]
Dermacor X-100[3]	chlorantraniliprole	1.5-6.0 fl oz	Control of RWW larvae; fall armyworm and true armyworm larvae. Suppression of GC larvae.
NipsIt INSIDE 5 FS	clothianidin	1.92 fl oz	Control of RWW and GC larvae; chinch bug nymphs and adults. Use only on dry-seeded rice. DO NOT spray crop with neonicotinoid insecticide after using NipsIt INSIDE. DO NOT use near fish or crawfish farms.
CruiserMaxx Rice	thiamethoxam	7.0 fl oz	Control of RWW and GC larvae; chinch bug nymphs and adults. DO NOT plant by aerial application, use treated fields for aquaculture, or exceed 120 lb seed per acre. NOT labeled for water-seeded rice.

Read and follow all label directions when using these products.

[1]See label for details on rates and restrictions.

[2]RWW = rice water weevil; GC = grape colaspis.

[3]24C Special Local Need label for use in water-seeded rice until June 5, 2018.

Results of 2014 Planting Dates Studies

Cultivar	Mar 26	Apr 18	May 2	May 21	Jun 5	Jun 18	MEAN
Antonio	197	192	177	174	122	132	**166**
Caffey	249	231	157	207	132	147	**187**
CL151	225	232	191	181	140	151	**186**
CL152	220	209	174	173	139	143	**176**
CL163	216	206	173	171	107	138	**168**
CL172	235	213	183	182	137	141	**182**
CL271	218	219	153	174	136	136	**173**
Jupiter	258	269	195	223	133	154	**205**
LaKast	242	255	203	199	131	147	**196**
Mermentau	194	210	185	173	139	136	**173**
RT CL XL729	244	242	213	211	166	187	**210**
RT CL XL745	207	229	207	190	160	160	**192**
RT XL753	221	253	240	240	189	180	**221**
Roy J	245	224	163	170	130	140	**179**
Wells	239	225	187	179	133	158	**187**

Results of 2012-2014 Arkansas Rice Performance Trials

Cultivar	Grain Size	Straw Rating	50% Hdg DAE	Height in	Milling HR-TR	Yield (bu/A) 2012	2013	2014	MEAN
Antonio	L	2.0	83	37	65-71	187	176	164	**176**
Caffey	M	2.2	85	38	58-68	197	198	202	**199**
CL111	L	2.1	81	38	63-70	169	162	170	**167**
CL151	L	1.6	83	39	64-71	191	169	190	**184**
CL152	L	1.7	85	37	65-71	179	153	144	**158**
CL172	L	1.0	84	35	64-71	214	174	165	**184**
Jupiter	M	2.9	86	38	60-67	197	178	196	**190**
LaKast	L	2.5	83	42	62-71	196	186	193	**192**
Mermentau	L	1.4	83	37	65-70	199	173	168	**180**
RT CL XL729	L	3.9	83	43	61-70	184	188	191	**188**
RT CL XL745	L	4.1	80	43	60-71	185	165	193	**181**
RT XL753	L	2.5	81	42	58-71	229	225	246	**233**
Roy J	L	1.0	88	41	63-71	219	188	192	**200**
Taggart	L	1.8	87	44	59-70	187	186	187	**186**
Wells	L	2.1	85	41	58-70	194	178	182	**185**

Soil Temperature

Minimum, maximum and mean undisturbed soil temperatures at a 4-inch depth for selected dates at three locations in Arkansas

Location	Rohwer, SEREC[1]			Stuttgart, RREC[2]			Keiser, NEREC[1]		
Latitude	33.45 N			34.49 N			35.68 N		
Soil Texture	Perry Clay			DeWitt Silt Loam			Sharkey Clay		
Daily Temperature	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
Date	4-inch undisturbed soil temperature, °F								
March 15	50	57	54	46	56	51	44	54	49
April 1	53	52	57	49	62	55	46	55	51
April 15	60	69	64	56	69	63	55	64	59
May 1	63	74	69	59	71	65	58	69	64
May 15	69	75	72	66	79	72	64	81	73
May 31	69	78	74	69	78	73	70	74	72

[1]Temperatures are the six-year average from 1990 to 1995.
[2]Temperatures are the nine-year average from 1990 to 1998.

General Agronomic Information by Seeding Date

General seeding, seedling emergence and flooding date information for the DD50 seeding date study in 2010 at the Rice Research and Extension Center near Stuttgart, Arkansas

Parameter	Seeding Date			
	March 16	April 14	May 9	June 5
Emergence date	April 9	April 30	May 19	June 10
Flood date	May 15	June 5	June 12	June 27
Days from seeding to emergence	24	16	10	5
Days from seeding to flooding	60	51	34	22
Days from emergence to flooding	36	37	24	17

Optimum Seeding Date by Geography

General suggested optimum and recommended seeding dates for south, central and north Arkansas geographic areas based on yield potential and management considerations

Geographic Region	Optimum[1]		Recommended Absolute[2]	
	Begin	Cut-off	Begin	Cut-off
South	March 28	May 20	March 20	June 15
Central	April 1	May 15	March 25	June 10
North	April 10	May 10	April 1	June 5

[1]Seeding during the optimum time frame does not guarantee high yields or suggest that crop failure cannot occur when rice is seeded during these times.

[2]Recommended absolute does NOT mean that a successful rice crop cannot be grown if seeded outside of the dates listed. Success may be evaluated and/or interpreted using various parameters (i.e., cropping systems, management, cash flow, field reclamation, etc.) and may differ among specific cultivars.

Expected Freeze Dates by Geography

Expected freeze dates for several eastern Arkansas locations

City – County	Last Date in Spring with Temperature < 32°F[1]	First Date in Fall with Temperature < 32°F[1]
Corning – Clay[2]	April 4 to April 17	October 11 to October 25
Augusta – Woodruff[3]	March 29 to April 14	October 19 to November 2
Pine Bluff – Jefferson[2]	March 20 to April 3	October 26 to November 9
Crossett – Ashley[2]	April 4 to April 16	October 22 to November 2

[1] Freeze dates were obtained from county soil surveys and are the dates for which temperatures below 32°F first or last occur in one to five out of every ten years.
[2] Time period from 1951 to 1974.
[3] Time period from 1951 to 1990.

Influence of Emergence Date on Harvest

Influence of emergence date on predicted dates for 20% grain moisture for common cultivars using 30-year weather norms for Stuttgart, Arkansas

Variety	Rice Emergence Date								
	April 1	April 10	April 20	May 1	May 10	May 20	June 1	June 10	June 20
	Predicted Date for 20% Grain Moisture[1]								
CL111	Aug 14	Aug 16	Aug 20	Aug 26	Sept 1	Sept 8	Sept 19	Sept 27	Oct 6
CL151	Aug 12	Aug 14	Aug 18	Aug 23	Aug 30	Sept 6	Sept 17	Sept 25	Oct 4
LaKast	Aug 13	Aug 15	Aug 19	Aug 24	Aug 31	Sept 7	Sept 18	Sept 26	Oct 5
Jupiter	Aug 21	Aug 23	Aug 28	Sept 1	Sept 8	Sept 15	Sept 26	Oct 4	Oct 13
CL XL745	Aug 12	Aug 14	Aug 18	Aug 22	Aug 30	Sept 6	Sept 17	Sept 25	Oct 4
XL753	Aug 11	Aug 13	Aug 17	Aug 22	Aug 30	Sept 5	Sept 16	Sept 25	Oct 3
Roy J	Aug 24	Aug 26	Aug 30	Sept 3	Sept 11	Sept 17	Sept 28	Oct 6	Oct 20

[1]Approximate date of 50% heading can be estimated by subtracting 35 days from listed date for CL111, CL151, LaKast, CL XL745, XL753 and Roy J; or 45 days for Jupiter.

Water-Seeded Rice

Conventional Water-Seeding

Field Prep:

- Destroy winter vegetation.
- Reduce the chance of seedling drift.

General Guidelines:

- Destroy winter vegetation.
- Reduce the chance of seedling drift:
  - Rough seedbed essential.
  - Leaving soil ridged minimizes seedling drift.
  - On clay soil – use disk and/or field cultivator.
  - On silt loam soil – use a groover.
- Recommended seeding rate is 30% greater than for drill-seeded rice – greater risk for seed loss from blackbirds, rice seed midge and rice water weevil.

Presoaking:

- Seed can be dry or pregerminated (presoaked).
- Pregerminated seed recommended to enhance stand establishment.
- Soak seed for 24-36 hours, drain for 24-48 hours, then fly onto field.
- Duration of drain period dependent on air and water temperature.
- DO NOT water-seed rice treated with gibberellic acid – causes rapid shoot development and increases risk of seedling drift.

Water Management:

- Adequate water supply necessary.
- Small fields ensure precise water management.
- Poor water management leads to nitrogen loss and reduced red rice suppression.
- Pinpoint flood recommended.
    - Drain water to allow seedlings to peg down.
    - DO NOT allow soil to crust.
    - Drain period is 1-5 days, depending on soil and weather conditions.
    - Reflood field to shallow depth and increase depth as seedlings develop.

Nutrient Management

Specific rates and nitrogen management practices are outlined in the **Soil Fertility** section.

Weed Control:

- Water-seeding rice can be used to effectively reduce red rice.
- A rule of thumb is that grass or rice will emerge either through soil or water but not both.
- For best red rice control, flood fields immediately after land preparation.
- Certain restrictions may apply when used in a water-seeded system. Refer to the herbicide label and MP44, *Recommended Chemicals for Weed and Brush Control*, for product use information.

Insect Control:

- Rice water weevil can be a severe problem in water-seeded rice.
- Preventative treatments are generally required to control this pest.
- Specific treatment options are outlined in the **Insect Management** section.

No-Till Water-Seeded Rice

Rice Stubble Management:

- Decaying residue from the previous crop can be toxic to seedling rice.
- Residue should be destroyed by tillage or burning.

Nitrogen Management:

- Critical for water-seeded rice.
- System doesn't allow efficient use of nitrogen fertilizer.

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How to Use the DD50

DD50 can be used by individual producers who manage their own crops, by consultants with multiple clients or by county agents for producers within their county.

http://dd50.uaex.uada.edu/dd50Logon.asp

DD50 accumulation begins the day plants first emerge from the soil in dry-seeded rice (when plants have 1/2 inch shoot lengths in water-seeded rice).

At the beginning of the season, the DD50 operates using 30-year temperature averages. It is continually updated with the current year's weather data to improve accuracy. Accuracy is influenced by management practices and variations in weather within each weather zone.

The DD50 program is not intended as a substitute for scouting fields but rather as a set of guidelines to assist growers and consultants with management decisions. Therefore, growers are encouraged to manually check the plant growth stage before making management decisions where growth stage is extremely important.

DD50 Accumulations

DD50 accumulations from recent years compared to the 30-year average accumulation at Stuttgart, Arkansas

Date	30-year mean	2006	2007	2008	2009	2010	2011	2012	2013	2014
	cumulative heat units									
March 16-31	112	53	251	105	108	59	89	292	50	46
April 1-15	155	228	80	123	86	239	230	243	142	136
April 16-30	228	297	201	188	265	232	252	220	211	214
May 1-15	285	248	371	244	268	338	254	349	209	292
May 16-31	376	414	359	384	338	420	347	432	393	355
June 1-15	408	410	427	458	399	471	476	378	398	396
June 16-30	439	439	457	436	476	471	466	453	452	433
July 1-15	447	447	430	446	450	464	465	455	399	423
July 16-31	479	486	465	507	422	503	504	499	461	406
August 1-15	443	477	480	427	438	472	457	453	451	414
August 16-31	469	480	506	435	425	482	484	445	449	484

Explanation of the DD50 Printout

The DD50 provides predicted dates for timing 25 management practices.

Growth Stages:

- Beginning and Optimum Tillering, Apply Early/Preflood N
- Final Recommended Time to Apply Preflood N
- Beginning Internode Elongation
- 1/2 inch IE
- 50% Heading
- Drain Date
- 20% Grain Moisture

Herbicides:

- Aim or Grandstand
- Blazer + Propanil Tank Mix
- Blazer or Lockout Application
- Londax
- Permit
- Phenoxys, 2,4-D
- Propanil
- Regiment
- Ricestar
- Whip

Other:

- Rice Water Weevil Alert
- Straighthead
- Midseason N
- Apply Boot N
- Sheath Blight
- Apply Tilt for Kernel Smut Prevention
- Blast
- Stink Bugs

Example of DD50 Printout

University of Arkansas Cooperative Extension Service
Rice DD50 Report

Jarrod Hardke
RREC
Stuttgart, AR 72160

July 24, 2013 13:17
County: Arkansas
Variety: Roy J

Field: Rice Production (1 acres) Field # 1
Emergence date: 4/30 DD50 weather zone: 11

**** Predicted dates for timing specific management practices in rice ****

Beginning and Optimum Tillering: Apply Early/Preflood N.....	5/21 - 5/30
Final recommended time to apply preflood N if early N delayed...	6/11
Rice Water Weevil Alert:	5/30 - 6/ 7
High risk of infestation, at flood scout first 7 days for leaf scars.	
Roy J is rated susceptible for straighthead.	
Have soil dried between.....	6/12 - 6/26
Begin checking for beginning of internode elongation.....	6/23
Predicted 1/2 inch internode elongation:.....	6/30
Apply 1st midseason N split between:.....	6/24 - 6/30
(May apply all midseason N as a single application)	
(Optional) Apply 2nd midseason N between:.....	6/30 - 7/ 7
Scout for sheath blight symptoms*.....	6/23 - 7/27
(Roy J is rated moderately susceptible for sheath blight.)	
Boot N Application	Not recommended
Apply Tilt for kernel smut prevention*.....	7/14 - 7/27
Roy J rated very susceptible for kernel smut; treatment recommended.	
Critical scouting time for blast symptoms*.....	6/23 - 8/ 2
(Roy J is rated susceptible for blast.)	
1st critical stage (approximate) for fungicide application*...	7/24
2nd critical stage (approximate) for fungicide application*...	8/ 2
* See explanation for disease control measures in MP192	
Scout for rice stink bug between:.....	8/ 1 - 9/ 4
Predicted date for 50% Heading:.....	7/31
Draining field	8/25
Approximate time of 20% grain moisture:.....	9/ 4

Herbicide Application Information

Apply Ricestar Between:.....	5/12 - 6/23
Apply Regiment Between:.....	5/17 - 6/23
Apply AIM or Grandstand - R between.....	5/17 - 6/30
Apply Blazer+Propanil tank-mix between:.....	5/17 - 6/23
Apply Londax between:.....	5/12 - 7/ 6
Apply Blazer or Lockdown for coffeebean/NJV control.....	6/15 - 7/16
Propanil application cut-off date.....	6/23
Recommended Beyond application cut-off date	Not recommended
Apply Phenoxy (2,4 - D) between:.....	6/18 - 6/30
Recommended Grasp application cut-off date.....	7/ 6
Recommended Permit application cut-off date.....	7/18

Produced through the joint efforts of the Agricultural Experiment Station and the UA CES using weather data supplied by the Southern Regional Climate Center - LSU.

Drain Timing

General guide for days to draining after 50% heading:

Long-grain	25 days
Medium-grain	30 days
Short-grain	35 days

Rice panicles at varying maturity levels described by percent straw color: Left – 100%, Center – 67%, Right – 33%.

Fields with nearly all kernels straw colored (100%; left) are well past the safe point to drain.

Fields with two-thirds kernels straw colored (67%; center) would be safe to drain on a silt loam soil.

Fields with one-third kernels straw colored (33%; right) would be too early to drain on a silt loam soil, but approaching the point of safe to drain on a clay soil.

Harvest Aids

Sodium Chlorate

Apply 3-6 lb AI per acre when rice grain is near 25% moisture.

Harvest within 4-7 days after application.

Although typically used to desiccate weeds and foliage, grain moisture is also reduced.

Sodium chlorate at 6 lb AI significantly reduces grain moisture by 2% to 5% within 4 days after application.

Sodium chlorate should be applied to rice that is between 18% to 25% moisture with timely harvest following application.

Desiccation is noticeable within 36 hours – especially with high temperatures.

Exercise caution when considering sodium chlorate on fields with uneven maturity.

Aim 2 EC

Aim can be added or used instead of Sodium Chlorate for desiccation of primarily morningglory species. Apply 1.5 oz/A of Aim plus 1% COC when average grain moisture is at or near 25%.

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Soil Fertility

Nitrogen Management for Dry-Seeded, Delayed Flood Systems

The N fertilizer can be applied in the **standard two-way split** or as a **single optimum preflood application** (see recommended N rate and distribution table).

Early (Preflood) N Application and Management

Apply as an ammonium N source onto dry soil immediately prior to flooding near the 4- to 5-leaf growth stage.

No “exact time” but a two-week window. See the DD50 printout.

Maintain flood for a minimum of three weeks for maximum N uptake!

DO NOT apply the preflood N into the flood in a single application.

If wet/muddy conditions persist, apply NBPT-treated urea to muddy soil but wait until soil dries before flooding to minimize N loss.

If rainfall has flooded the field and prevents the large preflood N application, increase the early N rate and split-apply it every week in increments of 30-45 lb N/A per application until IE.

Preflood N application.

Midseason and Late Boot N Application

Apply the 45 lb N/A midseason N in one application to pureline cultivars.

Apply midseason N in one application a minimum of three weeks after the preflood N application AND internode elongation has started.

Midseason N is taken up in three to five days.

Hybrids require 30 lb N/A at the late boot stage to minimize lodging and maximize grain yield.

Rice stems showing internode elongation (IE).The stem on the far left is at the green ring stage (note the green band above the top node), the stem in the middle is at 1/2 inch and the stem on the far right is at 1 inch IE.

Nitrogen Fertilizer Rates

Recommended nitrogen rates and distribution for common rice cultivars grown in Arkansas

Cultivar	Optimum Preflood[1] N Rate	Rates and Distribution for Two-Way Split Application			
		Total N Rate (lb N/A)	Preflood N Rate[2] (lb N/A)	Midseason N Rate[3] (lb N/A)	Late Boot N Rate[4] (lb N/A)
Antonio	115	135	90	45	--
Bengal	130	150	105	45	--
Caffey	115	135	90	45	--
Cheniere	130	150	105	45	--
CL111	130	150	105	45	--
CL151*	100	120	75	45	--
CL152	130	150	105	45	--
CL261	115	135	90	45	--
Cocodrie	130	150	105	45	--
Colorado	115	135	90	45	--
Della	90	110	65	45	--
Della-2	115	135	90	45	--
Francis	130	150	105	45	--

Jazzman	115	135	90	45	--
Jazzman-2	115	135	90	45	--
Jupiter	130	150	105	45	--
Mermentau	130	150	105	45	--
Presidio	115	135	90	45	--
Rex	130	150	105	45	--
Roy J	115	135	90	45	--
Taggart	130	150	105	45	--
Wells	130	150	105	45	--
RT CL XL729	--	120	90	0	30
RT CL XL745	--	150	120	0	30
RT XL723	--	120	90	0	30
RT XL753	--	150	120	0	30

[1]Conditions for use of optimum preflood N rate: 1) flood field timely, 2) maintain 2-4 inch flood depth for 3 weeks after flood. Use NBPT or ammonium sulfate if can't flood silt loam in 2 days or clay in 7 days.
[2]N rate for rice on silt loam soils following soybean in rotation. Adjust rate for soil, stand, other crops.
[3]Midseason N applied in single application between internode elongation (IE) and 1/2-inch IE.
[4]Midseason N for hybrids should be made at boot rather than IE. Refer to DD50 for timing.
*Total of 120 but may split 75-45 or 90-30.

Early N Rate Adjustments

1. Increase early N rate by 30 lb/A if rice is grown on clay soils.
2. Increase early N rate by 20 lb/A if:
   a. Rice follows RICE in rotation.
   b. Stand density is < 10 plants per sq ft. for varieties.
3. Increase early N rate by 10 lb/A if rice follows GRAIN SORGHUM, WHEAT, CORN or COTTON.
4. Decrease early N rate by 10 lb/A if rice follows FALLOW that is not continuously tilled in rotation.
5. Omit early N rate if rice follows FISH, LONG-TERM PASTURE or FIRST YEAR AFTER CLEARING.

Nitrogen Source Conversions	
Urea needed (lb)	[lb N recommended × 100]/46
Ammonium Sulfate needed (lb)	[lb N recommended × 100]/21

N-STaR (Nitrogen Soil Test for Rice)*

Sample depth:
0-18 inches for silt loam soils
0-12 inches for clay soils

Advantage of N-STaR soil sample bucket:
- Use of a drill rather than manpower
- Entire sample taken in a single core
- Ability to sample in variety of soil conditions
- Ease of sampling and sample transfer

Conditions critical for use of N-STaR:
- Timely flooding of field
- Urea treated with NBPT or use ammonium sulfate (unless field can be flooded in two days for silt loam or in seven days for clay)

For additional information, contact the N-STaR lab at **479-575-6752** or **nstarlab@uark.edu**.

*Correct identification of soil texture and use of correct sampling depth critical to ensure proper N-STaR nitrogen rate recommendation.

Nitrogen Fertilizer Sources

N Source (in order of preference)	Remarks
Early Season (65% to 75% of total N requirement)	
Urea – 46% N	High N analysis, high N loss via ammonia volatilization if applied to silt loam soil and not incorporated by floodwater in two days or less on silt loam or seven days or less on clay.
NBPT-treated Urea – 46% N	High N analysis, cost slightly more than urea, minimal N loss via ammonia volatilization if applied to soil.
Ammonium Sulfate – 21% N, 24% S	Low N analysis, high cost, minimal N loss via ammonia volatilization if applied to soil. Good source on soils that also require sulfur (e.g., sandy soils).
Urea ammonium nitrate solution (UAN) – 32% N	Medium N analysis, cost similar to urea, high N loss via ammonia volatilization if applied to soil and not incorporated by floodwater in two days or less and high N loss via denitrification from nitrates in solution. Not recommended for preflood N fertilization.
Midseason (25% to 35% of total N requirement)	
Urea – 46% N	High N analysis, widely available, minimal loss at midseason.
UAN Solution – 32% N	Even distribution, cost similar to urea, ammonia volatilization loss greater than urea at midseason.

Rice Nitrogen Uptake

List of tested and recommended NBPT-containing urease inhibitors (based on product labels available in May 2014) and suggested application rates for urea

Product Name	Manufacturer	Weight per gallon lb/gallon	NBPT concentration %	Recommended volume qt/ton fertilizer
Agrotain Ultra	Koch Fertilizer, LLC	8.84	26.7	3.0
Arborite AG-NT	Weyerhauser NR Co.	9.15	24.0	3.0
Factor	Rosen's, Inc.	9.09	24.5	3.25
N-Fixx PF	Helena Chemical	8.50	unknown	3.0 - 4.0
NitroGain	Arclin, Inc.	8.92	20.0	4.0
NitroGain	Arclin, Inc.	9.00	26.7	3.0
N-Veil	Invictis Crop Care, LLC	8.92	26.7	3.0 - 5.0

*One ton of fertilizer approximates 181 gallons of 32% UAN and 187 gallons of 28% UAN.

N Management for Alternative Systems

Water Seeding – Pinpoint Flood System

Apply N preplant incorporated and flood field. Maintain soil saturation or N loss will occur.

Alternatives

Apply early N:

1. When field is drained for pegdown.
2. After draining at the 5-leaf to early tillering stage.

Water Seeding – Conventional or No-Till System

No-till dry-seeded, delayed-flood. Apply preflood N as in conventional-till fields. If high amount of plant residue, add 10 lb N/A.

No-Till Water-Seeded

Not an efficient N management system.

Options:

1. “Spoon-feed” with biweekly top-dress N applications.
2. Drain and dry field at 4- to 5-leaf stage, apply N onto dry soil, reflood.

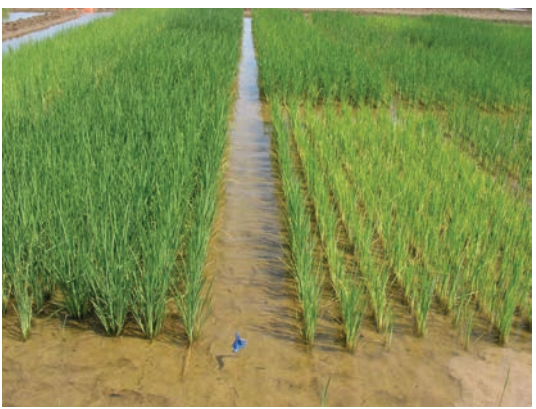
N Deficiency

Symptoms:

- Stunted plant with limited tiller number.
- Yellowish green upper leaves.
- Yellow older leaves.
- During reproductive growth, yellowish leaf canopy and subtle stunting.

Salvage:

- Vegetative growth: apply 30 lb N/A immediately.
- Reproductive growth: after flag leaf emergence, no need for additional N, yield is already set.



Rice with sufficient N fertilizer (left) compared to rice with no N applied (right).

Soil Sampling and Soil Analysis

Appropriate use of soil-test results requires that one understand that the soil test nutrient (e.g., P, K and Zn) values are simply an “availability index” and not an absolute value of soil nutrient content or plant-available nutrients.

- Soil sample from December to April.
- Soil sample to a 4-inch depth.
- Take enough soil samples to adequately represent the field, or collect samples based on “zone” or grid sampling methods.
- One composite soil sample should represent **no more than 20 acres**.
- Fields should be sampled in the direction of water movement across the field to detect pH gradients caused by the precipitation of Ca and Mg bicarbonates from well water.
- Obtain soil sample boxes, and submit samples through the nearest county Extension office.
- For additional information, call your local Extension office or the **Marianna Soil Test Laboratory (870-295-2851)**.

Guide for interpreting nutrient concentrations from plant tissue analysis

Nutrient	Plant Part	Growth Stage	Sufficient Concentration
Phosphorus	Whole Seedling	Mid-Tillering	> 0.20%
Potassium	Whole Plant	Midseason	> 1.80%
Potassium	Whole Plant	Late Boot	> 1.30%
Sulfur	Flag Leaf	Late Boot	> 0.15%
Zinc	Whole Seedling	Mid-Tillering	> 20 ppm

Sulfur (S) Management

Sulfur is most likely needed on sandy soils or sandy areas of the field and recently leveled clay soils.

- Apply 50-100 lb ammonium sulfate/A.
- Use ammonium sulfate as part of midseason N needs on fields with a history of late-season S deficiency.

S Deficiency

Symptoms:

- Initial yellowing of youngest leaves.
- Yellowing may progress to entire plant before midseason.
- Reduced tillering.
- Delayed maturity.
- Stunted growth.

Salvage:

- Plant tissue analysis to correctly identify.
- If early-season deficiency is verified, apply ammonium sulfate at 50-100 lb/A.
- If late-season deficiency is observed, corrective applications will not improve yield.

Symptoms on upper leaves due to late-season sulfur deficiency.

Sulfur deficiency occurring in sandy area of field.

Phosphorus (P) Management

Silt loam soils with a soil pH > 6.5 and very low soil test P levels are most likely to result in yield responses to P fertilizer.

- For precision-graded soils, 40 lb P_2O_5/A is recommended, unless the soil test calls for a higher amount.
- If a high rate (60 to 90 lb P_2O_5/A) of P is recommended, a split application may be useful on highly responsive soils (one-half to two-thirds applied preplant followed by one-third to one-half applied before flooding).

Phosphorus fertilizer recommendations for rice based on soil test P (Mehlich-3) and soil pH

Soil Test Level	Soil Test P Range	Soil pH	
		< 6.5	≥ 6.5
		lb P_2O_5/A	
Very Low	≤ 15 ppm	50	90
Low	16-25 ppm	30	60
Medium	26-35 ppm	0	50
Optimum	36-50 ppm	0	0
Above Optimum	≥ 51 ppm	0	0

P Deficiency

Symptoms:

- Seedling rice: severe stunting; small, very erect and dark green leaves; small stems; lack of tillering; delayed development.
- Leaf yellowing and bronzing in seedlings.

- Rapid deterioration of older leaves, especially after flood.
- Symptoms most common 7-14 days after permanent flood (mid-tillering).
- Can be confused with Zn deficiency.
- Plant tissue analysis (whole seedling) to correctly ID.
  - > 0.20% is sufficient.
  - 0.15%-0.20% is low.
  - < 0.15% is deficient.

Salvage:

- Plant tissue analysis to correctly identify.
- When seedling rice is P deficient, application of P fertilizer as late as panicle differentiation may improve growth and increase yield.
- Yield increase from midseason P fertilizer is usually less than that applied earlier in the growing season.

Phosphorus deficiency of rice. Notice dark green streak with stunted plants and reduced tillering.

Potassium (K) Management

Potassium is taken up by rice in amounts equal to or greater than N. Potassium-deficient plants may not show any visual deficiency symptoms, “hidden hunger,” and is well known for its important role in maintaining plant health. Potassium fertilizer recommendations are based on soil test K in the top 4 inches of soil.

Potassium fertilizer recommendations based on soil test K (Mehlich-3) in the top 4 inches of soil

Soil Test Level	Soil Test K Range	K Fertilizer Rate lb K_2O/A
Very Low	≤ 60 ppm	120
Low	61-90 ppm	90
Medium	91-130 ppm	60
Optimum	131-175 ppm	0
Above Optimum	≥ 175 ppm	0

K Deficiency

Symptoms:

- Seldom appear before midseason.
- Vegetative growth: normal color, no reduction in tillering, may lack vigorous growth with mild bronzing on lower, older leaves.
- Reproductive growth: stunted plants, yellowing of interveinal areas of lower leaves, leaf tips die and turn brown, development of brown spots on all leaves.
- Symptoms will often appear in and along barrow ditches first.

Salvage:

- Plant tissue anaysis to correctly identify.
- K fertilizer is recommended when rice shows deficiency symptoms during the season.
- Apply 60 lb K_2O per acre as soon as deficiency is positively identified.

Potassium-deficient leaf (top) compared to healthy leaf (bottom). Note severe brown spot and yellow/brown leaf margins of K-deficient leaf.

Potassium-deficient rice at heading. Note brown spot on leaves and panicles.

Poultry Litter

Contains appreciable amounts of many nutrients, including N, P and K, and may be used as an alternative to inorganic P and K fertilizers.

- Poultry litter, because of its low nutrient analysis, dictates it be applied with ground rigs prior to planting.
- When preplant incorporated about 25% of N in the poultry litter will be available to the rice crop. Reduce preflood N by 25% of the total N content of the poultry litter.
- Poultry litter should be applied to nongraded soil based on its P and K content and not on its N content.
- The P and K in poultry litter are as available as that in commercial fertilizers.
- Nutrient content of litter usually declines as its moisture content increases.
- Poultry litter should be analyzed for nutrient content since it is not a homogenous material.
- About one pint of a representative sample in a sealed plastic bag is needed for analysis.
- Send sample, completed form AGRI-429 (from county Extension Office) and the appropriate postage and analysis fee to **Agricultural Diagnostic Lab, 1366 West Altheimer Drive, Fayetteville, AR 72704**. Call 479-575-3908 for the analysis fee.

Poultry litter properties*

Property	Broiler Litter	Hen Manure	Turkey Litter
Observations	514	208	38
Moisture, %	30.2 (8.9)	39.7 (15.9)	29.5 (7.9)
pH	8.3	8.7	8.2
EC, µmhos cm^{-1}	11,400	7,734	8,545
Total C, %	25.5	19.4	26.6
Total N, %	3.08 (0.51)	2.06 (0.89)	3.53 (0.76)
C:N ratio	8.3	10.2	7.7
Organic N, %	85.2 (6.1)	82.7 (11.4)	85.0 (5.9)
NH_4-N, ppm	3,392	2,568	4,956
NO_3-N, ppm	420	365	227
Total P_2O_5, %	3.28 (0.66)	3.32 (0.94)	3.30 (0.60)
Total K_2O, %	2.96 (0.50)	2.29 (0.55)	2.66 (0.36)
Total Ca, %	2.38 (0.71)	5.66 (1.68)	2.40 (0.44)

*Mean and (standard deviations) of selected chemical and physical properties.

Zinc (Zn) Management

Zinc deficiency normally occurs on silt and sandy loam soils or on precision-graded fields. The availability of native soil Zn declines as pH increases. Zn availability is reduced when the soil pH is > 6.0. Zinc deficiency may be corrected by either acidifying the soil or applying a suitable Zn fertilizer source at the proper rate and timing. Granular zinc fertilizers with high water-soluble Zn content should be applied preplant to build soil test Zn when soil pH is > 6.0 and soil test Zn levels are Very Low. Highly water-soluble, granular Zn sources intended for soil application should be applied at 10 lb Zn/A and are the best sources for increasing soil test Zn.

Zinc

Soil-test Zn and soil pH based Zn fertilization recommendations for rice

Soil Texture	Soil pH	Soil-Test Zn Level and Concentration			
		Very Low	Low	Medium	Optimum
		≤ 1.5 ppm	1.6-2.5 ppm	2.6-4.0 ppm	≥ 4.1 ppm
		lb Zn/A			
Sandy Loam and Silt Loam	> 6.0	10	10	1-10	0
	≤ 6.0	5-10[1]	0	0	0
Clay Loam and Clay	> 6.0	10	0	0	0
	≤ 6.0	10[1]	0	0	0

[1]Recommended for general maintenance of soil-test Zn.

Suggested Zn fertilizer sources and rates

Fertilizer Source	Actual Zn lb/A
Organic chelates EDTA, DPTA, etc.	1.0
Organic complexes lingo-sulfonates, phenols, citrates mixtures, etc.	2.0-2.5
Inorganic sulfates, oxysulfates liquids such as nitrates and chlorides	10.0 2.0-2.5

Liquid Zn source conversion

Fertilizer Zn Concentration	Fertilizer Zn Content	Volume to Apply lb Zn
% Zn	lb Zn/gallon	quarts/A
4	0.40	10.0
6	0.62	6.5
8	0.62	6.5
8	0.80	5.0
10	1.00	4.0
12	1.14	3.5

As a seed treatment, apply Zn at 0.25-0.50 lb Zn per 100 lb of seed (cwt).

Zn Deficiency

Symptoms:

- Easily confused with P deficiency and salinity injury.
- Occurs after flushing or flooding (salinity problems occur under dry conditions).
- Basal leaf chlorosis – portion of leaf nearest stem is light green and tip is dark green.
- Bronzing – consists of brown "splotches" starting on oldest leaves. Midrib of lower leaves may be pale green or yellow and surrounded by bronzed leaf tissue.
- Short plants – stacking of leaf sheaths or joints.
- Floating leaves – lose turgidity and float on the water surface.

Salvage:

- Drain immediately after symptoms detected.
- Recovery takes 7-14 days.
- Correction with foliar Zn application NOT recommended when rice still flooded unless detected early, flood depth is shallow and Zn deficiency not severe.
- After draining and new root and shoot growth are observed, apply 1 lb Zn/A.
- Wait 3-5 days after Zn application, then apply 100 lb ammonium sulfate/A and reflood.

Mottled discoloration due to chlorosis and bronzing of lower rice leaves caused by prolonged zinc deficiency.

Stacked leaf collars of zinc-deficient rice plant.

Management of Saline Soils

Salinity damage occurs mainly on rice during the seedling stage and on larger rice located on levees both prior to and after flooding. Salinity injury may occur on soils having an EC1:2 > 400 micromhos/cm. Salt accumulation at the soil surface can reduce stands in areas of the paddy such as the breaks of ridges, stagnant water areas (low spots) and on the top or south and west sides of levees.

Symptoms:

- Plants are usually at the 2- to 5-leaf stage. Rice is relatively tolerant to salinity during germination; however, it becomes quite sensitive to salinity during early seedling development.
- Symptoms include leaf tip die-back, leaf rolling, stunting and rapid death, increased sensitivity to herbicides and reduced stand density. Salt-stressed plants may turn chlorotic (yellow), with the yellowing beginning in the youngest leaves.
- Plant analysis usually indicates an excessive level of chlorides and/or nitrates in the tissue.
- Tissue analysis (whole seedling) interpretation:
    - Normal
        < 10,000 ppm Chloride
        < 1,600 ppm Nitrate
    - Possible Toxicity
        10,000-12,000 ppm Chloride
        1,600-2,400 ppm Nitrate
    - Probable Toxicity
        > 12,000 ppm Chloride
        > 2,400 ppm Nitrate

Management:

- Flush the seedling rice frequently with good quality water that is low in salts to minimize accumulation of salts within the root zone.
- Flood the rice as soon as it can tolerate a flood.
- Have irrigation water tested for quality. When possible, minimize the use of poor quality water by substituting good quality surface water.

Liming

Generally for the benefit of the other crops in rotation because rice grows well in moderately acidic soil.

- Liming is beneficial to rice when soil pH is 5.0 or lower.
- It is best to apply lime in the fall after the rice crop to minimize the chance of inducing a Zn deficiency in rice.
- Uniform application is critical to avoid lime-related production problems.
- Lime rates can be halved and applied in separate years to gradually adjust pH.

Lime rates by soil texture for soils that have rice in rotation[1]

	Soil pH			
	< 5.0	5.0-5.3[2]	5.4-5.7[3]	5.8-6.2
Soil Texture	lb ag lime/A			
Sandy loam	2,000	2,000	0	0
Silt loam	3,000	2,000	0	0
Clay loam	4,000	3,000	0	0
Clay	5,000	4,000	0	0

[1]Lime upper half of field only when well water concentration is < 3 meq Ca/L and soil pH of water-inlet area < 5.5.
[2]Apply lime to crops grown in rotation with rice in this pH range.
[3]Consult soil-test recommendations to determine the lime recommendations for specific crops grown in rotation with rice.

Diagnostic Soil and Plant Tissue Sampling

Correct diagnosis of nutritional problems is not always easily performed through soil testing and visual identification of deficiency symptoms. Plant tissue analysis should be used to help identify the nutritional or salinity problem(s).

To submit for analysis:

For seedling rice samples:

- Send complete plants (without roots) of both healthy and unhealthy plants. About 30-40 seedlings are needed to provide enough tissue for analysis.
- Rinse fresh plant tissue with clean water to remove soil contamination.
- Place the healthy and unhealthy seedlings in separate paper sacks, and deliver to the county Extension office.

For older plants:

- Submit as whole plants or samples of the affected tissues (i.e., top or bottom leaves).

Send samples, completed AGRI-423 form and check for postage and analysis fee to **Agricultural Diagnostic Laboratory, 1366 West Altheimer Drive, Fayetteville, AR 72704**. Phone 479-575-3908.

Fertilization and Management of Precision-Graded Soils

Productivity often declines from precision grading of silt and sandy loam soils. Graded fields of silt loam soil that have the topsoil removed, stock-piled and replaced after the field is put to grade typically do not have as great a loss of productivity.

General:

- Observation of winter vegetative growth can identify the problem areas.
- The deeper the cut, the greater the decline in soil productivity.
- Clay soils do not generally exhibit reduced productivity following grading.
- Routine soil testing is often unable to identify the nutrient(s) that are limiting plant growth on the cut areas, but at least apply the nutrients the soil test recommends.
- Deeper cuts require poultry litter for reclamation.
- Cultivar selection is very important, so select one that has excellent seedling vigor. Use seed treatments that aid in quick, uniform stand establishment.
- Be careful with herbicide application, especially the residuals.
- Rice is usually the best crop to grow on a graded soil.

Management:

- Apply recommended rates of commercial fertilizer based on soil test results.
- For cuts < 6 inches, apply poultry litter at a rate of no less than 1,000 lb/A.
- If the cut is > 6 inches, apply 2,000 to 4,000 lb/A of poultry litter.
- For the best results, apply poultry litter in the spring rather than the fall.
- Poultry litter application can probably be ceased when two consecutive productive crops are produced on the graded soil.

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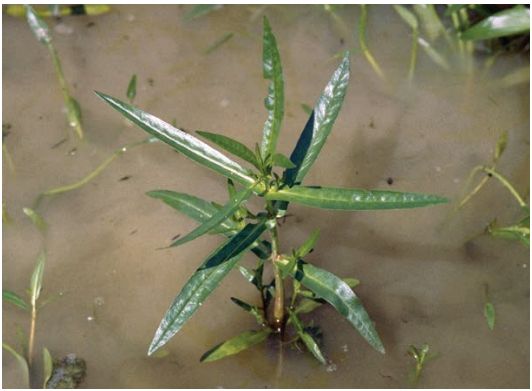
Weed Control

Identification of Common Weeds of Rice

Alligatorweed (*Alternanthera philoxeroides*)

Amazon sprangletop (*Leptochloa panicoides*)

Ammannia (red stem) (*Ammannia robusta*)



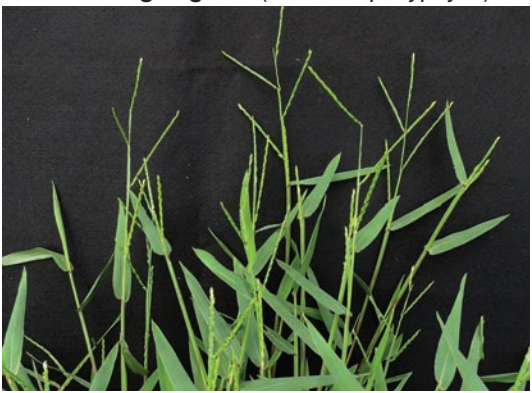
Arrowhead *(Sagittaria spp.)*

Barnyardgrass (*Echinochloa crus-galli*)

Flat sheath, no ligule, no hairs on blade, no auricles.

Bearded sprangletop (*Leptochloa fusca*)

Broadleaf signalgrass (*Urochloa platyphylla*)



Crabgrass *(Digitaria spp.)*

Ducksalad (*Heteranthera limosa*)

Fall panicum (*Panicum dichotomiflorum*)

Round sheath, ligule with fringe of hairs, blade smooth with prominent midvein, no auricles.

Rice flatsedge (*Cyperus iria*)

Gooseweed (*Sphenoclea zeylanica*)

Hemp sesbania (coffeebean)
(*Sesbania herbacea*)

Johnsongrass (*Sorghum halapense*)

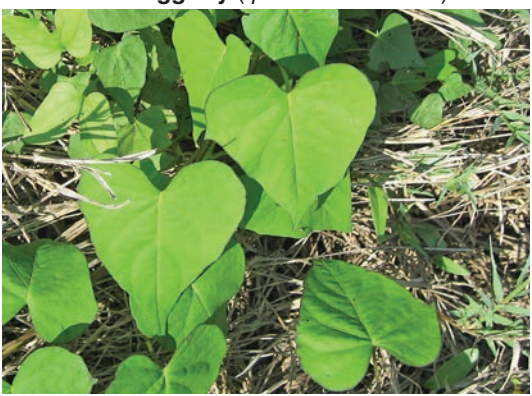
Round sheath; membranous, tall, jagged ligule; blade smooth with prominent midvein; no auricles.

Junglerice (*Echinochloa colona*)

Northern jointvetch (curly indigo)
(*Aeschynomene virginica*)

Palmleaf morningglory (*Ipomoea wrightii*)

Pitted morningglory (*Ipomoea lacunosa*)



Red rice (*Oryza sativa*)

Rice cutgrass (*Leersia oryzoides*)

Roundleaf mudplantain (*Heteranthera reniformis*)

Smartweed (*Polygonum spp.*)

Smallflower Umbrella Sedge (*Cyperus difformis*)

Waterhyssop (*Bacopa spp.*)

Yellow nutsedge (*Cyperus esculentus*)

Stems and leaves triangular, reproduces by seed and tubers.

Preemergence Herbicide Weed Response Ratings (0 = no control, 10 = 100% control)

Herbicides	Herbicide MOA	Grasses								Broadleaf Weeds																Sedges			
		Barnyardgrass[1]	Broadleaf signalgrass	Crabgrass	Fall panicum	Red rice	Rice cutgrass	Sprangletop (loosehead/bearded)	Sprangletop (tighthead/Amazon)	Ammania (red stem)	Dayflower	Ducksalad	Eclipta	False Pimpernel	Gooseweed	Groundcherry	Hemp sesbania (coffeebean)	Indian jointvetch	Northern jointvetch (curly indigo)	Palmleaf morningglory	Pigweed, Palmer	Pitted Morningglory	Smartweed	Texasweed	Water hyssop	Flatsedges[2]	Spikerush	Umbrella sedge	Yellow nutsedge[2]
League	2	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	9	7	7	2	0	2	-	8	-	8	-	0	8
Prowl[3]	3	8	6	8	7	0	0	6	6	0	0	4	0	0	0	-	0	0	0	0	6	0	0	0	0	0	0	0	0
Facet[5]	4	9	9	9	9	0	0	0	0	3	5	3	8	3	3	8	6	7	7	7	4	7	0	0	6	5	-	0	0
Facet + Prowl[3]	4,3	9	9	9	9	0	0	7	7	3	5	3	8	3	3	-	7	7	7	8	6	8	0	0	6	5	-	0	0
Facet + Bolero[3]	4,8	9	9	9	9	0	0	8	8	6	7	7	9	7	5	-	8	8	8	8	5	8	5	-	6	8	7	0	0
Obey (Facet + Command)	4,13	10	10	10	10	0	0	9	9	3	6	3	8	3	4	8	7	8	8	8	4	8	6	0	6	5	7	-	0
Bolero[3]	8	7	5	7	7	0	0	7	7	7	8	7	8	8	6	-	5	5	5	5	-	5	5	-	7	7	7	4	4
Bolero[4]	8	8	7	7	-	8*	0	8	8	3	6	6	-	5	6	-	-	-	-	-	-	-	-	-	5	7	5	3	3
Command[5]	13	9	9	9	9	0	0	9	9	0	3	3	3	-	0	-	2	3	3	4	0	3	2	0	0	0	0	0	0

[1]Some biotypes of barnyardgrass are resistant to Command, propanil, Facet, both Facet and propanil, and Newpath, Grasp and Regiment.
[2]Some biotypes of flatsedge and yellow nutsedge are resistant to Permit, Permit Plus, Regiment, Strada, Grasp, and Newpath.
[3]Delayed PRE [4]Water seeded [5]PRE/delayed PRE *Water seed pinpoint flood culture

Read and follow all label directions when using these products.

Early Postemergence Weed Response Ratings (0 = no control, 10 = 100% control)

Herbicides	Herbicide MOA	Grasses								Broadleaf Weeds														Sedges			
		Barnyardgrass[1]	Broadleaf signalgrass	Crabgrass	Fall panicum	Red rice	Rice cutgrass	Sprangletop (loosehead / bearded)	Sprangletop (tighthead / Amazon)	Ammania (red stem)	Dayflower	Ducksalad	Eclipta	False Pimpernel	Gooseweed	Groundcherry	Hemp sesbania (coffeebean)	Indian jointvetch	Northern jointvetch (curly indigo)	Palmleaf morningglory	Pigweed, Palmer	Pitted Morningglory	Smartweed	Texasweed	Water hyssop	Flatsedges	Spikerush	Umbrella sedge	Yellow nutsedge
Clincher	1	8	9	5	9	0	2	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ricestar HT	1	9	9	8	7	0	2	9	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grasp	2	8	0	0	0	0	6	0	0	7	8	9	8	-	-	8	8	8	8	4	0	5	7	7	8	9	8	0	6
Londax	2	0	0	0	0	0	0	0	0	9	7	9	8	9	9	0	6	6	6	5	0	5	6	0	9	8	8	0	6
Newpath fb Newpath	2	9	9	9	9	9.5	9	8	7	8	5	7	0	0	5	9	0	0	0	5	0	7	9	5	0	9	9	0	8
Permit	2	0	0	0	0	0	5	0	0	5	8	3	5	-	4	6	9	3	6	0	0	4	4	5	-	8	-	0	9
Permit Plus	2	0	0	0	0	0	5	0	0	8	9	7	7	-	4	8	9	5	7	3	0	5	8	5	-	8	-	0	9
Regiment	2	8	0	0	0	0	7	3	2	6	9	9	7	-	0	-	8	7	7	4	0	5	10	7	6	8	-	3	5
Strada	2	0	0	0	0	0	0	0	0	8	7	6	7	-	-	4	9	8	9	3	0	4	5	6	-	9	-	0	7
Facet	4	8	9	7	6	0	2	0	0	3	3	3	9	3	3	8	8	8	8	8	4	8	0	0	3	5	-	0	0
Grandstand + Permit	4,2	0	0	0	0	0	0	0	0	8	8	4	5	-	-	4	8	9	9	9	4	9	7	9	-	9	-	3	9

Facet + propanil	4,7	9	9	7	9	0	2	4	5	6	5	6	9	7	5	8	9	9	9	8	8	8	6	6	8	9	9	3	5
Grandstand + Propanil	4,7	9	9	7	9	0	0	4	5	9	5	8	9	8	8	4	9	9	9	9	9	9	7	8	8	9	9	3	5
Basagran	6	0	0	0	0	0	0	0	0	8	9	6	8	7	7	0	3	3	3	8	0	3	7	0	8	8	8	7	6
Basagran + propanil	6,7	9	9	7	9	0	2	4	5	9	9	7	9	8	7	4	9	9	9	8	7	5	8	6	9	9	9	8	7
Propanil	7	9	9	7	9	0	1	4	5	6	5	7	8	7	5	-	9	9	9	4	7	4	6	6	8	9	9	5	4
Propanil fb propanil	7	9	9	7	9	0	2	7	8	6	6	7	9	7	5	-	9	9	9	5	9	5	8	6	8	9	9	6	6
Propanil + Londax	7,2	9	9	7	9	0	2	4	5	9	8	7	9	8	9	0	9	9	9	9	7	9	8	5	8	9	9	6	8
Propanil + Permit	7,2	9	9	7	9	0	1	4	5	6	9	7	8	7	5	6	10	9	9	4	7	4	6	5	8	9	9	3	9
Propanil + Prowl	7,3	9	9	7	9	0	1	9	9	7	5	7	9	7	6	-	9†	9†	9†	5	7	5	6	4	7	9	7	3	5
Propanil + Bolero	7,8	9	9†	7	9	0	2	9	9	8	8	8	9	9	6	-	9†	9†	9†	5	0	5	6	4	9	9	9	8	5
Aim	14	0	0	0	0	0	0	0	0	6	7	5	7	-	-	8	9	6	6	10	6	10	9	3	7	0	0	3	0
Sharpen	14	0	0	0	0	0	0	0	0	8	7	5	9	-	7	8	9	9	9	9	9	10	-	8	8	8	-	6	6
Ultra Blazer + propanil	14,7	8	8	7	8	0	1	4	5	6	5	7	8	7	5	8	9	6	9	8	9	8	7	3	8	8	8	2	5

[1]Some biotypes of barnyardgrass are resistant to Command, propanil, Facet, both Facet and propanil, and Newpath, Grasp, and Regiment.
[2]Some biotypes of flatsedge and yellow nutsedge are resistant to Permit, Permit Plus, Regiment, Strada, Grasp, and Newpath.
*Water seed pinpoint flood culture †Postemergence control only **Read and follow all label directions when using these products.**

Midseason Herbicide Weed Response Ratings (0 = no control, 10 = 100% control)

		Grasses								Broadleaf Weeds																Sedges			
Herbicides	Herbicide MOA	Barnyardgrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Red rice	Rice cutgrass	Sprangletop (loosehead/bearded)	Sprangletop (tighthead/Amazon)	Ammania (red stem)	Dayflower	Ducksalad	Eclipta	False Pimpernel	Gooseweed	Groundcherry	Hemp sesbania (coffeebean)	Indian jointvetch	Northern jointvetch (curly indigo)	Palmleaf morningglory	Pigweed, Palmer	Pitted Morningglory	Smartweed	Texasweed	Water hyssop	Flatsedges	Spikerush	Umbrella sedge	Yellow nutsedge
2,4-D	4	0	0	0	0	0	0	0	0	9	9	9	9	9	6	5	9	5	5	9	8	9	6	0	9	8	8	3	5
2,4-D + propanil	4,7	6	6	2	6	0	0	6	6	9	9	8	9	9	8	5	9	8	8	8	9	9	7	0	9	8	8	3	6
Grandstand + propanil	4,7	2	2	2	2	0	0	0	0	9	-	6	6	8	7	3	9	8	9	9	7	9	5	0	8	5	8	5	3
Propanil	7	4	4	4	4	0	0	0	0	4	0	3	4	4	0	4	8	5	5	3	6	0	3	0	8	5	7	5	3
Propanil + Ultra Blazer	7,14	5	5	5	5	0	0	0	0	5	2	4	5	5	2	5	9	6	6	7	7	8	7	0	8	6	7	5	4
Ultra Blazer	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9	0	0	3	6	3	6	0	0	0	0	0	0

Read and follow all label directions when using these products.

Levee Weed Control (Larger Weeds)* (0 = no control, 10 = 100% control)

Herbicides	Herbicide MOA	Grasses					Broadleaf Weeds								
		Barnyardgrass	Bermudagrass	Broadleaf signalgrass	Crabgrass	Foxtail spp.	Entire/lvyleaf morningglory	Groundcherry	Hemp sesbania (coffeebean)	Northern jointvetch	Palmer amaranth	Palmleaf morningglory	Prickly side (Tearweed)	Sicklepod	Smartweed
Clincher	1	7	3	6	0	0	6	0	0	0	0	0	0	0	0
Ricestar HT	1	6	2	4	3	0	8	0	0	0	0	0	0	0	0
Beyond	2	7	0	7	4	4	4	3	0	0	0	4	4	0	6
Grasp	2	7	2	0	0	6	-	-	5	7	-	4	0	5	5
Permit	2	0	0	0	0	5	0	0	8	6	0	3	2	5	6
Permit Plus	2	0	0	0	0	6	0	0	8	7	0	4	3	5	8
Strada	2	0	0	0	0	3	-	-	5	5	0	-	-	4	0
Regiment	2	8	0	0	0	4	-	-	7	7	-	0	2	6	9
2,4-D	4	0	0	0	0	8	0	6	9	5	8	9	9	9	9
Facet	4	6	0	5	3	6	4	6	7	5	0	5	4	3	7
Grandstand	4	0	0	0	0	9	0	5	9	9	4	9	3	6	7
Basagran	6	0	0	0	0	4	0	2	2	0	0	4	4	0	5
Propanil	7	6	4	6	3	4	0	3	9	8	6	3	2	4	7
Aim	14	0	0	0	0	8	0	3	6	3	3	8	2	3	7
Sharpen	14	0	0	0	0	9	0	7	8	8	8	8	6	6	-
Ultra Blazer	14	0	0	0	0	7	0	3	9	0	4	6	2	0	6

*For good levee broadleaf weed control, a combination of products is needed, especially where 2,4-D cannot be used. Applying Facet or other residuals prior to weed emergence is recommended in 2,4-D restricted areas.
Read and follow all label directions when using these products.

Herbicide Modes of Action and Resistance

MOA	Herbicides	Weeds Resistant to This Group in Arkansas
1	**Postemergence grass herbicide (ACCase inhibitor)** Hoelon, Axial, Select, Fusilade, Clincher, Ricestar HT, Assure II, Poast	annual ryegrass
2	**ALS inhibitor herbicide** Newpath, Classic, Staple, FirstRate, Scepter, Synchrony XP, FirstShot, Harmony, Oust, Regiment, Permit, Finesse	annual ryegrass, pigweed, common cocklebur, red rice, barnyardgrass, annual nutsedge, smallflower, umbrella sedge, and yellow nutsedge
3	**DNA herbicides** Prowl H2O, Treflan, Sonolan, Barricade, Pendimax, Trilin	goosegrass
4	**Synthetic auxins** Facet	barnyardgrass
7	**Photosynthetic inhibitors (amides)** Propanil (SuperWham, Stam, others)	barnyardgrass
8	**Inhibitor of lipid synthesis (not ACCase)** Bolero	none

MOA	Herbicides	Weeds Resistant to This Group in Arkansas
9	**EPSPS inhibitor** Roundup	horseweed, Palmer pigweed, common ragweed, giant ragweed, annual ryegrass, johnsongrass
10	**Glutamine synthase inhibitor** Liberty	none
13	**Pigment inhibitors** Command	barnyardgrass
14	**PPO inhibitors** Valor, Flexstar, Ultra Blazer	none
15	**Acetamide herbicides** Dual, Lasso, Degree, Outlook, Parlay	none

Row-Crop Plant-Back Intervals for Common Herbicides in Rice Rotations

Herbicide	Cotton	Field Corn	Grain Sorghum	Rice	Soybeans	Wheat
2,4-D	28D	7D	7D	21D	14D	7D
Aim	I	I	I	I	I	I
Basagran	I	I	I	I	I	I
Beyond	9M	8.5M	9M	9M[13]	I	3M
Bolero	6M	6M	6M	6M	6M	6M
Clarity	21D[12]	I	15D	22D	14D[12]	22D
Clearpath[7]	18M	10M	18M	18M[13]	10M	10M
Clincher SF	3M	3M	3M	I	3M	3M
Command	I	9M	9M	I	I	4M[21]
Distinct	30D[14]	7D	30D[14]	30D[14]	30D[14]	30D[14]
Express	14D[6]	14D[6]	14D[6]	0D	7D[6]	0D
Facet L	10M	10M	I	I	10M	I
FirstShot	14D[6]	14D[6]	14D[6]	I	7D[6]	I
Grandstand	4M	4M	4M	I	4M	4M
Grasp/Xtra	3M	3M	3M	3M	3M	3M
League	8M	12M	12M	I	12M	12M
Londax	4M	4M	4M	I	4M	4M
Newpath[7]	18M	8.5M	18M	18M[13]	I	4M
Obey	309D	309D	309D	I	309D	309D
Permit/ HaloMax/ Permit Plus	4M	1M	2M	I	9M[16,19]	2M

Propanil	I	I	I	I	I	I
Prowl	I	FS	FS	FS	I	4M
Regiment	FY	FY	FY	I	FY	FY
RiceBeaux	60D	60D	60D	I	60D	60D
Ricestar HT	30D	30D	30D	I	30D	4M
Select/Select Max	I	30D	30D	30D	I	30D
Sharpen	1.5-3M[21]	I	I	I	0-30D[21]	I
Storm	100D	100D	100D	I	I	40D
Strada PRO	6M	3M	3M	I	9M	3M
Strada XT7	309D	309D	309D	I	309D	309D
Ultra Blazer	100D	100D	100D	I	I	40D
Valor	30D[6]	30D[6]	30D[6]	30D[6]	I	30D[6]

***Not all herbicide listed labeled for use in rice – herbicides listed commonly used in rice, in rice rotations, or for burndown.**

[6] Time interval increases with increase of rate and soil pH level.

[7] For Newpath use rates greater than 8 oz/A per season; only Soybeans may be planted the following year.

[12] Time interval is based on 8 oz/A application rate and does not begin until 1 inch of rainfall is received.

[13] Clearfield Rice may be planted at any time after application of Beyond, Clearpath or Newpath.

[14] If 4 oz/A or less used and 1 inch of rainfall/irrigation received after application.

[16] STS Soybeans can be planted immediately.

[19] Rotation interval for Soybeans is 2 months where pH is less than 7.5.

[21] Rotation intervals increase with higher application rate.

Rainfall-Free Periods for Postemergence Rice

Herbicide	Time Before Rainfall
2,4-D	6 hours
Aim	1 hour
Basagran	8 hours
Beyond	4 hours
Bolero	none on label
Clincher	1 hour
Facet	none on label
Grasp	1 hour
League	6 hours
Newpath	4 hours
Permit/Permit Plus	1 hour
Propanil	6 hours
Regiment	8 hours
Ricestar HT	1 hour
Sharpen	1 hour
Storm	8 hours
Strada	6 hours
Ultra Blazer	4 hours

Herbicide Injury to Rice

Newpath injury to Clearfield rice

Not common, but can occur under cool, wet conditions. Symptoms include yellowing and interveinal chlorosis (leaves appear to have yellow stripes). Symptoms can be induced when Newpath or Beyond is tank-mixed with another ALS herbicide such as Regiment or Grasp. Drain and dry the field to allow rice to recover.

Paraquat injury to rice

Symptoms include burned spots or lesions resulting in no yield loss unless filling grains directly contacted.

Glyphosate injury

Vegetative injury results in stunting, but may not reduce yields; however, reproductive injury can/will lead to potentially significant yield loss. Timing of injury as important as rate of herbicide.

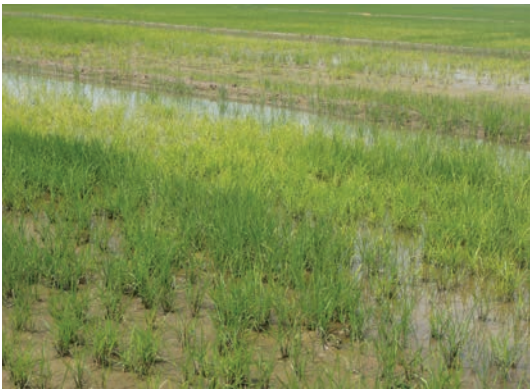
Select/ACCase injury

Symptoms include death of primary shoots typical of graminicides. Injury can be severe, often yield losses are not great, but a delay in maturity is common. Often only the main or center tiller is affected.

Glufosinate injury

Symptoms include "water-soaked" leaves and yellow discoloration in spots. Typically not yield-limiting, even with severe crop response.

Permit injury



Rare and usually in combination with very high pH, symptoms include bright yellow plants and interveinal chlorosis. Removal of standing water key to recovery.

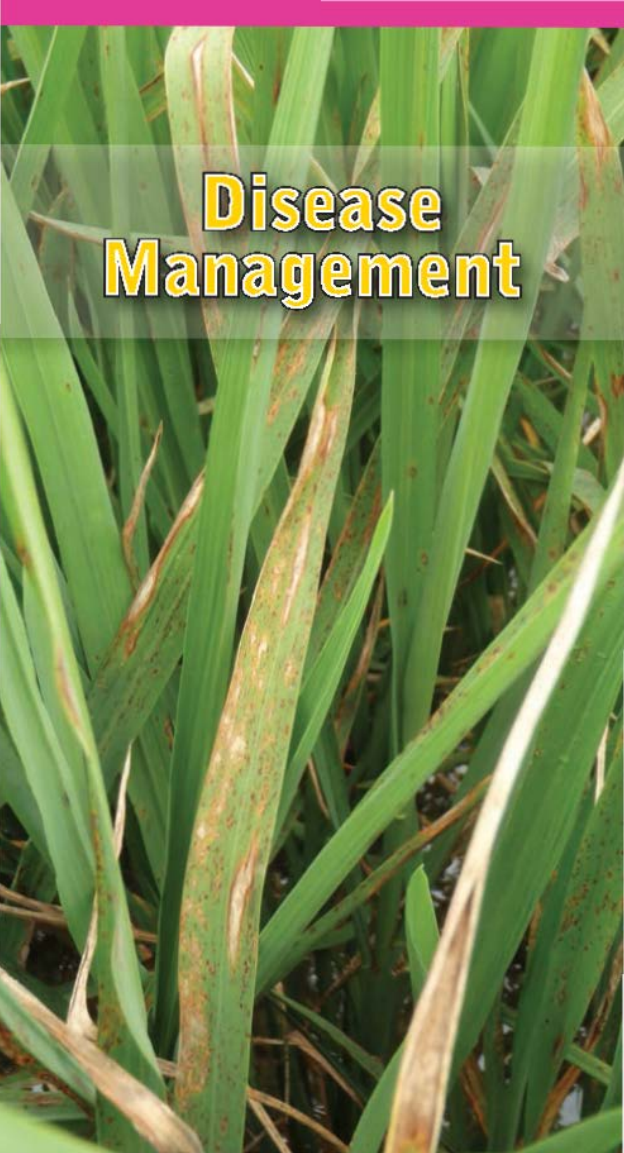
Glyphosate tank contamination

Direct application of high rates can result in plant death.

Delayed Phytotoxicity Syndrome (DPS, Delayed Phytotoxic Shock)

Symptoms can vary but include excessive tillering, twisting of tillers and "fish-hooking" of roots. Multiple herbicides including Facet and Bolero can be responsible, in combination with the right set of environmental conditions or stress on plants.

Disease Management



Rice Cultivar Reactions to Diseases, 2014

Cultivar	Sheath Blight	Blast	Straight-head	Bacterial Panicle Blight	Narrow Brown Leaf Spot	Stem Rot	Kernel Smut	False Smut	Lodging	Black Sheath Rot
Antonio	S	S	--	MS	MS	S	S	MS	MS	--
Caffey	MS	MR	--	S	R	--	--	MS	--	--
Cheniere	S	VS	VS	VS	S	S	S	S	MR	MS
CL111	VS	MS	S	VS	VS	VS	S	S	MS	S
CL142 AR	MS	S	MS	S	S	S	S	S	S	S
CL151	S	VS	VS	VS	S	VS	S	S	MR	S
CL152	S	VS	S	S	MR	--	VS	S	--	--
CL163	MS	--	--	MS	--	--	--	--	--	--
CL172	MS	--	--	MS	--	--	--	S	--	--
CL261	MS	VS	S	VS	S	VS	MS	S	MS	MS
CL271	S	MR	--	MS	MR	--	--	--	--	S
Cocodrie	S	S	VS	S	S	VS	S	S	MR	S
Colorado	S	VS	--	S	MS	--	--	S	--	--
Della-2	S	R	--	S	MS	--	--	--	--	--

Francis	MS	VS	MR	VS	S	S	VS	S	MS	S
Jazzman	MS	S	S	S	S	S	MS	S	MS	MS
Jazzman-2	VS	S	--	VS	MR	--	S	S	--	--
Jupiter	S	S	S	MR	MS	VS	MS	MS	MS	MR
LaKast	S	S	MS	S	MS	S	S	S	MS	MS
Mermentau	S	S	VS	MS	MS	--	S	S	MS	--
Neptune	MS	MS	VS	VS	MS	VS	MS	MS	MR	MR
Rex	S	S	S	S	MS	S	S	S	MR	S
Roy J	MS	S	S	S	MR	S	VS	S	MR	MS
RT CL XL729	MS	R	MS	MR	MS	S	MS	S	S	S
RT CL XL745	S	R	R	MR	MS	S	MS	S	S	S
RT XL723	MS	R	S	MR	MS	S	MS	S	MS	S
RT XL753	MS	R	MS	MR	--	--	MS	S	--	S
Taggart	MS	MS	R	MS	MS	S	S	S	MS	MS
Wells	S	S	S	S	S	VS	S	S	MS	MS

R = Resistant; MR = Moderately resistant; MS = Moderately susceptible; S = Susceptible; VS = Very susceptible (cells with no values indicate no definitive Arkansas disease rating information is available at this time). Reactions were determined based on historical and recent observations from test plots and in grower fields across Arkansas. In general, these ratings represent expected cultivar reactions to disease under conditions that most favor severe disease development.

Sheath Blight

Sheath Blight Management

- Plant less susceptible cultivars.
- Avoid thick stands.
- Avoid excessive N fertilization.
- Scout fields from PI to 50% heading.

Sheath Blight Treatment Thresholds

Cultivar Reaction	Treatment Thresholds		Comments
	% Positive Stops	% Infected Tillers	
VS	35	5-10	Scout starting at PI and be prepared to treat when canopy closes or shortly after, but before upper leaves are infected
S	35	5-10	Scout starting at midseason (PD) and treat when positive stop threshold is reached and upper 2-3 leaves threatened (early boot)
MS	50	10-15	Scout from 7 days after midseason (PD) to 50% heading and treat when positive stop threshold is reached and upper 2-3 leaves are threatened (mid to late booting)
MR	n/a	n/a	Spraying is not usually warranted

VS = Very susceptible; MS = Moderately susceptible; MR = Moderately resistant

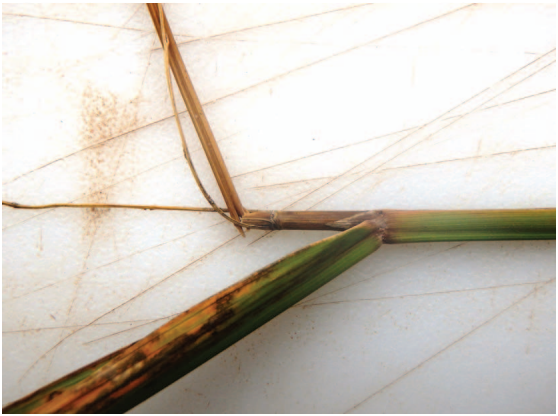
Scout entire field in a zigzag pattern stopping every 50 steps. Inspect a 3-foot long section of rice at each stop for sheath blight symptoms. If symptoms are present, the stop is positive. Make 50 stops per field, 1 stop per acre. If sheath blight is concentrated in certain areas, then treating only those areas with fungicide may be more economical. While experience may be substituted for scouting in fields with a history of sheath blight, the economic use of fungicides depends on adequate knowledge of the distribution of the disease in a field and its intensity between 1/2 inch internode elongation and early heading.

Fungicides Recommended for Sheath Blight Control/Suppression

Disease	Fungicide	Active Ingredient	Rate/Acre	Comments
Sheath Blight	Quadris 2.08 FL®	azoxystrobin	8.5-12.3 fl oz	Lower rates may not provide adequate control under some conditions. DO NOT apply near fishponds or apple orchards. Use higher rates or two applications for severe sheath blight conditions on highly susceptible cultivars.
	GEM®	trifloxystrobin	8-9.8 fl oz	
	Stratego®	trifloxystrobin + propiconazole	16-19 fl oz	
	Quilt®/Quilt Xcel	azoxystrobin + propiconazole	14-34/14-27 fl oz	Use highest rates earlier in season, and lower rates should be tank-mixed with Quadris to increase sheath blight control under certain circumstances.

Read and follow all label directions when using these products.

Blast



Blast Management

- Plant resistant cultivars.
- Use clean, fungicide-treated seed.
- Plant early to avoid late-season blast pressure.
- Avoid excessive N fertilization.
- Maintain a consistent, deep flood (> 4 in).
- Scout fields.

Fungicides Recommended for Use in Management of Blast

Fungicide	Active Ingredient	Rate/Acre[1]	Comments
Quadris 2.08 FL®	azoxystrobin	12.3 fl oz	Use on susceptible cultivars if leaf/collar blast present or field has history of blast. Apply at late boot to 10% heading (50% of main tillers are cracking the boot). Make a second application 5 to 7 days later when one-half of main tillers have 70%-90% of panicles emerged, but bases of panicles are still in the boot. Lower than label rates NOT recommended.
GEM®	trifloxystrobin	6.4-9.8 fl oz	
Stratego®	trifloxystrobin + propiconazole	19 fl oz	
Quilt Xcel®	azoxystrobin + propiconazole	21-27 fl oz	

Read and follow all label directions when using these products.

[1]Assumes proper application and typical weather. Adverse conditions may decrease the performance of fungicides. Fungicide performance is greatly enhanced when plants are grown using proper cultural practices including maintaining continuous deep flood and using recommended N rates for the cultivar. Proper cultural practices greatly enhance the field resistance of ric

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Stem Rot

Stem Rot Management

- Soil sample.
- Apply K fertilizer recommended by soil test.
- Avoid excessive N fertilization.

Crown (Black) Sheath Rot

Crown Sheath Rot Management

- Soil sample.
- Apply K fertilizer recommended by soil test.
- Avoid excessive N fertilization.

Kernel Smut

Kernel Smut Management

- Plant less susceptible cultivars.
- Avoid excessive N fertilization.
- Apply a fungicide containing propiconazole.

False Smut

False Smut Management

- Plant less susceptible cultivars.
- Plant early.
- Avoid excessive N fertilization.

Fungicides Recommended for Suppression of Kernel Smut and False Smut

Fungicide	Active Ingredient	Rate/Acre[1]	Comments
Tilt 428C®	propiconazole	6 fl oz	Apply from boot to boot split before heading begins as a preventative treatment for kernel smut and/or to suppress false smut. Propiconazole fungicides can be tank-mixed with certain sheath blight fungicides or follow them as needed.
Propimax®	propiconazole	6 fl oz	
Bumper®	propiconazole	6 fl oz	
Stratego®	trifloxystrobin + propiconazole	19 fl oz	
Quilt Xcel®	azoxystrobin + propiconazole	21 fl oz	

Read and follow all label directions when using these products.

[1]Suppression only of kernel smut and false smut. For lower fungicide rates, apply when main tillers are at late boot stage but prior to any head emergence. Earlier applications of low fungicide rates may not be effective. Applications after heads start to emerge are NOT legal. Fields with disease history, high N rates or thick stands most likely to benefit from disease suppression with fungicides.

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Bacterial Panicle Blight

Bacterial Panicle Blight Management

- Plant MR/R cultivars.
- Plant early.
- Avoid water stress.
- Avoid excessive N fertilization.

Brown Spot

Severe brown spot disease of potassium-deficient rice plants on leaves and panicles.

Brown Spot Management

- Plant R cultivars.
- Use clean, fungicide-treated seed.
- Soil sample.
- Avoid excessive N fertilization.

Straighthead

Straighthead of rice. Note the distortions (parrot-beaking) of the grains.

Straighthead (left) versus normal (center) versus Glyphosate (right) affected panicles.

Straighthead Management

- Plant less susceptible cultivars.
- “Drain and dry” soil to aerate roots (consult DD50 for timing).
- Fields with silt or sandy loam high in organic matter favor straighthead.

Autumn Decline (Akiochi)

Autumn decline symptoms without crown rot (top) and with crown rot (bottom).

Autumn decline, possibly caused by hydrogen sulfide toxicity.

Autumn Decline Management

- Begin scouting 10 days after permanent flood.
- Use “drain and dry” strategy if symptoms present.
- Check water source for presence of sulfur – change to different water source.
- Consider short-season cultivars.

Narrow Brown Leaf Spot

Narrow brown leaf spot lesions.

Narrow brown leaf spot lesion on sheath late in the season.

Narrow Brown Leaf Spot Management

- Avoid highly susceptible cultivars.
- Soil test.
- Plant early.

Other Minor Diseases

Bordered sheath spot.

Aggregate sheath rot.

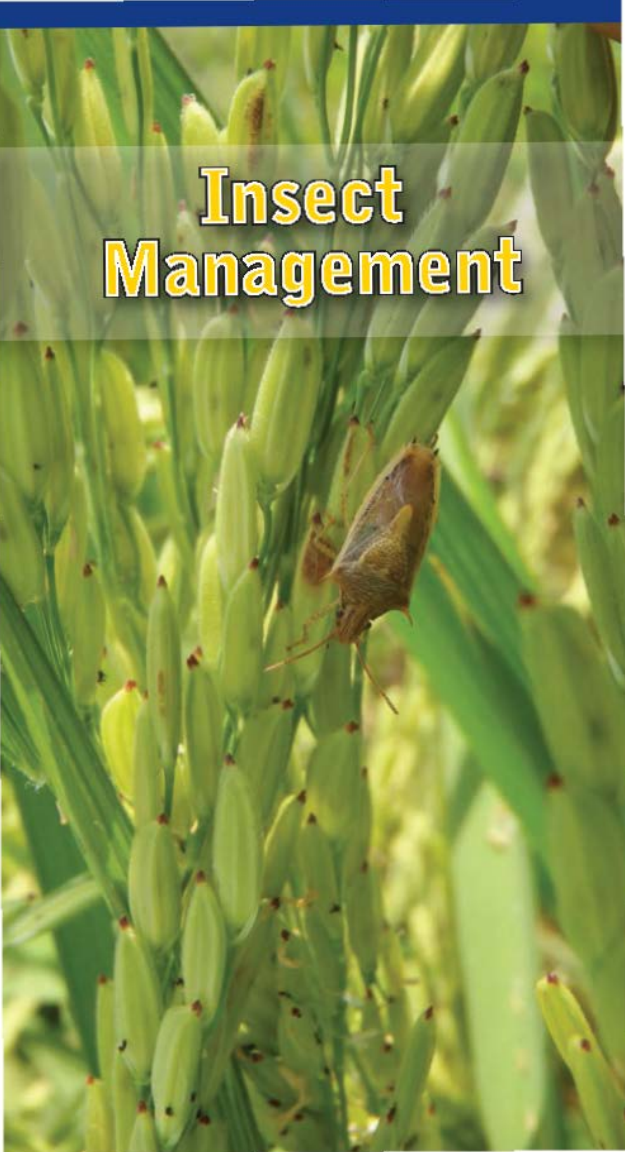
Leaf smut.

Sheath rot.

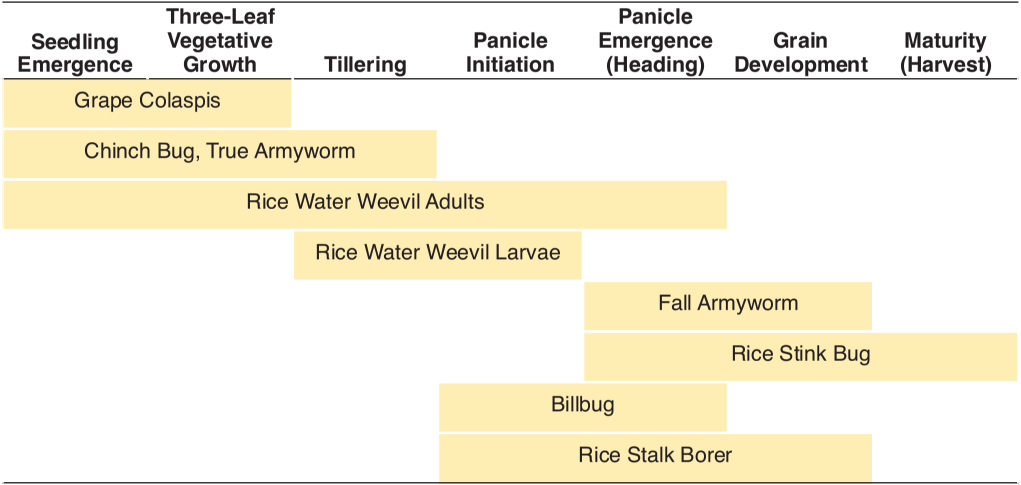
Head scab.

Scald.

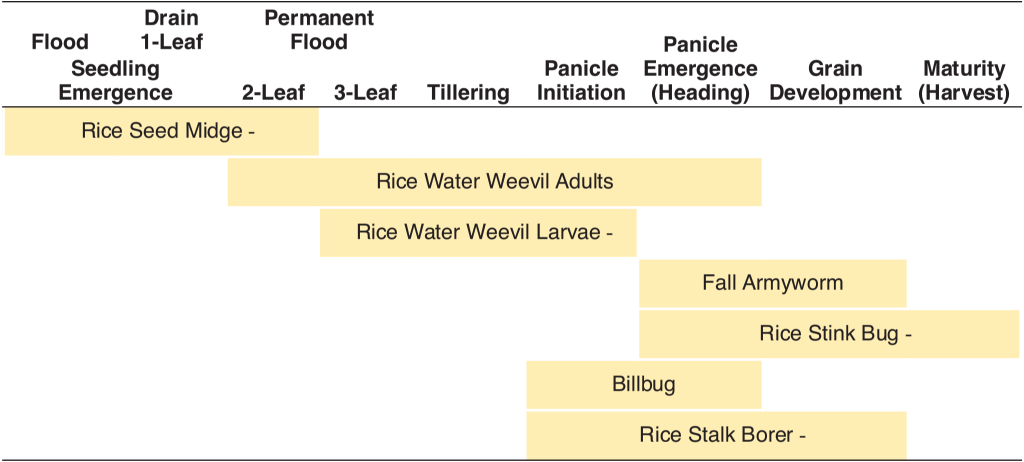
Insect Management



Insects Impacting Drill-Seeded Rice and General Growth Stages Affected



Insects Impacting Water-Seeded Rice and Growth Stages Affected



Rice Insecticide Performance Ratings

	Restrict Use	Chinch Bug	Fall Armyworm	True Armyworm	Short Horned Grasshopper	Rice Stink Bug		Rice Water Weevil			Rice Stalk Borer	Aphids (Greenbug, Bird-Cherry Oat)	Grape Colaspis
						Adults	Eggs and Immatures	Adults	Larvae	Eggs			
Cruiser	X	6		2				6	7				8
Declare/Prolex	X	7	8	8	7	8	8	9				8	
Dermacor X-100	X	1		8					8		8		6
Dimilin 2 L	X							0	8	7			5
Karate Z[1]	X	7	8	8	7	8	8	9				8	
Malathion		1	2	5	6	6	5	0				4	
Methyl Parathion	X	6	6	8	6	6	6	0				7	
Mustang Maxx	X	7	8	8	7	8	8	9				8	
NipsIt INSIDE	X	6		2				6	7				8
Penncap-M		6	6	8	6	7	6	0				7	
Sevin		6	6	5	6	8	5					1	
Tenchu	X					8	8						

Read and follow all label directions when using these products.

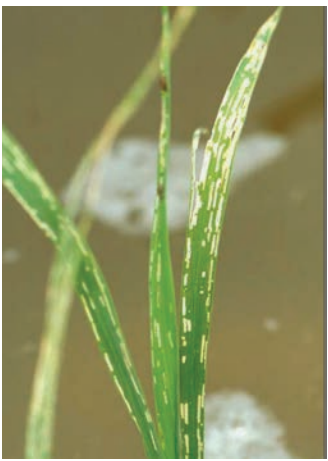
[1]Includes other products containing lambda-cyhalothrin.

Rice Water Weevil

Rice water weevil adult.

Leaf scars from adult rice water weevil feeding.

Rice water weevil larva.



Leaf scars from adult rice water weevil feeding.

Rice water weevil egg mass.

Insecticides Labeled for Rice Water Weevil Control

Stage	Damage	Timing of Treatment	Treatment	A.I./Acre[1]	Product/Acre	PHI[2]
adults	Prevent adults from laying eggs	**Drill-Seeded:** > 10 days after flood when adults present. **Water-Seeded:** > 7 days after flood when adults present; second application 5-7 days later if needed.	**lambda-cyhalothrin**[3] Karate Z 2.08 CS	0.025-0.04 lb	1.6-2.56 fl oz	21 d
			zeta-cypermethrin Mustang Maxx 0.8 EC	0.02-0.025 lb	2.64-4.0 fl oz	14 d
			gamma-cyhalothrin Proaxis 0.5 CS Prolex 1.25 CS Declare 1.25CS	0.0125-0.02 lb	3.2-5.12 fl oz 1.28-2.05 fl oz	14 d
larvae	Prevent larval damage to roots	Apply with PRE herbicide after pegging or with early POST herbicide at 1- to 2-leaf rice when adults are moving into water-seeded rice.	**zeta-cypermethrin** Mustang Maxx 0.8 EC	0.02-0.025 lb	2.64-4.0 fl oz	14 d

eggs	Prevent eggs from hatching	**Drill-Seeded:** > 10 days after flood when adults present. **Water-Seeded:** > 7 days after flood when adults present; second application 5-7 days later if needed.	**diflubenzuron** Dimilin 2L	0.125-0.25 lb	12-16 fl oz	

Read and follow all label directions when using these products.
[1]Active ingredient per acre.
[2]Pre-Harvest Interval (days).
[3]Many formulations of lambda-cyhalothrin; read and follow label for appropriate rates. -

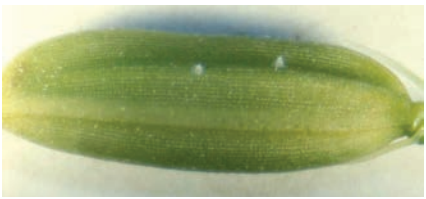
Rice Stink Bug

Adult rice stink bugs mating.

Rice stink bug adult.

Just-hatched rice stink bug nymphs clustered near egg shells.

Rice stink bug nymph.



Rice stink bug feeding scars on a rice kernel.

Insecticides Labeled for Rice Stink Bug Control

Damage	Timing of Treatment	Treatment	A.I./Acre[1]	Product/Acre	PHI[2]
nymphs and adults suck juices from the kernel, causing blanks and/or discolored rice kernels	5 bugs per 10 sweeps at heading; 10 bugs per 10 sweeps 2 weeks after heading. Scout in morning for best results.	**lambda-cyhalothrin**[3] Karate Z 2.08 CS	0.025-0.04 lb	1.6-2.56 fl oz	21 d
		zeta-cypermethrin Mustang Maxx 0.8 EC	0.02-0.025 lb	2.64-4.0 fl oz	14 d
		gamma-cyhalothrin Proaxis 0.5 CS Prolex/Declare 1.25 CS	0.0125-0.02 lb	3.2-5.12 fl oz 1.28-2.05 fl oz	14 d
		malathion Malathion 57% EC Cythion 5EC	0.3-0.6 lb	0.5-1.0 pt 1.25-1.87 lb	7 d
		carbaryl Sevin 80S, 80WSP Sevin 4L, 4F, XLR	1.0-1.5 lb	2-3 pt 0.5-1.0 pt	14 d
		methyl parathion Methyl 4 EC/Penncap M	0.5 lb	2 pt	15 d

Read and follow all label directions when using these products.

[1]Active ingredient per acre. [2]Pre-Harvest Interval (days).

[3]Many formulations of lambda-cyhalothrin; read and follow label for appropriate rates.

Grape Colaspis

Adult grape colaspis beetle.

Grape colaspis larvae (Lespedeza worm).

Damage by grape colaspis larvae on stem between seed and base of plant (right) compared to normal (left).

Insecticides Labeled for Grape Colaspis Control

Type of Damage	Treatment Timing	Treatment[1]	Product/ Acre
Reduce plant stand in drill-seeded rice	Pre-emergence to 1- to 2-leaf rice; flush within 10 days after application	Mustang Maxx 0.8 EC	4 fl oz

[1]CAUTION: Insecticides listed for rice insect control may interact with propanil causing severe injury to rice unless timed properly. DO NOT apply malathion or Sevin within 14 days before or after propanil applications. DO NOT apply methyl parathion within 7 days before or after propanil application. If insecticides are necessary, the timeframe suggested cannot be followed; consider herbicide options other than propanil. Many generic lambda-cyhalothrin materials are available; consult individual labels.

See seed treatment control options.

Minor Rice Insects

Nearly fully grown rice stalk borer larva near the bottom of the stem.

Entry hole into stem made by borer larva and whitehead (blank) due to rice stalk borer (or billbug).

Insecticides Labeled for Rice Stalk Borer Control

Type of Damage	Treatment Timing	Treatment[1]	Product/ Acre
Cause deadhearts before heading and whiteheads at heading	Apply at boot stage and/or panicle emergence for prevention of whiteheads	Karate Z 2.08 CS	1.6-2.56 fl oz
		Mustang Maxx 0.8 EC	2.64-4.0 fl oz
		Proaxis 0.5 CS	3.2-5.12 fl oz
		Prolex 1.25 CS	1.28-2.05 fl oz
		Declare 1.25 CS	1.28-2.05 fl oz

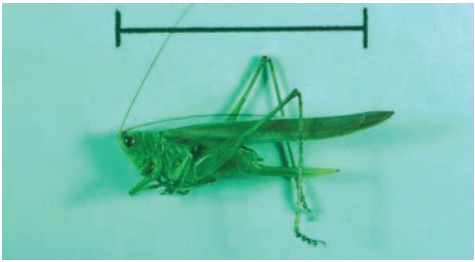
[1]CAUTION: Insecticides listed for rice insect control may interact with propanil causing severe injury to rice unless timed properly. If insecticides are necessary, the timeframe suggested cannot be followed; consider herbicide options other than propanil. Many generic lambda-cyhalothrin materials are available; consult individual labels.

True armyworm larva.

Fall armyworm larvae.

Adult billbug.

Billbug larva in cavity at base of stem.



Long-horned grasshopper.

Short-horned grasshopper.

Adult and nymph greenbugs.

Insecticides Labeled for Control of Other Rice Insects

Insect	Type of Damage	Treatment Timing	Treatment	Product/Acre
Short-Horned Grasshoppers (nymphs and adults)	Leaf feeding and head damage	Treat where damage is evident; border treatment may be beneficial	Sevin 80S, 80WSP Sevin 4L, 4F, XLR Methyl parathion 4EC Malathion Karate Z 2.08 CS Mustang Maxx 0.8 EC Proaxis 0.5 CS Prolex 1.25 CS Declare 1.25 CS	1.25-1.87 lb 2-3 pt 0.5-1.0 pt 1.0-1.5 pt 1.6-2.56 fl oz 2.64-4.0 fl oz 3.2-5.12 fl oz 1.28-2.05 fl oz 1.28-2.05 fl oz
Chinch Bug (nymphs and adults)	Reduce plant stand by sucking sap	When insects are causing stand reduction	Sevin 80S, 80WSP Sevin 4L, 4F, XLR Karate Z 2.08 CS Mustang Maxx 0.8 EC Proaxis 0.5 CS Prolex 1.25 CS Declare 1.25 CS	1.25-1.87 lb 2.0-3.0 pt 1.6-2.56 fl oz 2.64-4.0 fl oz 3.2-5.12 fl oz 1.28-2.05 fl oz 1.28-2.05 fl oz

Fall Armyworm (larvae)[2]	Flag leaf and panicle feeding reduces yield	Treat when larvae feeding on flag leaf or panicles	Sevin 80S, 80WSP Sevin 4L, 4F, XLR Karate Z 2.08 CS Mustang Maxx 0.8 EC	1.25-1.87 lb 2.0-3.0 pt 1.6-2.56 fl oz. 2.64-4.0 fl oz.
True Armyworm (larvae)[2]	Plant feeding may reduce stand or delay growth	When insects are causing stand reduction	Proaxis 0.5 CS Prolex 1.25 CS Declare 1.25 CS Methyl parathion 4EC	3.2-5.12 fl oz. 1.28-2.05 fl oz 1.28-2.05 fl oz 0.5-1.0 pt
Greenbug (Aphid) (nymphs and adults)	Reduces stand and causes stunting	Treat when 2-3 greenbugs per 1- to 2-leaf rice plant or when plants become yelllowed and stunted	Karate Z 2.08 CS Mustang Maxx 0.8 EC Proaxis 0.5 CS Prolex 1.25 CS Declare 1.25 CS Methyl parathion 4EC	1.6-2.56 fl oz 2.64-4.0 fl oz 3.2-5.12 fl oz 1.28-2.05 fl oz 1.28-2.05 fl oz 0.5-1.0 pt

[1]CAUTION: Insecticides listed for rice insect control may interact with propanil causing severe injury to rice unless timed properly. DO NOT apply malathion or Sevin within 14 days before or after propanil applications. DO NOT apply methyl parathion within 7 days before or after propanil application. If insecticides are necessary, the timeframe suggested cannot be followed; consider herbicide options other than propanil. Many generic lambda-cyhalothrin materials are available; consult individual labels.

[2]See seed treatment control options.

Read and follow all label directions when using these products. -

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Water Management

Determining Water Needs

Recommended pumping rates for different soil textural groups

Soil Textural Group	(GPM/Acre)	
	Minimum	Desired
Silt Loam with pan	10	10
Sandy Loam	15	25
Silt Loam without pan	10	15
Clay and Silty Clay	15	20

General guide for irrigable acreage for different soil textural groups at various pump capacities

Pump Capacity (GPM)[1]	Irrigable Acreage			
	Silt Loam - with pan	Silt Loam - no pan	Clay and Silty Clay	Sandy Loam
400	40	27	20	16
600	60	40	30	24
800	80	53	40	32
1000	100	67	50	40
1200	120	80	60	48
1400	140	93	70	56
1600	160	107	80	64
1800	180	120	90	72
2000	200	133	100	80
2200	220	147	110	88
2400	240	160	120	96
2600	260	173	130	104
2800	280	187	140	112
3000	300	200	150	120

[1]GPM = gallons per minute

Determining Pump Flow

Hours of operating time to pump one acre-inch of water

Pump Capacity (GPM)[1]	Surface Acres							
	20	40	60	80	120	160	200	240
	Time (Hours)							
400	23	45	68	91				
800	11	23	34	45	68	91		
1200		15	23	30	45	60	76	91
1600		11	17	23	34	45	57	68
2000			14	18	27	36	45	54
2400			11	15	23	30	38	45
2800				13	19	26	32	39
3200				11	17	23	28	34
3600					15	20	25	30
4000					14	18	23	27
4400						17	21	25
4800							19	23

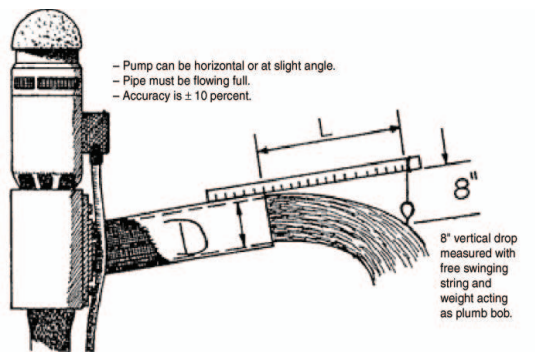
[1]GPM = gallons per minute

Water Volume and Flow Conversions and Equivalents

Volume	equals
1 gallon (gal)	8.33 pounds (lb)
1 cubic foot (ft^3)	7.48 gal
1 acre-foot (ac-ft)	325,851 gal
1 acre-inch (ac-in)	27,154 gal
1 ac-in	3,630 ft^3

Flow	equals
1 cubic foot per second (cfs)	448.83 gallons per minute (GPM)
1 cfs	1 ac-in per hour
1 GPM	0.00223 cfs
1 GPM	0.00221 ac-in per hour
1 liter/second (L/s)	15.83 GPM
1 cubic meter/minute (m^3/min)	264.2 GPM
1 cfs for 1 hour	1 ac-in
542 GPM for 1 hour	1 ac-in

Plumb-bob method for flow estimation
GPM = D × D × L



Pump Flow Calculated From Yardstick and 8-Inch Plumb Bob Measurements

Length (L)	Inside Diameter of Pipe (D) – Inches										
	4"	5"	6"	7"	8"	9"	10"	11"	12"	13"	14"
Inches	Flow (GPM)										
	64	100	144	196	256	324	400	484	476	676	784
4	96	150	216	294	384	486	600	726	864	1014	1176
6	128	200	288	392	512	648	800	968	1152	1352	1568
8	160	250	360	490	640	810	1000	1210	1440	1690	1960
10	192	300	432	388	768	972	1200	1452	1728	2028	2352
12	224	350	504	686	896	1134	1400	1694	2016	2366	2744
14	256	400	576	784	1024	1296	1600	1936	2304	2704	3136
16	288	450	648	882	1152	1458	1800	2178	2592	3042	3428
18	320	500	720	980	1280	1620	2000	2420	2880	3380	3920
20	352	550	792	1078	1408	1782	2200	2662	3168	3718	4312
22	384	600	864	1176	1536	1944	2400	2904	3456	4056	4704
24	416	650	936	1274	1664	2106	2600	3146	3744	4394	5096
26	448	700	1008	1372	1792	2268	2800	3388	4032	4732	5488
28	480	750	1080	1470	1920	2430	3000	3630	4320	5070	5880
30	512	800	1152	1568	2048	2592	3200	3872	4608	5408	6272

General Rice Irrigation Water Quality

Water Quality Variable	Level Considered to Cause Concern[1]	Concern
Calcium (Ca)	> 60 ppm (> 3 meq/L)	Together cause soil pH increase near water inlet; cause Zn or P deficiency.
Bicarbonate (HCO_3)	> 305 ppm (> 5 meq/L)	
Electrical Conductivity (EC) [after lime deposition]	> 770 ppm (> 1,200 µmhos/cm)	Causes high soil salinity – can injure/kill seedling rice.
Chloride (Cl)	> 100 ppm (> 35 meq/L)	Contributes to measured EC. High Cl alone problem for soybeans.
Sodium Adsorption Rate (SAR)[2]	> 10	Causes sodic soil – poor physical condition.

[1]Lower levels can cause injury in some cases.

[2]SAR = Na $\sqrt{[(Ca + Mg)/2]}$, where Na, Ca and Mg are in meq/L -

Water Quality Sampling and Analysis

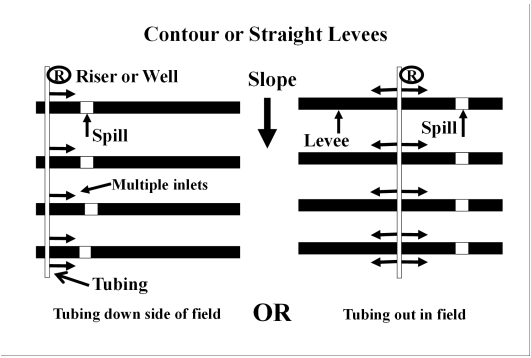
For information on the analysis of irrigation waters, contact your local Extension office or the AWRC Water Quality Laboratory (**479-575-7317** or **awrc@uark.edu**).

- Prior to collecting an irrigation water sample, run the well long enough to remove any residue or contaminants from the pipe.
- Using a plastic bottle (minimum 500 mL), and after rinsing the bottle three times with irrigation water, fill the bottle completely with irrigation water and cap tightly.
- Submit samples through the nearest county Extension office or directly to the AWRC.
- For assistance with interpreting the results of the water quality analysis, consult with your local Extension office and specialists (see **Contacts**).

Multiple-Inlet (MI) Irrigation

- Cross tubing perpendicular over levees to keep tubing from rolling. Use small diameter PVC tubing through pipe if necessary.
- Set levee gates higher when using MI compared to traditional cascade irrigation. Higher gate settings with MI allow for rainfall capture and can reduce pumping by 25%.

Comparison of multiple-inlet irrigation setup with tubing placed along the edge in a side-inlet design (left) and down the middle of the field in a traditional multiple-inlet setup (right).



Suggested Pipe Sizes for Multiple Inlet

< 1200 gpm – 12 in
< 2200 gpm – 15 in
> 2200 gpm – 18 in

MI Gate Calculations:

$$\frac{\text{total flow in gpm}}{\text{field area in acres}} = \text{gpm/acre}$$

gpm/acre × paddy* area = flow rate needed in paddy

*a paddy is the area between any two levees

$$\frac{\text{flow rate needed in paddy}}{\text{75 gpm per hole}} = \text{Number of holes}$$

- Round up for number of holes and punch.
- Use blue gate in last hole to regulate.

Example MI Gate Calculation:

Pump flow rate = 1200 gpm; Area of field = 80 acres

$$\frac{\text{total flow in gpm (1200)}}{\text{field area in acres (80)}} = \text{15 gpm/acre}$$

15 gpm/acre × 11 paddy acres = 165 gpm for paddy

$$\frac{\text{flow rate needed in paddy (165)}}{\text{75 gpm per hole}} = \text{2.2 holes}$$

- Punch 3 holes, install blue gate in last hole.
- Close gate to choke down flow.
- Repeat steps for remaining paddies.

Keys to Water Management Success

- Keep acreage within limits of pumping capacity and select fields that hold water adequately.
- Establish a smooth field surface that provides a good seedbed, drainage and water control.
- Contact county CES for water quality testing if no recent history.
- Use multiple-inlet irrigation to improve water management.
- For multiple-inlet irrigation and intermittent flooding, set levee gates higher than levee irrigation to store rainfall.
- Accurate levee survey, proper levee construction and correct gate installation.
- Establish a levee base early on clay soils.
- Seed longer-season cultivars on fields with good water-holding capacity.
- Service and repair pumps before the season begins.
- Analyze differences in energy costs (diesel vs. electric).
- Timers/pump control technology to manage irrigation pumps.
- Use flow meters to monitor water use.
- Flush if necessary for stand establishment and herbicide activation.
- Operate irrigation system so no water leaves the field during pumping or small rain events.
- Use surface water when possible.

Critical Water Management Situations

Situation	Rice Stage	Recommended Practice
After dry-seeding, no moisture for germination	Rice not germinated	Flush quickly – water off in 2 days. Use multiple water inlets if possible to reduce flush time.
Soil surface is crusted	Rice germinated but not emerged	Flush to soften crust before rice emerges/loses penetrating power.
Residual herbicides have been applied, soil surface is dry	Rice has germinated and may be emerged	Flush to activate herbicides.
Barnyardgrass is drought stressed and less than 4-leaf	Rice may or may not be emerged	Flush and apply herbicide before grass gets too large
Barnyardgrass too large, drought stressed, or not controlled	Rice is 6" to 8" tall	Flood, treat with Clincher, Ricestar or Regiment, and maintain flood.
Seedling rice has tipburn and dying before flooding (salinity)	Rice has emerged but may be less than 8" tall	Dilute salts by flushing and don't let soil surface dry.
Rice is chlorotic within 2-4 days post-flood (high pH, Zn deficient)	Rice is 6" to 10" tall	Drain, apply zinc and, after recovery, add N; reflood to shallow depth.
History of straighthead	Rice is about 2-3 weeks prior to internode movement (consider DD50 drying time frame)	Drain before first DD50 drying date to dry soil thoroughly until rice plants are drought stressed; then reflood before 1/2-inch IE.

Not enough water; severe drought stress	Rice can be in various stages	Flush quickly, then close gates and raise flood to desired depth as water becomes available.
Nitrogen applied on dry soil	Rice is 3 weeks old	Flood within 7 days to place N below soil surface.
Nitrogen applied into flood	Rice is at internode elongation.	Prefer low flood with little water movement. Delay pumping for 24 hours after N application.
Sprangletop/large barnyardgrass	Rice is tillering to IE stage	Apply Clincher into flood. Flood must be maintained for suppression
Drought, pumping flow rate is low	Rice near heading	Use multiple inlets; clean out algae in flow pattern to ensure sufficient water as heads emerge.
Preparation for harvest	Rice is 10-14 days after heading; heads dropping and some ripening	Consider ceasing pumping for harvest 10-14 days after heading if adequate flood on the field to prevent drought stress during grain fill. If not, continue pumping 5-7 days.

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Miscellaneous

Flag the Technology
Marker Flag Colors

Color Codes

RED
signifies conventional varieties with no herbicide technology traits. *Extreme caution.*

BRIGHT YELLOW
is the color chosen for Clearfield® rice technology and STS® soybeans.[1]

WHITE
represents the Roundup Ready® technology that is tolerant to glyphosate herbicide.

TEAL
indicates tolerance to both 2,4-D and FOP (Accase) herbicides or the Enlist® technology. The white stripes indicate tolerance to glyphosate. For Enlist cotton and soybean fields, a green flag should be added to denote tolerance to glufosinate (Liberty).

BRIGHT GREEN
indicates the Liberty Link® technology. This technology is tolerant to glufosinate (Liberty®) herbicide.

BLACK
indicates tolerance to dicamba herbicide or Xtend®. The black and white checks indicate tolerance to both dicamba and glyphosate (Roundup). A green flag should be added for cotton to denote glufosinate (Liberty) tolerance.

[1]Although many herbicides are in the ALS family of herbicides, crops with this technology are not tolerant to all ALS herbicides.

Chemical Formulation Abbreviations*

Abbreviation	Meaning
AF	Aqueous flowable
AS	Aqueous solution or suspension
C	Concentrate
CM	Concentrate mixture
CG	Concentrate granules
D	Dust
DF	Dry flowable
DS	Soluble dust
E or EC	Emulsifiable concentrate
F	Flowable (liquid)
G	Granules
GL	Gel
L	Liquid (flowable)
LC	Liquid concentrate or low concentrate
LV	Low volatile
M	Microencapsulated
MTF	Multiple temperature formulation
P or PS	Pellets
RTU	Ready-to-use
S	Solution
SD	Soluble dust
SG	Soluble granule
SP	Soluble powder or soluble packet
ULV	Ultra low volume
ULW	Ultra low weight or ultra-low wettable
W	Wettable powder
WDG	Water-dispersible granules
WP	Wettable powder
WS	Water soluble
WSG	Water-soluble granules
WSL	Water-soluble liquid
WSP	Water-soluble powder packet

**Common abbreviations encountered in rice production; may include some that do/do not apply.*

Spray Tip Classification by Droplet Size

Classification Category	Color Code	Droplet Size	Approximate VMD (µm)†	Coverage	Used For	Drift Potential
Extremely Fine	Purple	Small	< 50	Excellent	Exceptions	High
Very Fine	Red		51-150	Excellent	Exceptions	
Fine	Orange		151-230	Very Good	Good Cover	
Medium	Yellow		231-340	Good	Most Products	
Coarse	Blue		341-405	Moderate	Systemic Herbicides	
Very Coarse	Green		405-505	Poor	Soil Herbicides	
Extremely Coarse	White		506-665	Very Poor	Liquid Fertilizer	
Ultra Coarse	Black	Large	> 665	Very Poor	Liquid Fertilizer	Low†

†*Estimated from sample reference graph in ASABE/ASAE Standard S572.1 2009. Spray Nozzle Classification by Droplet Spectra. American Society of Agricultural and Biological Engineers.*

Relative Sensitivity[1] of Major Arkansas Field Crops to Commonly Used Rice Herbicides

Herbicide Trade Name	(common name)	Soybean	Corn	Cotton	Milo	Rice
Numerous	(glyphosate)	T*	T*/VS	T*/S	VS	VS
Newpath	(imazethapyr)	T	S	S	S	T*/VS
Facet	(quinclorac)	M	M	S	T	T
Prowl	(pendimethalin)	T	T	T	M	T
Command	(clomazone)	T	M	M	M	T
Numerous	(propanil)	S	S	S	S	T
Regiment	(bispyribac)	M*/VS	S	S	S	T
Permit	(halosulfuron)	T*/VS	T	S	T	T
Grasp	(penoxsulam)	M*/VS	S	S	S	T
Londax	(bensulfuron-methyl)	M*/VS	S	S	S	T
Strada	(orthosulfamuron)	M*/VS	S	S	S	T
Ricestar	(fenoxaprop)	T	VS	T	VS	T
Clincher	(cyhalofop)	T	VS	T	VS	T
Blazer/Storm	(acifluorfen)	T	M/S	M	M/S	T
Numerous	(2,4-D)	S	T	VS	T	T
Grandstand	(triclopyr)	S	M	S	M	T
Aim	(carfentrazone)	M	M/S	M/S	M/S	T

[1]T = Tolerant, M = Moderately Tolerant, S = Sensitive, VS = Very Sensitive

T*/M* = Some crops are available with tolerance/moderate tolerance to these herbicides.

Read and follow all label directions when using these products.

Grades and Grade Requirements

Grade	Maximum limits of ----							Color requirements
	Seeds and heat-damaged kernels			Red rice and damaged kernels	Chalky kernels			
	Total	Heat-damaged and other	Heat-damaged kernels		Long grain rice	Medium or short grain rice	Other types†	
	#[1]	#	#	%[2]	%	%	%	
U.S. #1	4	3	1	0.5	1.0	2.0	1.0	White/creamy
U.S. #2	7	5	2	1.5	2.0	4.0	2.0	Slightly gray
U.S. #3	10	8	5	2.5	4.0	6.0	3.0	Light gray
U.S. #4	27	22	15	4.0	6.0	8.0	5.0	Gray/rosy
U.S. #5	37	32	25	6.0	10.0	10.0	10.0	Dark gray/rosy
U.S. #6	75	75	75	15.0	15.0	15.0	10.0	Dark gray/rosy

[1] # = Number per 500 grams of seed. [2] % = Percent of kernels.

U.S. Sample grade shall be rough rice which:

a. does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 6 inclusive;
b. contains more than 14.0 percent of moisture;
c. is musty, or sour, or heating;
d. has any commercially objectionable foreign odor; or
e. is otherwise of distinctly low quality.

Grades and Grade Requirements for the Classes of Long-Grain Milled rice, Medium-Grain Milled Rice, Short-Grain Milled Rice, and Mixed Milled Rice, USDA, 2009

Grade	Maximum limits of ----										Color requirements	Minimum milling requirements
	Seeds, damaged and paddy kernels		Red rice and damaged kernels	Chalky kernels		Broken kernels				Other types‡		
	Total	Heat damaged and other		Long grain rice	Medium or short grain rice	Total	Removed by 5 plate†	Removed by 6 plate†	Whole kernels	Whole and broken kernels		
	#[1]	#	%[2]	%	%	%	%	%	%	%		
U.S. #1	2	1	0.5	1.0	2.0	4.0	0.04	0.1	--	1.0	White, creamy	Well milled
U.S. #2	4	2	1.5	2.0	4.0	7.0	0.06	0.2	--	2.0	Slightly gray	Well milled
U.S. #3	7	5	2.5	4.0	6.0	15.0	0.1	0.8	--	3.0	Light gray	Reason-ably well milled

U.S. #4	20	15	4.0	6.0	8.0	25.0	0.4	1.0	--	5.0	Gray, rosy	Reason-ably well milled
U.S. #5	30	25	6,0	10.0	10.0	35.0	0.7	3.0	10.0	---	Dark gray, rosy	Reason-ably well milled
U.S. #6	75	75	15.0††	15.0	15.0	50.0	1.0	4.0	10.0	---	Dark gray, rosy	Reason-ably well milled

[1]# = Number per 500 grams of seed. [2] % = Percent of kernels.

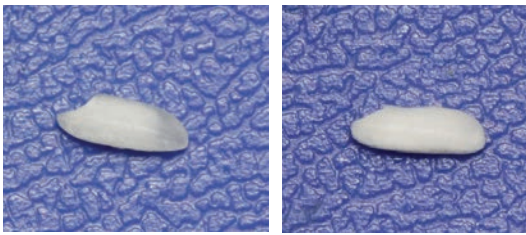
U.S. Sample grade shall be milled rice of any of these classes which:

a. does not meet the requirements for any of the grades from U.S. No. 1 to U.S. No. 6, inclusive;
b. contains more than 15.0 percent of moisture;
c. is musty or sour, or heating;
d. has any commercially objectionable foreign odor;
e. contains more than 0.1 percent of foreign material;
f. contains two or more live or dead weevils or other insects, insect webbing, or insect refuse; or
g. is otherwise of distinctly low quality.

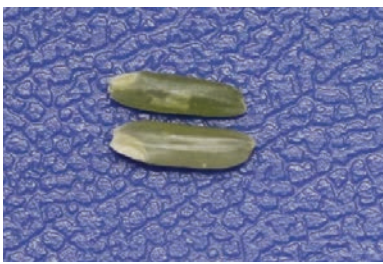
Example of Foreign Material and Low Milling Yield Effects on Rice Price and Net Profit

Description	Sample 1	Sample 2	Sample 3
Sample weight, grams	162	162	162
Foreign material, grams	0	0	10
Head rice weight, grams	89	94	88
Brokens weight, grams	24	19	18
Milling yield percentage	55/70	58/70	54/65
Value per hundredweight[1]	$6.48	$6.60	$6.13
Difference in price/cwt	--	+$0.12	-$0.35
Value at 150 bu/A	$437.84	$445.95	$414.19
Value difference at 150 bu/a	--	+$8.11	-$23.65
Value at 200 bu/A	$583.78	$594.59	$552.25
Value difference at 200 bu/a	--	+$10.81	-$42.34

Production Factors Impacting Rice Milling Yield



Chalk affecting a region of a kernel (left) or the entire kernel (right).



Immature kernels after harvest and hulling.

Kernel fissured due to rapid moisture adsorption.

Glossary of Rice Industry Terms

Aging – physiological changes rice undergoes predominately during the initial three postharvest months.

Amylopectin – one of two major starch molecules characterized by glucose units arranged in a linear, unbranched chain. Higher concentrations contribute to drier, less sticky cooked rice.

Anthesis – the series of events between opening and closing of the rice flower (spikelet). Also referred to as **Flowering**.

Aromatic (scented) Rice – rice that contains high concentrations of volatile constituents yielding an aroma similar to roasted popcorn or nuts.

Auricles – clasping appendages arising at the junction of the leaf blade and the leaf sheath.

Basmati Rice – a type of aromatic rice that tends to cook into long, slender grains that are dry, separate and fluffy.

Barrel – unit of measure of rough rice used in some areas of the U.S.; equivalent to 162 pounds of rough rice (3.6 bushels).

Booting – stage prior to heading characterized by swelling of the leaf sheath as the panicle grows in size and internodes elongate, pushing it up through the leaf sheath. During this stage, meiosis occurs and pollen is formed. One of the stages most vulnerable to environmental stresses.

Bran – outer layers or coverings of brown rice; composed of the pericarp, seed coat and aleurone layer. (**Note:** industrial bran normally is a mixture of bran and embryo).

Breeder Seed – seed reserved for licensed plant breeders for production of foundation, registered or certified seed; marked with a white tag.

Brewers Rice – small pieces of broken rice kernels.

Brown (cargo) Rice – the rice kernel with the protective hull removed.

Bushel – volumetric measure of rough rice approximately equivalent to 45 pounds.

Caryopsis – the mature fruit of grasses in which the seed coat firmly adheres to the pericarp.

Certified Seed – produced by planting either registered or foundation seed and guaranteed for purity by the State Plant Board; marked with a blue tag.

Chalky Rice – rice that has a brittle texture due to loose packing of starch granules in the grain; results in weaker grain more susceptible to breaking.

Coleoptile – the topmost part of the embryo axis that serves as a protective sheath for young leaves and the growing point during seedling emergence.

Converted Rice – (see **Parboiled Rice**). The term “converted rice” is a trademark.

Crown – the compacted section at the base of the stem containing nodes for new tillers and buds for new roots.

Culm – a commonly used name for the stem of a grass-type plant, such as rice, consisting of nodes and hollow internodes.

Cultivar – an inclusive term that represents lines, hybrids, selections or varieties of crops. (see also **Hybrid**, **Variety**)

Embryo (germ) – the reproductive portion of the rice grain located on the ventral side.

Endosperm – the white central portion of the rice grain, composed primarily of starch.

Enrichment – the addition of specific nutrients to partially compensate for those lost during the milling process. Regulations in the U.S. specifically stipulate enrichment for rice must contain thiamine, niacin and iron and may contain riboflavin.

Flag Leaf – the last leaf to develop on a tiller that emerges during boot stage and fully extends in full boot stage. Major source for carbohydrates and nutrients for the developing panicle.

Flowering – (see **Anthesis**)

Fortification, Glazing – (see **Enrichment**)

Foundation Seed – produced by planting breeder seed. Is reserved for licensed plant breeders but may be produced under direct supervision of a licensed plant breeder to maintain genetic purity and identity of the cultivar. Used to produce registered or certified seed; marked with a white tag.

Gelatinization Temperature – the temperature at which irreversible swelling of the starch grains leads to formation of a gel (induced by hot water).

Genetically Modified Organism (GMO) – a plant or animal that has a gene inserted from another organism resulting in the expression of a desirable trait.

Green Ring – (see **Panicle Initiation**)

Hard Dough Stage – part of the process of grain ripening characterized by a firm whole kernel but moisture content greater than 20 percent.

Heading – growth stage when the panicle exserts from the boot, often synonymous with anthesis or flowering of the spikelets. Heading date is defined as the time when 50% of the panicles have at least partially exserted from the boot. It takes 10 to 14 days for a field to complete heading.

Head Rice – after milling, unbroken kernels of rice and broken kernels that are at least three-fourths the length of an unbroken kernel. Usually expressed as a percentage of rough rice (referred to as head rice yield [HRY]).

Heat-Damaged Grains – kernels of rice reddish-brown to orange in color and are substantially darker than the majority of the grain. This defect may occur in white or parboiled rice.

Hull – outer covering structures (palea and lemma) that enclose the rice kernel.

Husk – (see **Hull**)

Hundredweight (cwt) – a mass measurement of rice yield equal to 100 pounds of rough rice (2.22 bushels).

Hybrid – the first-generation (F1) progeny of a cross between two plants of the same species but have different genetic backgrounds (e.g., different varieties or lines).

Imbibition – initial process of seed germination characterized by water absorption into the seed.

Indica Rice – subspecies of rice that typically is long-grain, has high amylose content, profuse tillering, high pubescence (hairy leaves); typically grown in tropical climates; tends to cook dry, loose and fluffy.

Instant Rice – a type of precooked rice that is easily rehydrated at temperatures below boiling. Typically it is fully hydrated in less than 5 minutes when added to boiling water.

Internode Elongation (IE) – the period when internodes elongate and the plant grows in height. Begins at panicle initiation (PI) and continues until the plant reaches full height. Often called "jointing."

Japonica Rice, Temperate – subspecies of rice characterized as long-grain rice with intermediate amylose content (20% to 25%), low tillering, smooth leaves (not hairy); typical of most U.S. long-grain varieties.

Japonica Rice, Tropical – subspecies of rice characterized as medium- and short-grain rice with low amylose content (10% to 20%) which causes it to cook wet and sticky; typical of most U.S. medium- and short-grain varieties.

Jasmine Rice – an aromatic long-grain rice that cooks moist and often clings together.

Lemma – the part of the rice hull which covers two-thirds of the surface area of brown rice.

Length, Kernel – the distance between the most distant tips of the kernel.

Ligule – a membranous fringe on the inner side of the leaf at the top of the leaf sheath of rice and other grass plants.

Maximum Tillering – the point at which the maximum tiller number is reached and the main culm is difficult to distinguish from the tillers.

Meiosis – the process of cell production that reduces the chromosome number in new cells by one-half the number in the parent cells (reduction division). Sex cells are formed by meiosis.

Mesocotyl – the internode between the scutellar node and the coleoptile.

Milk Stage – the first step in the grain-ripening process characterized by developing starch grains in the kernel that are soft and the interior of the kernel is filled with white liquid resembling milk.

Mill, Rice – a machine for removing bran from the endosperm. Mills are of two general types: *polishers* that rub the bran off (friction-type mill or pearlier) and *whiteners* that grind or strip the bran away.

Milled Rice – whole or broken kernels of raw or parboiled rice from which hulls, bran and germ have been removed. Usually expressed as a percentage of rough rice.

Milling, Degree of – the extent to which bran layers and germ are removed from the rice endosperm.

Milling Yield – after milling, the quantity of total milled rice produced in the milling of rough rice to a well-milled degree (includes all kernels whole and broken), usually expressed as a percent of rough rice (total milling yield [TMY]), but when specified may be expressed a percent of brown rice.

Palea – part of the rice hull which covers approximately one-third of the surface area of brown rice. Its edges fit inside those of the lemma forming a tight closure.

Panicle Differentiation (PD) – when the young panicle has grown about 1 to 2 mm long and can be seen by the naked eye. Generally occurs about 5 to 7 days after panicle initiation when the internode is 1/2 to 3/4 inch in length.

Panicle Initiation (PI) or Panicle Primordia Initiation – corresponds to the time when the fourth leaf from the top begins to elongate, approximately 30 days before heading. The panicle is not visible to the naked eye. Often called **Green Ring** or *beginning internode elongation*.

Parboiled Rice – rice that has undergone a parboiling process.

Parboiling (converting) – a hydrothermal process in which the crystalline form of starch is changed into an amorphous one, typically accomplished by soaking, steaming and drying rough rice; typically increases the percentage of head rice and the vitamin content in the milled rice.

Pecky Rice – discoloration of rice grain due to rice stink bug feeding, environment, diseases and other factors; generally results in easily broken kernels.

Physiological Maturity – the end of the grain filling period, at which time growth increases are in balance with metabolic losses.

Polishing – the removal of traces of bran that remain after milling; resulting in a smooth surface that has a glossy appearance (see **Milled Rice**).

Quality, Rice – the composite of characteristics that differentiate individual units of rice and have significance in determining the degree of acceptability by the consumer. Rice quality components include milling quality; cooking, eating and processing quality; nutritional value; and specific standards for cleanliness and purity.

Quick-Cooking Rice – rice that has been pretreated to substantially reduce cooking time, especially rice that has been cooked in water, steam or both, then dried in such a manner as to retain an open, porous structure without clumping.

Red Rice – rice of the same genus and species as white rice but characterized by a red seed coat. The hull may be black or straw-colored. Noxious weed because of discoloration of white rice.

Registered Seed – used to produce certified seed. Produced by planting breeder or foundation seed; marked with a purple tag.

Rough (paddy) Rice – whole or broken unhulled kernels of rice.

Shell – (see **Hull**)

Stabilized Rice Bran – rice bran that has been treated to essentially inactivate or inhibit enzymes that hydrolyze lipids to release free fatty acids.

Soft Dough Stage – part of the grain-ripening process characterized by the initial starch formation in the grain. The interior of the kernel is firm but still soft.

Tillering – production of tillers which are shoots that develop from the leaf axils at each un-elongated node of the main shoot and from other tillers. Tillers are produced in a synchronous manner, the *n*th leaf on the main culm (or tiller which is producing tillers) and the first leaf of the tiller on the (*n*B3)th leaf emerge simultaneously.

Variety – a genetically pure line of a crop species that exhibits certain traits; seed will produce plants that exhibit the same traits as the original plant. An experimental line becomes a variety when it is officially named and released for commercial production.

Vegetative Lag Phase – the period from the end of active tillering (maximum tiller number) to the beginning of the reproductive stage which occurs upon initiation of the panicle primordial.

Waxy Rice – rice whose starch contains less than 2 percent amylose.

Width, Kernel – the distance across the kernel at the widest point.

Y-Leaf – “young leaf”; youngest fully developed leaf on the plant.

Calibration

GPM = gallons per minute
GPA = gallons per acre
mph = miles per hour
W = nozzle spacing (in.) - broadcast spray
= spray width (in.) – single nozzle – band or boomless spray
= row spacing (in.) divided by nozzles per row for directed spray

Formulas:

$$\text{GPM (per nozzle)} = \frac{\text{GPA} \times \text{mph} \quad \text{W}}{5{,}940}$$

$$\text{GPA} = \frac{5{,}940 \times \text{GPM (per nozzle)}}{\text{mph} \times \text{W}}$$

Measuring Travel Speed

Measure a test course with similar surface conditions to area to be sprayed. Minimum travel length of 100 and 200 ft recommended for speeds up to 5 and 10 mph, respectively.

$$\text{Speed (mph)} = \frac{\text{Distance (ft)} \times 60}{\text{Time (seconds)} \times 88}$$

Ounce Method for determining GPA

$$\text{Calibration distance (feet)} = \frac{4{,}080}{\text{average row or nozzle spacing (inches)}}$$

Determine time required to travel calibration distance. Catch nozzle discharge for the same length of time required to travel calibration distance. Number of ounces collected is equal to GPA applied.

Abbreviations

Area		
acre (ac or A)	hectare (ha)	square foot (ft^2)
Measure		
foot/feet (ft)	inch (in)	yard (yd)
centimeter (cm)	meter (m)	kilometer (km)
Volume		
gallon (gal)	fluid ounce (fl oz)	pint (pt)
quart (qt)	liter (L)	milliliter (mL)
Weight		
pound (lb)	ounce (oz)	kilogram (kg)
gram (g)	milligram (mg)	microgram (µg)
Speed		
mile per hour (mph)	kilometer per hour (kmh)	feet per second (ft/s)
Yield		
pounds per acre (lb/A)	kilogram per hectare (kg/ha)	bushels per acre (bu/A)
bushels per hectare (bu/ha)	bushel (bu)	
Pressure		
pounds per square inch (PSI)		

Conversion Factors

Mass		
1 g	=	0.0022 lb
454 g	=	1 lb
1 kg	=	2.2 lb
Length		
1 m	=	3.283 ft
2.54 cm	=	1 in
1 yd (yard)	=	3 ft
Volume		
1 L	=	0.265 gal
3.785 L	=	1 gal
1 gal	=	4 qt/8 pt/128 fl oz
Area		
1 ha (hectare)	=	2.471 A
0.405 ha	=	1 A
1 A	=	43,560 ft^2
Application Rate or Crop Yield		
1 kg/ha	=	0.893 lb/A
1 bu/ha	=	0.405 bu/A
1 bu/A	=	45 lb
3.6 bu/A	=	1 barrel
Concentration		
g/L	=	parts per thousand
mg/L	=	parts per million
mg/kg	=	parts per million

Application Rate		
1 gal/A	=	9.35 L/ha
1 lb/A	=	1.12 kg/ha
mg/kg	=	parts per million
Speed		
1 mph	=	1.609 kmh
Pressure		
1 PSI	=	0.069 bar/6,896 kilopascal

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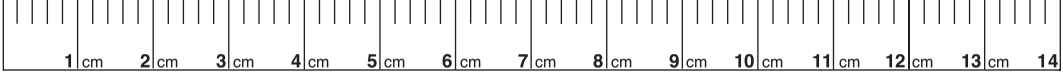
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