

RISE

INFORMATION

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CLEARFIELD* Rice - A New Approach to Red Rice Control*

Red rice has long been a major weed pest in commercial white rice production in the Southern USA. Red rice is the same genus and species (*Oryza sativa* L.) as white rice, making its control an option only available in rotational crops, such as soybeans. CLEARFIELD® rice, developed based on resistance to imazethypr herbicide, now allows producers to control red rice with direct herbicide applications to the current white rice crop.

CLEARFIELD® rice varieties were jointly developed by Louisiana State University and BASF and will be produced and sold through Horizon Ag's ORYGEN™ Seed Marketing System. CLEARFIELD® rice varieties are protected under the PVP act and BASF's CLEARFIELD® Stewardship Program. CLEARFIELD® rice seed will be available only to growers who attend a stewardship training course. CLEARFIELD® rice was developed by mutating the DNA of conventional rice with radiation and then making selections following crosses with other conventional varieties. Because CLEARFIELD® rice maintains pure DNA from only rice, it is not considered a Genetically Modified Organism (GMO). This is critical because of potential marketing constraints associated with GMO crops.

Three CLEARFIELD® rice varieties have currently been developed. Two CLEARFIELD® varieties, CL121 and CL141, were released and available during the 2002 growing season with an additional variety, CL161, to be available in 2003. CL121 is a very-early maturing, semi-dwarf, long-grain, imazethypr-tolerant variety with good

* Prepared by: Charles E. Wilson, Jr., Extension Agronomist-Rice; Bob Scott, Extension Weed Scientist; Ken Smith, Extension Weed Scientist; Rick Cartwright, Extension Plant Pathologist; Karen Moldenhauer, Professor; James Gibbons, Research Assistant Professor; John Bernhardt, Research Assistant Professor; Rick Norman, Professor; Nathan Slaton, Assistant Professor; Maurice Blocker, Research Associate Amanda Tolbert, Research Specialist; and Jeff Branson, Area Extension Rice Agronomist.

yield potential. CL141 is an early maturing, standard-statured long-grain variety with imazethypr resistance and good yield potential. CL 161 is an early maturing, semi-dwarf long-grain variety with imazethypr resistance and good yield potential. CL121, CL141, and CL161 each have typical U.S. long grain cooking qualities, an apparent starch amylose content of 22.1% and an intermediate gelatinization temperature (70 to 75°C).

Agronomic Traits and Yield Comparisons

Yield comparisons for the CLEARFIELD® rice varieties and other popular mid-south rice varieties from the Arkansas Rice Performance Trials (ARPT) show that the CL121 and CL141 have good yield potential in Arkansas (Tables 1 - 3). CLEARFIELD* varieties typically produce yields less than the highest yielding conventional varieties, such as Francis, Wells, and LaGrue, but they are comparable to other commonly grown varieties, such as Drew and Cypress. However, when grown in fields that have limited yield potential because of severe red rice infestation, they become a very competitive alternative. The head rice yield potential of CL121 and CL141 has been similar to Drew in most of these tests. CL161 was derived from a second “generation” event and possesses higher yield potential and head rice yields than CL121 and CL141 and has better lodging resistance than CL141.

Date of seeding studies conducted at the RREC from 2000 to 2002 suggest that the yield potential of CL121, CL141, and CL161 is stable across a wide range of seeding dates (Table 5). The number of days required to reach 50% heading varies with seeding date and management. CL121 heads about 5 days earlier than Cocodrie and Francis, CL141 heads about 2 days earlier than Cocodrie and Francis, and CL161 heads about 2 days later than Wells. All of the CLEARFIELD® rice varieties are supported by the Arkansas Rice DD50 program. Based on 30-year weather norms and current DD50 thresholds, CL121 requires approximately 49 days (1115 DD50 units) and 73 days (1895 DD50 units) days to reach ½ inch internode elongation (IE) and 50% heading, respectively (based on Stuttgart weather data). CL141 requires approximately 54 (1280 DD50 units) and 78 (2050 DD50 units) days to reach ½ inch internode elongation (IE) and 50% heading, respectively. CL161 requires approximately 54 (1175 DD50 units) and 85 (2165 DD50 units) days to reach ½ inch internode elongation (IE) and 50% heading, respectively. CL121, similar to Cocodrie, requires a relatively short time to reach ½ inch IE compared to other varieties. The short vegetative growth stage is important since management practices like draining and drying for straighthead prevention and herbicide application must be performed very quickly. Differences in crop management and environment may result in a different rate of plant development than that predicted by the DD50 program.

The grain weight and seed dimensions of the CLEARFIELD® varieties are similar to those of Cypress (Table 6). Based on seed weight, seeding rates of 92.6, 98.3, and 84.5 lbs/acre are required to obtain 40 seed/ft² or 23 seed per 7 inch drill row foot for CL121, CL141, and CL161, respectively. This equates to 2.1, 2.2, and 1.9 bushels/acre for CL121, CL141, and CL161, respectively. Straw strength, plant height and leaf color are similar to that of Cypress. Although seedling vigor tests have not been performed,

visual observations in variety studies suggest that CL121, CL141, and CL161 have good seedling vigor comparable to Cypress. Use of fungicide and/or gibberellic acid seed treatments are advised when seeding at reduced rates, early seed dates, poor seedbed conditions, no-till seedbeds, and on clay soils.

Fertilization

The recommended nitrogen (N) rate for CL121, CL141, and CL161 grown on silt and sandy loam soils following soybean in rotation is 135 lb N/A (Table 9). This recommendation is for N applied in a 2-way split application where 90 lb N/A is applied pre-flood and followed by a single application of 45 lb N/A at midseason. The total and pre-flood N rate should be increased by 30 lb N/A for rice grown on clay soils. Similar to Cocodrie, growers should be aware that CL121 reaches midseason (green ring and ½ inch IE) about 5 to 7 days faster than most other varieties. Thus, the plant size of CL121 at midseason may be somewhat smaller compared to other varieties. Also, remember to adjust the pre-flood N rate when rice is grown on clay soils, previous crops other than soybean, or thin stands.

Limited data is available to suggest how CLEARFIELD® rice varieties will perform on high pH and salt affected soils in relation to other varieties. Follow University of Arkansas soil test recommendations for phosphorus, potassium and zinc fertilizer rate recommendations. Most CLEARFIELD® rice is sold with a zinc seed treatment. However, for fields with soil test zinc levels less than 5 lbs/acre, additional granular zinc should be applied (10 lbs Zn/acre) prior to planting.

Red Rice Control

The primary target for CLEARFIELD® rice is fields with heavy infestations of red rice. The herbicide registered for use on Clearfield rice for red rice control, Newpath® (imazethypyr), is a good grass herbicide, but will require additional herbicides for control of some broadleaf weeds. Newpath® has both foliar and residual soil activity on most grass weeds. It is rated 9 (10 = 100% control) on barnyardgrass, broadleaf signalgrass, fall panicum, crabgrass, and flatsedge. It is rated 8 on yellow nutsedge, duck salad, and sprangletop, and is rated 7 on redstem. However, tank mixing with propanil or other suitable products will be required for control of weeds such as hemp sesbania, northern jointvetch, and eclipta. Always read and follow the label directions carefully for Newpath® herbicide.

The current registration specifies that Newpath® should be applied at a rate of 4 oz./acre (0.063 lbs a.i./acre) preplant incorporated or preemergence followed by 4 oz./acre post-emergence for CL121 and CL141. The soil applied treatment should be applied up to 7 days prior to planting or preemergence immediately following planting. The preferred method for soil application is preplant incorporated at the time of final seedbed preparation. The post-emergence treatment should be applied when rice is in the 3-5 leaf growth stage. For CL161, an additional option is to apply the first application early post-emergence and then follow with the late post-emergence application at the 3-5 leaf growth stage. Flushing is required for activation if rainfall does not occur within a

few days of planting. Repeat flushing as needed to keep the soil-applied treatment active.

Some injury has been observed in CL121 and CL141 with early post-emergence applications of Newpath®, which is why the soil applied timings are recommended. CL161 has improved tolerance to the herbicide and can tolerate much higher rates of Newpath® than will be allowed. However, always follow the instructions printed on the label. Rates higher than those listed on the label are illegal.

To prevent out-crossing between CLEARFIELD® rice and red rice, strive to achieve 100% control of red rice, allowing no escapes. Use good cultural practices, including good spray coverage, flush as necessary, rogue escapes, etc. Seed produced from out-crossing will result in red rice tolerant to the Newpath® herbicide. The University of Arkansas recommends growing CLEARFIELD® rice in the same field only one year in a row. Conventional rice varieties cannot be planted the year following CLEARFIELD® rice due to the potential for rice injury from carryover of the Newpath® herbicide. A plant-back restriction of 18 months following CLEARFIELD® rice should be followed for oat, grain sorghum, cotton, and conventional rice. The restrictions are 8.5 months for corn, 4 months for wheat, and 26 months for sugar beets, canola, and potatoes. Because of these restrictions, the best rotational crops are soybean and corn.

CL121, CL141, and CL161 have not shown sensitivity to other registered rice herbicides when applied at the labeled rates and times. Always read the pesticide label to ensure that specific varieties are not excluded and/or included for each herbicide.

Other Pest Management

Based on peck damage taken from the ARPT, the CLEARFIELD® varieties are susceptible to rice stink bug damage, but perhaps more tolerant than Cypress or Cocodrie (Table 1). CL121 is rated **very susceptible** to sheath blight, **moderately susceptible** to rice blast and false smut, **susceptible** to stem rot, kernel smut, and straighthead, and **moderately resistant** to lodging (Table 10). CL141 is rated **very susceptible** to blast, **moderately susceptible** to sheath blight and false smut, and **susceptible** to stem rot, kernel smut, straighthead, and lodging. CL161 is rated **very susceptible** to sheath blight, **susceptible** to kernel smut, false smut, and stem rot, and straighthead, **moderately susceptible** to blast, and **moderately resistant** to lodging. Varieties rated as susceptible and very susceptible to kernel smut may benefit from a preventative application of Tilt fungicide to minimize yield and quality losses from kernel smut. Fungicide applications should be considered as soon as sheath blight incidence (% positive stops) reaches 35% on CL121 and CL161. In fields with a history of severe sheath blight, scouting should commence shortly after green ring as fungicide treatment may be needed earlier than in most fields and the higher labeled fungicide rate used. CL 141 should be scouted and treated for sheath blight like Ahrent or Wells. Because of the blast susceptibility, do not plant CL141 in areas with a history of blast problems,

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fields with marginal water capacity, and in areas with tree-lines that encourage blast development.

Additional Information Sources

Univ. of Arkansas Cooperative Extension Service Web

- www.aragriculture.org
- S Rice Information Sheet No. 151 & 148
- S University of Arkansas Agricultural Publications
- S <http://www.uark.edu/depts/agripub/Publications/>
- S B.R. Wells Rice Research Studies 1999-2001

Table 1. Agronomic performance of the CLEARFIELD and other selected varieties in Arkansas Rice Performance Trials averaged across the three-year period of 2000-2002.

Maturity Group and Variety	Grain Type	Straw Strength ²	50% Heading ³	Plant Height	Milled Grain Weight	Rough Seed Weight	Pecky Rice ⁴	Milling Yield				Grain Yield by Year			
								2000	2001	2002	Mean	2000	2001	2002	AVG.
		Rating	Days	in.	mg	mg	%	% Head Rice - % Total Rice				Bushels / Acre			
CL121	L	2	79	38	18.2	23.8	1.97	58-71	62-69	64-72	61-71	143	144	163	150
CL141	L	5	83	45	17.9	24.3	1.21	58-69	62-68	63-72	61-70	150	147	158	152
CL161	L	2	89	41	16.0	22.0	1.78	-	66-70	69-73	68-72	-	151	175	163
Ahrent	L	3	85	42	16.4	22.2	2.42	63-69	63-67	65-70	64-69	154	176	176	169
Cocodrie	L	2	86	39	17.8	21.8	2.71	64-70	67-71	66-73	65-71	160	180	185	175
Cypress	L	2	89	38	17.5	23.1	2.07	65-70	66-70	67-72	66-70	147	154	169	157
Maybelle	L	3	77	41	16.7		0.97	47-69	66-71	58-72	57-71	123	125	141	130
Francis	L	3	86	40	16.7	21.7	1.49	64-71	63-70	64-72	64-71	187	190	203	193
LaGrue	L	4	88	45	17.9	24.0	1.52	57-68	62-69	63-71	61-69	167	180	196	181
Wells	L	3	87	42	19.1	25.2	1.74	56-73	66-71	64-74	62-73	185	190	197	191

- 1 Grain type: L=long grain; M=medium grain
- 2 Relative straw strength based on field tests using the scale: 0=very strong straw, 9=very weak straw.
- 3 Number of days from emergence until 50% of the panicles are visibly emerged from the boot
- 4 Average percent, by weight, in brown rice for stink bug damage from 1999 and 2000

Table 2. Agronomic characteristics of the CLEARFIELD and other selected varieties in Arkansas Rice Performance Trials during 2002 at six locations.

Maturity Group and Variety	Grain Type ¹	Straw Strength ²	50% Heading ³	Plant Height	Milled Grain Weight	Milling Head - Total	Grain Yield by Location					
							Cross Co.	Jackson Co.	PTBS	RREC	SEREC	Mean
		Rating	Days	in.	mg		Bushels / Acre					
CL121	L	2	81	38	17.7	64 – 72	137	142	181	165	191	163
CL141	L	5	84	46	17.8	63 – 72	88	163	201	152	185	158
CL161	L	2	92	41	16.1	69 – 73	153	175	192	140	216	175
Ahrent	L	3	87	43	15.7	65 – 70	177	106	223	170	205	176
Cocodrie	L	2	89	40	17.9	66 – 73	166	192	207	175	187	185
Cypress	L	2	93	39	17.3	67 – 72	144	176	196	151	180	169
Maybelle	L	3	78	41	17.2	58 – 72	84	138	176	168	141	141
Francis	L	3	89	42	16.6	64 – 72	176	198	236	186	220	203
LaGrue	L	4	91	46	17.8	63 – 71	158	210	228	165	222	196
Wells	L	3	90	42	18.9	64 – 74	193	191	212	186	203	197

- 1 Grain type: L=long grain
- 2 Relative straw strength based on field tests using the scale: 0=very strong straw, 9=very weak straw.
- 3 Number of days from emergence until 50% of the panicles are visibly emerged from the boot
- 4 Average percent, by weight, in brown rice for stink bug damage from 1999 and 2000

Table 3. Yield Performance of CLEARFIELD and other selected varieties in date of seeding studies conducted during 2000-2002 at the RREC.

Variety	2000 Seed Date					2001 Seed Date					2002 Seed Date				
	Mar. 31	April 19	May 16	June 13	2000 Avg.	April 4	April 26	May 17	June 11	2001 Avg.	Mar. 29	April 25	May 16	June 12	2002 Avg.
	bus/acre														
CL121	172	176	124	136	150	167	146	87	132	133	195	173	160	96	156
CL141	172	158	134	123	146	161	131	124	127	136	177	157	151	86	143
CL161	--	--	--	--	--	176	143	139	146	151	189	179	156	137	165
Ahrent	--	--	--	--	--	165	156	156	142	155	184	194	152	129	165
Francis	--	--	--	--	--	185	165	167	161	170	207	209	183	148	187
Drew	183	163	149	124	153	176	164	124	139	151	--	--	--	--	--
Wells	183	193	153	124	164	185	165	167	161	170	203	196	170	137	177

Table 4. Effect of seeding date on the days required for the CLEARFIELD and other selected varieties to reach ½" internode elongation.

Variety	2000 Seed Date					2001 Seed Date					2002 Seed Date				
	Mar. 31	April 19	May 16	June 13	2000 Avg.	April 4	April 26	May 17	June 11	2001 Avg.	Mar. 29	April 25	May 16	June 12	2002 Avg.
	days to ½" internode elongation														
CL121	--	50	44	51	48	60	51	--	38	50	60	49	39	--	49
CL141	--	59	47	53	53	63	60	--	43	55	67	54	44	--	55
CL161	--	--	--	--	--	59	54	--	43	52	64	52	40	--	52
Ahrent	--	--	--	--	--	57	58	--	45	54	67	56	44	--	56
Francis	--	--	--	--	--	60	55	--	43	53	63	53	41	--	52
Drew	--	55	50	48	51	63	57	--	44	55	--	--	--	--	--
Wells	--	56	49	53	53	64	57	--	45	55	68	55	43	--	55

Table 5. Effect of seeding date on the days required for the CLEARFIELD and other selected varieties to reach 50% heading.

Variety	2000 Seed Date					2001 Seed Date					2002 Seed Date				
	Mar. 31	April 19	May 16	June 13	2000 Avg.	April 4	April 26	May 17	June 11	2001 Avg.	Mar. 29	April 25	May 16	June 12	2002 Avg.
	days to 50% heading														
CL121	78	78	70	69	74	84	79	64	64	73	87	78	65	67	74
CL141	83	86	77	68	79	87	83	68	73	78	89	80	71	68	77
CL161	--	--	--	--	--	90	85	72	79	82	94	85	75	72	82
Ahrent	--	--	--	--	--	81	82	67	73	76	91	81	68	66	77
Francis	--	--	--	--	--	87	85	72	74	80	92	82	71	69	79
Drew	89	88	81	72	83	89	85	71	76	80	--	--	--	--	--
Wells	85	86	82	71	81	88	83	72	74	79	97	82	71	71	80

Table 6. Kernel dimensions of CLEARFIELD rice varieties.

Kernel Class	Length, mm	Width, mm	Thickness, mm	Length/Width Ratio
CL121-Rough	8.91	2.63	1.92	3.39
CL121-Brown	7.01	2.32	1.71	3.03
CL121-Milled	6.61	2.21	1.62	2.99
CL141-Rough	9.23	2.48	1.95	3.73
CL141-Brown	7.18	2.21	1.75	3.25
CL141-Milled	7.14	2.13	1.71	3.35
CL161-Rough	8.80	2.42	1.89	3.64
CL161-Brown	6.82	2.17	1.67	3.15
CL161-Milled	5.56	1.95	1.63	2.85
Cypress-Rough	9.02	2.52	1.97	3.58
Cypress-Brown	7.03	2.20	1.73	3.20
Cypress-Milled	6.50	2.09	1.65	3.11

Table 7. Influence of nitrogen fertilizer rate on grain yields of 'CL121' rice.

Nitrogen Rate	Grain Yield					
	RREC			SEREC		
	2000	2001	2002	2000	2001	2002
lbs N/a	bu/a					
0	137	71	108	63	82	74
60	-	123	146	-	-	-
90	150	141	165	128	138	125
120	172	147	182	132	158	144
150	162	148	183	143	162	154
180	144	153	185	149	176	155
210	148	-	-	142	169	149

Table 8. Influence of nitrogen fertilizer rate on grain yields of 'CL141' rice.

Nitrogen Rate	Grain Yield					
	RREC			SEREC		
	2000	2001	2002	2000	2001	2002
lbs N/a	bu/a					
0	75	70	81	87	107	62
60	-	119	131	-	-	-
90	130	127	155	126	138	107
120	160	150	161	146	156	129
150	154	146	170	167	172	135
180	153	137	166	164	174	134
210	136	-	-	155	175	133

Table 9. Influence of nitrogen fertilizer rate on grain yields of 'CL161' rice.

Nitrogen Rate	Grain Yield			
	RREC		SEREC	
	2001	2002	2001	2002
lbs N/a	bu/a			
0	107	93	94	103
60	148	138	-	-
90	157	157	131	134
120	174	168	150	150
150	160	179	166	157
180	163	180	151	164
210	-	-	127	149

Table 10. Disease ratings¹ for the CLEARFIELD and other selected long grain varieties for common diseases.

Variety	Sheath Blight	Rice Blast	Kernel Smut	False Smut	Stem Rot	Brown Spot	Straight-head
CL121	VS	MS	S	MS	S	MR	S
CL141	MS	VS	S	MS	S	R	S
CL161	VS	MS	S	S	S	R	S
Ahrent	MS	R	MS	S	S	S	S
Cocodrie	VS	MS	VS	S	S	R	VS
Cypress	VS	MS	S	S	MS	R	MS
Francis	MS	S	VS	S	S	R	MS
Wells	MS	S	MS	S	S	R	MS

Letter Ratings; R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible; VS, very susceptible